Exploring Computer Science

Version 10.0

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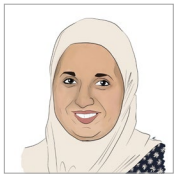

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For more information, visit the *Exploring Computer Science* website at https://www.exploringcs.org/

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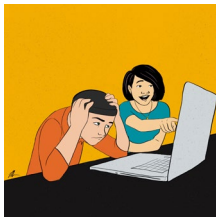

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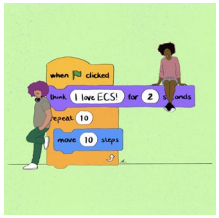

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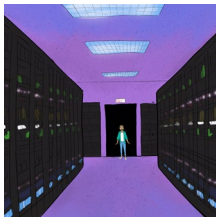

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Course Overview

Historical Context

In 2008-09, *Exploring Computer Science* (ECS) was designed to introduce students to the breadth of the field of computer science through an exploration of engaging and accessible topics. Rather than focusing the entire course on learning particular software tools or programming languages, the course was designed to focus on the conceptual ideas of computing and help students understand why certain tools or languages might be utilized to solve particular problems. The goal of *Exploring Computer Science* was to develop in students the computational practices of algorithm development, problem solving and programming within the context of problems that are relevant to their lives. Students were also introduced to topics such as interface design, limits of computers, and societal and ethical issues.

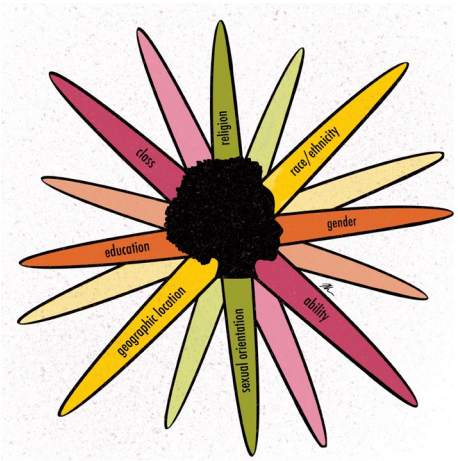
This course was originally developed for students in the Los Angeles Unified School District in an effort to broaden participation in computing district-wide, particularly for girls and students from historically marginalized communities. After initial success in Los Angeles, *Exploring Computer Science* has grown to national prominence, with districts across many areas of the country through a variety of different partnership models adopting ECS. Reaching historically underrepresented students continued to be a major emphasis of the ECS program.

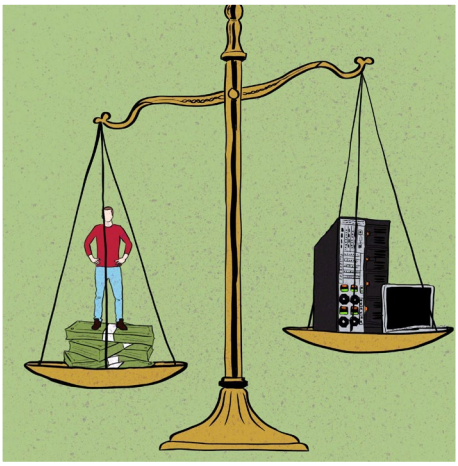
Co-redesign of ECS v. 10

Fifteen years since its inception, ECS was collaboratively redesigned (co-redesign) by a group of ECS teacher facilitators during 2022-24 to develop ECS version 10. While supporting marginalized students with a robust introductory computer science high school course is still a focus of the program, the co-redesign effort has led to revising multiple existing lessons, units, and accompanying teacher professional development sessions to better align the teaching and learning of computing concepts towards justice issues across several dimensions of oppression such as race, gender, socioeconomic status, etc.

"Address and incorporate the things that are currently going on in our world, and modify the curriculum to address those needs and things that can help us best deal with it, like, within the curriculum—like cultural relevance and how we can be more responsive teachers?"

***Faythe Brannon**, co-design teacher facilitator, discussing goals of program redesign*





Exploring Computer Science v. 10 includes interactive lessons and collaborative activities which will engage students to learn ways of leveraging computing concepts in service of furthering justice within their communities. And to do so, the course provides opportunities for students and teachers to work on their multiple, intersectional identities and explore their connections with computing. The course is designed to focus on the conceptual ideas of computing and help students understand how computing can be used for self-expression and social good. Overall, the goal of *Exploring Computer Science* is to develop in students the computational literacies to engage consciously and meaningfully within the field of computing by enabling multiple opportunities to practice algorithm development, problem solving, and programming within the context of problems that are relevant to students' lives and their communities. Students will also be introduced to topics such as artificial intelligence, limits of computers, and societal and ethical issues as interwoven with the field of computing.

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Standards

The *Exploring Computer Science* curriculum was developed around a framework of both computer science content and computational practice. This combination of both content and practices provides students with a sense of what computer scientists do. ECS is aligned with both the K-12 Computer Science Framework and the CSTA Computer Science Standards.

Prerequisites

It is recommended that students have completed an Algebra course prior to enrolling. ECS is designed to be a college preparatory high school course and thus, should provide a rigorous, but accessible, introduction to computer science. No previous computer science experience is required.

Hardware

An ideal laboratory environment for this course would include a classroom with tables, chairs, and computers that are conducive to group-work. While it is also ideal to have one computer for each student in the class, the collaborative nature of this class allows for a 2-1 student-computer ratio if fewer computers are available. These computers can be either Macintosh or PC depending on availability. A networked system makes installation of software easier for the teacher.

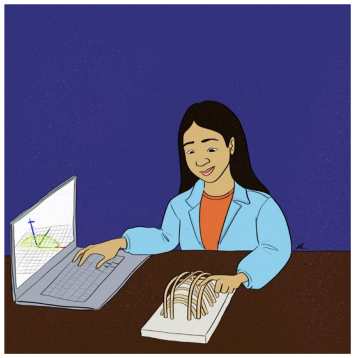
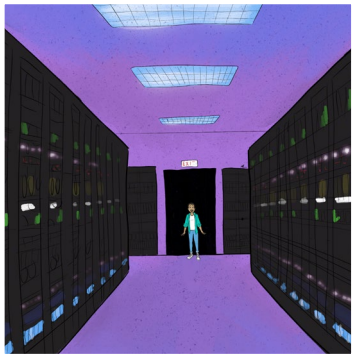
Software

Each computer in the classroom should have a web browser installed that allows students to perform searches and make use of a variety of websites and Internet tools. Scratch 2.0 and 3.0 are available through a web browser, but teachers who prefer to use the downloadable version can download and install Scratch 1.4 available at http://www.scratch.mit.edu. Also, v3.0 is compatible with smartphones and tablets.

**Please note that website URLs included in this version of the curriculum may change over time.

The Instructional Philosophy of *Exploring Computer Science*

The *Exploring Computer Science* course is more than a curriculum—it is a course that is shaped by four intertwined elements: curricular materials, professional development, assessments, and local policy support to ensure the course "counts" in the curriculum and is supported by local administrators. The course orients teaching and learning of computer science towards justice by addressing the "how" and the "what" of computing learning in classrooms. Learning of foundational computer science concepts is interwoven with opportunities to develop computational practices and a critical stance towards understanding the role of computing within communities and societies. The program emphasizes on equitable computing learning, the "how," by supporting inquiry-driven practices to solving problems and creating products while affording multiple opportunities to challenge the neutral, apolitical, and siloed approach to understanding computing concepts, influencing "what" is valued within computer science classrooms. The reorientation and co-redesign necessitate teacher participation in *Exploring Computer Science* professional development before offering an ECS course.


Curricular Approach

Exploring Computer Science teaches the creative, collaborative, critical, interdisciplinary, and problem-solving nature of computing with instructional materials that feature an inquiry-based approach to learning and teaching. As part of this course, students will delve into real world computing problems that are relevant to their daily lives and their communities, and address social and ethical issues while delivering foundational computer science knowledge to students. Throughout the unit, there are multiple opportunities for students to bring their fuller selves, examine their intersectional identities and let those inform their computing learning. Students will engage in several in-depth projects to demonstrate the real-world applications of computing.

This curriculum builds off of learning theories that view learning as a social, cultural, and political process that does not only occur in a vacuum at school; that is, students bring to school bodies of knowledge from their lives, culture, and communities. Building from students' prior knowledge, the collection of problem-solving skills, and the social and ethical knowledge of computer-related problems will result in a more active curriculum relevant to students' lived experiences. Each unit connects students' identities, communities, informal knowledge, technology skills, and beliefs about computing to the theoretical and foundational tenets of computer science and empowers them to integrate the technical with the social aspects in service of realizing justice within contexts that matter for students. Students will become members of a "computing

community of practice" in the classroom where they will be introduced to the behavior, language, and skills of computer scientists while leveraging computing ideas to further explore their lived realities and imagine new ones. Furthermore, the interdisciplinary nature of computing allows for the incorporation of subject-matter topics across disciplines into the computing curriculum.

Concrete Instructional Strategies

There are several concrete instructional strategies that are included in each unit to implement this justice-oriented program that is responsive to students' lived realities.

- Each unit begins with a description of the topic, an explanation of the importance of this topic, possible connections to the self, communities, and other social dimensions, and objectives for the unit.
- Units typically begin with a kinesthetic activity to get students involved in the unit topic. Students are more engaged when they go beyond seatwork to gain familiarity with the scope of a topic. Acting out computing concepts is one way to have students actively engaged in the curriculum.
- In most units, the final unit project is presented at the beginning of the unit so students understand what type of project they will engage in at the end of the unit. Daily assignments help scaffold their knowledge towards gaining the knowledge needed to complete a particular project. The final project represents a culmination of their new knowledge and provides an opportunity to expand their understandings to a particular socially-relevant problem.
- Computing terms and definitions are explicit and part of the instruction. The curriculum avoids unnecessary jargon, which might distract from learning of the critical content. Students have opportunities to use writing to reinforce the literacy component behind these computing terms and definitions.
- Foundational computing topics are connected to students' lived experiences with technical solutions such as mobile phones, softwares and applications aiding decision-making across different social sectors, social networks, blogs, search engines, generative-AI platforms, etc.
- Real world problems are presented in the context of socially-relevant issues impacting urban communities (housing, safety, poverty, health care, access to equal rights, educational opportunities, improving social services, translation services, transportation, etc.)
- Students have opportunities to work on problems that they help define and can individualize—i.e. selecting their own content for websites; creating original, not pre-scripted, problem-solving strategies, etc.
- Activities are designed to encourage students to work in a variety of collaborative settings including elbow partners, peer-programming, and group research projects. This collaboration encourages conversations around computing topics.
- Students will experience a variety of ways to communicate their answers—academic writing, journal entries, writing a letter to a friend or companion, using presentation software, developing graphics or animation, storyboarding, listing algorithms, drawing illustrations, oral presentations, etc.
- Units incorporate examples of careers in computing as they arise in the curriculum. Students will be given hypothetical opportunities to act as a professional to take on the behavior and skills to solve a given problem.
- Although using technology is a core component of this curriculum, using computers is not necessarily embedded in the curriculum on a daily basis.

All of these strategies contribute to developing the problem-solving skills and computational practices that are emphasized throughout the course.

It is important to note that each unit focuses on different instructional strategies; this is purposeful. In some cases, it is because the particular subject matter lends itself more successfully to a particular set of strategies, but this was also done to highlight the wide variety of possible strategies that can be used effectively in teaching this course. We encourage teachers to experiment by trying strategies that work well for them in a variety of different places in the curriculum. Journal responses and blog entries can be used by students to communicate about their work in any of the units. Peer reviews, gallery walks, jigsaws, role-plays and collaborative groups of varying sizes can be used for activities throughout the course. There are many other possibilities to consider.

Pedagogy and Professional Development

The lessons in ECS forward a pedagogical approach that is aligned with what we know about most effective teaching approaches. In her 2007 book, *Powerful Learning: What we Know About Teaching for Understanding*, Linda Darling-Hammond notes that studies across different content areas find effective teachers support the process of meaningful learning by:

- Creating *ambitious and meaningful tasks* that reflect how knowledge is used in the field;
- Engaging students in *active learning*, so that they apply and test what they know;
- Drawing c*onnections to students' prior knowledge* and experiences;
- Diagnosing student understanding in order to scaffold the learning process step by step;
- *Assessing student learning continuously* and adapting teaching to student needs;
- Providing clear standards, *constant feedback*, and opportunities for work;
- Encouraging *strategic and metacognitive thinking*, so that students can learn to evaluate and guide their own teaching (p. 5).

Because this view of active knowledge runs counter to traditional concepts of teaching as delivery, professional development support is key to building the instructional strategies and dispositions needed to effectively teach this course. The two-year ECS professional development format provides an intensive and focused learning experience for teachers to develop the pedagogical content knowledge to successfully engage all students in the learning materials. The professional development model also encourages teachers to take on the role of reflective practitioners so they can examine how their pedagogy influences student learning, particularly for historically underrepresented groups. Many lessons reference videos and other external resources. Teachers are encouraged to preview these materials prior to using with students, since many contain references to sensitive material and individual teachers are most equipped to make appropriate decisions about these materials for their classrooms.

ECS is intended to be an introduction to computing for all students regardless of backgrounds and abilities. Today's classrooms often include multilingual students, students with diverse cultural backgrounds, students with disabilities, and students with differing ways of learning. The fact that the projects at the end of each unit can be done individually or in a small group allows students to show what they have learned in different ways. Nonetheless, the teacher may face challenges when a student needs a language interpreter in the classroom, a student who is blind and uses a screen reader to access information, or a student with limited mobility who uses an alternative input device, not a standard keyboard and mouse. As part of their professional development, teachers will learn aspects of accessibility and universal design of instruction that will better prepare them for students with diverse characteristics. In addition, teachers will be introduced to computer science programming tools that are accessible to students with varying disabilities and to alternative curricular resources that are accessible.

Assessment

With the exception of the final projects, there are no specific assessments listed in the lesson plans. There are also very few specific “homework” assignments. Differences in grading policies, types of assessments required, and student schedules make it difficult to gauge the best combination of assessment tools to use in a particular environment. Teachers are encouraged to determine which class activities might lend themselves to some research outside of class and which might make useful assessments. For the same reasons, the rubrics provided represent samples of different types of rubrics that could be used, but these should be tailored to reflect the choices teachers make in choosing activities to assess and methods of assessment.

Overview of the Instructional Materials

The pages that follow contain the core of the materials teachers will need in order to plan and teach *Exploring Computer Science*. The materials begin with the unifying themes and practices that are woven throughout the course followed by an overview of each unit that includes the unit description and overall objectives of the unit. There is also a table that indicates the topics for each instructional day of the course. Teachers should continue to refer back to previous units where appropriate. For example, Unit 3 builds on many of the Unit 1 concepts by taking students from examining their intersectional identities and developing websites to building on these ideas to make mini-projects in a block-based programming environment. The approximate time allotment noted in the chart includes all activities from introduction through application.

Daily lesson plans with detailed student activities and teaching strategies for each day are the final component of the instructional materials. Each lesson has been built on a 55-minute class period. In schools where class periods are shorter or longer (or on varying block schedules) adjustments will need to be made; such adjustments may include combining lessons (for longer class periods) or assigning parts of the lesson for homework (for shorter class periods).

An attempt was made to provide enough detail to the teaching strategies sections to give teachers clear guidance as to the activities involved and the types of questions that might need to be asked to prompt discussion. At the same time, an effort was made not to be prescriptive. As noted on the previous page, strategies such as journaling and collaborative work can and should be incorporated in as many lessons as possible.

Each unit includes supplementary materials, a final project, and a sample rubric for the final project.

Recommendations for Curriculum Adoption

The first four units of the course provide the necessary foundational framework of concepts and practices that underlie further investigation into computer science topics. For this reason, it is necessary to teach the full four units in sequence before launching into extension topics or deviating from the curriculum. Unit 5 Robotics applies the learning from the first 4 units.

Unifying Themes, Practices, and Literacies

The individual lessons in this course were developed to reinforce the unifying themes and support the use of the computational practices and critical computational literacies that we expect students to employ.

The three themes are:

- The connections between computing, self, communities, and societies
- The relevance of computer science and its impact on society
- Technology as a tool for solving problems in some contexts and exacerbating harm in others

There are many technological tools that enable people to explore concepts and create exciting and personally relevant products that impact society. At the same time, there are many more that perpetuate and amplify historical injustices caused to the marginalized communities as these tools encode racist, sexist, heteronormative norms in the form of programs and data supporting decision-making within these systems. In this course, programming is used as one of the tools, but not the only tool. Students are asked to be critical analyzers of technologies around them, and also bring their creativity and self-expression into designing and implementing solutions as they translate ideas into tangible forms. As students actively create, they will also discuss the broader implications of computing technologies in relation to heir lived experiences.

- Throughout the course students will gain experience in employing the following computational practices:
- Analyze the effects of developments in computing (impact/connections)
- Design and implement creative solutions and products
- Apply abstractions and models
- Understand the role of data in shaping outcomes of computational tools
- Analyze their computational work and the work of others
- Communicate computational thought processes, procedures, and results to others
- Collaborate with peers on computing activities

As students design and implement solutions using abstractions and models, they will analyze the processes they and their peers use to arrive at solutions, study the effects of their creations and learn how computing concepts connect explicitly and implicitly to other disciplines. Students will learn about the collaborative nature of computer science by working teams and will communicate the results of their work in writing and orally supported by graphs, visualizations and computational analysis.

Unit Overviews

Unit 1: Human Computer Interaction

Lesson	Instructional Day	Topic
1	1-5	Explore the concepts of computers, computing and computer scientists.
2	6-7	“Demystify” and learn about the functions and parts of a personal computer.
3	8	Explore how modern technology and need for materials impact the environment.
4	9-10	Understand how the internet works.
5	11-13	Practice searching and experimenting with internet resources and create a way to evaluate sources.
6	14	Research the data that online applications gather from users and how it is used.
7	15-16	Explore how computers have changed the way society communicates.
8	17-19	Examine the implications of data on society and the real life consequences of online data
9	20-21	Explore how different visuals can give different data
10	22-24	Introduction of artificial intelligence and machine learning and its uses
11	25-29	Explore how computers are used as a tool for visualizing data, modeling and design, and art in the context of culturally situated design tools.
12	30-31	Discover how communication differs for humans and computers
13	32-35	Research and evaluate how modern technological inventions and innovations have impacted society.

Unit 2: Problem Solving

Lesson	Instructional Day	Topic
1	1-2	Introduce data collection and problem solving through exploration of communities and building on their identity websites..
2	3	Introduce the four main phases of the problem-solving process.
3	4-5	Apply the problem-solving process with a focus on community problem solving. Use different strategies to plan and carry out the plan to solve several problems.
4	6-8	Reinforce the four main phases of the problem-solving process while continuing to explore cultural practices. (cornrows)
5	9-10	Count using the binary number system. Convert between binary and decimal numbers in the context of topics important to computer science.
6	11	Explore Search Algorithms and their influences.
7	12-13	Explore sorted and unsorted lists and various sorting algorithms.
8	14	Introduce minimal spanning trees and how graphs can be used to help solve problems.
9	15-21	Introduce final projects and presentations, addressing a social problem in the context of the problem-solving process. Complete final projects and presentations

Unit 3: Programming

Lesson	Instructional Day	Topic
1	1-4	Through student's names, identities and cultures' discussions, Scratch programming language is introduced, including the basic terms utilized in the language,
2	5	The discussion of names & identities is continued from the first lesson as the focus of building a dialogue. This lesson explores how to create a dialogue between two sprites by first creating a written dialogue then implementing it using Scratch.
3	6-8	Students analyze the cultural and personal significance of physical community landmarks, reflecting on how their name and identity are connected to their community. Students learn how to move sprite in different ways on a map of their community.
4	9-11	Students will think about a celebration that is important to them, including the customs surrounding it, and write a program titled Create Your Celebration Animation that responds to user-created events from the mouse and keyboard to represent the different customs/traditions that go around this celebration.
5	12-13	Students improve the project from the previous lesson. They listen to and respond to events and change backgrounds of the stage to reflect new scenes in their project by using Broadcast blocks.
6	14-15	Students' choice of different items of clothing to make an outfit that represents themselves, will introduce them to the concept of variable. Point system representing their clothing choice / preferences drives the discussion about biases embedded in computer systems.
7	16-18	Students explore cultural milestones and their associated responsibilities and privileges. Students build a point-value system using conditional statements and explore the inherent built-in inequities in these systems.
8	19 -21	Students will use all they have learned so far to develop a story about a current event that is important to them and/or community. Discuss the positives & negatives of using programs to implement stories.
9	22-24	Students write complex decision-making programs using the logical operators AND & OR. Students reflect on AI tools that make complex decisions.
10	25-26	Students explore the importance of customization in programming by using abstraction and user-defined blocks in Scratch to create and customize a relevant or culturally themed dance party animation.

Lesson	Instructional Day	Topic
11	27-28	Students add custom blocks with parameters and a timer to the dance party animation.
12	29-31	Students explore the issue of limited resources and how they affect decisions by creating a program that uses a budget to plan a relevant community event. Students will explore AI systems used to determine loan application denial or approval as an example of how decisions are made.
13	32	Introducing the final project: My Community, My career, My dreams or Who I Am? Students connect to earlier projects and use the problem solving steps to plan and execute the program. Students must utilize scratch blocks learned throughout the unit.
14	33-35	Students work on a final project.
15	36-37	Final project presentations & unit reflection on learning

Unit 4: Data and Computing

Lesson	Instructional Day	Topic
1	1	This lesson introduces “Big Data” and its impact on our world. Students will investigate “Big Data” sets and analyze their characteristics, scope, and effects on our society.
2	2-3	Students will analyze how data is used to solve problems and explore the pitfalls and challenges of combining and managing large sets of data. An overview of the final project is provided.
3	4-5	In this lesson students will investigate data sets and discuss findings.
4	6	In this lesson students will predict how useful particular data would be in answering research questions.
5	7-8	This lesson provides an opportunity for students to explore commonalities and differences of cultures and communities by using images as a data source to communicate these stories.
6	9-10	Students will evaluate rural and urban medical facilities by analyzing data and presenting their findings.
7	11-12	Students will investigate how to transform raw data into visualizations.
8	13-14	In this lesson students will communicate stories about their local communities, histories or relevant issues by collecting, analyzing, and visualizing data.
9	15-17	Students will explore Bar plots and the differences between categorical and continuous data. Mosaic plots are introduced as a vehicle for comparing categorical data and looking for trends in data.
10	18-19	In this lesson, students will identify what data they create online is of interest to organizations that analyze big data, and determine how it could be used and the role it plays in society.
11	20-21	Students extract data from datasets and discuss how the use of big data might be helpful or harmful.
12	22-26	In this lesson students review their data collection and begin composing their final projects. Students will have one week to work on and complete their final project and present them.

Topic Description and Objectives

Unit 1: Human Computer Interaction (7 weeks)

Topics to be addressed:

- Computers, the Internet, and Artificial Intelligence/Machine Learning
- Intersectional, multidimensional identities and their (dis)connections with computing
- Societal impact of computing
- Uses of data by humans and computers

Topic Description:

In this unit, students are introduced to the concepts of computer and computing while investigating the major components of computers, their origins, and the suitability of these components for particular applications. Students will analyze their own identities and make connections to impactful computer scientists. Students experiment with internet search techniques, explore a variety of websites and web applications, and discuss data and issues of privacy and security. Fundamental notions of Human Computer Interactions (HCI) and their connections to people, communities, and societies are introduced. Students will learn that "intelligent" machine behavior is based on algorithms applied to useful representations of information, including large data sets. Students will gain a better understanding of the many ways in which computing-enabled innovations impact society and determine if the effects have been more positive or negative. Connections among social, economic, and cultural contexts will be discussed, including the impact computing has on equity- and justice-related issues across race, gender, class, national contexts. Students will demonstrate their understanding of these concepts in a variety of products including websites, posters, and presentations.

Objectives:

The student will be able to:

- Analyze the characteristics of hardware components to determine the applications for which they can be used, and explore their sustainability.
- Demonstrate how the Internet operates and use appropriate tools and methods to execute searches that yield requested data.
- Evaluate the results of web searches and the reliability of information found on the Internet.
- Explain the differences between tasks that can and cannot be accomplished with a computer.
- Analyze the effects of computing on society within economic, social, and cultural contexts.
- Communicate legal and ethical concerns raised by computing innovation.
- Explain the implications of communication as data exchange.
- Explain the idea of intelligence especially as it relates to computers.
- Explain what it means for a machine to "learn."

Unit 2: Problem Solving (4 weeks)

Topics to be addressed:

- Tools for problem solving
- Problem-solving process
- Role of data in the problem-solving process
- Algorithms and abstraction
- Connections between community problem solving, mathematics and computer science
- Societal impacts of computing

Topic Description:

This unit provides students with opportunities to become "computational thinkers" by applying a variety of problem-solving techniques as they create solutions to problems that are situated in a variety of contexts. The range of contexts motivates the need for students to think abstractly and apply known algorithms where appropriate, but also create new algorithms. Students will become familiar with the problem-solving reiterative process. Analysis of various tools, algorithms and solutions will highlight problems that are not easily solved by computer and for which there are no known solutions. This unit focuses on highlighting the connections between problems in the community and the mathematical and computing tools. Students will be introduced to selected topics in discrete mathematics including Boolean logic, functions, graphs and the binary number system and their connections to problem-solving. Students are also introduced to searching and sorting algorithms as related to their experiences with search engines and embedded biases.

Objectives:

The student will be able to:

- Name and explain the steps they use in solving a problem.
- Solve a problem by applying appropriate problem-solving techniques.
- Express a solution using design tools.
- Determine if a given algorithm successfully solves a stated problem.
- Create algorithms that meet specific objectives.
- Analyze various tools, algorithms and solutions
- Explain the connections between binary numbers and computers.
- Summarize the behavior of an algorithm.
- Compare the tradeoffs between different algorithms for solving the same problem.
- Explain the characteristics of problems that cannot be solved by an algorithm.

Unit 3: Programming (7 weeks)

Topics to be addressed:

- Programming and connections with self and communities
- Algorithms and abstractions
- Connections between mathematics and computer science
- Societal impacts of computing

Topic Description:

Students are introduced to some basic issues associated with program design and development within contexts exploring aspects of their identities and connections with social and cultural communities. Students design algorithms and create programming solutions to a variety of computational problems using an iterative development process in Scratch. Programming problems include mathematical and logical concepts and a variety of programming constructs. Reflective prompts and whole class discussions will enable students to make connections between the programming constructs and their implications for communities when embedded in systems that aid social decision-making (e.g., algorithms that support urban planning, job recruitment, etc.).

Objectives:

The student will be able to:

- Use appropriate algorithms to solve a problem.
- Design, code, test, and execute a program that corresponds to a set of specifications.
- Select appropriate programming structures.
- Discuss implications of programming constructs on people and communities
- Locate and correct errors in a program.
- Explain how a particular program functions.
- Justify the correctness of a program.
- Create programs with practical, personal, and/or societal intent.
- Use abstraction to reduce complexity.

Unit 4: Data and Computing (5 weeks)

Topics to be addressed:

- Data and information
- Algorithms and abstraction
- Connections between community problem solving, mathematics and computer science
- Programming
- Societal impacts of computing
- The role of data and Artificial Intelligence systems

Topic Description:

In this unit students explore how computing has led to new methods of managing and interpreting data. Students will use computers to translate, process and visualize data in order to find patterns and test hypotheses. Students will work with a variety of large data sets from diverse social contexts such as healthcare, urban planning, food security, and ecological sustainability that illustrate how widespread access to data and information facilitates identification of problems. Students will collect and generate their own data related to local community issues and discuss appropriate methods for data collection and aggregation of data necessary to support making a case or facilitating a discovery.

Objectives:

The student will be able to:

- Describe the features of appropriate data sets for specific problems.
- Apply a variety of analysis techniques to large data sets.
- Use computers to find patterns in data and test hypotheses about data.
- Compare different analysis techniques and discuss the tradeoffs among them.
- Discuss the role of data in shaping outcomes among AI tools
- Justify conclusions drawn from data analysis

Unit 5: Robotics (7 weeks)

For the 2025-26 Academic Year, use ECS v9.0 Unit 6: Robotics

Unit 1: Human Computer Interaction

Introduction

Computers and other computing technology have become an integral part of our global society. Because of that it is easy to forget that not every student will come to this course with the same background and skills. In this course, students will be investigating how computer science has been entwined in their daily lives.

Unit 1 is used as the foundation for the rest of the curriculum both in content as well as classroom environment and procedures. The topics in this unit are designed to allow all students to gain familiarity with computers and computing in the context of activities that give students an opportunity to work at their own pace, collaborate in groups where they can learn from each other, and generally gain an overview of the many and varied ways in which computers and computing are used.

Many of the topics in Unit 1 ask students to be reflective of their own identities, communities, and experiences as they expand their computer science knowledge. Students are introduced to many topics like data and artificial intelligence, that they will continue to deepen their knowledge on throughout the course. At the beginning of this unit, students will create a website about how they can relate to accomplished computer scientists through their identities. Although not explicitly written in the lessons, this resource can become a tool for students to create a portfolio of what they learn and how it applies to their lives.

The goal is for all students in the class to reach a level of comfort in using the computer and understand that the computer is not magic. The fact that for a computer to accomplish its tasks it needs to be given precise instructions motivates the need for the problem-solving techniques that will be addressed in Unit 2.

Daily Overview Chart

Lesson	Instructional Day	Topic
1	1-5	Explore the concepts of computers, computing and computer scientists.
2	6-7	“Demystify” and learn about the functions and parts of a personal computer.
3	8	Explore how modern technology and need for materials impact the environment.
4	9-10	Understand how the internet works.
5	11-13	Practice searching and experimenting with internet resources and create a way to evaluate sources.
6	14	Research the data that online applications gather from users and how it is used.
7	15-16	Explore how computers have changed the way society communicates.
8	17-19	Examine the implications of data on society and the real life consequences of online data
9	20-21	Explore how different visuals can give different data
10	22-24	Introduction of artificial intelligence and machine learning and its uses
11	25-29	Explore how computers are used as a tool for visualizing data, modeling and design, and art in the context of culturally situated design tools.
12	30-31	Discover how communication differs for humans and computers
13	32-35	Research and evaluate how modern technological inventions and innovations have impacted society.

Instructional Lessons

Lesson 1. Days 1-5

Topic Description: In this lesson, students define what a computer and computing is and understand the need for diversity in computer scientists.

Objectives

The student will be able to:

- Explain and give examples of the concepts of computer, computing, and computer scientist.
- Identify various diverse computer scientists and their contributions to computing.
- Consider their own personal role in the world of computing and potential that exists.
- Design a template website about personal identity and share with peers.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Exploring computers (35 minutes) • Definition of the terms computer and computing (10 minutes)	• Basic introduction to what is a computer and computing processes.
Day 2 • Journal entry (10 minutes) • Diversity of computer scientists (10 minutes) • Exploring computer scientists (30 minutes) • Journal entry (5 minutes)	• Appreciation, celebration, and need for diversity in computer science field
Day 3 • Identity Chart Activity (15 minutes) • Brainstorm Identity Website Project (10 minutes) • Google Sites Intro (20 minutes) • Begin working on Identity Website Project (10 minutes)	• Understanding of personal identity and connections to computer science
Day 4 • Continue working on Identity Website Project (55 minutes)	• Build template website on personal identity
Day 5 • Finish working on Identity Website Project (20 minutes) • Guided Speed Sharing (35 minutes)	• Share identity with peers to acknowledge and celebrate diversity of the class

Student Activities

Day 1

- Complete journal entry.
- Groups of students create lists of their ideas of what a computer is.
- Groups do presentations and debates.
- Participate in discussion of classification groups and definition of computer and computing.

Day 2

- Complete journal entry.
- Participate in discussion of who a computer scientist is and why diversity is important.
- Research different CS pioneers from diverse backgrounds using CS Pioneers Calendar
- Present on CS pioneers
- Complete journal entry.

Day 3

- Complete Identity Chart Activity.
- Brainstorm Identity Website Project.
- Participate in Google Sites introduction.
- Begin working on Identity Website Project.

Day 4

- Continue working on Identity Website Project.

Day 5

- Finish working on Identity Website Project.
- Participate in guided speed sharing

Teaching/Learning Strategies:

Day 1

Journal entry: *How many computers are in the room?*

- Have students write responses to the question in their journals and then share the response with their elbow partner.

Note: This sequence of individual, elbow partner, then group sharing is an essential part of the course.

- Ask a few student pairs to share their responses.

Exploring computers

- Some students may have counted only the desktop computers in the room while others may have recognized that there are other items that are computers as well.

- Divide students into groups of 3 or 4. Ask the students to discuss additional examples of computers (or things containing computers). Students may also want to come up with a list of things that are definitely NOT computers for easy comparison later on when they define what a computer is. Have students write their examples on post-its and add them to a large chart at the front of the room or have groups make a list on flipchart paper and tape their list somewhere in the classroom.

Note: Other examples of computers include: tablets, cell phones, most appliances (television, coffee maker, washer, dishwasher, etc.), cars, medical equipment, planes, cash registers, ATMs, traffic lights, scoreboards, smart watches, smart rings, ring cameras, humans, and calculators.

- Have student groups share their ideas. After each presentation, give the other students an opportunity to suggest why any particular example seems not to be a computer (or is not obviously a computer). If necessary, ask questions to draw out the student questions and responses. (For example, if the student says “dishwasher,” you might ask, “Why is a dishwasher a computer?”)
- Have a brief discussion on the power of cell phones and the apps that run on them. Mention collection of data as a foreshadowing of future lessons.
- Ask students to suggest possible classifications for the items on the list (which will connect to a future lesson on AI about how data gets classified and sorted); create a new list with the various items listed under a group classification. Have a conversation with students about how computers serve different purposes in our lives.

Note: Students may come up with many different classifications, such as the rooms that the devices exist in, the type of work the device does, etc.

Definition of the terms computer and computing

- Ask students to create a list of what makes a computer vs not (example: it has to input data, etc)
  - Some students may not come up with the terms “input” or “output” etc - this is okay! Their definitions can be informal at this point and based on their own examples.
  - You should guide students that all computers should be able to have input, output, processing, and storage (but they may not use these exact words on their own)

Note: There are many possibilities for answers. These definitions will be revisited and possibly modified throughout the course of the unit.

- Define computer and computing. Revisit the question “What is a computer?” and ask the more pertinent question, “What is computing?”
- Have the students use their list of “computers” and their classifications to help formalize their answers.
- Reinforce the idea of different types of computers and classifications by reviewing the lists and groups created by the students.

Day 2

Journal entry and Discussion: *Who is a computer scientist? What does a computer scientist look like?*

- Draw a sketch - feel free to include any additional details about their environment or materials

– Ask students to draw what they envision a computer scientist to look like. This often manifests as a Bill Nye or mad scientist but generally will be white males in front of a computer in a room by themselves (as these are most seen in popular culture)

Note: For students who do not like/want to draw, they can create a list of attributes instead.

– Ask students to share with their group (of 3-4 students) and ask: What do you notice? What do you wonder about these drawings (or lists)

– Show a picture of what an AI art generator such as craiyon (See resources.) shows when you type "computer scientist" or just simply from a web search. Discuss how this stereotype leaves out a lot of important identities that we don't often see.

Note: This is the first introduction to AI tools in this curriculum. Please note that we are suggesting that only the teacher use or demonstrate the activity in order to limit the negative impact of utilizing AI in classrooms. If this is the first time students are seeing an AI tool, you may want to just explain briefly that we will use tools like these occasionally within this curriculum and that there are biases with their use which is why we will often use these solely for demo purposes only.

– **Discuss** how this stereotype leaves out a lot of important identities that we don't often see.

– **Discuss** aspects of a computer scientist that may not be obvious within these images, like language(s) spoken, ways the person speaks, the work that the person does - these may not fall into a traditional viewpoint of a computer scientist.

- Tell students we will have more time to investigate the computer scientists who are "hidden figures" from underrepresented groups in CS and really think about our own identities in today's lesson

Suggestion: If you teach the full year ECS course (rather than a semester course), you should include this movie for students to identify diverse individuals in computer science (beyond what our popular culture references). You could have students research the 3 main characters (Dorothy Vaughan, Katherine Goble Johnson, and Mary Jackson) and create posters or presentations about their identity, successes, and challenges in working in the field of computer science

Diversity of computer scientists

- Ask students if they have any ideas who the inventors were for the following types of technology:
  - GPS (Gladys West)
  - Video game consoles (Jerry Lawson)
  - Wifi (Hedy Lamarr)
  - Home security systems (Marie Van Brittan Brown)
- Have a discussion with students about why we don't know these individuals even though they'd made such big discoveries
- **Discuss** current trends in computer science and why it's so important to make computer science accessible to all (more information and stats from Kapor Center)

Exploring computer scientists

- Have students explore the CS Pioneers calendar (See resources.) to learn about a few different computer scientists that celebrates traditionally underrepresented identities in CS
- Ask student groups to select one CS Pioneer and research their work, making note of defining elements of their identity (race, gender, sexuality, nationality, ability, language, etc)
  - Have student groups create a product to share their work with classmates in a gallery walk

Note: Products could include a digital presentation, poster, comic, podcast, poem, song, etc. that demonstrates their learning

Journal entry: *What parts of your own identity do you think will provide an important perspective in this computer science course? (Hint: think about things that made the CS pioneers unique and gave adifferent perspective to the field of Computer science)*

Day 3

Identity Chart Activity

- Have students look back at the previous day's closing journal entry to consider how their identity plays an important perspective in this computer science course.
- Emphasize how important diversity in computer science is and why it's so important to make computer science accessible to all (more information and stats from Kapor Center)
- Have students complete the Identity Chart Activity
  - During this activity, students will need to think about their own identity. It may be helpful to create one yourself based on your own identity and share with students or create one about a CS Pioneer (from the calendar or previous lessons) for students.
  - Additionally, it is imperative that you create a safe space for sharing information but also allow students to share what they are comfortable with, given how this is still the first week of this course (you can always build on this as the year progresses with other future lessons and projects involving identity)

- Ask students to think about these different areas of their own identity if they're having difficulty thinking of ideas (feel free to choose what makes most sense for your classroom). They also could use an article with a graphic from Sylvia Duckworth that also discusses the concept of intersectionality of identity markers. (See resources.)
  - Gender
  - Nationality
  - Language(s)
  - Age, Race
  - Ethnicity
  - Neurodiversity
  - Students could also consider communities they are a part of such as their neighborhood, teams, religious groups, etc.

Remind students that although more superficial things like "My favorite food is chocolate" is fun, it doesn't really dive deep into one's personal identity the way that these other factors do and we need to dig deeper here.

Brainstorm Identity Website Project

- Ask students to think about at least 5 parts of their identity (from their identity chart activity) that they feel most connected to or that gives a different perspective to the field of computer science.
  - These 5 items will be the basis of a Google website they will develop over the next few days.
- Have them put a star by these 5 things on their identity charts and share with a partner which they chose and why.

Google Sites Intro

Note: Any template website builder works for this project (Google Sites is advised because it's free and relatively easy to use). Students will NOT be learning HTML for this project and do not need to have any prior knowledge.

- Students can access Google Sites by logging into a google account and going here: https://sites.google.com/
  - **Discuss that we will NOT publish these sites to the web i**n order to protect our own privacy but also note that Google (or whoever is providing the website template for us) also collects information which we will discuss more during our privacy lesson coming up
- Have students explore the basic parts of the website builder and write down any questions they have in their journals
  - Layout and themes
  - Adding text to different areas
  - Adding images
  - Adding pages (if students are more advanced)

- Allow time to answer questions and review the basic parts they just explored (10 minutes)
  - You may choose to walk students through a template you create or show them this version (https://sites.google.com/view/ecsunit1csidentityproject/home) to give them a sense of what it could look like.

Begin working on Identity Website Project

- Students will create an Identity Website using the Google Sites or other website template builder showcasing the 5 identity themes of their choice
- Each of the 5 pieces of their identity should have the following on their website:
  - Description of this part of their identity and how they think it could relate to a unique perspective in computer science
  - An image to represent this part of their identity
  - Connection to a computer scientist that shares this identity characteristic (could be from the CS Pioneers calendar or other research)

Day 4

Continue working on Identity Website Project

Day 5

Finish working on Identity Website Project

Guided Speed Sharing (35 minutes)

- Students will open their websites on computers to be viewed by their peers
- All students will partner up and share their websites with each other using the following protocol. Please advise that students should be thinking about what they are learning about each other as they pair up. It may be helpful for students to record notes in their journals as they Speed Share.
  - Student A will share for 2 minutes
  - Student B will share for 2 minutes
  - For the following 2 minutes, both students will discuss similarities, differences, and any other noticings (Teacher should guide these conversations to focus more on identity and less on any specific design choices like colors, fonts, images chosen, etc)
  - Teacher will keep time and let partners know to switch at the end of the 6 minutes and set the rotation movement so new pairs are formed every rotation. After 1 minute to rotate, groups can repeat the process.
- After the last rotation, have students share some of what they learned about their peers' identities. Remind students that we will revisit these ideas as we move throughout the curriculum but it's important we acknowledge and celebrate all the diversity that exists in this room.

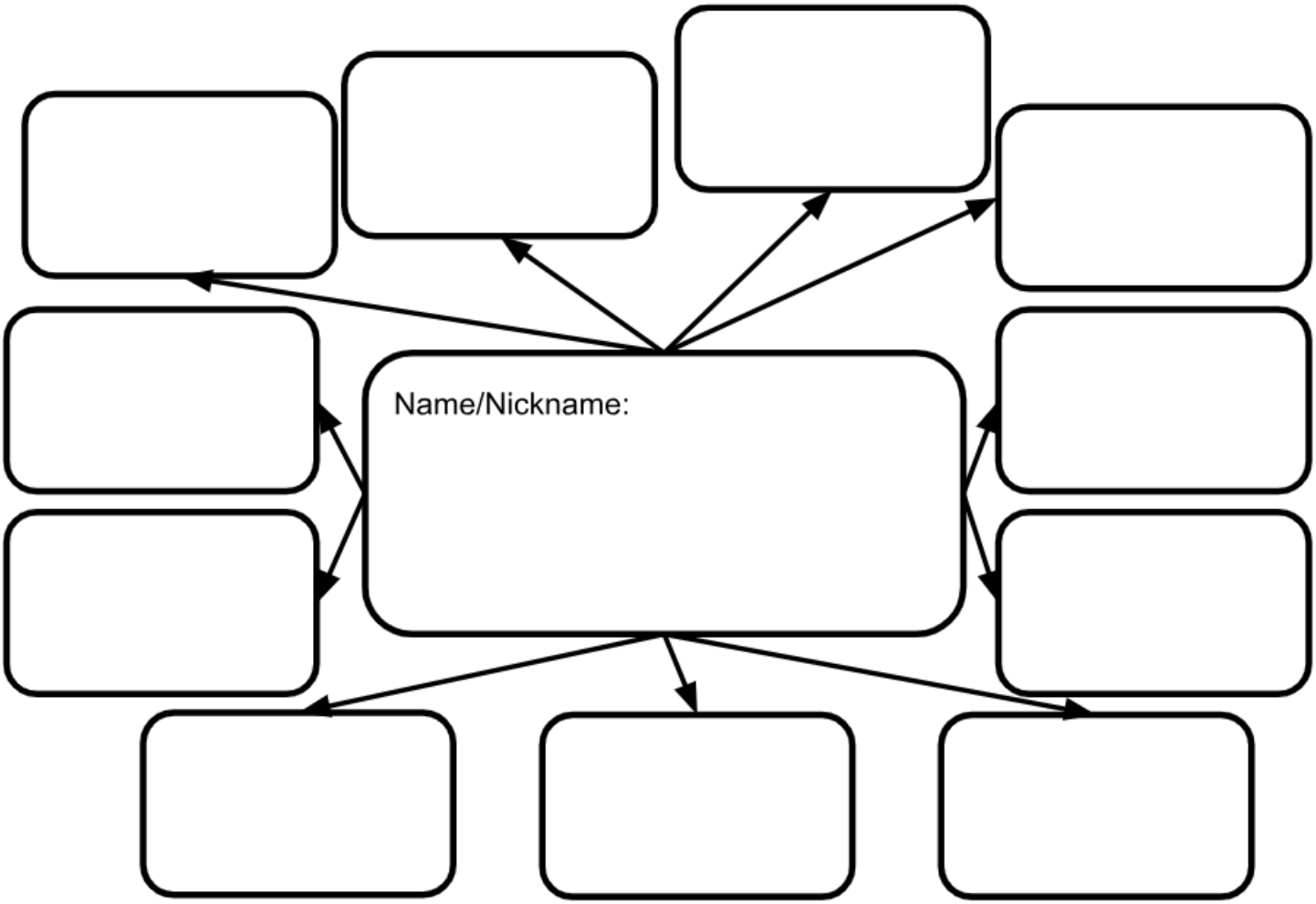
Resources

- CS Pioneers Calendar (note this is for 2022-23 school year; the updated calendars each year can be found at https://sites.google.com/schools.nyc.gov/cs4all-equity/cs4all-equity) - this is to be used to explore diverse CS pioneers to encourage windows, mirrors, and sliding glass doors
- Craiyon AI Art Generator (https://www.craiyon.com/)
- Google Gemini AI Art Generator (https://gemini.google.com/)
- Kapor Center (https://www.kaporcenter.org/) is a resource to get statistics about CS diversity and trends used in day two of this lesson
- Identity chart activity for students (https://www.facinghistory.org/resource-library/starburst-identity-chart)
- Identity Chart Activity (https://csteachers.org/identity-markers-equity-in-cs/)
- Sylvia Duckworth article (https://sdpride.org/wp-content/uploads/2022/11/Wheel-of-Power-Privilege-Sylvia-Duckworth.pdf) (Wheel of Power and Privilege graphic for students)
- Google sites (https://sites.google.com/) (or similar tool)
- Safe Space Resources
  - Video: Brené Brown on Empathy (https://www.youtube.com/watch?v=1Evwgu369Jw)
  - Article: Safe Spaces, Difficult Dialogues, and Critical Thinking (https://digitalcommons.georgiasouthern.edu/cgi/viewcontent.cgi?article=1390&context=ij-sotl)

Teacher Reflection Notes

Identity Chart Activity

Directions: Write your name in the center box. At the ends of the arrows pointing outward, write words or phrases that describe what you consider to be key aspects of your identity. Consider different aspects of your identity such as race, ethnicity, gender identity, languages spoken, etc.



Adapted from Starburst Identity Chart (https://www.facinghistory.org/resource-library/starburst-identity-chart)

Lesson 2. Days 6-7

Topic Description: Students complete a project related to choosing appropriate components for a personal computer.

Objectives

The student will be able to:

- Describe the uses for computer hardware components.
- Choose hardware components for various types of users.
- Discuss types of persons with disabilities and accessibility of technologies.
- Understand how financial access to technology can impact the digital divide.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Read and discuss about individual needs (25 minutes) • Computer Buying Project (25 minutes)	• Students learn about parts of the computer and how these may relate to the specific user's needs
Day 2 • Computer Buying Project continued (20 minutes) • Presentations (25 minutes) • Reflective Journal entry (10 minutes)	• Students share projects with peers and learn about specific needs of diverse users

Student Activities
Day 1 • Complete journal entry. • Read and discuss individual needs and interests. • Review Computer Buying Project information and rubric. • Groups of students select one of the scenarios. • Groups research and create project products. **Day 2** • Continue creation of project product in groups • Presentation of projects

Teaching/Learning Strategies:

Day 1

Journal entry: *What are some features and components you would consider if you were buying a new computer?*

- Have students write responses to the question in their journals and then share the response with their elbow partner.
- Ask a few student pairs to share their responses.
- Ask students why they chose these features. Remind them that we are diverse and individuals may have very different needs so technology needs to meet the needs of all those people. Today and tomorrow we will work in groups to determine how an individual may choose the best computer for themselves based on their personal needs, interests, budget, and access to resources.

- Using the articles provided, complete a jigsaw activity where students read one article and then group students to have one reader from each article to share ideas, create a poster, and gallery walk amongst the class.
  - Ask students to record the following as they read and share when in reading groups:
  - Who is this article about and in what ways is that group using technology?
  - How does this differ from the populations who are not experiencing similar obstacles?
  - How is this similar or different from your own identities and experiences?
  - How does the digital divide affect different communities?
  - What kinds of choices might these groups make when buying a computer as a result of this?
- Have groups of 4 students (with one person from each article) share with each other some of the things that came up in their discussions with each other as well as what is similar and different about each of the 4 different groups identified in the articles. Have groups record and share their ideas on a poster paper.
- Articles (See resources.):
  - Digital divide persists even as Americans with lower incomes make gains in tech adoption
  - Americans with disabilities less likely than those without to own some digital devices
  - Accessibility in tech improved in 2020, but more must be done | Engadget
  - What is Indigenous Connectivity? And Why Should We All Care?

Computer Buying Project

- Show students the computer buying project information and rubric (see end of lesson). This should include relevant information on research skills (as needed) for the students.
  - Project overview
  - Checklist research
  - Scenario research
- Divide students into groups to create one product based on one scenario per group. Either assign groups one of the following scenarios or ask the groups to choose.

Note: Students may create their own scenarios that are more relevant to them; however, this activity is written to see the diverse needs of people surrounding computers and to offer new perspectives that they may not have thought about before, so make sure to review their scenarios for this.

  - Scenario #1: A college student with paralysis in their legs, requiring them to be in a wheelchair for mobility, and carrying limited items with them to and from class.
  - Scenario #2: A student who takes classes remotely from home and also spends a lot of time on photo editing programs when she's done with classes.
  - Scenario #3: A person who has never owned a computer before and does not have much digital literacy.
  - Scenario #4: A mother who has a limited budget is buying a computer to be used at home for her children to share.
  - Scenario #5: A high school student on the eSports team who wants to buy a gaming computer. This person also records themselves playing games on a live stream with their computer camera.
  - Scenario #6: Someone that is going to college next year and will need to download software required by the university and be able to bring their laptop around to different classes.
- Answer any relevant questions about the project.

Day 2

- Have groups continue researching their computer buying project and create a product
- Have groups present their products
  - This could be a gallery walk if students aren't ready yet for full group presentations utilizing some note catcher (for example: have students add a sticky note on each project poster/presentation/laptop/etc that has one question for the group as well as one thing they really thought was interesting or liked about the project)

Reflective Journal entry: *How has technology changed the way society learns, plays, works, etc.? What are some specific examples of how technology has been beneficial or harmful for society? Are there some communities that have been impacted more than others?*

Note: These reflective journals about benefits and drawbacks of technological innovations will be used for the final project. It is suggested to have students group these together or highlight them so it is easier for them to find when brainstorming for their project topic.

Resources

- Digital divide persists even as Americans with lower incomes make gains in tech adoption (https://www.pewresearch.org/short-reads/2021/06/22/digital-divide-persists-even-as-americans-with-lower-incomes-make-gains-in-tech-adoption/)
- Americans with disabilities less likely than those without to own some digital devices (https://www.pewresearch.org/short-reads/2021/09/10/americans-with-disabilities-less-likely-than-those-without-to-own-some-digital-devices/)
- Accessibility in tech improved in 2020, but more must be done | Engadget (https://www.engadget.com/accessibility-in-tech-2020-150002855.html)
- What is Indigenous Connectivity? And Why Should We All Care? (https://www.internetsociety.org/blog/2024/08/what-is-indigenous-connectivity-and-why-should-we-all-care/)

Teacher Reflection Notes

Computer Buying Project

Choose one of the scenarios of buying a new computer to use for this project. Your task is to give them at least 4 options, considering the needs and identity of the user and then give them advice on which one to buy. Your project will be presented to the class.

The final product can be a:

- Presentation
- Debate
- Skit
- Video
- Other approved product

Your final product should have:

- A title with group members' names
- The scenario chosen/assigned
- Computer comparison chart
- Which computer is chosen
- Justification for choosing that computer, including completion of the Computer Components Checklist

Computer Components Checklist

Below are the different components for you and your group (up to 4 students) to investigate:

1. Processor
2. Graphics Card
3. Screen Resolution
4. Operating system
5. Memory
6. Hard Drive
7. Optical Drive
8. Monitor or Screen Size
9. Camera Megapixels
10. Keyboard
11. Mouse
12. Speakers

For each of the components above, write down:

- The name
- What is it used for
- What are the different options or sizes for the components
- Why you included the component in the list of components for the person who is buying the computer

You should be prepared to answer questions about your choices from other students.

Example computer comparison chart (more information can be added). You can also use different computers as appropriate for your scenario.

Component	Dell Inspiron	MacBook Pro	MacBook Air	Chromebook
Laptop or Desktop				
Processor (CPU)				
Graphics				
Screen Resolution				
Operating System				
Memory (RAM)				
Hard Drive (storage)				
Optical Drive				
Monitor or Screen Size				
Camera Details (if applicable)				
Battery Life (if applicable)				
Other Accessories/Details				
Cost				

Computer Buying Project Sample Rubric

Group Members Names (up to 4): _____

Do you have?	Points Possible	Yes	No	Points Earned
Product				
Title with group members' names	5			
Scenario is described	10			
Computer comparison chart with at least 4 options	10			
Chart has specifications of options	5			
Options on chart fit your scenario	10			
Justification for your computer choice	10			
Your choice fits the scenario	10			
Visuals of your choices (pictures or video of choices)	10			
Computer Components Checklist	5			
Presentation				
Present all required parts of project	10			
All group members participate	5			
Able to answer questions	10			
Extension				
Project exhibits creativity above and beyond	Up to 10			
Total	100 + 10			

Lesson 3. Day 8

Topic Description: Introducing students to the materials and process for the creation of devices will open their eyes to the supply chain bringing their phones into their hands. Knowledge of the methods used to extract Earth's elements to develop technology develops students' roles as educated consumers. The concepts of sustainability, sourcing, recycling and human rights are brought into the discussion in this lesson.

Objectives

The student will be able to:

- Gain knowledge of the source of materials that make up the technology we use today.
- Discuss issues with this supply chain, from mining and refining to shipment of materials.
- Discover means of reusing materials to reduce waste and consumption of the Earth's elements.
- Form opinions about the sourcing and recycling of materials used in creating devices.

Outline of the Lesson:

Segment	Reason/Purpose
• Journal entry (10 minutes) • Jigsaw about materials and sources (30 minutes) • Solutions to issues (15 minutes)	• Introduce students to the materials that makeup their devices • Learn about issues with materials' sources and toxicity • Develop solutions and learn about some already in action today

Student Activities
• Complete journal entry. • Complete jigsaw activity to gain knowledge of the materials in their devices, and any issues surrounding origins or materials • Discuss some solutions in action today, and come up with new solutions

Teaching/Learning Strategies:

Journal entry: *Where and how is your phone made? Any ideas on what materials make up your phone?*

- Jigsaw Activity: Sustainability and Computers
- Start by showing these 2 videos (See resources.)
  - Where does your phone come from
  - Cobalt mining for phones: How you could be holding a product of child labor
- Next, assign articles/videos (See resources.) for each group to use to gather knowledge about sustainability and cell phones. Ask students to focus on the quality of life and safety issues, as well as solutions. Remind them that most people do not have this knowledge, and ask them to include clear details and explanations of their findings. Discuss why most consumers do not know where they are sourced, and who benefits from this lack of awareness.
- Use a teaching strategy such as jigsaw to ensure all students gain sufficient understanding of computers and sustainability.
- Form groups of equal amounts of students. Assign each group a video or article
- Instruct each group to use their resource and create a product with at least 5 pieces of significant information from their resource.
- Have students share their learning in a collaborative process like a jigsaw, gallery walk, presentation, etc.
- Have students return to their product and add one important or significant fact from each of the other groups. Have groups share what they added and/or why they added it.
- Teachers may need to help students with some terms such as circular economy.
- Teachers review the work as the groups are talking, and take notice of any missing big ideas, such as sustainability, the quality of life and safety issues where materials are sourced, as well as solutions like recycling devices. After the groups finish, students share their ideas, and teachers can fill in the gaps.
- In a wrap up discussion, ask students to suggest solutions they thought of related to the resources they reviewed. This discussion can lead into the journal discussion.

Journal and share out: *What are examples of positive and negative environmental aspects of sustainability in the supply chain of computer components?*

Write about a connection to your own identities and communities in your portfolio. Consider your background, beliefs, and goals, and comment on the sustainability of devices, issues and solutions.

Note: Refer back to Lesson # 1 Day 2 where a cell phone is considered a computer. What other devices besides phones could be discussed in this Sustainability lesson?

Resources

- Where does your phone come from? (https://www.youtube-nocookie.com/embed/cKvGzS8LYbY?playlist=cKvGzS8LYbY&autoplay=1&iv_load_policy=3&loop=1&modestbranding=1&start=)
- Cobalt mining for phones: How you could be holding a product of child labour (https://www.youtube-nocookie.com/embed/AA6BnitgdP8?playlist=AA6BnitgdP8&autoplay=1&iv_load_policy=3&loop=1&modestbranding=1&start=)
- Not So "Green" Technology: The Complicated Legacy of Rare Earth Mining (https://hir.harvard.edu/not-so-green-technology-the-complicated-legacy-of-rare-earth-mining/)
- Are Electronics Bad for the Environment? – The Sustainability Co-Op (https://thesustainabilitycooperative.net/2022/03/24/are-electronics-bad-for-the-environment/)
- How the Circular Economy of Consumer Electronics Can Change Sustainability | Entrepreneur (https://www.entrepreneur.com/science-technology/how-the-circular-economy-of-consumer-electronics-can-change/454998)
- UN report: Time to seize opportunity, tackle challenge of e-waste (https://www.unep.org/news-and-stories/press-release/un-report-time-seize-opportunity-tackle-challenge-e-waste)
- The Dark Origins of the Gold in Your Smartphone | MIT Technology Review. Examples of those recycling parts (https://www.technologyreview.com/2016/11/16/155981/the-dark-origins-of-the-gold-in-your-smartphone/)

Teacher Reflection Notes

Lesson 4. Days 9-10

Topic Description: In previous lessons, students learned about the makeup and use of devices. Today they will learn how devices and communities are connected, that the Internet is a network of devices, and related basic concepts. The complex flow of data through the Internet is then modeled through an enactment between two networks. The concepts of packets and errors in transmission are also introduced.

Objectives

The student will be able to:

- Understand the internet as a network of computing devices in terms of peoples' lived experiences
- Discuss how data gets created and flows in a network
- Discuss equity implications of omnipresence or lack of internet as it relates to data privacy and digital divide

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (15 minutes) • Discussing the basics of the Internet (10 minutes) • Set up and execution of enactment activity (20 minutes) • Journal entry (10 minutes)	• Connect the internet with students' experiences as users • Model what happens in layers when a message is sent between 2 devices
Day 2 • Tablets of Stone activity (40 minutes) • Journal entry (15 minutes)	• Experience what can happen when messages are sent between two entities, and solve the problem • Reflect on potential data privacy and digital divide issues that surface

Student Activities

Day 1

- Complete journal entry.
- Discuss the basics of the internet
- As a class, act out what happens when sending a message to your friend.
- Explain how a message is passed between friends' devices.

Day 2

- In groups, send messages using packets and solve problems when errors occur.
- Journal entry.

Teaching/Learning Strategies:

Day 1

Journal entry: *Share 1-2 activities in your everyday lives where you use the internet. Based on these experiences, how would you describe the internet?*

- Highlight how most of the devices around us are connected to the internet. Facilitate a discussion by gathering all the responses to highlight how the internet is a network of devices, each having a unique ID called IP address. Include insight into different communities' connectivity, or lack of.

- Basics of the Internet
  - As a continuation of the previous discussion, facilitate a conversation to recognize the different aspects of the internet they may have experienced such as the browser, search engines, world wide web, social media, gaming apps, and cloud storage. Highlight the role of the network in communicating data between devices.

Note: In this lesson, there are 2 physical movement activities. The first one demonstrates how information is sent over layers on the internet. The second one shows the importance of the use of metadata in the ordering of packets of messages sent over the internet.

Set up for Activity

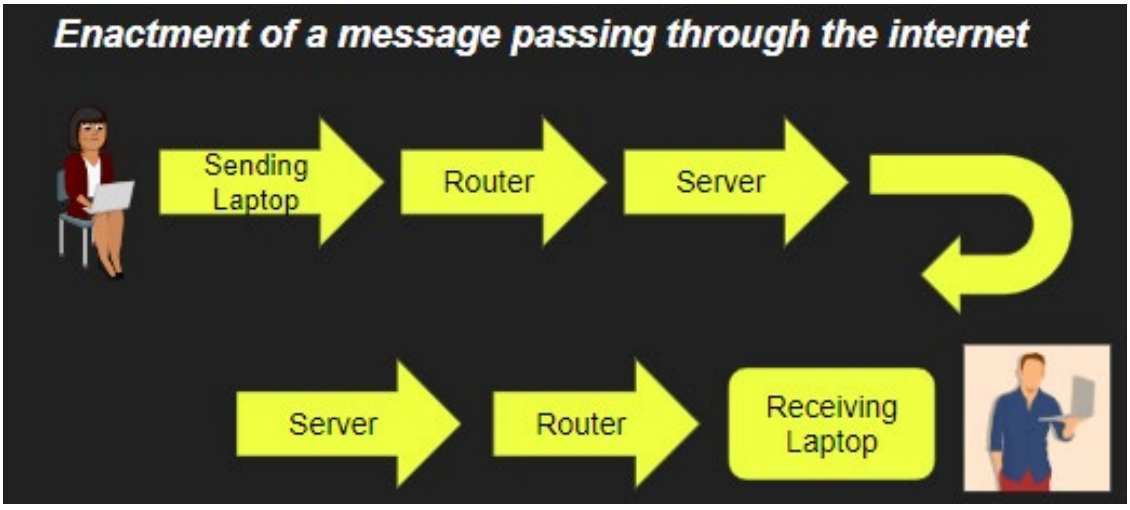
- In the next activity, a message is going to be sent from your laptop/PC at home to a student's device at school. To set up for this activity, students need to learn how to find IP addresses of the devices in the network. You also need a printout of an image or email, cut it into 6 pieces, called packets. These will be passed through each layer one at a time.
- Students Indicate the need for giving the devices unique names (e.g., to and from addresses for mail to be delivered) and introduce the idea of IP addresses.
- Find the IP address of your school's server and router, and the address of your device

Note to teachers: Find this information at home before this lesson

  - To prepare, teachers must find the IP addresses of their laptop/PC, router, and server for their Internet Service Provider (ISP)
  - To find the IP address, go to the command prompt (an application). Type ipconfig /all
  - Your IP address will be listed next to IPv4, and your server's IP address will be listed next to DNS server, and the router IP address will be next to Default Gateway.
- Teach students how to look up their IP addresses on their devices. For the router and ISP server, follow the directions above.
- For phones:
  - Go to wifi
  - Click on the wifi you are connected to.
  - Scroll down to find IP address.
- Choose a student to write their IP address on a card. This is the 6th card for the activity
- With the IP addresses from your home and from the students in school, create 6 8 X 11 cards (manilla folders work well).

Enactment of sending a message

- Ask students - "What do you think happens when you send a text or image to a friend with your phone? How does it get from your phone to their phone?"
  - Explain that there are layers the message passes through with this video
  - Sample video: How Does the Internet Really Work? | Britannica (See resources.)
- Enactment of a message passing through the layers on the Internet.



- Choose 5 students to demonstrate. Each student will hold one of the cards with the IP address on it, in order, as pictured above
- You are the 1st card, the sending laptop. Take the cut up packets of the message or image, and pass each piece one at a time through the layers.

  - You can do these using different methods like wifi, ethernet and fiber optics. If you are using wifi, you can drop a piece to model wifi reliability issues. For fiber optics you can pass them faster.
    - Ethernet Cable: reliable, shorter distance than fiber optic. could cause pauses/hiccups, needs electricity, faster, secure, indoor
    - Fiber Optic: faster than ethernet, reliable, outdoor, works with light, can't be bent
    - Wifi: access, slower data transmission, needs electricity, doesn't go far, not always reliable service, hackable
  - You can also choose a student to perform this role, and explain the differences to them
- When the packets reach the receiving laptop (device), reconstruct the pieces to view the message.

Journal entry: *Explain how an image is sent between two friends' devices. What do you think could happen that would prevent or delay the message being sent? Who has access to this data? Explain*

Day 2

Tablets of Stone Activity

- Have students complete the Tablets of Stone Activity. (See resources.)

Note: The setup of this activity takes some time, especially in the creation of the messages between the governors

- **Discussion:** What can you do to solve the problem of missing packets or packets that are out of order?

Journal entry: *When using the internet, what data is being sent and created? How might companies or someone use that data?*

Resources

- How Does the Internet Really Work? | Britannica (https://www.britannica.com/video/222274/A-Packets-Tale-How-Does-the-Internet-Work)
- Tablets of Stone Activity—CS Unplugged (https://www.exploringds.org/curriculum), Bell, Tim, Ian Witten and Mike Fellows. Computer Science Unplugged. Canterbury, New Zealand: 2002.
- Additional resource: How Does the Internet Work? - Glad You Asked S1 (https://youtu.be/2J0VoWv4p40) (20 minutes)

Teacher Reflection Notes

Lesson 5. Days 11-13

Topic Description: Search engines and how they work are explored through various searching activities and discussions. Through the evaluation of sources, one can determine if it is reliable or not based on a set of criteria.

Objectives

The student will be able to:

- Perform searches and explain how to refine searches to retrieve better results.
- Identify resources for finding information.
- Evaluate the reliability of a resource.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Scavenger Hunt & Discussion (35 minutes) • Journal entry (10 minutes) • Reflective Journal entry (5 minutes)	• Students will answer a variety of questions and keep track of their answers and how they searched to find them. Students will discuss why they found different answers.
Day 2 • Journal entry (10 minutes) • Rubric creation (30 minutes) • Rubric Presentations (15 minutes)	• In groups, students will brainstorm what a credible website needs and how to evaluate if a source should be used or not.
Day 3 • Journal entry (10 minutes) • Definitions (5 minutes) • Information Exploration (30 minutes) • Journal (10 minutes)	• Students will explore the difference between misinformation and disinformation.

Student Activities

Day 1

- Complete journal entry.
- Students complete a searching scavenger hunt.
- Students share out answers noting how they found the information and if their answers are the same or different.
- Complete journal entry.
- Complete reflective journal entry.

Day 2

- Complete journal entry.
- Groups of students create a rubric to evaluate online resources.
- Students share rubrics.

Day 3

- Complete journal entry
- Definitions
- Information Exploration

Teaching/Learning Strategies:

Day 1

Journal entry: *What are three ways that you use the internet?*

- Have students write their responses in the journals and share with their elbow partners.
  - Share out with the class, creating a list of resources and uses.
- Most resources can be divided into three categories: information, social, and entertainment.

Scavenger Hunt

- Have student groups complete an internet scavenger hunt.
- A sample is provided (See resources.), but you may want to create your own that is more specific to the interests of your students or have the groups create their own and exchange with another group.
- Students should keep track of how they found their answers for the closing discussion. This can be done in a note catcher or as a set role in their groups.

Note: Most search engines give an AI answer at the top. Encourage students to find actual sources instead of the al generated ones. This can also be an opportunity to discuss the validity of the AI answers.

Discussion

- Have students share their answers and searching techniques with the class.
- Teacher should ask prompting questions

- Did anyone else get a different answer? How did you search differently?
- Why do you think different answers were found?
- What could have been searched to find the correct answer more efficiently?

Journal entry: *If we all had the same questions, why do you think different answers were found?*

Discussion

- In this discussion, students may discuss cookies, algorithms, what they used to search and where they started their search.
- If these topics are not covered in discussion, play the "What are Cookies?" video that can be found in the resource section for this lesson.

Reflective Journal entry: *What technology did we learn about today? What are the positives and negatives of this? OR What might be examples of positive and negative impacts of cookies?*

Day 2

Journal entry: *Why is it important to evaluate search results and sources?*

Discussion

- The goal of the discussion is for students to explain that not all searches and sources provide reliable information.
- Can refer back to the scavenger hunt in asking why not all answers were the same.

Rubric Creation

- In groups, students should brainstorm how they would evaluate if a website is reliable or not.

Note: If students struggle with coming up with their own, it may be helpful to give a sample website to look at.

- After brainstorming the group should create a visual for their rubric that includes a minimum of 5 criterion and how the rubric should be used.
- If students get stuck, try to push them to consider
  - current
  - relevance
  - author
  - accuracy
  - purpose
  - domain
  - security
  - advertisements
  - grammar
  - professional look
- Each group should present their rubrics.

Note: If time permits, have students apply their rubric to a website of their choice.

Day 3

Journal entry: *What do the prefixes "mis- ", "dis-" and "mal-" mean? Think of words with those prefixes, how does the addition of the prefix change the meaning?*

- Have students discuss with elbow partners and share out
- In discussion ask students what they think the difference is between misinformation and disinformation. As part of the discussion, have students identify a few examples of information around them that they aren't sure about and/or they know isn't accurate.
- How would they go about identifying something as misinformation, disinformation, malinformation in websites and social media? How might you use the rubric you created related to reliable sources to help?

Information Exploration

- Divide students into groups of 2 to 4. Each group should identify three instances they know where misinformation/malinformation was shared via websites or social media.
- Each group should use a medium of their choice (poster, webpage, powerpoint, video) to highlight the following about each instance they chose
  - Explain the type of misinformation presented
  - How widely was it shared and through what channels?
  - How did the fact that it was misinformation surface?
  - What could be done to stop the spread of misinformation in situations like these?
  - Who was impacted?
  - How might similar situations be avoided in the future?

Note: Students should do a gallery walk of the presentations.

Journal: *How has the availability and manipulation of information online had positive or negative personal, societal, economic or environmental impact ? Provide examples that have not been presented already? Who has been impacted and in what contexts?*

- Students should share with elbow partners before sharing out with the whole class.

Resources

- Sample Scavenger Hunt Activity
- Fake News/Misinformation/Disinformation : What is Fake News? (https://subjectguides.lib.neu.edu/fakenews)
- What are Cookies? And How They Work | Explained for beginners (https://www.youtube.com/watch?v=rdVPflECed8)

Teacher Reflection Notes

Sample Scavenger Hunt

Directions: Individually, using at least three different search engines answer the following questions. The search engines should vary from general search engines (google.com, bing.com) and specialized search engines (Internet Movie Database, Google Maps, Yellow Pages, etc.)? Do not use each search engine more than twice.

Question

1. Who starred in Hidden Figures?
2. What MLB player has the highest current batting average?
3. Who is the current Speaker of the House?
4. What time will the sun set tonight in Kihei, Hawaii?
5. Between Jim's Original and Byrons, where would you go for a hot dog? Explain why.
6. How to remove a pen stain from your shirt?
7. How would you get to Wrigley Field from Amundsen via CTA?
8. What is a trending topic right now? What is it about?
9. Who has the most streams on Spotify?
10. What is one website that relates to your interests?

(adapted from Scavenger Hunt created by Meghan Taylor, Chicago Public Schools)

Lesson 6. Day 14

Topic Description: The way most users use the internet can be broken down into three categories: work/informative, entertainment and communicative. Previously, a discussion was had over what makes a website reliable when looking for information. In a look at websites and applications that are used for entertainment and communication, a discovery on what data is required to use the websites will end in an evaluation of whether it is worth the user giving up their personal information and data.

Objectives

The students will be able to:

- Explain what is necessary for a website or application to be considered web 2.0.
- Use a variety of Web 2.0 applications.
- Determine what data is given off on a variety of sites and applications.
- Reflect on their own digital footprint and its privacy.

Outline of the Lesson:

Segment	Reason/Purpose
• Journal entry (5 minutes) • Brainstorm (5 minutes) • Application / Website Analysis (20 minutes) • Presentations (15 minutes) • Reflective Journal entry (10 minutes)	• Students will discover what makes a website or application 2.0 and follow with an analysis of what data is collected from these websites and finally evaluate if the source is worth giving their data.

Student Activities
• Complete journal entry. • Brainstorm examples of Web 2.0 applications and websites. • In groups, analyze an example of web 2.0 to determine how it is a web 2.0, functions, uses, and what data the website tracks. • Present their group analysis. • Complete reflective journal entry.

Teaching/Learning Strategies

Journal entry: *What features do you think makes a website or application web 2.0?*

Discussion

- During this discussion, most students will say that web 2.0 is the second version of the web or internet. Push the discussion further for students to question what does that mean? What makes the internet now different than before? The goal is for students to arrive that 2.0 means that users can generate content (websites provide for two-way communication).

Note: Web 1.0 does not allow for user generated content and is usually more reliable. Examples would be Whitehouse.gov, dictionary.com or most news sources.

Brainstorming Journal: *How many examples of web 2.0 can you think of? List as many as you can. Which of these examples have you used personally?*

- Do a whip around and have each student (or group of students) share their examples and create a composite list on the board.
  - Examples: Youtube, any social media, Spotify, Quizlet
  - Debatable examples: streaming services, some shopping websites

Application / Website Analysis

- In groups students should analyze one of the web 2.0 applications from the class list.
  - What is the purpose of the application?
  - What are some of the functions that it has?
  - How is it an example of web 2.0?
  - What data does a user give off when using this application?
  - How does the application use the user's data?
  - Be specific, what data has members of your group given to this web 2.0 and how has it been used?

Presentations

- Students should complete a short 3-minute presentation over what they discovered during their research time.
- Presentation should have a visual to aid in the presentation
  - It may be beneficial to give students the reflective journal to help generate a conversation after each presentation or for them to take notes.
  - This is a great opportunity to reinforce what was learned about cookies the day before to extend the conversation about how users have different experiences online.

Reflective Journal entry: *What are the positive and negative impacts of giving personal information to websites? Explain.*

Resources

- Google Web Activity (myactivity.google.com) and/or My Ad Center (myadcenter.google.com)
- Google Maps History (maps.google.com/locationhistory)
- Twitter Ad Settings (twitter.com/settings/your_twitter_data/ads)
- Instagram Ad Topics (instagram.com/ads/preferences/ad_topics)

Teacher Reflection Notes

Lesson 7 Days 15-16

Topic Description: Computers have changed the ways society communicates. Through analysis and research, students will determine what data is being exchanged when communicating, the benefits and drawbacks of a communication method, and give guidance for best use.

Objectives

The student will be able to:

- Explain how computers are used for communication.
- Recognize various forms of communication as data exchanges.
- Describe the implications of data exchange on social interactions.
- Analyze the consequences of permanence and availability of data in regards to privacy.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Communication Choices (10 minutes) • Communication Methods Jigsaw (25 minutes) • Share out (15 minutes)	• Students will reflect on how they communicate using a variety of communication methods and analyze the data exchange when using a chosen method.
Day 2 • Journal entry (10 minutes) • Communication Methods Jigsaw (20 minutes) • Share out (15 minutes) • Reflective Journal entry (10 minutes)	• Students will continue working with their chosen communication method and create a visual for the benefits, drawbacks and rules for guidance that will be shared with the class.

Student Activities

Day 1

- Complete journal entry.
- Groups of students create a visual on their chosen communication method with the benefits, drawbacks and rules for guidance.
- Students will share their visuals.

Day 2

- Complete journal entry.
- Groups of students create visuals on a chosen communication method and the data exchange when using it
- Students will share their visuals.
- Complete reflective journal.

Teaching/Learning Strategies:

Day 1

Journal entry: *List as many computer-based forms of communication as you can think of.*

- After 1 minute make a composite list on a board or chart paper.

Note: Students may choose examples like email, text, social media, etc.

- Using a few of the following scenarios, ask the class which one they would use and then why? Notes: This is to be used as brainstorming for the jigsaw, you do not need to do the whole list. Teachers can also ask if using computer-based communication is not appropriate in that situation and why?
  - Breaking up with a significant other (boyfriend/girlfriend/partner)
  - Asking parents' permission to do something when you think they will likely say "no"
  - Figure out where and when to meet a friend to see a movie
  - Getting help on homework
  - Announce you met someone famous
  - Complain about your parents
  - Mourn someone you lost
  - Buy something from someone you don't know well.
  - Show off or brag about something that you are proud of (new haircut, good grades, awards, etc.)

Communication Methods Jigsaw

- For this activity, students should be split into groups. Each group should pick a different communication method. The list created in the journal could be used for students to pick from. For the purpose of this activity and the following, at least one group needs to be assigned face to face (a way without technology) and one group assigned email.
- Groups should create a visual for their communication method that includes:
  - Two scenarios that one would use that communication method and why
  - What data is being given off
  - Who has access to this data and for how long?
    - Have students research the privacy policies and terms and conditions

Note: If students do not know this information, they should research.

- **Share out:** Groups can either present their information or students can complete a gallery walk. Teachers can assign the journal during or after the share out.

Note: If not discussed, teachers should point out that face to face and phone calls do not have the same permanence of data as computer-based communication methods as well as more people have access to data.

Note: While groups are working and researching the last question about the privacy policies and terms and conditions, ask students what they notice about how they are written. Why do they think they are written the way they are?

Journal entry: *How might someone's demographics impact what communication methods they choose for general communication?*

- For this discussion, teachers should push students to think about age, socioeconomic status, location, education levels, etc. This is an opportunity to continue the conversation about digital divide which was touched on in the computer buying project.
- Teachers should caution students about stereotyping groups of people (ex: all old people are "bad" with technology) but instead think of why certain communications and groups of people warrant one form over the other

Day 2

Journal entry: *From yesterday, what similarities and differences do you notice between the data being given off by the different forms of communication?*

- Students might note that data from technology-based communication lasts longer than in person, more people or organizations have access to communication data, but characteristics including tone and body language are harder to convey. On the other hand, what is shared on platforms such as Facebook or X will stay, sometimes even after deleting the account, creating a personal portfolio for the companies that own these platforms and using it for different for-profit activities. People's lives represented on these platforms have also been studied to have negative consequences on one's mental health, making adolescents vulnerable to suicides, online bullying, and harassment.

Communication Method Best Use Jigsaw

- In their groups, students should create a second visual for their communication method with:
  - Benefits
  - Drawbacks
  - Guidelines for use of that communication method
    - For this section, teachers should monitor groups and push students to think about phishing scams in emails, texts, and direct messages as well as deep fakes of videos and voices. Teachers can reference the evaluating websites lesson and how students should create things to look for when using the different communication methods.
    - Examples: do not download email attachments or open links from unknown senders, be wary of phone numbers or email addresses, check email addresses for suspicious letters, don't add people you do not know, do not share locations with strangers, etc.
- **Share Out:** Students should present their visuals to the class. Teachers should keep a list of important guidelines for students to copy down after the discussion and to refer back to.

Reflective Journal entry: *How has technology changed the way society communicates? How have changes in communication been beneficial or harmful for society?*

Resources

- No additional resources needed

Teacher Reflection Notes

Lesson 8. Days 17-19

Topic Description: The use of computers for communication and the impact this has had on individuals and society

Objectives

The student will be able to:

- Explain how computers are used for communication.
- Recognize various forms of communication as data exchanges.
- Describe the implications of data exchange on social interactions.
- Analyze the consequences of permanence and availability of data in regards to privacy.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Impacts of permanence of data on society discussion (20 minutes) • Journal entry (15 minutes) • Assign Privacy Scenario Activity (10 minutes)	• Have students reflect on these data they give off in person and online. • Reflect back on the communication method chart and discuss how what is electronically sent has a record. Set foundation for discussion about consequences. • Brainstorm negative online behavior and possible consequences.
Day 2 • Privacy Activity (55 minutes)	• Work collaboratively on assignment.
Day 3 • Privacy Presentations (45 minutes) • Journal entry (10 minutes)	• Discuss the possible real life consequences for online behavior.

Student Activities

Day 1

- Complete journal entry.
- Students reflect on their communication methods chart and their journals to discuss their digital footprint and permanence of data.
- Complete journal entry.
- Students will be grouped for the privacy scenario activity and learn about the expectations for the project.

Day 2

- Students collaboratively work on the Privacy Activity

Day 3

- Students present their scenario to the class followed by a discussion of the consequences of each scenario.
- Complete journal entry.

Teaching/Learning Strategies

Day 1

Journal entry: *How do you give off data? Who has access to this data? Give at least 3.*

Discussion: Discuss how some of the examples given by students are permanent.

- Ask follow up questions about if and how this might have an impact on their lives?
- Depending on the examples, ask students if it is okay for everyone to have access to this data? Or who should the access be limited to?

Journal entry: *What are two examples of how data posted online could have an impact on a person's life?*

Discussion: Students can give personal examples, ones they have heard in the news or theoretical. Use this to make connections or create a foundation for the privacy scenario activity.

If students struggle to come up with their own, allow time for them to research examples online.

During this share out, ask students how the person's identities may have had an impact on their scenario?

Privacy Activity (See resources.)

- Students are placed into groups and assigned a scenario.
- They are to prepare a presentation to answer questions for their given scenarios
- Groups deliver presentations
- As audience members, students should be forming opinions if they agree or disagree with presented information.

Day 2

- Students work collaboratively in their group on the privacy scenario assignment. During this time, teachers should check in with each group and ensure that their answers go beyond a surface level response. Teachers should remind students that each student needs to do an analysis of their own digital footprint.

Day 3

- Each group should present their privacy scenarios to the class.
- After each presentation, allow time for a discussion. Sample questions:
  - Do you agree with this group? Explain why or why not?
  - Do you agree with the consequences?
  - What could have been done differently by either party involved?
  - Can you think of any other examples?

Reflective Journal entry: *Give one positive and one negative example of how the availability of data has had an impact on society. For the negative, how can these consequences be minimized?*

Resources

- Privacy Activity

Teacher Reflection Notes

Privacy Activity

Directions: read the scenario assigned to you (many of these are based on real stories):

1. A boss sees an employee who called in "sick" in a picture that someone posted on Facebook. In this picture the employee is partying the night before. The boss fires the employee.
2. A student is being suspended because they have been harassing another student through texts and social media.
3. A company who has contracts with the Federal Government doesn't want to hire you because a Facebook friend leaves lots of enthusiastic "legalize marijuana" postings on your wall.
4. A teacher is fired because there's a picture of this teacher holding alcoholic drinks on her Facebook page.
5. An 18-year-old Senior boy is charged with distributing child pornography when he uses his cell phone to send naked images of his 15-year-old Sophomore ex-girlfriend to his friends.
6. A student is being suspended because of cyberbullying. She has been posting rumors on social media.
7. A person is fired because of inappropriate emails that were sent to other coworkers.
8. A senior in high school had their college admittance revoked after posting on Tik Tok something that was against the values of the college.
9. A student is suspended for posting false information about a possible threat to the school.
10. An employee posted about their low wages and working conditions and was fired.

Presentation Requirements:

Prepare a three to five minute (3-5) presentation for the class that includes answers to the following:

1. Names of everyone in your group
2. The scenario you were assigned
3. In your scenario, did the people have the right to use the information they did, or should the information remain private? Why?
4. Are the people who were affected by the use of this information at fault? Why?
5. Give another example of a real life scenario you experienced or heard about something unexpected happening because of information shared on sites such as Facebook, X, SnapChat, Tik Tok, blogs.
6. Consider TWO of the following broad categories of societal change:
   - Privacy
   - Safety
   - Globalization
   - Connectivity (keeping in touch with people)
   - Permanence of data

Discuss whether the availability of data has had a positive or negative impact on each aspect of society and, if negative, how these consequences can be minimized

7. **EACH GROUP MEMBER:** Think about what data you've made available in different places/ spaces such as Facebook, Twitter, texting, Tik Tok, email, searches, at the grocery store, etc. What might other people think about who you are based on this data? Give specific evidence. Does the online data give an accurate impression of who you are?

Lesson 9. Days 20-21

Topic Description: Points of view: Telling a story with data

Objectives

The student will be able to:

- Explain how different views of data can tell a different story.
- Recognize that data is an incomplete record of reality and there is bias.
- Describe the limits of data representation.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Room Activity (35 minutes) • Reflective journal entry (10 minutes)	• Students are introduced into the world of data as information that can be biased.
Day 2 • Journal entry (10 minutes) • AI art (20 minutes) • Bias in data (15 minutes) • Reflective Journal entry (10 minutes)	• Students learn how data is connected to AI and how bias is related.

Student Activities
Day 1 • Complete journal entry. • Complete Room Activity. • Complete reflective journal **Day 2** • Complete journal entry. • Experiment with AI art. • Discuss bias in data. • Complete reflective journal entry.

Teaching/Learning Strategies:

Day 1

Journal entry: *What is data? Where can it be found? Where does it come from?*

- Have students write responses to the question in their journals and then share the response with their elbow partner.
- Ask a few student pairs to share their responses and write down the ideas for the class.
- Emphasize that this lesson is meant to stretch their thinking about data. Some ideas students may come up with include: names, numbers, pictures, sounds, designs, etc. (this will be revisited in the next lesson with cultural designs as well so getting kids thinking outside the box here is important).

- Assign various groups different versions of the Room Activity (there are 3 total versions so dividing the class up into a number of groups that is divisible by 3 is helpful but not absolutely necessary)
  - Room Activity Instructions (3 versions for 3 different groups—See resources.)
  - Depending on the amount of time available and the size of the class, you can have some students work with the picture (in the Supplemental Materials), some work with the entire word list, and some work with the word cloud.
  - When each group is finished with their first 3 instructions, have them compare with a group that has a different version.
  - Have groups share their answers to question 2 with the entire class.
    - *If students are struggling to come up with different aspects of their identity, you may want to discuss these: Gender, Nationality, Language(s), Age, Race, Income level, Ethnicity, Neurodiversity*
  - As students share, challenge their thoughts (ex. if everyone said "boy" for gender, you might ask why or if it's possible that the person is a girl or if the person is non-binary, etc.)
- Show groups the different versions of the room.
- Have groups complete questions 4-6.
- Have some groups share their answers for 4-6.
- Emphasize that the appearance of the data and amount of data collected inform the inferences that can be made.
- **Discuss** the fact that this image was actually generated using artificial intelligence, rather than having an artist or photographer create one. Where do you think the computer or program got the information to create this image? Could that information be biased in generating this art?
  - *It might be helpful to share with students the prompt used with Stable Diffusion AI art generator: "Teenager sitting on the floor of a messy bedroom with a Laptop, video game system, cell phone, 2 Televisions, 3 Toy Cars, Calendar, 3 Ribbons, Sprite Can, 3 Plaques, Gold Medal, Mug, Trophy, Picture Frame in it"*

Note: In this unit, we use several AI Generative tools only for demonstrative purposes. We advise that these are done only through the teacher's lens (rather than students directly using them) as much as possible to limit other implications emerging from AI use.

- You should connect students' ideas about computing from the very first lesson (input-processing-output) to AI. Artificial intelligence simply takes a lot of data in, it's processed to find patterns, and the output is predictions (in our case an image to represent what the system predicts those words to visually look like).
- We will talk more about AI in the next day's lesson so this is just a bit of a teaser to get students thinking about decisions being made by AI through datasets (like the decision of what a "teenager" looks like for the image provided).

Reflective Journal entry: *How can technology help us tell a story? Where does technology have limitations or biases in the communication of the story?*

Day 2

Journal entry: *How can data be biased? Provide some examples.*

- Ask students to think about the previous day's lesson using the AI picture as support for how data is biased

AI art

- Teacher should use a free AI art generator such as Stable Diffusion, Craiyon, Google Gemini, or others you have may have access to (See resources.) and first demo using the prompt "computer scientist" to draw on our first lesson about what computer scientists look like (or do this ahead of time). Have them review the results - what do they notice, what do they wonder? Have a few groups share their ideas. Ideally here you are showcasing the bias in these systems and the datasets they have to make assumptions like who a computer scientist is and isn't. We do not advise that students use these platforms themselves, as they may need parental consent to use generative AI in schools and can further drive potential bias in data.
- Next students will review pictures around the room made by generative AI (this should be done using the pictures provided in the Generative AI Art Activity). It is important that students view these in color, so if you have access to print in color, you can print them. Otherwise, you could use one laptop/computer per viewing station around the room that you set up ahead of class. The prompts used (which you should not disclose to students and remove from the labels attached to the activity sheets) are listed in the table below. Ask students to move around the room in groups and answer the questions below:
  - What do you notice about the images for each prompt? Were there any major similarities amongst the images for each prompt?
  - What prompt (search terms) do you think was used to make these images?
  - Why do you think the images looked this way? Where does the data come from?

Image Number	Prompt used
1	College graduate in a city
2	Rich older woman on a cruise ship
3	Latino father at a fast food restaurant
4	A mother who gets food stamps, at a school
5	A person who is transgender at a grocery store
6	A muslim teenager going to school
7	An indigenous person at the dinner table

Note: If you are unfamiliar with the potential stereotypes of any of the groups listed in the table above, it is important to familiarize yourself prior to this lesson. You may need to guide discussions with students if they are unaware of these stereotypes as well.

- Now have students go back with their groups (after you post the original prompts for each) to discuss the following questions::
  - Compare your guess and the actual prompt. Which ones were you most accurate in? Why do you think that's the case?
  - Do you feel these images represent these groups of people accurately? Why or why not?
- Have students reflect and discuss the following:
  - What bias(es) did you notice today using this program? Were there any assumptions the computer made about identities of people? If you didn't notice any, what potential bias(es) could exist? Consider different identity characteristics (ex. Different races, nationalities, neurodiversities, sexualities, etc.)
  - How do you foresee this type of program (Generative AI Art) being used in the future?
  - What concerns do you have about people using this type of technology in your future?

Bias in data

- Now that students have seen a bit about how AI art software works, they will read and annotate an article about stereotypes in AI art (See resources.)

Note: The article briefly mentions sexuality so teachers should preview before providing to students in the event it needs to be modified

- Ask students to look for connections between the activity we just did and this reading as well as connections to the real world

- You may want to give them some other references of AI like facial recognition systems that take in visual data, find patterns, and make conclusions (that are often biased) and could be consequential (for example, the facial recognition data is disproportionately collected in areas with more people of color and subsequently individuals of color are more likely to be misidentified due to biased technology systems that are less accurate in identifying people of color compared to those who are not).

Reflective Journal entry: *Why is it important that we understand how software like AI art generators work and the bias that exists?*

Resources

- Room Activity Instructions
- Generative AI Art Activity (See Supplemental Resources: exploringcs.org/curriculum)
- Stable Diffusion Online website (https://stablediffusionweb.com/#demo) (or similar AI art generator)
- Google Gemini AI Art Generator (https://gemini.google.com/)
- Craiyon AI Art Generator (https://www.craiyon.com/)
- The Washington Post article (https://www.washingtonpost.com/technology/interactive/2023/ai-generated-images-bias-racism-sexism-stereotypes/)

Teacher Reflection Notes

Group A: Room Activity PICTURE Instructions

Look at the picture provided.

1. Make a list of the objects in the picture.
2. What does this data tell you about the person who lives in this room? What does it not tell you? Think about some different aspects of a person's identity.
3. What are most of the items in this room related to?

Now compare with the other group.

4. Are there any advantages to one representation or another?
5. Do you think different representations can tell different stories?
6. What do you think came first - the drawing of the room or the list?

Group B: Room Activity ENTIRE WORD LIST Instructions

Look at the following list of items found in someone's room.

- Person
- Laptop
- video game system
- cell phone
- 2 Televisions
- 3 Toy Cars
- Calendar
- 3 Ribbons
- Sprite Can
- 3 Plaques
- Gold Medal
- Mug
- Trophy
- Picture Frame

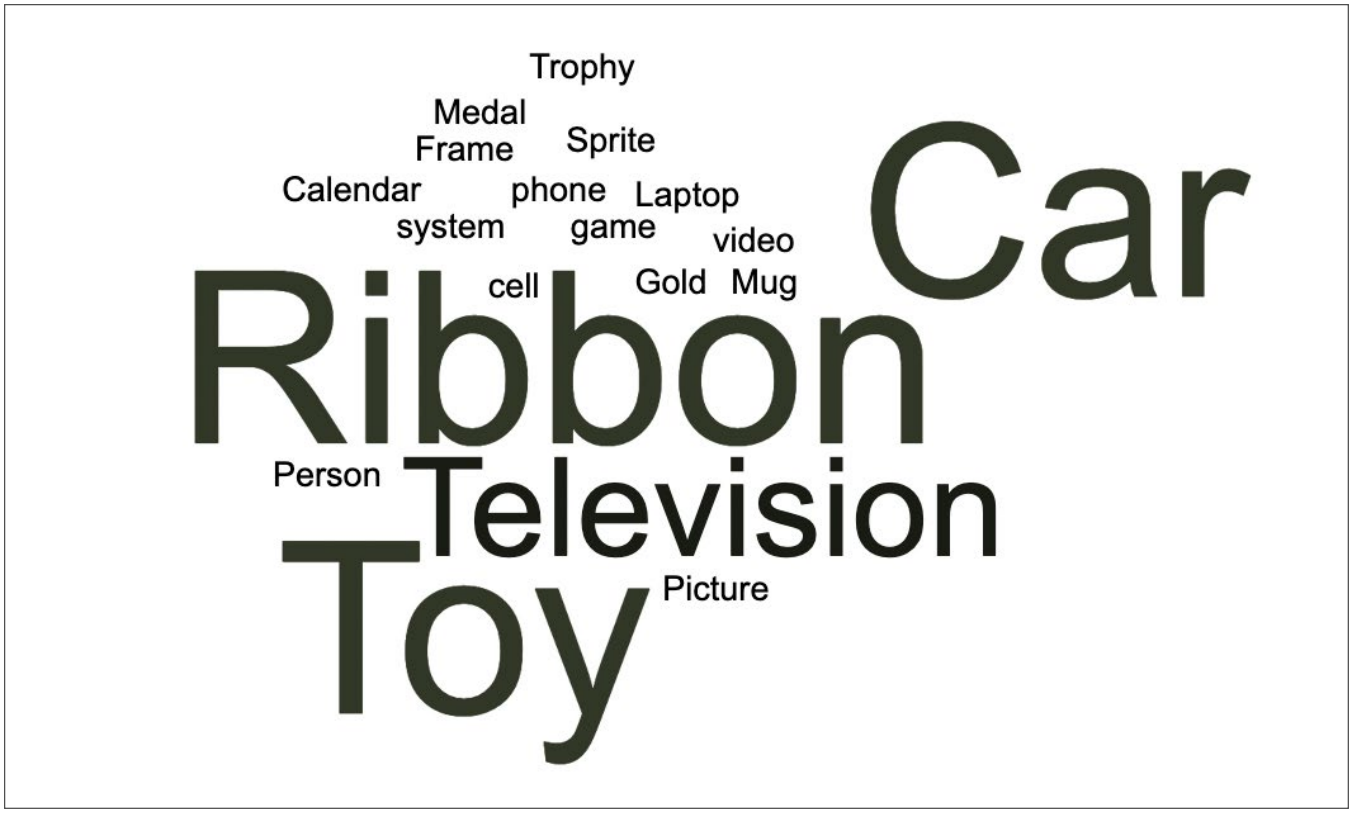
---

1. Draw a picture of the room including each of the items from the list above.
2. What does this data tell you about the person who lives in this room? What does it not tell you? Think about some different aspects of a person's identity.
3. What are most of the items in this room related to?

Now compare with the other group.

4. Are there any advantages to one representation or another?
5. Do you think different representations can tell different stories?
6. What do you think came first (the drawing of the room or the list?)

Group C: Room Activity WORD CLOUD Instructions



1. Draw a picture of the room including each of the items from the word cloud above.
2. What does this data tell you about the person who lives in this room? What does it not tell you? Think about some different aspects of a person's identity.
3. What are most of the items in this room related to?

Now compare with the other group.

4. Are there any advantages to one representation or another?
5. Do you think different representations can tell different stories?
6. What do you think came first (the drawing of the room or the list?)

Lesson 10. Days 22-24

Topic Description: The question “What is intelligence?” is addressed through discussion of the differences between humans and computers. Various models of machine learning are investigated along with the concept of natural language processing. The concepts of big data and the inherent bias that accompanies artificial intelligence are also introduced.

Objectives

The student will be able to:

- Explain the idea of intelligence especially as it relates to computers.
- Explain what it means for a machine to “learn.”
- Make connections regarding the relationship of data to artificial intelligence.
- Examine the bias in the development of computing innovations that use artificial intelligence(AI) .

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Discussion of AI experience (10 minutes) • Discover how AI works, intro to machine learning (10 minutes) • Deeper discussion of machine learning and complete a machine learning training activity (25 minutes)	• Consider the difference between human and artificial intelligence (AI), and connect AI to data. • Experience the training of an AI tool using machine learning with data
Day 2 • Journal entry (10 minutes) • Bias in AI activity (35 minutes) • Journal entry (10 minutes)	• Bias can be built into computing innovations using AI or built into the intended purpose for use of these innovations
Day 3 • Journal entry (10 minutes) • Ethical concerns (35 minutes) • Journal entry (10 minutes)	

Student Activities

Day 1

- Complete journal entry.
- Discuss knowledge and experience with AI
- Discover how AI works, intro to machine learning
- Dive deeper into machine learning and train a tool using data (The Teachable Machine Activity)

Day 2

- Complete journal entry.
- Investigate and discuss ethics and bias in relation to innovations using AI
- Complete journal entry.

Day 3

- Complete journal entry.
- Investigate and discuss ethics in relation to innovations using AI

Teaching/Learning Strategies:

Day 1

Journal entry: *What is intelligence? Are computers intelligent? Why or why not?*

- Volunteers share their responses. Craft a definition with the class. If students need help with definitions, share definitions for intelligence vs artificial intelligence (AI).

Note to teachers: the term intelligence has historically been used to oppress marginalized groups, as it has been weaponized and racialized to justify slavery and eugenics.

Discussion:

- Part I: What do you know about AI? Where have you experienced it?
- Teachers can create a collection of class answers on a poster or other media, and can help add more examples, such as coding IDEs, that students may not know yet.

Part 2: Journal: *How does AI work? For example, explain how snapchat works.*

Experiment with Machine Learning and AI tools

Note: As a reminder, in this unit, we will use several AI Generative tools. We chose 2 tools that students can use for this lesson - QuickDraw and Teachable Machine, which do not collect or store student data. We advise that any other AI tools are used only through the teacher's lens (rather than students directly using them) as much as possible to limit the unethical impacts of AI.

These impacts are addressed in this lesson: Asking students to use AI tools provides free labor to the creators of the tool. These tools are in their infancy and some are free to use with no restrictions. They will continue to become a more intelligent form of artificial intelligence with the help of users who provide feedback to the responses it generates. You are considering if you want your students to help train an AI tool as part of their education.

Intro to how AI works: (See resources.)

- Show this video about machine learning What is Machine Learning?.
- AND this video about facial recognition in Snapchat: How Snapchat's filters work
- Discuss the contents of datasets - what can be data? (Images, Measurements (time, views, length, etc), Text, Video recordings) Refer back to previous lessons that discussed data collection by computers.
- Use an AI tool together with the class. Use Google's Quick Draw application, Quick, Draw!
- Let students experiment individually, then have a few demonstrate to the class. It's fun!
- Have students see the data collected by this app by clicking on the appropriate links in the app, or here: Quick, Draw! The Data
- Take the opportunity to emphasize the importance of training and test data, an AI model, and outcomes of the model. Explain that Quick, Draw! used our data to train it too.
- **Discuss** how the dataset informs the AI tool to predict your drawing by employing human-like learning strategies within machine-learning algorithms.

Machine Learning Activity

- Machine Learning and Classification
- Start by asking how a baby learns new information. Introduce the concept of classifying data when babies read books with animals, colors, etc. The more books they read that contain these, the easier they can recognize those animals and colors. (the more data they receive)
- Next, find examples of classifying in technology. Some examples: filing systems for documents or emails, face detection, handwriting detection, filtering data sets, results of online searches
- Machine learning involves classification. Students will now train an AI tool by classifying data.
- Explain the Machine Learning Activity.
  - You will train your own machine learning model!
  - Go to the Teachable Machine by Google site (See resources.) https://teachablemachine.withgoogle.com/
  - Scroll down to watch the video under "What is Teachable Machine?"
  - Scroll down to the steps:
    1. Gather data (read the directions and/or show the video)
    2. Train your model (read the directions and/or show the video)
    3. Export your model (read the directions and/or show the video)

    • Then click on "Get Started" to start training the face recognition model
      - Choose Image Project
      - Steps will pop up on the page instructing the users
      - Collect 2 sets of data by using 2 different faces (or a face and an object), then train the machine, then test it by switching the image to see what percentage correct the machine is after learning

    • Students can also train using 'sounds' and 'poses' if they wish.

Note: Teachers may wish to demonstrate this activity for the class. Note that everyone has to have a working camera on their device for this tool to work.

- Next, students answer questions about their experience.
  - Hit refresh. This time click "skip the tutorial." Train the same classifier with your face and hands.
  - Sample questions:
    - What happens when you only train one class?
    - What happens when you increase the number of images in your dataset?
    - If you've mainly been training with one hand up, try using the other hand. What happens when your test dataset is different from your training dataset?

Journal entry: Think about the data you provided to train the AI tool, the teachable machine. What training data do you think is provided to the AI tools you mentioned yesterday in our discussion? Where do you think these training data come from?

Day2

Note to teachers: Addressing bias and ethics in AI requires a multi-faceted approach. Bias appears in many forms in computing: historical biases present in the data, algorithmic bias, representation bias, feedback loop bias, and deployment bias. These biases have profound implications on the lives of individuals from the most marginalized communities, thus replicating and exacerbating societal inequality.

Many AI tools operate unethically, collecting data, spreading misinformation, or leaving communities out. Lack of diversity in the AI workforce, company leadership, boards, and investors affect the ethical, moral, and social decisions in deploying the tools.

Robust testing is needed for bias, as well as ongoing monitoring and ethical considerations. Efforts to increase diversity and inclusion in AI research and development teams can help mitigate bias. Remember: Technology is not biased; the human creators are.

Journal entry: *Can computers be more intelligent than humans? Would you trust a computer to make all decisions? Why or why not?*

Ethical Concerns and Bias

- Students begin to learn about bias that is inherent in innovations in computer science, and how this occurs. They visited it in previous lessons like 'Telling a Story with Data' and will continue learning in the 'Culturally Situated Design Tools' lesson. They can connect what they learn and feel about this bias back to their identity portfolios as well, and they may choose this topic for their Final Project.
- Show a video about Algorithmic Bias. (See resources.)
- Jigsaw activity and Discussion:
  - Students will learn about historic issues with bias in computer science.

- Find current articles or videos for the topics listed below. Each should preferably take 5-7 minutes to read/watch. Each group watches or reads one of the resources, records in their journals, then shares out class. ***What did you learn about? What do you think could be considered ethical concerns or bias for your reading?***

Options for topics: *(See Supplemental Resources for examples)*

- AI's interpretations of language of underrepresented groups
- AI tools used in recruiting include bias against women or other underrepresented groups
- The use of facial recognition and neighborhood data by police in America
- AI tools used in rating employees or exams for entrance into schools
- The effects of Deep Fake, AI therapists, AI relationships
- Creativity and AI - examples of music and film industry fighting back against AI
- The history of use of surveillance in China (and many other countries)
- Tay, the chatbot that was quickly trained to be hostile and negative by users

- Following the activity, you can host a discussion. Some prompts to use:
  - Where did we discuss bias with data before in this unit? (a: Telling a Story with Data)
  - What happens when a machine learning algorithm is biased in some way?
  - What possible impacts are there on people who relied on the predictions made by the algorithm?
  - Connect to identity—is the machine learning algorithm representing all identities (race, gender, what else is being discussed)

Day 3

Journal entry: *Write a reflection on this quote: "If we're not careful, AI will perpetuate bias in our world. Computers learn how to be racist, sexist, and prejudiced in a similar way that a child does. The computers learn from their creators — us."– Aylin Caliskan Computer Scientist*

- Some of the benefits we have seen with using AI are: the potential for AI to identify breakthroughs in disease prevention and treatment; improve efficiency in communication through auto-complete, virtual assistants, and chatbots; reduce business costs and improve efficiency and worker productivity; and enable greater personalization to improve educational outcomes for students with disabilities and multilingual learners.
- However, there is concern about AI advancement. This activity allows discussion about ethics and AI.

Ethics of AI Activity (See resources.)

- In groups, students will review different scenarios where AI is used. They will then rate them using a scale from unethical to ethical. You can display the scale on the board, or have one for each group. For the scenarios, you can distribute them as a list students can cut and place on the ethics scale where their group decided they fit.

Journal entry: *Write about the beneficial and harmful effects of AI and machine learning in your portfolios, thinking about identities and any benefits or harm to those aspects as well.*

Resources

- What is Machine Learning? (video) (https://www.youtube.com/watch?v=QghjaS0WQQU)
- How Snapchat's filters work (video) (https://www.youtube.com/watch?v=Pc2aJxnmzh0)
- Quick, Draw! (application) (https://quickdraw.withgoogle.com/)
- Quick, Draw! The Data (application) (https://quickdraw.withgoogle.com/data)
- What is artificial intelligence? BBC News (video) (https://www.bbc.com/news/av/technology-34224406)
- Algorithmic Bias and Fairness: Crash Course AI #18 (https://www.youtube.com/watch?v=gV0_raKR2UQ) *(10 minutes)*
- Gender Shade (5)s (https://www.youtube.com/watch?v=TWWsW1w-BVo)
- Artificial Intelligence is Biased. She's Working to Fix It (https://www.youtube.com/watch?v=lyZxOA113Gw) *(5 minutes)*
- How I'm fighting bias in algorithmsIJoy Buoalmwini (https://www.youtube.com/) *(9 minutes)* watch?v=UG_X_7g63rY&list=PLj62-wQeg_DhmYphxg70DhPEJcjfmnVEt&t=7s)
- Ethics of AI Activity (See Supplemental Resources: exploringcs.org/curriculum)
- The Coded Gaze: Unmasking Algorithmic Bias (https://www.youtube.com/watch?v=162VzSzzoPs) *(~3 minutes)*

Teacher Reflection Notes

Lesson 11. Days 25-29

Topic Description: In this lesson, students learn how cultural practices can be modeled through computational tools for visualizing data, modeling and design, and art. Connections between the design of the tools and mathematics will be explored as well as the connections and importance of culture and technology.

Objectives

The student will be able to:

- Explain how our day-to-day practices can involve computation, but may not be obvious
- Explore how computers can be used as tools for visualizing data, modeling and design, and art related to cultural practices.
- Explain how cultures and technology are related to one another, and how there are hierarchies among cultures.
- Discuss how technology has been utilized to represent cultural practices embedded within Native communities.
- Identify mathematical connections in the output of the tools.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Research on the cultural background (25 minutes) Revisit identity chart and website (20 minutes)	• Introduction to how cultural practices such as bead looms are both mathematical/technical as well as cultural. Connection to prior lessons about humans and computers' interactions, as well as data. Investigation into the culture of Native American designs and the incorporation of mathematical concepts.
Day 2 • Meeting of Strangers Activity (15 minutes) • Video of History (10 minutes) • Acknowledgement of Land (5 minutes) • Implications of language (25 minutes)	• Explain the history of Native communities (and how they are marginalized across colonized societies) and for students to understand the deep connections of culture and design within tools, fashion, and other items.
Day 3 • Cultural costumes (5 minutes) • Appropriation vs Appreciation discussion and video (30 minutes) • Begin design tool tutorials (20 minutes)	• Engage in discussions around representation of cultures and how those may lead to either appropriation or appreciation.

Segment	Reason/Purpose
Day 4 • Creation of designs using the design tools (55 minutes)	• Utilizing math concepts to recreate Native American designs on CSDT website
Day 5 • Preparation of presentations (30 minutes) • Group presentations (15 minutes) • Reflective journal entry (10 min)	• Students share and discuss various cultural influences on design and the connections across all 3.

Student Activities

Day 1

- Complete journal entry.
- Research on cultural practices
- Revisit identity chart and website.

Day 2

- Complete Meeting of Strangers Activity
- Discuss History of Native New York
- Acknowledgement of Land
- Discussion of implications of language

Day 3

- Complete journal entry.
- Discuss in small groups and define cultural appropriation.
- Watch video and discuss how we honor members of communities and their values.
- Participate in reading and discussion
- Participate in wrap up appropriation vs appreciation - student definitions
- Each member of the group completes the math tutorial

Day 4

- Create designs using the design tools as a way to develop appreciation

Day 5

- Prepare presentations.
- Groups deliver presentations.
- Groups respond to questions from other students and teachers.
- Complete reflective journal entry

Teaching/Learning Strategies:

Note: This series of lessons begins with connections to daily activities that require computation, then gets into teaching about the history and cultures of Native communities and how they were/are marginalized. It may be helpful to explain this to students at the beginning of these lessons so students understand the connections and importance of each day.

Day 1

Journal entry: *What are some examples of your daily activities that require computation/ mathematics that may not be obvious to you or to others? Are any of these activities common to your friends and family?*

- Have students share their responses. What are some common types of computation they use in these activities? (showing pictures of bead loom, rug, and basket from CSDT website specifically that they will use in this lesson; to see the pictures, click on "Mathematics" at the top, then scroll down to where you see "Cartesian Coordinates")
  - Have students share what types of patterns they see in the designs?
- Explain to students that some of these designs will be created in this series of lessons in groups and that we will be learning more about Native communities and cultural practices over the next few days

Research on cultural practices

- Emphasize how several practices across cultures have involved complex and sophisticated computations but may not be discussed and celebrated the same way as computing is as a discipline
- Post the possible design cultural practices:
  - Bead Loom
  - Basket Weaving
  - Rug Weaving
- Display the first page of each tool in a screenshot or image of the designs for visual reference.
- Display the first page of each tool in order to give students an idea of what each does. You can access these by going to CSDT.org then clicking on Mathematics then scrolling down to Cartesian Coordinates (the three choices are listed there).
- Students divide into to investigate the history of the practice of their choice (it would be helpful to have at least one group investigate each of the practices)
- Group sizes will depend on the size of the class. You may need to have more than one group per tool.
- Each member of the group should go through the entire cultural background section individually.
  - As students are reviewing the background section ONLY to learn more, they should be taking notes (at least 5 important ideas they read) on the culture and how that connects to both math and/or design. They should also be noting any questions they have.

- All group members discuss the background.
- Resolve answers to questions and mathematical connections.

Revisit identity chart and website

- Have students refer to the practices they included in their first journal entry of the lesson and consider the following question
  - How was that practice established?
  - How long has it been in existence?
  - Is it local to your family/community or a practice with a long cultural history.
  - Do any of these practices have commonalities with histories of those you investigated?
  - Add these items to your identity chart and/or your website.

Day 2

Meeting of Strangers Activity

- Create cards or some way for students to find random partners in the class to allow for more community-building opportunities and diverse groupings. Give each student a card and have them find their partner without talking. This could be matching colors, letters, numbers, emojis, etc. (example: students with the “red triangle” on their card will find each other - students should be in pairs after this activity)
- After the students find their partners, WITHOUT TALKING (or writing), ask them to try to find out the following about the other person for 1 minute then switch roles

Note: You can add to or modify these questions based on the needs of your students and their personal interests or comfort in sharing:

  - What did you eat for breakfast today?
  - How did you get to school today?
  - What are your plans for this weekend?

- Debrief activity with students (note that this is front loading the experience of Native Americans and Europeans in early American history - but do not necessarily name this for students yet - they will see a video after this discussion):
  - What made the interaction difficult? Since you couldn’t speak, how did you communicate with your partner? What helped you understand your partner?
  - How might this lead to confusion if you were trying to settle an argument or come up with a resolution to a problem?
  - Was there any particular person with more or less power in this exchange? Who? Why? (this can lead to further discussion later when we address the themes around oppressed Native Americans by the white European settlers)

History of Native New York

- Watch the History of Native New York video (See resources.)
  - The video addresses how the fur trade brought together Native people and Europeans, two dissimilar cultures that looked and spoke very differently from one another. Additionally, this brings up the power that European settlers felt they had over Native populations and ideas around which cultures (language, designs, money, etc.) are more valuable.

Note: If there's a more locally relevant historical reference about Native communities, you may want to use that here.

Land Acknowledgement:

- To deepen student conversations, teacher can show the map of Indigenous land they are living on today using this site: https://native-land.ca/
- This article gives more information on the map for the teacher. (https://www.npr.org/2022/10/10/1127837659/native-land-map-ancestral-tribal-lands-worldwide)

Discussion of implications of language

- In small groups have students discuss the following questions and summarize in their journals
  - How did language impact the relationship between Native communities and the Europeans? What happened as a result of their lack of similar languages? What potential was there for stereotyping and developing singular, simplistic stories of Native peoples and communities?
  - Who told this story in history? How might that impact it?
  - Does this kind of miscommunication still happen today when dealing with people from different cultures? Give some examples. Are some examples more harmful than others? Which cultures tend to believe theirs is more valuable? Which do not? It might be helpful to show students the graphic around power and privilege at this point in the lesson (See resources.) to explain how this still exists today as well - or to support students in coming up with examples.
- Have a few groups share responses

Note: Emphasize to students the point made in the video that Native accounts and perspectives are often left out of history. Native histories were maintained through oral traditions and mnemonic devices, such as wampum belts, and are reflected in the material culture. The fact that Native people did not have a written language has had tremendous implications for how history has been recorded, passed down, and understood. Much of what historians know regarding life in and around the Hudson River Valley during the fur trade has come from Dutch documents, archaeological material culture, and Native oral traditions. When reviewing the featured sources in this inquiry, students should be encouraged to ask themselves:

  - Who wrote the source?
  - Which voices are present and which are not? When was the source written?
  - What else was happening at that time?

  - Who was this written for, and why was it written?
  - How does this relate to what we have seen so far regarding data and AI?

- Watch video about language preservation (See resources.)
  - The video addresses the oppression of Native languages by the Europeans and how students in South Dakota, in a summer camp are blending tech and tradition to preserve their endangered Indigenous language.

- Return to small groups to reflect on their own linguistic and cultural histories
  - In what ways do they relate to the histories presented?

Day 3

Journal entry: *What attire and objects do you associate with specific cultures?*

- Debrief responses, highlighting some of the stereotypes that are perpetuated by Halloween costumes that may fall into this category.

Note: It should be apparent by the end of this discussion that most "cultural" costumes that are produced for purposes like Halloween are not actually historically accurate and cannot be appropriate when the person wearing it doesn't associate with this identity - ie. someone wearing blackface that identifies as white (more background information can be gained here for teachers: https://www.youtube.com/watch?v=zSV7Hi2eYLQ although this video is too long to show students)

- Remind students about the AI Art activity and the bias that was shown with a prompt involving a Native American. All generated images had a formal headdress and/or feathers on the person. The data used to create those images is 'aggregated' and that often means flattening many different Indigenous nations into a single "Native American" umbrella, exposing stereotypes.

Debrief

- Discuss in small groups:
  - How would you describe cultural appropriation?
  - What are some examples you've seen before?
- Share out and define cultural appropriation for students as the unacknowledged or inappropriate adoption of the customs, practices, ideas, etc. of one people or society by members of another and typically more dominant people or society.

Show video and discuss

- Cultural appropriation video (See resources.)
- Ask students what's the difference between cultural exchange, appropriation and appreciation, having them define each term in their own words and giving one example of each.

Reading and discussion

- Have students read the article on Indigenous People's Day (See resources.)
- Discuss the following questions in groups:
  - Why have some places in the United States renamed this holiday? Why have some not?
  - What is the impact of the naming as Indigenous Peoples day as opposed to Columbus day?
  - What does our school community call this day? How about other schools around the country? Why might that be the case?
  - What responsibilities do schools have to teach us about the history and culture of Native Americans?
  - What other holidays have been more newly announced as national holidays in the U.S. and why do you think this has happened? Why is Indigenous Peoples day not a national holiday?

Wrap up

- Have students share a summary of appropriation vs appreciation with examples of each.

Note: This could be used for the final presentation in this series of lessons.

Design tool tutorials

- Each member of the group completes the tutorial

Note: These are only available for Bead Loom and Navajo Rug Weaver but NOT for Pacific Northwest Basket Weaver. You may choose to differentiate your groups based on this, or work with that group more closely to explain how it works. Also please note that ALL designs should be done with the MATH software, NOT the programming software as this will be taught more directly in later units.

- Students should go through the tutorial at their own pace, but discuss with other members as questions arise.
- Encourage students to record in their journal points that they want to remember.
- At this point, as students work, they may (depending on their prior math coursework and strengths/weaknesses) need your assistance in explaining concepts like symmetry

Day 4

Creation of designs using the design tools

- Groups create designs using the Grade 4–12 Math software.
- Each person should choose one of the goal pictures (by clicking the picture on the right to choose) for practice and discuss any issues with the other group members.
- Groups decide whether they want to create one design as a group or have multiple designs for their presentation.
- Groups work on design/designs—these should be their own creations rather than a mimic of one of the preloaded designs.

Day 5

Preparation of presentations

- Prepare presentations to include:
  - Culture—an explanation in their own words
  - Math connections—an explanation in their own words
  - Demo of software
  - Display of designs—include a written description of how they created their design and the meaning behind it (this could be related to the colors they chose or the design created)
  - Connection to personal culture/community

Group presentations

- Groups deliver presentations.
- Groups respond to questions from other students and the teacher.
- Specifically ask, what did the computer scientists who created the tools need to know? (Computer science, graphics, culture, anthropology, visual arts, language arts, history, etc.)
- Ask students to wrap up (if there's time) by answering one of the following journal prompts:
  - How did your understanding of the culture influence your creation?
  - Why was an understanding of the culture important to the original design principles behind this tool?
  - What is something that you didn't know about cultural practices, communities, or their histories before this project?
  - How can you connect your own experiences to those of the Native communities we studied both historically and today?
  - What was your process in designing your product? How does this process compare with the process outlined on the website?
  - What is the connection between computational practices and culture?

Reflective Journal entry: *How does this technology (Bead Loom software) help us visualize data, culture, and mathematics? What are the benefits and limitations of this?*

Resources

- Culturally Situated Design Tools (https://csdt.org/math/)
- Bead Loom (https://csdt.org/culture/beadloom/index.html)
- Basket Weaving (https://csdt.org/culture/northwestbasketweaver/index.html)
- Navajo Rug Weaver (https://csdt.org/culture/navajorugweaver/index.html)
- Meeting of strangers activity adapted from the following resource (https://americanindian.si.edu/nk360/manhattan/pdf/manhattan-staging-question-teacher-instructions.pdf
- History of Native New York (https://americanindian.si.edu/nk360/manhattan#staging)
- This AI Camp is TEaching Teens to Preserve Their Lakota Language (https://www.youtube.com/watch?v=quwcGtupcBA) (Language preservation video)
- Wheel of Power and Privilege (https://www.thisishowyoucan.com/post/__wheel_of_power_and_privilege)
- Cultural Appropriation video (https://www.youtube.com/watch?v=KXejDhRGOul)
- Indigenous People's Day article (https://www.nytimes.com/article/indigenous-peoples-day.html)

Teacher Reflection Notes

Lesson 12. Days 30-31

Topic Description: This lesson introduces the concept of a computer program within the context of a set of instructions for completing a common activity.

Objectives

The student will be able to:

- Explain the concept of a computer program, and connect this experience to the cultural practices explored in the (previous) CSDT lesson, where specific steps had to be followed and had meaning.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Following directions Quiz (10 minutes) • Drawing directions activity (15 minutes) • Discussion directions as they relate to coding (15 minutes) • Designing a program (15 minutes)	• Level up the importance of precise directions for computational thinking and practice • Design a program written with computational thinking.
Day 2 • Finish designing a program (10 minutes) • Running a program (20 minutes) • Being more precise with instructions (25 minutes)	• Test a program written with computational thinking. • Improve on program design using iteration.

Student Activities
Day 1 • Complete following directions quiz. • Complete drawing pictures activity • Begin designing a 'program', writing directions using computational thinking **Day 2** • Finish designing a program, then test it by executing it • Improve your program by being more precise with instructions for your program

Teaching/Learning Strategies:

Day 1

Following directions

- Distribute copies of Following Directions Quiz (see below) to each student face down in front of them. Each student should have a blank piece of paper and a pencil as well.
- Give the students five minutes to do the quiz. Make note of how many students stand up and shout "hooray."
- Collect the papers when time has expired.
- Point out that a perfect paper is one which has only the word "December" written in the top left corner. (The directions said to read all parts of the test before doing anything and step 14 says to only complete step #3.)

Complete the Drawing Pictures Activity.

- Give students about 10 minutes to complete the Drawing PIctures Activity (See resources.)
  - Ask volunteers to show their pictures and explain why they drew the pictures as they did.
  - After the first volunteer, ask if someone drew it differently and allow for discussion.

Discussion

- Ask the students how following directions relates to computers. Prompt them as necessary that a computer follows a specific set of instructions called a computer program and must follow all of the directions precisely.

Designing a program

- This is going to be an iterative process. Students will write programs, you will test them by acting them out, and they will revise. This will be repeated as you see fit.
- In groups, ask students to write down a set of instructions for a computer to make a peanut butter and jelly sandwich. Give them 5 minutes to write down these instructions on a poster.

Note: Check in advance to determine if any students have peanut allergies. Other spreads can easily be substituted. Teachers have used cold cuts and ice cream sandwiches, or have not used food at all. You can have students write directions for any task you would like, such as doing a jumping jack as long as you can act it out.

Day 2

Finish designing a program

- Collect the instructions. You will act these out next.

Note: This example works with the sandwich option, but the steps of completing instructions and iterating to address issues is for all options.

Running (testing) a program.

- Take out the bread, peanut butter, jelly, and knife and put them on your desk. Pick a set of instructions for making a sandwich (best to pick one which is not too detailed).
- Read each instruction and carry it out—literally. For example, if the first instruction is "put the peanut butter on the bread," take the jar of peanut butter and put it on the loaf of bread. If an instruction says to "spread the peanut butter on the bread," use your fingers rather than a knife. If an instruction says to "cut the sandwich in half," be creative and cut it between the two slices of bread. In other words, your goal is to show that instructions need to be very precise.
- Repeat the process with another set of instructions. Most groups will want their instructions tested.
- Highlight the implicit knowledge that students bring to the task and how that has to be "unpacked" for the computer.

Being more precise with instructions

- Clearly, no matter how precise they tried to be, the instructions for making a peanut butter and jelly sandwich were open to interpretation. Ask the students to brainstorm how we could overcome this problem so that a computer could follow the instructions and make a perfect sandwich each time.
- Students should update their posters using sticky notes to improve their 'programs'.

Repeat as necessary within time limits.

Journal: *How does today's lesson relate to computer science? What is important when giving instructions?*

  - Guide the students toward the idea that we need a better "language" than English for describing the instructions. This is, in fact, the idea behind a computer program. There is a limited set of instructions that defines very precisely what the computer does. Note though that we don't have an instruction for the computer to "draw a picture of a house" as that's much too general and too open for interpretation. This is also a good place to discuss iteration, failure and testing.

- **Discussion:** How is machine learning related to giving instructions to a computer such as those we wrote in this lesson?
  - Teachers can also revisit the discussion of language from the Meeting of Native Peoples activity in the 'CSDT' lesson

Resources

- Following Directions Quiz
- Drawing Pictures Activity

Teacher Reflection Notes

Following Directions Quiz

Directions: You have a 5 minute time limit to complete the parts of this quiz. Carefully read all of the parts of the quiz before doing anything. In order to ensure the accuracy of this quiz, you should not use more than the allotted time of 5 minutes. Good Luck!!

You may begin now!!

1. Write today's date—month-day-year in the top right-hand corner of your quiz paper.
2. Write the answer to the following multiplication problem directly underneath the date on your quiz paper—6 X 5 = ?
3. Write the name of the month that begins with the letter "D" in the top left-hand corner of your quiz paper.
4. Add 15 to the answer you got in part #2, and write this new total directly underneath your answer for part #3.
5. In the lower left-hand corner of your quiz paper, write the names of your favorite singer and your favorite group.
6. Just above your answer to part #5, write "This quiz is very easy."
7. In the lower right-hand corner of your quiz paper, draw a rectangle and inside the rectangle draw a five-pointed star. The size of these drawings is not important.
8. Directly above your answer to part #7, draw a row of three small circles. Once again, size is not important.
9. Write the name of the first president of the United States on the back of your quiz paper anywhere you choose. If you don't know who this is, write your own name instead.
10. Write the name of any country that begins with the letter "I" directly underneath your answer to part #2.
11. Stand up, shout "hooray!", and sit down.
12. Take the number of dwarfs in the Snow White story and add it to the number of bears in the Goldilocks story. Divide by 2. Write this total in the approximate center of your quiz paper.
13. Think of a number between 1 and 50. Double that number. Add 20. Add 6. Subtract 17. Subtract 9. Divide by 2. Write this number on your quiz paper directly underneath your answer to part #11.
14. Now that you have carefully read all of the parts so far, and you have not carried out any of the actual work, skip the next 2 parts and go back and only complete part #3.
15. The name of the first president of the United States is George Washington. He was president from 1789 until 1797. Add the 2 dates together to see if the total is less than 5000.

You should not be reading the end of the exam before the beginning of the exam, but now that you are here you have just wasted some of the time you may need to complete the quiz.

Drawing Pictures Activity

1. Draw a house in the middle of the page.
2. Draw three stick figures who live in the house.
3. Draw a letter near the house.
4. Draw a sun in the sky.

Lesson 13. Days 32-35

Topic Description: Students will work in small groups to research an aspect of technology and its impact on society. They will analyze the positive and negative impacts of technologies on different groups of people with suggestions on how to minimize the negatives. Students will be encouraged to explore implications for different populations such as women in rural areas, Black high school students, etc.

Objectives

The student will be able to:

- Research technological impacts on society
- Evaluate resources for credibility
- Collaborate with peers in creating a presentation
- Present information to peers
- Discuss the positives and negatives of a technological innovation or invention

Outline of the Lesson:

Segment	Reason/Purpose
• Day 1 • Journal entry (10 minutes) • Think - Pair -Share (20 minutes) • Final Project Intro (25 minutes)	• Students will reflect on what they have learned in this unit and determine the positive and negative for whom and in what contexts.
• Day 2 /3 • Journal entry (10 minutes) • Research (100 minutes)	• The journal will be a review on evaluating sources before students conduct research for their final projects.
• Day 4 • Presentations (55 minutes)	• Students will present their information to the class.

Student Activities

Day 1

- Complete journal entry.
- In groups, students will create a visual representing one positive and one negative impact of one of the discussed answers for the journal.
- In groups students will begin the final project

Day 2/3

- Complete journal entry.
- Students will research and create a presentation for the final project.

Day 4

- Students will present their final projects.

Teaching/Learning Strategies:

Day 1

Journal entry: *What are 3 technological inventions or computational innovations that have impacted society?*

- Throughout the unit, students should reflect after each lesson on the technological topic that was discussed and how it impacted society. If students get stuck, teachers can prompt questions about societal shifts of economic impacts from their chosen topic. They can reflect on that or bring in outside knowledge to answer this question. Teacher can create a list of answers that would be appropriate for the final project.

Think - Pair -Share

- Discuss with your group and pick one to explain its impact. Create a visual including one positive and one negative impact for whom and in what context. Students will share with the class.
  - Possible probing questions during group work time
    - Do you have any experience with this topic?
    - Has your experience been positive or negative (considering your own personal identity and the role that may have played)?

Note: It may be helpful here for students to take their identity charts from lesson 1 of this unit out to think about the impact

    - Does everyone have that experience?
    - Are there any groups of people sharing specific identities that have a negative experience?
    - Are there any groups of people sharing specific identities that benefit from it?
- Students will do a gallery walk and leave feedback for other groups.

Final Project Intro

- Introduce the final project to students. Students can choose to do the one that they discussed, one from the list compiled during the journal, or choose an option given by the teacher.

Day 2/3

Journal entry: *What are three credentials to look for when checking the credibility of a resource?*

- Teacher keeps track of the discussion to create a checklist of what students should keep in mind when doing research.
- Teacher tells students to look back at their rubric for evaluating websites from lesson #5.

Research

- Students will have approximately two days to research and create a presentation for the final project. Each group should be divided in two with half researching the positives and half researching the negatives. Together they will decide the best ways to minimize the negatives.

Day 4

Presentation

- Students will present their information to the class. This can be done as a gallery walk or a traditional presentation to an audience. Students can ask questions and offer suggestions to each other.
  - Possible discussion questions:
    - Does anyone have any experiences with _____? Was it positive or negative?
    - Does this relate to anyone else's topic?
    - How else might you negate the drawbacks?
    - Are there any other positives not mentioned?
- Reflection Questions for Teachers to continue discussions into the next units:
  - What topics were successfully discussed?
  - Were there any guiding questions that helped with discussions?
  - Are there any topics that needed more support than others?
  - How might you continue these conversations?

Resources

- Final Project Societal Impact of Technology
- Final Project Sample Rubric

Teacher Reflection Notes

Final Project

Societal Impact of Technology

In your groups, research one technological invention or computational innovation and its impact on society. This can be an innovation that we have discussed in class, that you have written about in your reflective journals, something else that you find interesting or have previous knowledge on. Half of your group should research the benefits, while the other half should research the drawbacks. As a group, you will need to decide on ways to minimize the negative impacts on individuals.

Possible, but not limited to, these Topics:

- Artificial Intelligence
  - Automated Ethics
  - Use of robots
- Self-driving cars
- Social Media
- Sustainability of technology vs. hardware advancements
- Online Security
- Spread of information
- Changes in communication

Research

Research three benefits or drawbacks of your group's selected topic as well as best ways to negate the negatives. While researching, check the credibility of the website and the information being given. Each side should have a minimum of three sources. Each source should be on the worksheet with an explanation of why it is credible and how it will be used.

Presentation

Each group should prepare a presentation for their chosen topic. The presentation should have a visual. After each presentation, the class will discuss the topic. Be prepared to answer questions from your classmates.

Final Project Sample Rubric

	1	2	3	4
Research	Limited or unreliable sources used for research.	Some credible sources used, but not consistently.	Mostly credible sources used; clear evaluation of their credibility	All sources are credible, reputable, and well-evaluated.
Benefits	Limited or incorrect benefits identified.	Some benefits identified, but lacking depth or accuracy	Thoroughly researched benefits with clear explanations.	In-depth analysis of benefits, supported by evidence from multiple sources
Drawbacks	Limited or incorrect drawbacks identified.	Some drawbacks identified, but lacking depth or accuracy	Thoroughly researched drawbacks with clear explanations.	In-depth analysis of drawbacks, supported by evidence from multiple sources
Strategies to Minimize Drawbacks	Strategies are missing or irrelevant.	Some strategies suggested, but not well-developed	Clear and relevant strategies proposed to mitigate drawbacks.	Comprehensive and well-thought-out strategies to effectively counteract drawbacks.
Presentation	Visual aid is absent or irrelevant to the topic. Presentation lacks quality, effort, and polish.	Visual aid is present but not engaging or supportive. Presentation is somewhat prepared but lacks finesse.	Visual aid effectively enhances the presentation. Well-prepared presentation with good quality.	Engaging and highly relevant visual aid that strengthens understanding. Exceptional presentation with high-quality content and delivery.
Group Interaction and Participation	Lack of collaboration, uneven participation, and disengagement.	Some group members participate, but interactions are limited.	Most group members contribute and interact well.	Advanced: Strong collaboration, active participation, and seamless interactions.

Unit 2: Problem Solving

Introduction

In order for students to develop computational literacy and practices they need experience solving a wide range of problems and the opportunity to experiment with a variety of solution strategies. Unit 2 begins with an introduction to the problem-solving process. Students are asked to solve new problems by planning a strategy, designing and creating solutions and algorithms, and then reflecting on their solutions and strategies, including how they are related to people and communities.

Throughout the unit the emphasis should be on the process rather than the solution. Most of the world's problems today do not have single simple solutions. In order to contribute effectively to the solution of these problems, students need to be comfortable in a collaborative environment where multiple approaches are valued and encouraged and where failure is seen as part of the process toward solution. Students must learn to consider the implications of computational solutions for people and communities and apply known algorithms where appropriate, but also create new algorithms that can be applied to complex problems.

As students reflect on their solution processes and solutions and share those reflections with their peers, it is an opportunity to pull out instances where one strategy might be preferred over another and problems for which there are "standard" solutions versus those where there are many possible solutions.

Many of the problems presented have a mathematical basis and can serve to provide connections between mathematics and computer science. Further, students are encouraged to bring in problems from the communities they belong to, thereby creating opportunities to examine connections between community problem-solving and computer science. Common computer science topics such as searching, sorting, and graphing are introduced in relation to students' lived experiences with search engines and embedded biases. Although programming the solutions to many of these problems is beyond the scope of this course, students will gain a basic understanding of the algorithms and be able to analyze them. In particular, it is important to emphasize that the models used for solving computational problems are the underpinnings of computer science and as such remain largely the same even as we add new tools and languages.

A key point of emphasis throughout the unit is the connection between the solution "process" and the discussion toward the end of Unit 1 related to how computers are programmed. It is also important to emphasize that not all problems are easily solved by computers.

Specific topics for each instructional day are listed in the overview chart below.

Daily Overview Chart

Lesson	Instructional Day	Topic
1	1-2	Introduce data collection and problem solving through exploration of communities and building on their identity websites..
2	3	Introduce the four main phases of the problem-solving process.
3	4-5	Apply the problem-solving process with a focus on community problem solving. Use different strategies to plan and carry out the plan to solve several problems.
4	6-8	Reinforce the four main phases of the problem-solving process while continuing to explore cultural practices. (cornrows)
5	9-10	Count using the binary number system. Convert between binary and decimal numbers in the context of topics important to computer science.
6	11	Explore Search Algorithms and their influences.
7	12-13	Explore sorted and unsorted lists and various sorting algorithms.
8	14	Introduce minimal spanning trees and how graphs can be used to help solve problems.
9	15-21	Introduce final projects and presentations, addressing a social problem in the context of the problem-solving process. Complete final projects and presentations

Instructional Lessons

Lesson 1. Days 1-2

Topic Description: This lesson sets the stage for the unit's final project and connecting the learning in the remainder of the unit to the final project. The lesson provides an overview of data collection, problem solving, and ideas of what type of problems the students might want to address so that they will be prepared for the final project.

Objectives

The student will be able to:

- Recognize various forms of communication as data exchange.
- Describe the implications of data exchange on social interactions.
- Consider the privacy of data that they create.
- Explain the difference between data used for making a case and data that informs a discovery.
- Describe good research questions.
- Students identify different community identities.
- Develop a community problem that relates to social justice, mental health, racism, the environment, colonization, climate change, etc.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Communication Methods and DataVisuals Students created(15 minutes) • Data Journal (40 minutes)	• Recognize various forms of communication as data exchange. • Describe the implications of data exchange on social interactions. • Consider the privacy of data that they create.
Day 2 • Journal Entry (10 minutes) • Solving Community Problems Activity (35 minutes) • Journal Entry (10 minutes)	• Students identify communities. • Describe good research questions. • Discuss data collection and analysis and possible bias of data collection and analyzation.

Student Activities

Day 1

- Discuss Communications Methods and Data Chart with an elbow partner.
- Discuss Data Journal with an elbow partner.
- Read and discuss articles about “aggregate” data

Day 2

- Complete journal entry.
- Groups complete Solving Community Problems activity.
- Complete journal entry.

Teaching and Learning Strategies:

Day 1

Communications Methods and Data Chart

- Have students reflect back on their conversations about Unit 1 final projects with their elbow partner.
  - **Discuss** their Unit 1 projects and how they addressed the ethical issues.

Data Visuals and Application / Website Analysis

- Ask students to provide some examples of data they provide on a daily basis and how it is provided.
  - Take time to discuss what these data sources might tell us about ourselves if we “aggregated” or collected these data from lots of people—What good might be done? What services might be improved? Think back to unit 1 and Telling a Story with Data, how might AI use our data? What implications might the use of data have?
  - Have students think about which of these ways can be linked directly back to them. What are possible implications of the data being linked back to them?
- Have students read two articles about aggregate search data (See resources for example articles).
  - Does making search data available to researchers help improve search engines? What happens when the data becomes personal?
  - Have students complete a graphic organizer Venn Diagram about the two articles.

Journal entry: *What are some other ways you might think computers use our data? How is that data collected?”*

- If time, lead a discussion about how browsers may collect data by using clicks, history, cookies, etc.

Note: There are many new examples for the topics in each of these readings occurring every day. Teachers should use those as replacements as appropriate.

Day 2

Journal entry: *What are some of the groups or communities you identify with? What are some problems your community would like to solve?*

- Have students share in pairs and then the larger group. Maybe keep track of students who have similar communities or problem interests.
- How could we collect and use data to help solve their problems of interest?

Solving Community Problems Activity:

- Group students in 3 - 4 based on communities or problems of interest. Have students develop a problem related to their community. Topics for scenarios could include, but are not limited to: Social Justice, Racism, Mental Health, The Environment, etc. (See resources for more examples.)
- Teachers should have an example of a community problem they have worked on. Lead students in a discussion to answer some of the following questions. Explain that they should think about these questions as they work.
- For discussion purposes teachers might discuss community problems such as racial bias in policing or facial recognition for surveillance, language/accent bias in voice detection software (like an automated service from a drug store), etc.
  - What research questions might you ask to solve the problem?
  - Why would you choose to collect these data for this question?
  - What are the limitations of this data?
  - What perspectives might be left out based on your data?
  - What might you expect your data to say?
- Have students work in groups of 3–4 to complete the project. They should outline how they would:
  - Approach the problem
  - What kind of data they might need to collect
  - How they would collect and analyze the data
- Have students create a poster to display their projects.
- Have students do a gallery walk of student work and add feedback.

Note: Teacher might keep track of group members and may choose to use the same groups in Unit 2 Lesson 3 Day 2 activity

Closing Discussion

- Lead students in a discussion about the types of data that was collected and how. (Surveys, lists, numbers, etc.) What kind of implications might that have on how the problem is solved? What kinds of tools did we use to collect the data and/or solve the problems? Ask students to analyze any bias associated with the solution or tools they might use to solve their problem.
- Present students with a scenario related to the local community. For example, how does electronic waste or e-waste affect the community?
  - Topics for scenarios could include, but are not limited to: Social Justice, Racism, Mental Health, The Environment, etc.

Resources

- Uniquely Me!: How much information does it take to single out one person among billions?
- 'Anonymous' browsing data can be easily exposed, researchers reveal
- A Face is Exposed for an AOL Searcher (https://www.nytimes.com/2006/08/09/technology/09aol.html?auth=login-google1tap&login=google1tap; Alternate Link: https://www2.hawaii.edu/~strev/ICS614/materials/NYT%20-%20confidentiality%20-%20A%20Face%20is%20Exposed%20for%20AOL%20Searcher%20%202006-08-24.pdf)
- Volunteering data on Facebook and other social networking sites might tell people more about you than you intend. (http://www.nytimes.com/2010/03/17/technology/17privacy.html; Alternate Link: https://faculty.fairfield.edu/winston/How_Privacy_Vanishes_Online.pdf)
- *Note: NY Times has a pay wall, please try alternate links if necessary*

Teacher Reflection Notes

Lesson 2. Day 3

Topic Description: This lesson introduces four main phases of the problem-solving process.

Objectives

The student will be able to:

- Name and explain the steps necessary to solve a problem
- Solve a problem by applying the problem-solving strategies.
- Explain what the word algorithm means.
- Relate the problem-solving process to computers and AI tools

Outline of the Lesson:

Segment	Reason/Purpose
• Journal entry (10 minutes) • Candy Bar Activity (25 minutes) • Discussion of solutions (10 minutes) • Introduction to problem solving (5 minutes) • Reflect/Discuss on the steps necessary to solve a problem (5 minutes)	• Solve a relevant, fun problem • Students understand what an algorithm is as it relates to problem solving and computer science. • What kinds of problems can be solved by a computer • Explain how some problems may be solved by AI

Student Activities
• Complete journal entry. • In groups, participate in the candy bar activity. • Participate in discussion of solutions. • Reflect on the candy bar activity as it relates to the problem-solving process. • Complete journal entry.

Teaching and Learning Strategies:

Journal entry: *If you have twelve people in the room, how would you split up the candy bar?*

Class discussion: what were your approaches to solve the problem? Did everyone want the candy bar? Some might give an example of a heuristic approach. Heuristic means to discover. This can be through trial and error, visuals and other approaches that are not algorithmic.

Follow Up journal entry: *What are the steps you use to solve a problem?*

Candy Bar Activity

- Divide the students into groups of 2 or 3. Give each group a candy bar.
- Explain that their task is to determine how many "breaks" it will take to break the candy bar into 12 equal pieces. One break of one piece of the candy bar will result in that one piece being divided into two pieces. Demonstrate a "break" by breaking the bar into two pieces. Then stack the two pieces together and break or cut the two pieces into four.
- At this point, have each student predict in their journal: What is the number of breaks to break the bar into 12 equal pieces. This should be done without talking to their partner or group members.
- Working together with their partner or group, have the students discuss and then write their plan for solving the problem. They may revise their approach at this point.
- Once this is completed, the students should implement the plan by opening the candy, breaking the candy, and counting the number of breaks it takes to get 12 equal pieces.

Discussion of solutions

- Have several groups present their plan to the class.
- Teachers should highlight the variety of processes and solutions and the computational practice: analyzing their own work and the work of others.
    - Sample questions to ask—Was your group prediction correct? What approach did you use to come up with your ideas to split the candy bar? Did working with your group and creating your plan change your approach ? Did your plan work?
    - How do the steps they used compare what they wrote in their journal?
    - Why do they think they used the same approaches or different approaches than others in the class?
    - Use this as an opportunity to discuss how their identity can shape the ways in which they approach problems.

Introduction to steps in the problem-solving process

Note: There are many different versions of the steps involved in solving a problem. The purpose is for students to be able to articulate and carry out each phase rather than have specific definitions or strategies.

- Lead students in a discussion of how the steps they used relate to the "formal" steps of the problem-solving process.

1. **Understand the problem**—read or listen to the problem statement.
2. **Make a plan to solve the problem**—use pictures, charts, graphs, systematic lists, objects, or act out the solution to help you devise a plan to solve the problem. Does the plan require a computer? In Computer Science we call this plan an algorithm.
3. **Carry out the plan**—once the plan is conceived and understood, follow the plan. If you have planned well, this is the easy part.
4. **Review and reflect** —did the process result in a solution? Is it the best solution for the given problem?students reflect on the plan that they used. How do they know they found the best solution(s)? Are there better ways to solve the problem?Are there any unintended consequences of your solution? Was bias introduced into your problem solving process?
5. **Repeat the previous steps as many times as needed to arrive at the desired result**

Exit Journal OR Reflection/Discussion on the steps of problem solving

- Have students respond to the following prompts in their journal. Give students time to respond, explain they will be using their answers in the next lesson. If time permits, use think-pair-share or other discussion strategies to have students reflect on the prompts
  - Why is the Candy Bar problem an important problem to solve for: a carpenter, a chef, a teacher? How does the problem change with different people?
  - What kind of process might we use if we think about the ways AI might solve a problem like predicting which movie you watch on a Saturday night or what song you might like to play next on your favorite streaming services? Are there any problems that you think a computer could not solve? Why or why not?
  - Is it always better to use a computer or AI to solve a problem?

Note: What makes a problem solvable by computer—being able to provide a step-by-step algorithm is one important piece, but context matters. Think back to Unit 1 and the algorithm you wrote.. Why after reflecting on the problem was it important to go through the process again? Even if we refined our algorithm would a computer be able to make one? No, but a robot could. (Foreshadow Unit 5.)

Resources

- Candy bar problem suggested by Dr. Manuel Blum, Carnegie Mellon University
- Candy bars for student groups to use
- Number of Pieces/Number of Breaks Chart

Teacher Reflection Notes

Lesson # 3. Days 4-5

Topic Description: Students will apply varied strategies to help them make a plan and carry out the plan to solve problems. These strategies may include (but are not limited to): draw a diagram or picture, make systematic lists, divide and conquer, find the pattern, etc.

Objectives

The student will be able to:

- Name and explain the steps in the problem-solving process.
- Work toward solving a problem by applying the problem-solving process iteratively.
- Express a solution using multiple design tools.
- Determine if a given solution successfully solves a stated problem
- Solve problems using varied computational innovations, including Web 2.0 website tools or apps on smart devices.
- Explain the iterative process: why after reflecting on the problem it is important to go through the process again.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal Entry (10 minutes) • Work toward solving a Sample Community Problem as a class (45 minutes)	• Name and explain the steps in the problem-solving process. • Work toward solving a community problem by applying the problem-solving process iteratively.
Day 2 • Solving a Problem (30 minutes) • Student presentations (15 minutes) • Discussion of reflections (10 minutes)	• Solve a problem using varied computational innovations as tools. • Identify bias that might come from the tool chosen or the solutions discussed.

Student Activities
Day 1 • Complete journal entry. • Work toward solving a community problem as a class.
Day 2 • Students make a plan to solve a sample community problem. • Students give brief presentations of solutions explored. • Students participate in discussion and reflection.

Teaching and Learning Strategies:

Day 1

Journal entry: *Have students reflect their exit journal from the previous lesson.*

- What kind of process might we use if we think about the ways AI might contribute to exploring solutions to a problem.
- How do computers and technology contribute to exploring solutions for a problem identified in a Community?
- Are there any problems that you think a computer could not solve? Why or why not?
- Is it always better to use a computer or AI tool to solve a problem?

- Pair after journaling for students to discuss their ideas. Full class discussion before moving on to the next activity.

Work toward solving a Community Problem (as a class)

- Discuss with students how computers and technology might explore solutions to a chosen problem.
  - The teacher can choose a sample Community problem for this lesson, or students can choose their own topics, possibly in groups.
  - Include the idea of data needed to come up with potential solutions to the problem.
- Explain that today you all will solve a problem using the problem-solving process.
- Teachers may choose to present the initial problem in a variety of ways.

1. **Understand the problem**—have students restate the problem in their own words. Use a note catcher of some kind for students to record their answers. Have students share their answers in a think-pair-share.
2. **Make a Plan to address the Problem**—Have students write a plan to solve the problem. Encourage students to think about the computational innovations they explored in Unit 1, including Web 2.0 tools. Can they use those tools to help them solve the problem, if so, how? Give students time to explore and write about their own solution, then have students talk to 2 - 3 other students to share and revise their solution. Include identifying potential problems in your plan and how they might be part of the iterative process.
3. **Carry Out the Plan**—Guide students through a possible solution to the problem.
4. **Reflect**
   - How does your solution address or explore the problem? What can be revised as you reflect to understand the next steps.
5. **Repeat as needed**
   - Students will not carry out this step, but will discuss why it is necessary

- Recall the different elements of identity and bias in data explored in Unit 1. Here are reflection questions to consider: Do the solutions discussed reflect any bias? How does the tool you used help you solve the problem? Is your process efficient? Will all parts of the problem be solved? Would there be a better way to solve the problem? Whose problem are you solving, who benefits from the solution? Who might have been left out of the solution explored?

Day 2

Journal entry: *What ways can computers make our lives more automated? (ie. having a digital personal assistant).*

- Ask students to share their lists with their elbow partners.
- Explain that the term "smart" is used to signify computational automation and with a show of hands ask how many students have heard the term "smart" in this context.

Working toward possible solutions to a problem

- Explain to students that we will be looking at the community problems they have already brainstormed from Day 1.
- Group students in groups of 3 - 4.
- Have students create a product (poster, chart, slideshow, webpage, etc.) using the problem-solving process to solve a community problem using computational tools. Remind students that the problem-solving process has 4 parts, but they will focus on their plan for solving the problem.

1. **Understand the problem**
   - Students should be familiar with the problems.
2. **Make a Plan to Solve the Problem**
   - Encourage students to think about how a popular approach such as smart devices could be explored during the problem solving process. If they do not know what a specific device is, or it has not been invented yet, encourage students to create their own. (This could be an invention, mobile-app or website.)
   - Students should think about what data they might need to collect and what data is available to them.
3. **Carry Out The Plan**
   - Students will not have time to carry out a real plan. Encourage them to explain how they would use the tools they identify to help to solve the problem. If students are creating a solution that will include an algorithm, how might the iteration of their plan change the step-by-step approach? Take into account potential problems that might arise.
4. **Reflect**
   - Does your solution answer the question? Make connections to different elements of identity and bias in data explored in Unit 1, to make a case or a discovery. Does your proposed solution reflect any bias? How do the tools you used help you solve the problem? Is your process efficient? Will all parts of the problem be solved? Would there be a better way to solve the problem? Whose problem are you solving, who benefits from the solution? Who might have been left out of the solution explored?
5. **Repeat as necessary**

Resources

- No additional resources needed

Teacher Reflection Notes

Lesson 4. Days 6-8

Topic Description: In this lesson, students continue to explore their identities and cultural practices. They will continue the investigation of CSDT begun in Unit 1 through the historical context of cornrow braiding and model through computational tools. Connections between the design of the tools and mathematics will be explored as well as the connections and importance of culture and technology.

Objectives

The students will be able to:

- Explain how our day-to-day practices can involve computation, but may not be obvious
- Explore how computers can be used as tools for visualizing data, modeling and design, and art related to cultural practices.
- Solve a problem by applying the problem-solving process.
- Express a solution using standard design tools.
- Determine if a given solution successfully solves a stated problem.
- Explain benefits of diversity in software design and development teams.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Identity Iceberg experience (15 minutes) • Journal entry (10 minutes) • Research on cornrow braiding (20) • Begin group Presentations on historical cultural background of cornrow braiding (10 minutes)	• Further explore their own identity and cultural backgrounds. • Explore the historical context of cornrow braiding
Day 2 • Complete group presentations (10 minutes) • Cornrow curves design tool tutorial (20 minutes) • Cornrow curves design tool Create a Project Plan (10 minutes) • cornrow curves project project (15 minutes)	• Learn to Express a solution using CSDT design tools. • Plan a project to create a unique pattern using cornrow curves software. • Explore similar connections other relevant, cultural practices and histories

Segment	Reason/Purpose
Day 3 • Journal entry (10 minutes) • Finalize Cornrow curves project (30 minutes) • Gallery Walk and Reflection (15 minutes) with reflection journal.	• Execute the plan for the cornrow curves project. • Determine if a given solution successfully solves a stated problem. Connect the outcomes and effects of specific solutions of a given problem. • Participate in a gallery walk and reflection.

Student Activities

Day 1

- Complete Identity Iceberg Experience.
- Complete journal entry.
- Groups review the history of cornrow braiding and present to the class.

Day 2

- Complete the CSDT Cornrow Curves tutorial.
- Explore power hierarchies and perceived value of multiple cultural practices and designs
- Design a unique pattern for their own cornrow curves project as an exercise to examine power relationships and complex histories.

Day3

- Evaluate positive and negative consequences when algorithms and software is developed with or without hearing diverse voices and ideas.
- Complete the pattern designed and planned for the cornrow curves project
- Determine if a given solution successfully solves a stated problem
- Participate in a gallery walk and reflection journal.

Teaching and Learning Strategies:

Day 1

Identity Iceberg Experience

Journal entry: *What cultural practices are important to you? Why do they matter?*

Note: Teachers may choose to think-pair share or just let students journal. Students should be reminded of the different cultural practices we explored using CSDT in Unit 1.

- Using the Iceberg Activity (See resources), students work individually on the handout.
- Share with an elbow partner to continue the activity. Student volunteers can share one feature from above the line and one from below.
- Remind students about their learning from Unit 1 Human Computer Interaction- specifically What is a Computer and Room Activity lesson. This image can be added to their digital portfolio if one was created in Unit 1

Introduction to CSDTs Culturally Situated Design Tools with Cornrow Curves software

Journal entry: *How did you represent your cultural background on your Identity Iceberg? What connections can you make between your cultural practices and the software you reviewed in the CSDT collection in Unit 1? How might you as an individual feel important and valued in a diverse group?*

- Give students time to visit https://www.thecrownact.com/. Have students discuss with their partners what they notice and what they wonder.

Note: The purpose of this activity is for students to learn more about the historical and cultural context of cornrow braiding, including opportunities to discuss historical domination and exclusion of certain cultural practices and people.

Historical Perspective. https://csdt.org/

- Divide students into five groups and ask each group to read and take notes on one of the following sections and find additional sources on their topic, keeping what they learned that they did not know before and any connections they see to the earlier discussion of the Crown Act.
  - African Origins
  - Middle Passage
  - Civil War to Civil Rights
  - Hip Hop
  - AfroFuturism

Note: In all of the discussions that follow in this activity be very mindful of language used in framing the conversations. This is particularly important when discussing Middle Passage and Civil War to Civil Rights. During the Middle Passage section it is made clear that there were enslaved African people, free African American people and Black people (free and not of African origin). In Civil War to Civil Rights it talks about return to the African traditions and how the afro was added to cornrows as a form of resistance.

- Each group will be responsible for sharing their notes in a poster presentation from their group with the rest of the class.

Journal prompt: *What connections are you making between the African origins of cornrows and reading the Crown Act?*

  - Utilize Think-Pair-Share. Students should have the opportunity to journal quietly before sharing with a partner and finally a class discussion.

Group discussion on cultural background of cornrow braiding

- Students collectively work on understanding the cultural significance through the presentation activity from CSDT historical perspectives.
- Question to consider during conversations: What did you learn through researching the history of cornrows? What connections, if any, do you notice between histories of your cultural practices and the histories of cornrow braiding? What connections can you make between the history you learned about and trends you see in computing?

Day 2

Summarize the discussion from yesterday

  - Remind students that cornrow hairstyles come in a variety of shapes, designs, and arrangements with shapes and meanings that have evolved over the years in the U.S. and beyond.

Note that underlying this variety is a set of pattern recipes -- what computer scientists call “algorithms” and that the next set of activities will explore how to simulate cornrow patterns of students’ own creation.

Cornrow Curves design tool tutorial

- View “How to Braid” with elbow partner.
- Optional activity: Braiding with yarn to be able to experience and facilitate further discussion of the process of braiding as an algorithm.
- Individual students complete Part I of the tutorial, following all instructions and checking their work with their elbow partner.
- Students use their journal to take notes using the software tutorial.
- Think about your learning about iterative algorithms from the mathematical work in CSDT. We continue our work with algorithms later in this unit.
- Resource: Cornrow curves software tutorial

Cornrow Curves project plan and project

- Each group of students should complete the following. Each step of the process should be documented by the students:
  - Students create their own plan of a cornrow design. Questions students should be asking themselves when planning their design: "What context of the history of cornrows does their design draw from?" "What does their cornrow design communicate to others?"
  - Students create their strategy for their design. Highlight the mathematical concepts used and where and how they are used. Reinforce the strategy of finding a similar problem that has already been solved to help solve the new problem. Note that they can view other practices as mathematical and have tools like CSDT to help design them computationally.
  - Students create their own design using the Math software (Note: The programming software can be used in Unit 4 to allow students who are interested to create extensions of their designs.)
  - Students reflect upon their process and the outcome of their design. Students should also reflect on any connections they are making to earlier discussions on the historical context, power and exclusion and computing.

Day 3

Journal entry: *People experience discrimination because of a wide range of reasons. How do you think that discrimination impacts them? Are there any specific feelings they may have? How difficult is it for them to do things like go to school or work, take care of their family, be healthy, etc.?*

- Utilize Think-Pair-Share. Students should have the opportunity to journal quietly before sharing with a partner and finally a class discussion.
- Ask a few volunteers to share their thoughts with the whole class, leading to a class discussion.

- Please read through all of the questions below. It is not necessary to discuss all of them. Choose the questions that are right for the class based on what students have shared.
  - Then ask students to follow up this conversation in their journals about how someone would feel if the discrimination occurred because of an algorithm—meaning a non-human with which they had no recourse and were not able to even have a discussion regarding the discrimination.
    - Examples include: an oximeter working better for light skin tones, hiring algorithms favoring specific genders, healthcare algorithms that lead to unequal access in care, etc.
  - **Discussion:** As students learn to appreciate the impact of design, art and historical perspectives of diverse groups of people, could this type of learning and appreciation lead to less discrimination? How can we assure software development teams address coded bias in algorithms and software development?

Complete project

Gallery Walk and final reflection journal

- Students share their solutions on their screens with a Gallery Walk and Reflection journal.
- Ask students questions that will get them to reflect on the importance of diverse cultural perspectives on computer science during the design and development of software.

Journal entry: *What went well for you in carrying out your plan? What was difficult for you? What might you do differently if you prepared another design plan?*

Resources

- Above and Below: Your Cultures and Identities as an Iceberg (https://www.oregon.gov/ode/students-and-family/equity/NativeAmericanEducation/Documents/SB13%20Curriculum/Materials_GR10_Identity_and_Survivance_Iceberg_Worksheet.pdf)
- Teaching the Identity Iceberg (https://adl.org/sites/default/files/identity-iceberg/story.html)
- The CROWN act (https://www.thecrownact.com/)
- CSDT Legacy Pages (https://csdt.rpi.edu/culture/legacy/index2.html) Depending on your internet blockers, you may occasionally need to temporarily disable some settings.
- Barbershop computing (https://csdt.org/culture/barbershop/index.html)
- Afrofuturism (https://csdt.org/culture/afrofuturism/index.html)

Teacher Reflection Notes

Lesson 5. Days 9-10

Topic Description: This lesson builds on the historical contexts of counting in different cultures to introduce the binary number as the counting system used by computers. Students will learn how to count in binary and convert between binary and decimal numbers in the context of topics that are important to computer science and human communication.

Objectives

The student will be able to

- Convert base ten into binary and binary into base ten.
- Explain why binary numbers are important in computer science and how computers communicate differently than humans.
- Use binary digits to encode and decode messages.
- Compare problems in different contexts.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • CS Unplugged: Count the Dots— • Binary Numbers (30 minutes) • CS Unplugged: Count the Dots— • Working with Binary (10 minutes) • Journal entry (5 minutes)	• Access previous knowledge. • Become familiar with base then and base 2. • Understanding Base 2. • Connecting Base 2 to value representation. • Connecting base 2 to how computers store information. • How base 2 is used to code information
Day 2 • Count the Dots-Working with Binary cont. (20 minutes) • CS Unplugged: Count the Dots Sending Secret Messages (20 minutes) • Journal entry (15 minutes)	• How reiteration may be used to compress information into a small “space,” memory. If all files are only zeros and ones, what is the function of the extension of the file? • How the binary number system relates to The Candy Bar Problem. Students find similarities to seemingly different problems.

Student Activities

Day 1

- Complete journal entry.
- Complete count the dots activities.
- Complete journal entry.

Day 2

- Complete the Sending Secret Messages activity
- Complete journal entry

Teaching and Learning Strategies:

Day 1

Journal entry: *What are the different ways you know of representing the number 8? Students can write, show, draw, etc.*

- Utilize Think-Pair-Share. Students should have the opportunity to journal quietly before sharing with a partner and finally a class discussion.
- Have students compare their different representations. Discuss with students how some of their representations may have been based on language, culture, identity or community.
- Provide a few examples of representing the number 8 and place values in different cultures. For example, the historical perspective of "zero" within the Hindu-Arabic numerical system, also known as the decimal system.

Count the Dots Activities

- Teacher gives instructions for the Count the Dots activities and circulates while students participate in the Count the Dots activities.
  - Start with the introductory activity on p. 4 of the activity. This activity can be downloaded from http://exploringcs.org/curriculum. Download and unzip CSUnplugged files, then open. Note there are many additional resources listed that you may wish to explore.
  - It will be helpful to read through the entire activity in advance, so that you can revise questions, add your own questions, and think about how you might want to structure each part of the activity. The goal is for students to be actively involved in some way and for all students to be able to represent numbers and count in binary. What follows is the minimal suggestion.
  - Have 5 students come to the front of the room and demonstrate as you follow the instructions and ask the questions. (Each student should receive a large card with one of the numbers of dots—1, 2, 4, 8, 16.) Complete the Binary Numbers activity on p. 5.
- Teacher gives instructions for the Working with Binary activity activities and circulates while students participate in the Working with Binary activity on p. 7.
- Have 5 students come to the front of the room and try counting as you call out the numbers. (Each student should receive a large card with one of the numbers of dots— 1, 2, 4, 8, 16.)

- Have different groups of 5 students at a time come to the front and have the other students provide counting and representation challenges. You could also have a competition with multiple teams of students each trying to get the answer. There are many other possibilities. Be creative!!

Journal entry: *How do you think technology influenced the choice of using a binary system?*

- Discussion of Why are binary numbers important in computer science?

Day 2

Sending Secret Messages

- Teacher gives instructions for the Complete the Sending Secret Messages activity on p. 8 of the CS Unplugged: Count the Dots activity. (Solution is on p. 13.)

Journal entry: *How does the binary number system relate to The Candy Bar Problem? If all computer files are just a bunch of zeros and ones, what is the purpose of their extensions such as .txt, . jpeg, .mp3?*

Resources

- Bell, Tim, Ian Witten and Mike Fellows. Computer Science Unplugged. Canterbury, New Zealand: 2002.
- Computer Science Unplugged Activity 1: Count the Dots—Binary Numbers (See CSUnplugged ECSv10: exploringcs.org/curriculum)
- Binary number cards for each student from Count the Dots—Binary Numbers (See CSUnplugged ECSv10: exploringcs.org/curriculum)

Teacher Reflection Notes

Lesson 6. Day 11

Topic Description: Apply the problem-solving process. Algorithms and algorithm bias.

Objectives

The student will be able to:

- Describe the linear search algorithm.
- Describe the binary search algorithm.
- Explain conditions under which each search might be appropriate.
- Explore the consequences of search algorithms.

Outline of the Lesson:

Segment	Reason/Purpose
• Tower building Problem (20 minutes) • Students Model Linear and Binary searches (15 minutes) • Comparison of linear and binary search (10 minutes) • Journal entry (10 minutes)	• Hands on problem-solving using physical models • Connecting Tower problem to algorithms • Connecting tower problem to searches • Understanding the differences and limitations of solving problems with computers. • Reinforce the reflection part of problem solving. Develop strategies for solving the same problem in different contexts.

Student Activities
• In pairs complete the Tower Building Activity. Have students complete the Tower Building Activity with their elbow partner and write their solutions in their journals. • Model the tower building algorithm. • Share their solutions with another elbow partner pair. • Participate in the activity modeling linear and binary searches and their comparison. • Complete Journal entry.

Teaching and Learning Strategies:

The Tower Building Problem

- Teacher Introduces the Tower Building Problem.
  - Students in pairs use the four steps of the problem-solving process to create an algorithm for the solution to the given problem.
  - Have students use the physical model strategy for solving the problem.
- Have students share their algorithms to the Tower Building Problem
  - Ask students how could they have solved the Tower problem another way using other strategies?

Note: One is to start by taking half of the height of the tower and create that number of stacks of two. Continue halving the number of stacks and doubling the height (plus one stack of any remainder) until the desired height is reached. This foreshadows binary search. However, some students may interpret the problem differently and come up with different solutions. Use these solutions and interpretations to discuss the processes students are using

Discuss Linear and Binary Searches

- Linear—start at the beginning, look at each item until you find it or there is no more data. Data can be sorted or not.
- Binary—look at the middle item, eliminate the half where the value is not located. Find the new middle element and continue the process until you find it, or there is no more data. Ask students to describe what is necessary in order to use a binary search—the list must be sorted.
- Have students provide examples of where each type of search is appropriate and why. When the data is very large, which search type would be better?

Note that decisions often need to be made about whether to maintain lists in sorted order, provide an option for sorting should it be necessary, etc. based on the types of searches that are expected to be performed on the data.

Journal entry: *Is the computer doing searches like linear or binary search? Search engines use all types of algorithms to find information for people. If the algorithm includes personal data, previous searches, previous purchases, etc. how could this affect the results of a search? What kind of biases might a computer search algorithm have?*

- Encourage students to think about their work from Unit 1 with web 2.0 or picture activity.

Note: This lesson should reinforce algorithm bias. For example when students search for a pitcher, some might get an image of the drinking pitcher while others might see a baseball pitcher. Why? Other examples include hiring algorithms favoring specific genders, healthcare algorithms that lead to unequal access in care, etc.

Resources

- Tower Building Activity Instructions
- Some type of tower manipulatives such as lego, building blocks, wood tiles, or a square taffy candy similar to Starburst.

Teacher Reflection Notes

Tower Building Activity

- A construction company wants to build a 100-meter-high tower as quickly as possible. The company has unlimited resources and an unlimited budget and is willing to spend any amount to get the job done.
- The tower is to be built with blocks that are 100 meters long and 100 meters wide, but only 1 meter tall. The blocks interlock on top and bottom (like legos). They cannot be stacked sideways.
- Using special lifters, putting one stack on top of another stack takes one week regardless of how high the stacks are.
- What is the shortest amount of time that it will take to build the tower?

Suggestions:

- Use something like legos or a graph to help solve this problem.
- Start with a smaller tower of 5 or 10—solve a smaller problem.
- Extend that knowledge to the larger problem.

Lesson 7. Days 12-13

Topic Description: Explore sorted and unsorted lists and various sorting algorithms. Reinforce problem solving steps and strategies. There are some problems that cannot be solved by computers. Compare algorithms (solutions). Why are we so interested in searching and sorting?

Objectives

The student will be able to:

- Define sorted and unsorted lists.
- Describe various sorting algorithms.
- Compare various sorting algorithms.

Outline of the Lesson:

Segment	Reason/Purpose
• Day 1 • Journal entry (10 minutes) • CS Unplugged Lightest to Heaviest activity (35 minutes)	• Apply problem solving steps to investigate sorting methods
• Day 2 • Students repeat the problem-solving process either using more elements or at minimum follow the unplugged activity using another strategy. (20 minutes) • Students present their sorting algorithms to the class. (15 minutes) • Journal entry (20 minutes)	• Exploration of Algorithm: Explore additional Algorithms. There is not only one way. • Emphasizes the importance of reflection in problem solving. Consider limitations of algorithms. Students start to think about loops.

Student Activities
Day 1 • Complete journal entry. • Complete Lightest and Heaviest activity. • Complete journal entry **Day 2** • CS Unplugged: Lightest and Heaviest—Alternate method • Complete journal entry.

Teaching and Learning Strategies:

Day 1

Journal entry: *What are some things that you sort every day? How do you sort them?As students share their responses ask questions such as:*

- *Why is sorting important?*
- *What are the different ways we may sort elements?*
- *What several attributes you might be interested in when sorting?*
  - As a transition, ask students what types of sorting might a computer do better than humans? Provide some examples from their own experiences.
  - Reminder from the previous lesson a binary search algorithm can be efficient, but must be used on pre-sorted data.

CS Unplugged: Lightest and Heaviest

- This activity can be downloaded from the Exploring CS website (http://exploringcs.org/curriculum). Download and unzip CSUnplugged files, then open. Note there are many additional resources listed that you may wish to explore.
- It will be helpful to read through the entire activity in advance, so that you can revise questions, add your own questions, and think about how you might want to structure each part of the activity. The goal is for students to be actively involved in some way and for all students to be able to describe the various types of sorting.
  - Each group has a set of elements. The first round could have four elements. Each student would be responsible for creating strategies and their group's algorithm. One student could be the code writer and another student could be the code verifier that makes sure the code is understandable to others outside of their group. Another student could be the evaluator that compares two elements. And the last student could be the evaluator verifier to make sure that the evaluator and evaluator verifier agree on the results of the comparison of two elements.
  - There are many possible ways to make the weighted elements. One would be to use bags with varying numbers of pieces of candy. Or you could use takeout boxes and fill them with sand. If you don't have balance scales, you can help students come up with a strategy that will simulate a scale. For example, if the weights are clearly different in weight, the students could do this by feel. The students could be divided into groups of four with different jobs.
  - This activity can be done with many other elements. Teachers may choose to use student birthdays in their groups or classes, playing cards or any other hands on items; with students encouraged to share their ideas on other types of data to be sorted.
- Lead discussion of what the problem is and the constraints of the problem. Emphasize that the computer does not remember results of a comparison once the comparison is made. Therefore, their instructions need to have the computer do something or not according to what the results of the comparison is. Also emphasize that the computer only knows locations of elements and not their value at any time. Field students for any questions or clarifications.
- Have students develop a strategy for solving the sorting problem. Prompt students about their step

by step process when developing their strategy. Such as how will the algorithm "know" when it is done and all the elements are sorted? What details need to be in the algorithm instructions so that someone else may follow the instructions without asking questions? Commands for the algorithm may be: evaluate element # to element # with a conditional statement of an action command. Action Commands: swap, place at # position, place at beginning, place at end, copy list, create empty list, copy element to another named list.

- Teacher circulates to different groups while students carry out their plans and asks questions about the algorithm they are creating. When students feel they are finished the teacher could follow their instructions, read to them or have other groups follow their instructions to see how well their algorithm works. Once students have a working algorithm, the teacher has each student confer with their group and write their own reflection of the process.

Class Discussion

- Teachers facilitate students discussing other ways of sorting exploring more options with students. .

Day 2

Journal entry: *Reflect on your group's strategies algorithm. How did your algorithm know when to stop? What was the attribute you used to sort? How many reiterations did your group have to do before you had an algorithm that worked?*

- Teacher facilitates journal entry discussions of algorithms and reflection of the entire process and the importance of reiterations of the process.

CS Unplugged: Lightest and Heaviest—Alternate method

- Teacher has students refine their working algorithm with eight elements or create another method. Teacher ensures that the students repeat the entire ECS problem-solving process taking their reflections into consideration.

Journal entry: *How does the size of the data being sorted affect the sorting process? How do you compare these sorting criteria to your experiences of sorting on different platforms such as Netflix, Google search, Spotify?*

- As students share their responses, discuss
  - the possible effects of sorting and searching on our society when the process and attributes are not shared with the user?
  - Energy is needed to keep computers running. What are the environmental costs of sorting and searching large data sets?

Processing activity strategies after students respond to this journal entry:

- Pair up around the room and read their responses to a partner then listen to their partner's response, then swap to find a new partner, etc until the time is up - then afterwards, ask students what they heard frequently or what new ideas came up?
- If many questions exist during the discussion and they aren't building on each other, maybe assign each question to a group to discuss and present.

- Do a brainstorm carousel type activity where each question is on a poster around the room and have students rotate answering each question briefly on post-its on the poster paper then bring everyone back to discuss.

Resources

- Computer Science Unplugged Activity 7: Lightest and Heaviest—Sorting Algorithms (See CSUnplugged ECSv10: exploringcs.org/curriculum)
- Containers of the same size with different weights. Or takeout boxes with different amounts of sand in bags.
- Balance scales or have a group of four students. Have student one a code writer, student two a code verifier, student three a evaluator, and have student four a evaluator verifier. All four students create their sorting algorithm.

Teacher Reflection Notes

Lesson 8. Day 14

Topic Description: Introduces minimal spanning trees and how graphs can be used to help solve heuristic problems.

Objectives

The student will be able to:

- Solve a minimal spanning tree.
- Draw a node edge graph to solve a problem.
- Students reinforce their problem-solving strategies and solutions from one context to another.

Outline of the Lesson:

Segment	Reason/Purpose
• Journal entry (15 minutes.) • CS Unplugged: The Muddy City • (15 minutes) • CS Unplugged: The Muddy City— • extension (10 minutes.) • Journal entry (15 minutes)	• Students apply problem solving steps to The Muddy City. • Students explore different representations of their information and their advantages. • Students reflect upon their process and representations. • Students develop transitive applications of problem solving with different contexts. Some heuristic problems are not easily solved by computers.

Student Activities
• Complete journal entry. • Work in groups to solve The Muddy City • Students share their solutions with the class. • Reiterate the problem-solving process using the edge node graph to find other solutions that are better than their previous solution. • Journal entry

Teaching and Learning Strategies:

Journal entry: *Many Problems have different contexts, but the problems are similar regarding constraints and types of solutions. How could the following scenarios be similar? Shaking hands with a group of people and connecting computers together as a network? How are the two situations different?*

- Teacher leads student discussion about their journal entries making the connections between the two seemingly different problems. Teacher helps students see the possible differences of the two different contexts of the problems and their constraints. Teacher then makes the connections that there are other problems that may not seem similar, but have connections that are helpful to solve more problems.

CS Unplugged: The Muddy City

- This activity can be downloaded from the Exploring CS website (http://exploringcs.org/curriculum). Download and unzip CSUnplugged files, then open. Note there are many additional resources listed that you may wish to explore.
- It will be helpful to read through the entire activity in advance, so that you can revise questions, add your own questions, and think about how you might want to structure each part of the activity. The goal is for students to be actively involved in some way and for all students to be able to describe shortest path strategies. What follows is the minimal suggestion. Follow the directions in The Muddy City Problem on p. 78. Introduce the Muddy City Problem.
- Have students work with their elbow partners. Teacher ensures that students use the four steps of the problem-solving process.
- Have students share their solutions and lead the follow-up discussion p.77. Students have a class discussion on their reflections of their solutions.

CS Unplugged: The Muddy City extension

- If the node edge graph (https://en.wikipedia.org/wiki/Graph_theory) is not presented, then the teacher suggests other ways to represent the problem and find solutions using a node edge graph. Have students repeat the Muddy City Problem with the abstract representation in the figure on p. 79 and answer the questions on p 79. U
- Discuss the students' reflections of the process and reiterations. How do you know you have the best solution? Is there an algorithm to give us the best answer or is it only a strategy that we are using? Can computers solve such problems?
- Discuss various applications of this problem in the industry sector of Computer Science (p. 80). Why do we have different values for different paths? How does this relate to networking computers? What resources of material and energy are needed for networking? Given that different paths have different values and determine certain paths being used, how might that affect different groups of people depending on where they live?
- Emphasize the idea of the shortest path and how some representations may be more advantageous than others for a given context.

Journal entry: *Is there a formula we could use to figure this problem out? What other ways could we represent the paths, houses, and stones?*

- How does this relate to planning home delivery or bus routes? What happens when there are competing interests, such as minimizing gas usage vs timely arrival? How does this problem relate to computer science?
- Discuss various applications of this problem in the industry sector of Computer Science Why do we have different values for different paths? What would it mean to apply the problem-solving strategies for a data or network situation? How does this relate to networking computers or digital divide issues? What resources of material and energy are needed for networking? Given that different paths have different values and determine certain paths being used, how might that affect different groups of people depending on where they live?

Resources

- Computer Science Unplugged Activity 9: The Muddy City— Minimal Spanning Trees, pp.76–80. Materials

Teacher Reflection Notes

Lesson 9. Days 15-21

Topic Description: Summative Project: Students apply problem solving steps to address a community problem they are personally concerned with.

Objectives

The student will be able to:

- Apply problem solving steps.
- Document their process aligning with the problem-solving process, modeling and generalizing their solution. Mathematical modeling includes data presented through tables, charts, graphs and equations.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal Entry (10 minutes) • Brainstorming (10 minutes) • Explanation of final project (10 minutes) • Begin work on final project (25 minutes)	• Assist students decide on a problem to address. Ensure student success • Final projects may be individual or in groups so that students may demonstrate their proficiency using problem solving steps. • Students see other examples of how problem solving steps may be applied.
Day 2 • Work on final project (55 minutes)	
Day 3 • Work on final project (55 minutes)	
Day 4 • Complete final project (55 minutes)	
Day 5 • Presentations of final projects (55 minutes)	

Student Activities

Day 1

- Complete journal entry.
- Ask for clarification during the explanation of the project presented to them.
- Begin work on the final project.

Day 2

- Continue work on the final project

Day 3

- Continue work on the final project

Day 4

- Complete the final project.

Day 5

- Present the final project.

Teaching and Learning Strategies:

Day 1

Note: Before beginning the journal entry, review the ideas from Lesson 1 in this Unit. Discuss community (building community, community service, community organizing) and community related issues chosen can be local, regional or national, or global. Defining community and the idea of "think globally/act locally". A global problem such as world hunger and food insecurity can be addressed in a student's own community. As discussed at the start of the unit, community can be defined in any way from a class at school, the whole school, your family, a town or neighborhood, a region, state or another country.

Journal entry: *Community Problems are introduced in L1 and revised in L3, go back to your ideas from earlier in the unit to continue revision if you choose. OR "List at least four issues that you care about and would like to have agency. The community related to the issue chosen can be local, regional or national, or global.*

- Students then pair share.
  - Then student groups share responses.
  - Students circle one of the problems they are concerned with and think about why they are interested in this problem, and how they might be personally connected to the problem.
  - Helps students make decisions on what problem to choose and student grouping.

Brainstorming (https://www.lucidchart.com/blog/effective-brainstorming-techniques)

- As students brainstorm, have them consider what problems computers are "good" at solving and what problems need to be solved by diverse groups of people. Our future may include Artificial Intelligence applied to problem solving, however, when confronted with community problems what will be the input from computers, from AI, and from people involved. How will these various options (Computer software, AI, people in the community) provide input to different community problems, and how is data generated to make a case and/or make discoveries?
  - Community problem examples include: E waste, Scarce resources for technology, Green chemistry, Artificial Intelligence making societal decisions, Technology and its energy consumption, Environmental issues, Food or pharmaceutical deserts, People unhoused and food insecure, Problems in education, Violence, Mental and Physical Health, Medical privacy etc. Make explicit connections to problem solving process and Human Computer Interactions from Unit 1 especially sustainability and privacy lessons.
  - Possibly interview family members or develop a survey for the school community or to identify problems important to the students' communities as a strategy to include student created data. Note that with primary student gathered/ created data students need to cite their resources. What bias might be introduced into your data? How might this impact your problem-solving plan?
- Explain the projects and what computational products/deliverables are available to the students.
  - Explain that data may be used to help solve problems in many different ways.
    - Data may be used to help people be aware that a problem exists, "make a case".
    - Data may be used to better understand the problem.
    - And data may be used to find solutions to the problem, "make discoveries".
- Explain that they are not actually solving the problem but creating a white paper on how they would go about solving the problem outlining their plan using the ECS problem solving process.
- When addressing the problem they chose, students should include those that benefit from the problem and those who are affected adversely by the problem. Students should address what they might consider during the reflective process and how the reiterations would be adjusted in regards to their considerations. Students may revisit the problem they addressed in the first lesson (U2LP1) now applying the ECS problem solving process they learned or they may choose another problem.
- Have students apply the ECS problem solving process to the problem they chose and create their deliverable. Define how the problem-solving process aligns with their proposed solutions. Students reference research resources that include data sources-using the website rubric. What are the main benefits of a proposed solution? Do proposed solutions unintentionally create any harmful impacts? How can further data collection be a part of the problem-solving process? A project rubric is available
- The students might be served by allowing additional time depending on how deliverables are defined. Students may iterate in the problem-solving process and reflect on the process and develop and share milestone goals. The final project may take longer. Students may need to be mindful of what problem they are solving, whose perspectives they are considering, how are they formulating/computing, and how are they arriving at potential solutions. Discussions might note how much time would be needed to solve the problem identified with similar care we are advocating for the AI tool designers to do. Students are sharing early iterations in the problem-solving process. Consider the timeline and resources a more developed solution might take.

Day 2

- Work on Final Projects
  - Monitor student progress and ask questions as appropriate.

Day 3

- Work on Final Projects
  - Monitor student progress and ask questions as appropriate.

Day 4

- Complete Final Projects
  - Monitor student progress and ask questions as appropriate.

Day 5

- Presentation of Final Projects
  - Have students share deliverables. Structure of the share depends on what the deliverables are. Such as presentations, gallery walk, etc. An image of this project can be shared in their Digital Portfolio.

Resources

- Final Project Community Problems.
- Final Project Sample Rubric
- Hayes, Adam. 2020. "White Paper: What Everyone Should Know." Investopedia. 2020. (https://www.investopedia.com/terms/w/whitepaper.asp)

Teacher Reflection Notes

Final Project

Community Problems

In your groups, you will write a paper that describes how you would go about solving a problem that is important to you and your community. You will not actually be solving the problem, but rather describing the process you would use. As you describe the process, explain how each part fits with the problem-solving process you discussed in the lessons throughout the unit.

Possible, but not limited to, these Topics:

- E waste
- Scarce resources for technology
- Green chemistry
- Artificial Intelligence making societal decisions
- Technology and its energy consumption
- Environmental issues
- Food or pharmaceutical deserts
- People unhoused and food insecure
- Problems in education, Violence, Mental and Physical Health, Medical privacy etc.

Action items to include

- Those that benefit from the problem and those who are affected adversely by the problem.
- Define how the problem-solving process aligns with the proposed solutions.
    - Clearly define the problem
    - Overall plan
    - Strategies used
- Research resources that include data sources-using the website rubric.
- What are the main benefits of a proposed solution?
- Do proposed solutions unintentionally create any harmful impacts?
- How can further data collection be a part of the problem-solving process?

Presentation

Each group should prepare a presentation for their chosen topic. The presentation should have a visual. After each presentation, the class will discuss the topic. Be prepared to answer questions from your classmates.

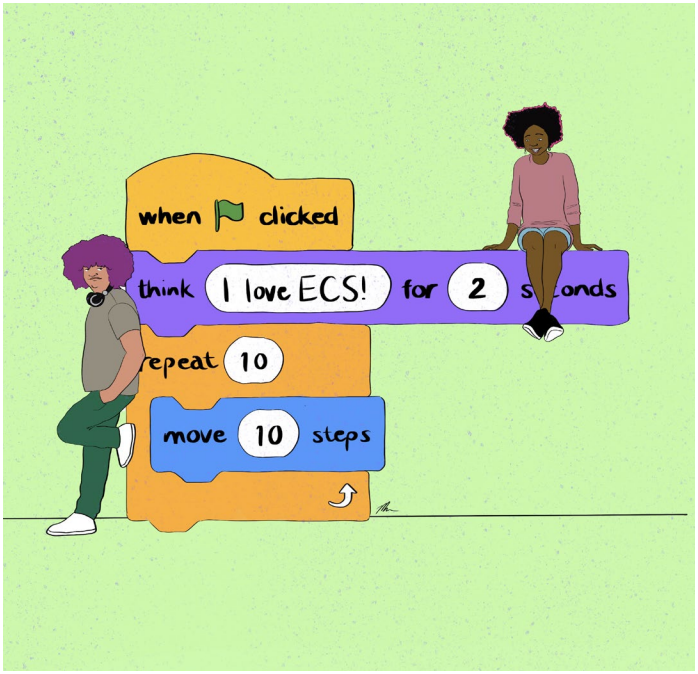
Final Project Sample Rubric

Group Members Names (up to 4)

_____ _____

_____ _____

Do You Have?	Points Possible	YES	NO	Points Earned
Detailed Plans				
• Identify Problem clearly • Overall Plan to solve problem • Outline of strategies	10			
• Research Data from each group member's research contributions. Include harmful and beneficial issues: those that benefit from the problem and those who are affected adversely by the problem.	20			
Project Parts- Modeled				
• Graph/Visualization 1 • Summary statement	10			
• Graph/Visualization 2 • Summary statement	10			
• Solution labeled on graphs/ Visualizations	10			
• Table with approach for solution in agreement with Visualizations.	10			
• Other conditions to consider	10			
Presentation				
• All group members participate	5			
• Present all parts of the project	10			
• Answer audience questions	5			
Total	100			



Unit 3: Programming

Introduction

Programming is a creative process that turns ideas into realities. Unit 3 introduces the role of programming as a tool for personal expression and cultural exploration, as well as for equity and social justice. Students use a block based programming language: Scratch to create projects that reflect the diversity of their classrooms, their personal identities, cultural backgrounds, and their communities. The projects center around specific themes such as their names, places in their communities, and the ways different cultures celebrate events and milestones. Students also have the opportunity to learn about the different cultures represented in their schools not only through projects, but also through discussions, journal writing prompts, and building stories that showcase their unique choices and perspectives.

While a powerful tool, programming can also incorporate the biases of the programmer and the inequities in our society, perpetuating inequalities related to race, socioeconomic status, and cultural backgrounds. Cultural biases and lack of diversity in the development of programs and algorithms lead to technology that does not include the voices of everyone in the community, especially historically marginalized communities. In this unit, students learn about these challenges and develop inclusive and equitable programming practices that respect and integrate the diverse backgrounds and cultures of their class. This ensures that technology is used to celebrate all people and include diverse perspectives rather than exclude them.

Students learn different programming tools through Scratch programming (or any other block based language that suits teachers), students use a drag-and-drop interface to experiment with code blocks without the issues inherent to other text based programming languages, such as syntax errors. This helps them make changes easily and allows them to see the effects of their changes immediately, developing an inquiry-based learning experience. As students move through the unit, they use skills developed in previous units to apply problem-solving processes, design and refine their projects, engage in discussions about the challenges they encounter, and explore the solutions they develop. These conversations connect mathematical concepts and logic processes to their programming tasks, helping them understand and visualize the abstractions used in their projects.

The unit further discusses how programming can be used to tell stories, deepen exploration of identity and community connection to make decisions and explore the implications of artificial intelligence in representing and exploring cultural identity and individuality. The versatility of Scratch allows students to incorporate elements like conditionals, iteration, and custom blocks (abstraction) to build complex, culturally relevant projects that represent their lived experiences and goals.

Students are encouraged to expand on their work by incorporating features, collaborating with peers, and adding more personalization to their creations. They may also join the vibrant online community of Scratch, where they can share their projects and learn even more, from a global network of creators. This external collaboration is supported by Scratch 3.0, accessible via web browsers and compatible with a range of devices, expanding the accessibility and collaborative potential of their programming endeavors.

Note: Internet Explorer will NOT be supported for v3.0.

There is also a Scratch Ed community for teachers (http://scratched@media.mit.edu).

Specific topics for each instructional day are listed in the overview chart below.

Daily Overview Chart

Lesson	Instructional Day	Topic
1	1-4	Through student's names, identities and cultures' discussions, Scratch programming language is introduced, including the basic terms utilized in the language,
2	5	The discussion of names & identities is continued from the first lesson as the focus of building a dialogue. This lesson explores how to create a dialogue between two sprites by first creating a written dialogue then implementing it using Scratch.
3	6-8	Students analyze the cultural and personal significance of physical community landmarks, reflecting on how their name and identity are connected to their community. Students learn how to move sprite in different ways on a map of their community.
4	9-11	Students will think about a celebration that is important to them, including the customs surrounding it, and write a program titled Create Your Celebration Animation that responds to user-created events from the mouse and keyboard to represent the different customs/traditions that go around this celebration.
5	12-13	Students improve the project from the previous lesson. They listen to and respond to events and change backgrounds of the stage to reflect new scenes in their project by using Broadcast blocks.
6	14-15	Students' choice of different items of clothing to make an outfit that represents themselves, will introduce them to the concept of variable. Point system representing their clothing choice / preferences drives the discussion about biases embedded in computer systems.
7	16-18	Students explore cultural milestones and their associated responsibilities and privileges. Students build a point-value system using conditional statements and explore the inherent built-in inequities in these systems.
8	19 -21	Students will use all they have learned so far to develop a story about a current event that is important to them and/or community. Discuss the positives & negatives of using programs to implement stories.
9	22-24	Students write complex decision-making programs using the logical operators AND & OR. Students reflect on AI tools that make complex decisions.
10	25-26	Students explore the importance of customization in programming by using abstraction and user-defined blocks in Scratch to create and customize a relevant or culturally themed dance party animation.

Lesson	Instructional Day	Topic
11	27-28	Students add custom blocks with parameters and a timer to the dance party animation.
12	29-31	Students explore the issue of limited resources and how they affect decisions by creating a program that uses a budget to plan a relevant community event. Students will explore AI systems used to determine loan application denial or approval as an example of how decisions are made.
13	32	Introducing the final project: My Community, My career, My dreams or Who I Am? Students connect to earlier projects and use the problem solving steps to plan and execute the program. Students must utilize scratch blocks learned throughout the unit.
14	33-35	Students work on a final project.
15	36-37	Final project presentations & unit reflection on learning

Instructional Lessons

Lesson 1. Days 1-4

Topic Description: Students are introduced to block programming language, including the basic terms utilized in the language, through student's names, identities and cultures.

Objectives

The student will be able to:

- Name the basic terms used in Scratch and create the beginning of a simple program in Scratch
- Build upon previous units to explore the concept of identity through personalized projects and demonstrate how programming can be used to express and explore cultural and personal identity.
- Revise name projects responding to comments & feedback (Iterative process of programming)

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Complete Scratch KWL chart (15 minutes) • KWL Chart discussion (10 minutes) • Journal entry (10 minutes) • Name discussion (10 minutes)	• Scratch *(or any other chosen programming language)* is used as a tool to solve problems and create products reflective of students' identity, culture & community. • Establish the different knowledge levels about Scratch • Discuss names & how they represent/tie to a person's identity • *(Teachers who choose other languages to teach, can replace their own language with Scratch)*
Day 2 • Journal entry (10 minutes) • Investigate features of Scratch (25 minutes) • Design name project (20 minutes)	• Explore Scratch
Day 3 • Complete name project (45 minutes) • Journal entry (10 minutes)	• Implement first program using Scratch features

Segment	Reason/Purpose
Day 4 • Gallery walk of name projects (15 minutes) • Revise programs responding to comments/feedback (30 minutes) • Journal entry (10 minutes)	• Give feedback about name projects and how accurately they reflect identities • Learn the iterative process of programming by revising programs in response to feedback

Student Activities

Day 1

- Complete journal entry
- Complete Scratch KWL
- KWL Chart Discussion
- Complete journal entry
- Name discussion

Days 2

- Complete journal entry
- Investigate features of Scratch
- Design name project

Day 3

- Complete name project
- Complete journal entry

Day 4

- Gallery walk of name projects
- Revise programs responding to comments/feedback
- Journal entry

Teaching/Learning Strategies:

Day 1

Journal entry: *Reflect on the various themes you've encountered in this class so far- community, identity and technology- how do those themes help us perceive the world around us and how we are perceived?*

- Discuss what it means to program a computer. Remind students that in Unit 1 they learned about following directions and in Unit 2 they learned about algorithms. Discuss the ways in which programming can overcome constraints or create additional ones.

- Explain that Scratch is a block-based programming language. Students will learn the different features of Scratch to build increasingly complex programs. Students will use the pair programming model to design, program & revise their programs. The themes of identity & community will be explored and represented in the programs created throughout the unit.
- Students meet in groups of 2-3 and each group completes a KWL chart. (Know, Want to Learn, Learned) related to Scratch

KWL chart discussion

- Students take turns sharing out their K's and W's orally. Encourage them not to repeat anything that has already been said. Put KWL charts up in the classroom; tell students that they will finish the L towards the end of the unit.
- Wrap up the discussion by previewing their first Scratch project and a conversation about the meaning of names.

- You are going to create a Scratch program to animate the letters of your preferred name, to reflect the meaning of your name and how it relates to your identity. Remind students of their unit 1 discussion and website they created about identity.
  - What does the name Scratch suggest about how it might be used to create and explore?
  - Who makes up names and gives them meaning? What meaning do you attribute to your own name?
    - What values do names have?
      - PBS- Say It Loud- "Black Sounding" Names and Their Surprising History (https://www.pbs.org/video/black-sounding-names-and-their-surprising-history-mjlggn/)
        Suggested Clips:
        - Introduction: 1:00-2:25
        - Middle Passage 2:54-4:22
        - Civil Rights & Islam: 4:31-5:56
        - Creole & French: 7:12-7:57
        - Creating new names: 7:58-8:35
        - How the hosts got their names: 8:48-9:48
        - Why is this important?: 10:52-11:56
      - PBS- Origin of Everything- "Why Do We Have Middle Names? (https://www.pbs.org/video/why-do-we-have-middle-names-afqotq/)
        Suggested Clips:
        - History of: 0:00-2:11
        - Paternal & Roman Names: 2:20-3:25
        - Not in the Middle: 3:36-4:04 (Korean middle names)
        - Not in the Middle: 4:10-4:43 (Spanish middle names)
        - MIddle Initial: 4:50-5:20
        - Why is it important?: 5:20-5:49

Journal entry: *What is the story of your given name (either first/middle/last name): Who chose the name? Why was this name chosen? What is your preferred name? Do you use your given name or another name (nickname,..)? Why/why not? Encourage students to share as much or as little as they feel comfortable with.*

- Students elbow share, then share in groups of 4-5

Day 2

Journal entry: *Choose 2 letters from your preferred name. What would these 2 letters look like /do if you were to turn each into an animation that represents your identity, culture & interests?*

- Sample answers: Letter S will turn into a bird because my last name means Blue Jay in Czech.
- Letter E will say: Hola, Hi, Salaam,...
- Each student shares one letter, its animation and how it relates to the student's identity/ name meaning.
- Bring it all together- help students make the connection between names, visual representations, symbolism, and how those can be combined to create animations of their own names.
- Additionally, talk about the word abstraction. Students will see it in later lessons and should become familiar with it.
- Remind students that they are going to create a Scratch program to animate the letters of their preferred name, to reflect the meaning of their name and how it relates to their identity. Scratch has many features that they can use to create the animation.

Investigate features of Scratch

- Prior to lesson: Address how sound will be handled in the classroom.
  - Ensure that each student has access to a computer with Scratch cloud access or installed. (Check with IT and make sure not blocked. A couple weeks may be needed.
  - Scratch lends itself to playing sounds so it can get noisy. Headsets with microphones are one possible way to address it.
- Begin the Scratch interface exploration by demonstrating how to navigate and use key features. This helps students feel more comfortable before engaging in hands-on activities.
- Assign students in pairs. Instruct students that in pair programming one person is the "driver" and does the clicking and typing. The other person is the "navigator" and describes to the driver what to do at each step. Students should trade roles every 5–10 minutes. Keep track of the time and announce that students should switch at regular frequencies. Make sure students trade and that both students are contributing equally. This strategy will be used often throughout the unit. Emphasize the importance of collaboration during pair programming. Encourage students to communicate effectively and switch roles regularly.
- Display the Scratch interface and show students how to open the name tutorial, by looking under the tab labeled Ideas.
- Have students explore and try to determine what the various blocks do.
  - Encourage students to experiment. They can't break the computer by dragging the wrong block.
  - Show students where they can access ScratchGettingStarted.pdf and/or the Tutorials section of Scratch.
- Stop after about 20 minutes and do a quick debrief of what they have discovered so far. Ask questions that get students to discuss the following features:

- Every character in Scratch is called a Sprite.
- How to choose a Sprite from a file
- How to paint your own sprite
- Each sprite has its own scripts.
- You can right-click any block and select help to get more information on how to use it.
- How to change the language in Scratch (for your English Learners)
- How to go to full screen mode and back
- How to switch back and forth between sprites by clicking on them
- X- and Y-coordinates on the screen are shown on the bottom right below the stage.
- Demonstrate how to change the background:
  - Choosing a background from the background library
  - Uploading an image as background

Design Name Project

- Explain that before the programming starts they will spend the rest of today completing the plans for animating each letter of their preferred name to reflect a different part of their identity, culture, and/or interests.
- Since students will be working in pairs, they each will decide on what blocks to use to animate their individual names and display both names and their animations when the program executes.

Day 3

Complete Name Project

- Students follow their plans from day 2 to execute the animation of their names
- Show them the rubric for the Name project. (See resources.)
- Students can draw or use the sprites included for the letters; identify colors and actions.

Journal entry: *How are names racially/ethnically/ culturally coded? What technologies do our names interact with? What coding is embedded in your own name? How does your name determine how ethnically visible or invisible you are?*

- Teachers can discuss that some cultures have last names that include both maternal & paternal lineage such as Latinx names & Jewish names. They can also discuss

Day 4

Gallery walk

- Students follow directions provided by the teacher to review 3-4 name projects. They write comments or questions on post-it notes for each project reviewed. Students should consider the following when reviewing the projects:
  - What did they understand about the identity of the creator of the project from the animation?
  - Was the animation effective in communicating the identity/interests of the project owners?
  - What could be added to the project to strengthen its representation of the identity of its owners?

- Provide sentence starter sample for comments:
  - I liked .....
  - I wonder how....
  - Why / how did you .....
- Encourage students to use these starters when writing feedback on the name projects.
- Provide the order of project viewing. Consider spacing groups around the room rather than staying at their desks.

Revisions

- Students read comments & feedback.
- Discuss / plan with partner at least one change in each name
- Execute plans & revise programs

Journal entry: *Write one new piece of information you learned about one of your classmates through their project? How was it represented? Why was this representation effective?*

Resources

- Review the getting started guide and create a teacher account using the following links. Consider sharing the Getting Started Guide with students ahead of time. Check out Scratch on the landing page and explore the activities you will have students complete. Check out the scratch tips page and consider sharing that with students as well. Use the sample rubric to grade the finished Scratch programs.
- Getting Started Guide (https://resources.scratch.mit.edu/www/guides/en/Getting-Started-Guide-Scratch2.pdf)
- Teacher Accounts (https://scratch.mit.edu/educators/#teacher-accounts)
- Scratch Landing Page (http://scratch.mit.edu)
- Scratch Tips page (https://scratch.mit.edu/ideas)
- Name Sample Rubric
- Scratch Files (www.exploringcs.org/curriculum)
- Ruha Benjamin's 'Race After Technology' (https://www.ruhabenjamin.com/race-after-technology)

Teacher Reflection Notes

Name Sample Rubric

Do You Have?	Points Possible	YES	NO	Points Earned
A separate sprite for each letter of your name?	5			
At least 3 different behaviors for your name	5			
All the letters have a behavior	4			
The “forever” block	3			
Can you explain the meaning of your new name?	3			
Total	20			

Lesson 2. Day 5

Topic Description: This lesson describes how to create a dialogue between two sprites by first creating a written dialogue. The discussion of names & identities is continued from the first lesson as the focus of dialogue.

Objectives:

The student will be able to:

- Continue the discussion of identity & names
- Develop a written dialogue and program it using block programming.
- Explain the reasoning behind how their dialogue works.

Outline of the Lesson:

Segment	Reason/Purpose
• Participate in activity to learn what makes an effective dialogue (5 minutes) • Develop a written dialogue (15 minutes) • Program the written dialogue (25 minutes) • Student presentations (10 minutes)	• Student learn how to sequence events by creating a dialogue in which characters wait for each other to finish before talking • Students share out challenges/successes

Student Activities
• Participate in activity to learn what makes an effective dialogue • Develop a written dialogue (10 minutes) • Program the written dialogue (20 minutes) • Student presentations (10 minutes)

Teaching/Learning Strategies:

Participate in activity to learn what makes an effective conversation.

- Teacher has a dialogue between 2 characters written and asks a student to read one part of the dialogue while the teacher reads the other part, occasionally interrupting the student. Teachers should have a prewritten dialogue that is pertinent to their class/students.
- Students discuss the rules of conversation where everyone gets a chance to talk without being interrupted.
- Students discuss why they need to use the “wait _ sec” block in addition to using “say _ for _ secs” blocks.

Develop a written dialogue

- Students develop a dialogue about their animation choices for their name project. The dialogue needs to be at least 5-6 sentences for each character.

  Example:
  - Student 1: What did you choose to animate your first letter to do?
  - Student 2: My first letter says the traditional greeting I use in my family.

Program the written dialogue

- Students write a program using their developed dialogue using :say_for_secs” & “wait _sec blocks” & test their programs to make sure that characters are not interrupting each other.
- Explain that blocks such as “wait _sec blocks” use multiple steps to calculate elapsed time and these steps are abstracted to allow programmers to focus on the function of the block instead of how it works.

Student presentations (10 minutes)

- Choose 2-3 dialogues to run. Allow students to discuss how they choose the values for the different “wait_sec” blocks. Discuss challenges if they decide to change the length of one sentence or more in the dialogue, foreshadowing the need to use a better mechanism to create sequences (broadcasting)

Resources

- No additional resources needed

Teacher Reflection Notes

Lesson 3. Days 6-8

Topic Description: Students analyze the cultural and personal significance of community landmarks, reflecting on how their names and identities are connected to a physical community or location. Students learn how to move sprite in different ways on a map of a location that holds significance for them.

Objectives

The student will be able to:

- Students analyze the cultural and personal significance of community landmarks
- Students reflect on how their names and identities demonstrate the multidimensional nature and intersectionality of their community.
- Students learn different blocks to move characters in Scratch using x & y coordinates

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (20 minutes) • moving.sb3 (20 minutes) • Discussion of responses to • questions (10 minutes)	• Explore differences / similarities between communities • Learn about movements in scratch (3 ways)
Day 2 • Map Route Activity (55 minutes)	• Apply Scratch movements to a map representing community & destinations to visit
Day 3 • Finish Map Route activity (15 minutes) • Gallery walk (15-30 minutes)	• Share out • Revisit original program to enhance it (part of software cycle)

Student Activities

Day 1

- Complete journal entry.
- Pairs examine moving.sb3
- Discuss responses to questions.

Day 2

- Pairs complete Map Route activity.

Day 3

- Finish Map Route activity

Teaching/Learning Strategies:

Day 1

Journal entry: *How would you describe your chosen physical community? Be specific in your description to include details about urban, rural settings. What are some special places you regularly visit in your community? How do you move around your community: Car, public transportations, bike, walk. How does your name connect you to the places in your community?*

- Students write in journals and discuss responses in groups of 3-4. Each group chooses one community detail to share with the whole class. Encourage the discussions by asking questions such as: How are the communities different/similar? Where do you get what you need daily? What places do you enjoy going to and why?
- Students should be given as much room as possible to share only as much as they are comfortable.
- Teachers should instruct students to be respectful and positive in their discussion of community and to dissuade comments with negative connotations.

Journal entry: *Imagine that you need to give a visitor directions to a destination in your community: your school, the movie theater, or a community event. Their phone is broken so you have to give them a paper map. How would they find the place they need to go?*

- Students share answers with class.
- You will create a Scratch program that moves a character on a map of your community. You will now learn how to move a sprite on a map representing some destinations in your community through the following activity. Introduce different methods of sprite movement, such as change x/y, turn, and glide. Discuss when those movements might be important to insert in the script.

Moving Project investigation

- Teachers should be aware that there are 3 different blocks to move sprites: Move (# of steps), Glide (to x, y position) & Change (x or y position). Students should be able to differentiate between the effect of each block on the sprite's movement.

  - Students open moving.sb3 (See resources.) and work in pairs. For this lesson they will use the rules of pair programming as they respond to the following questions and complete moving.sb3 activity.
  - There are basically 3 ways to move sprites in Scratch. Try the file moving.sb3 and answer the questions below:
    - Look at the scripts for each of the 3 sprites. What 3 blocks do all three sprites use?
    - What blocks does the cat use to move?
    - What block does the dog use to move?
    - What block does the monkey use to move?
    - Describe in your own words how the move block works.
    - Describe in your own words how the go to xy block works.
    - Describe in your own words how the glide block works.
    - Some of the blocks require x: and y: coordinates. Click on the cat and drag it around. Look at the values of x and y. How are the x and y coordinates arranged on the stage? What are the maximum & minimum values of x & y coordinates that will keep the cat on the stage.
    - Use what you've learned about moving to complete the Map Route Activity.
- Discussion after students answer questions
  - Emphasize that the "repeat" block will do whatever is inside it n times. This behavior can be called iteration or looping. Remind them about the forever loop in lesson one.
  - Ask students about previous instances of iteration (Cornrow Curves).
  - Point out that iteration is a construct that is used in other programming languages.
  - Emphasize the differences between the 3 ways to move.
  - make sure students find and understand the coordinate plane. Ensure they understand the x and y coordinates on the Scratch stage.
    - Optional- compare N, S, E, W directions to X, Y.
    - Can remind students of how they used x and y in Cornrow Curves.
  - Circulate the room and help students respond to the questions.

Day 2

Map Route Activity

- Students will import a map from google that shows their chosen location/community and at least 4 landmarks/destinations to which they want to navigate. (See resources.)
  - Circulate the room and help student pairs finish the activity. Remind them to switch roles.
  - Students may need assistance importing a map background.
  - **Make sure students use the resize icons in the toolbar instead of resizing the image in the costumes editor.** Have them explore the way to make an image stay centered and edit the images in the costume editor. If they resize the image in the costume editor the sprite may not turn appropriately when turn block is used.

Day 3

Complete project and get ready for gallery walk

- During Gallery walk leave suggestions for extra fun to add to projects you review

- Class discussion to support student understanding of the importance of using the x and y coordinates to describe movement of characters.
  - What do x and y coordinates allow programmers to do?
  - How do we use x and y coordinates in other classes?
  - How do we use them in the real world?

Journal Reflection: *Students reflect in their journal about the places they saw others visit. Do they visit the same kinds of places? What similarities did they see between different communities?*

Resources

- Moving Project
- Scratch Files (www.exploringcs.org/curriculum)
- Map Route Activity

Teacher Reflection Notes

Moving Project

Answer the questions below:

1. Look at the scripts for each of the 3 sprites. What 3 blocks do all three sprites use?

2. What blocks does the cat use to move?

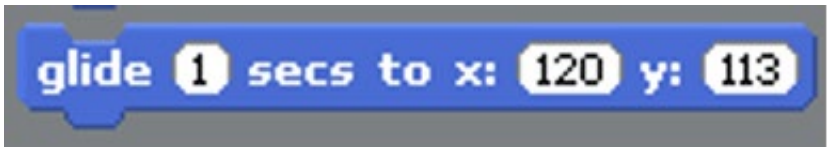
3. What block does the dog use to move?

4. What block does the monkey use to move?

5. Describe in your own words how the move block works.

6. Describe in your own words how the go to block works.

7. Describe in your own words how the glide block works.



8. Some of the blocks require x: and y: coordinates. Place the mouse over the white window and look at the mouse x: and mouse y: numbers underneath the bottom. How are the x: and y: coordinates determined in Scratch?

9. Use what you've learned about moving to complete the Map Route Activity

Map Route Activity

Directions

Now that you have analyzed movement in Scratch, let's try something more intricate. You are going to design a Scratch program to command a sprite to get from point A on a map to point B and back to point A using only streets.

Using Google Maps, find a map representing your community location and 4 destinations– maybe your neighborhood, school block, or fun place you spend time at. Incorporate cultural landmarks or symbols on your map routes. You probably don't want to make your destination too far away as the street map will be really small and more difficult to navigate.

Once you have your map on the screen, using screen capture software (like snipIt or cmd-shift-4 on a mac), save the map area as a jpg. Now going to Scratch, upload your map image as a new background. You need to mark your start location and destinations with colored dots in the Scratch editor.

Choose an appropriate sprite and use the resize buttons in the toolbar to resize your sprite.

Remember to click on the resize icon then on your sprite to change size.

Start writing the program to move your sprite from starting to end destination with at least 2 other places visited in between.

Lesson 4. Days 9-11

Topic Description: The students will think about a personally significant celebration and the customs that go with it, and write a program Create Your Celebration Animation that responds to user-created events from the mouse and keyboard to represent the different customs/traditions that go around this celebration.

Objectives

The student will be able to:

- The students will think about an important celebration and customs/traditions that go around it.
- Write a program that responds to user-created events from the mouse and keyboard

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal Entry: Celebration(s) (15 minutes) • Journal entry: Event driven programming in daily life (15 minutes) • Description of Create Your Celebration Animation (25 minutes)	• Explore identity/community through celebrations & customs around them • Introduce the concept of Event Driven Programs • Plan the program through storyboarding, image imports
Day 2 • Create Your Party (55 minutes)	• Execute the planned program
Day 3 • Student presentations (40 minutes) • Students implement challenges (15 minutes)	• Present & get feedback • Revise/ add to program based on feedback

Student Activities

Day 1

- Journal entry: Celebration(s) (15 minutes)
- Journal entry: Event driven programming in daily life (10 minutes)
- Description of Create Your Celebration Animation (10 minutes)
- Storyboarding the program (20 minutes)

Day 2

- Create Your Party (50 minutes)

Day 3

- Student presentations (25 minutes)
- Revise programs (25 minutes)

Teaching/Learning Strategies:

Day 1

Journal entry: *Choose an important celebration in your community (Christmas, Eid, Día de los Muertos,..). Describe some unique things you do to commemorate this celebration: (Special food items, clothes, places you visit,...)*

- Students share with class. Highlight the different things they do around the same celebrations depending on their cultures. Highlight the variety of celebrations and their different times around the year.

Journal entry: *How do the programs on the computer (or phone) know what the user wants to do next? In other words, if you are surfing the web, how does the computer (or phone) know what website to go to next? If you were writing a story, how would you know which scene should come next?*

- Allow some students to share journal entries with class. Point out the idea of user events (clicks, typing, touch, talking) driving the program and causing it to respond.
- Show students that Scratch provides some blocks that allow you to write programs that respond to user events.
- When Sprite clicked
- When _ key pressed
- Allow students to explore the blocks for a few minutes.
- Explain that students will develop a story that responds to user input. The story will describe the celebration you wrote about in your journal and the things you do to commemorate this celebration through a conversation between 2 attendants of the party. The story will advance when it takes input from the user.

Description of Create Your celebration animation project:

- Direct the students in a short discussion to emphasize the concepts they have learned so far.
  - Include user events, sprite actions, and program responses, as well as coordinate plane and iterations.
- Create a sample first conversation with students that introduces the celebration they chose in their journal.
  - One strategy is to have students take turns providing you sentences, pausing and asking other students to predict what will happen. Emphasize that users will discover what happens next when they click on a sprite.
- Students complete a storyboard for their story. The story is told through a conversation describing the celebrations and the customs around it guided by the Create Your Own Party Sample Rubric (See resources.). Storyboard should include the name of the celebration and transitions between at least 3 scenes, sprites, costumes, backgrounds,...
- Students identify images for the sprites to be used in their story after completing the storyboard.
- **Ethical Image Use Discussions:** Lead a brief discussion about ethical image use. Remind students to respect copyright and licensing when importing images from the internet. Encourage them to credit sources appropriately.
- Show students how to access free image libraries, public domain works, and open-source licensed images
- Explain that students will bring in pictures from the internet.
  - Download a .gif or .jpg.
  - Use import or paint to make it the second costume for your letter.
- Show how to change costumes and backdrops.
  - Use a “switch to costume _” or “switch to backdrop _” block.
- Show students how to output in talk bubbles.
  - Use a “say _ for _ sec” block.
- Remind students that they are creating an animation to tell a conversation about their celebrations and the customs around it. Encourage creativity and story cohesion. Remind students to be respectful about their story telling (https://www.ted.com/talks/chimamanda_ngozi_adichie_the_danger_of_a_single_story?language=en). Emphasize respectful portrayals and conversations, as well as age and school appropriateness.
- Circulate room and answer questions as student pairs complete their storyboard.

Day 2

Create your party

- Students create their programs guided by storyboards created earlier. Students test their scenes as they go and advance to the next conversation once the current is working to their specifications.
- Teacher circulate & give feedback

Day 3

Student presentations

- Students share their programs with 2-3 groups. Students explain how their program works, the storyboards they created, and why they chose specific Scratch blocks and features.
  - Discuss why they made these programming choices, which may include colors, symbols, or movements that represent different aspects of the identities and cultures shown in their program.

Extra fun

- If the class is small and the presentations don't take the entire class, then add one or more challenges
  - Add sounds and motion to your sprites.
  - Add a title at the beginning.
  - Add and end scene

Resources

- Create Your Own Party Animation
- Create Your Own Party Sample Rubric
- Scratch Files (www.exploringcs.org/curriculum)

Teacher Reflection Notes

Create Your Own Party Animation

Directions: The story will describe the celebration you wrote about in your journal and the things you do to commemorate this celebration through a conversation between 2 attendants of the party. The story will advance when it takes input from the user.

You will work together with a partner using the driver–navigator protocol. Partners will present their scenes to the class. You may decide not to include a title scene to see if the class can guess the movie/TV show/play or book.

Before you get started coding, you will need to create a storyboard and have it approved. Your storyboard should include:

- specific background choices
- specific sprite choices
- scene transitions
- dialogue
- animation action
- soundtrack ideas

Be creative and have fun! Can you recreate your scene using existing sprites and backgrounds? Constraint breeds creativity

Create Your Own Party Animation Sample Rubric

Do You Have?	Points Possible	YES	NO	Points Earned
Completed storyboard with backdrops, events labeled, sprites and speech bubbles labeled	5			
At least 3 scenes to your party	4			
Two choices per conversation, excluding the last one	3			
Backdrops or costumes change when sprites are clicked or letters pressed	4			
Sprites change costume and/or show movement	4			
The “say _ for _ sec” outputs what the letter stands for (i.e. “S is for Soccer field”)	3			
Program can be reset	2			
Total	25			

Extra Fun

Do You Have?	Points Possible	YES	NO	Points Earned
Students incorporate other scratch features such as, playing, recording sounds for scene transitions, or any other fun additions	suggested 2-5			
Total with Extra Fun!	27-30			

Lesson 5. Days 12-13

Topic Description: Students improve the project from the previous lesson. They listen to and respond to events and change backgrounds of the stage to reflect new scenes in their project by using Broadcast blocks.

Objectives:

The student will be able to:

- Continue to explore identity & community issues and reflect them in programs they create.
- Understand the concept of broadcast events, listen to and respond to events they create and change the background of the stage to reflect new scenes.
- Incorporate broadcasting in their Create Your Celebration Animation program from the previous lesson (Reinforce the software iterative cycle).

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Participate in discussion of journal entry (10 minutes) • Participate in role play. (20 minutes) • Revisit storyboard for Create Your Celebration Animation (10 minutes) • Rewrite the storyboard with broadcast (10 minutes)	• Journal entry allows the students to explore the meaning of broadcasting in the context of media: radio & TV • Students understand that even though a lot of things are being broadcast, not everyone is listening to everything that is being broadcast. • Playing out the roles deepens students' understanding on the use of broadcasting in controlling the flow of a complicated play that has multiple roles and guarantees the smooth progression of the play.
Day 2 • Review of proposed revisions (5 minutes) • Modify the Create Your Celebration Animation • (35 minutes) • Discuss / reflect on the programs (15 minutes)	• Students apply their new understanding of the role of broadcast blocks to previously created Create Your Celebration Animation

Student Activities

Day 1

- Complete journal entry.
- Participate in discussion of journal entry.
- Participate in role play.
- Revisit your storyboard for Create Your Celebration Animation.
- Rewrite the storyboard with broadcast

Day 2

- Review proposed revisions.
- Modify the Create Your Celebration Animation
- Discuss/reflect on the program

Teaching/Learning Strategies:

Day 1

Journal entry: *What does it mean to broadcast something (for example, the radio station is broadcasting music right now)? If a radio or television station is broadcasting something, does that mean that everyone is listening to it?*

Participate in discussion of journal entry.

- Have a few students share their responses. Ask students for examples of current broadcasting, do they use a different word (streaming, for example), and how broadcasting is used in their community to announce events and celebrations.

Participate in role play. (Script for role play is at the end of the lesson in the resources section)

- Solicit Volunteers to be the various characters.
- Give the performers a paper with ONLY their part. See Scratch Broadcast Role Play.
- Scratch Broadcast Role Play Interwoven.
- The students can think of it as a three act play where the scenes change. The difference: There are no curtains so they will see everything change.
- The teacher will be the director and will make sure everything and everyone is in place during each scene. The teacher can call out “action” before the scene starts to signify that everything checks out.
- Each performer’s paper is broken into scripts for the various scenes.
- One performer will be in charge of setting the stage. They can do this by erasing and drawing pictures on the whiteboard behind the stage.
- Emma ends scene 1 with a broadcast, telling the teacher/director it is time to change to scene 2 & start the script for scene 2. Sarah ends scene 2 with a broadcast, telling the teacher/director it is time to change to scene 3 and start the script of scene 3.
- You might want to have different students perform the role play a second time. This time the teacher will only yell out when the green flag is clicked. The students can check themselves to make sure that everything is okay.

- Instead of using broadcast, do you think you could just use “wait _ secs” blocks? Why / why not? (Encourage students to realize that broadcast allows for later changes in the script without having to change the wait times.)
- What might be an advantage to using broadcast instead? (Encourage students to realize that broadcast is used to synchronize multiple events: change of scenes, start of dialogue in the next scene.)

Revisit storyboard

- Show students examples of broadcast & when I receive blocks
- Students experiment with these 2 blocks. Emphasize that they can create & name as many messages as they need. Message names should describe what happens next and facilitate the transition between scenes.
- Instruct the students to revisit their storyboard for Create Your Celebration Animation and update it to use the 2 new blocks you learned. Encourage students to create an organized version of the storyboard that includes the names of the messages triggering the broadcast & receive events.

Day 2

Review of proposed revisions

- Ask pairs of students who completed the storyboard to exchange journals and review each other’s work for the correct flow and transitions of the story of their Create Your Celebration Animation.

Modify the Create Your Celebration Animation

- Students implement their new storyboard in scratch.

Discuss/reflect: on the programs and how do they authentically represent their celebrations traditions or not.

- How authentically does your animation story reflect your celebration traditions? What are the limitations of the representations through sprites, scripted dialogue & still backgrounds? Example answers: Sprites might not accurately reflect characters, the story represents the creators version of the celebration.
- Pick a few students to share journal responses.

Resources

- Scratch Broadcast Role Play

Teacher Reflection Notes

Scratch Broadcast Role Play

This is meant to be performed in front of a whiteboard: the stage. Select students for the 4 characters and give them their parts of the scripts. Whiteboard/ Stage: Depict change of scenes by drawing the background of the scene on the board. This conversation is meant to be a neutral example. Teachers are encouraged to develop an example conversation relevant to their own classroom.

Play with 4 characters: 3 friends Sarah, Mike & Emma planning a beach themed birthday party for their friend Lisa.

Title: Celebration Preparations

Scene 1: The Planning Stage (Sarah's House)

- [The stage is divided into three sections, each representing a different location. Sarah, Mike, and Emma are gathered around a table at Sarah's house, surrounded by party supplies and decorations.]
- Sarah: We need to make sure Lisa's birthday party is unforgettable!
- Mike: Definitely! What's the plan?
- Emma: How about a beach-themed party? We can bring the beach to Lisa's backyard!
- Sarah: I love it! We'll need sand, beach balls, maybe even a kiddie pool.
- Mike: And don't forget the drinks & snacks.
- Emma: Sounds perfect! Let's make a list of everything we need.

Scene 2: Gathering Supplies (Hardware Store)

- [The stage now represents the hardware store aisle. Sarah, Mike, and Emma are pushing a cart filled with various supplies.]
- Sarah: Okay, let's see. We need sand, beach balls, pool noodles...
- Mike: And how about some palm tree decorations?
- Emma: Good idea!
- Sarah: Perfect! Let's grab everything on our list and head to the checkout.
- [They gather the supplies they need, head to Lisa's backyard]

Scene 3: Setting Up (Lisa's Backyard)

- [The stage transforms into Lisa's backyard, with a makeshift beach setup. Sarah, Mike, and Emma are busy arranging decorations and setting up the party area.]
- Sarah: This looks amazing, guys! Lisa's going to be thrilled.
- Mike: [hanging up a string of lights] Just wait until we turn these on when it gets dark. It'll feel like a real beach party!
- Emma: [placing beach towels on chairs] And don't forget the sandcastle contest we planned!
- Sarah: [spreading out a beach blanket] I can't believe we pulled this off. Lisa is going to love it.
- [As they put the finishing touches on the setup, the door opens and Lisa enters.]
- Lisa: [gasping in delight] Oh! This is incredible!
- Sarah: Happy birthday, Lisa!
- Mike: We wanted to make sure you had the best beach party ever!
- Emma: Dive in and enjoy!
- [They share hugs and laughter as the scene fades out.]

[End of play.]

Lesson 6. Days 14-15

Topic Description: Students' choice of different items of clothing to make an outfit that represents themselves, will introduce them to the concept of variable. Point system representing their clothing choice / preferences drives the discussion about biases embedded in computer systems.

Objectives:

The student will be able to:

- Explain the concept of variables.
- Create examples of variables.
- Discuss & explain the influence of clothing choices in creating biases & misconceptions

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Prep for the project (15 minutes) • Discussion bias and stereotypes related to clothing choices and how students are influenced by it. (20 minutes) • Journal entry (10 minutes) • Discussion of project (10 minutes)	• Pictures will be used in this activity. • Students examine the influence of clothes and the biases and misconceptions they might create. • Familiarize students with variables • Introduce students to the concept of variables in clothing choices.
Day 2 • Introduce the blocks needed to complete the project (10 minutes) • Worktime on the project (30 minutes) • Reflect on the project (15 minutes)	

Student Activities

Day 1

- Prep for the project
- students take pictures of their clothes or find images of clothes online.
- Discussion bias and stereotypes related to clothing choices
- Journal entry
- Discussion of project

Day 2

- Introduce the blocks needed to complete the project
- Complete the project
- Reflect on the project

Teaching/Learning Strategies:

Day 1

Prep for the project

- You will create a program that helps you and your friends choose an outfit to attend the celebration for your community. Your outfit will include items of clothing, footwear, accessories and hairstyle/head dress suggestions. Each of the items will be represented by a picture of the item. Your first task is to collect as many pictures as you want to represent different alternatives for each part of the outfit (at least 2-3). You can use the internet to find pictures, or you can upload pictures of items you or your friends are wearing. Traditional, cultural or cross-cultural items of clothing and hairstyles are encouraged.
- Teachers can remind students about The Crown Act from Unit 2 and how it changed attitudes toward hair styles. Students may even want to use their Cornrow Curves styles as a reference.
- **Discussion** bias and stereotypes related to clothing choices and how students are influenced by it.
  - What pictures of clothing did you choose? why?
    - **Discuss** how clothes make you feel. Discuss the role of clothes on how people perceive others. Discuss the data or story an outfit might tell.
    - **Discuss** biases & misconceptions associated with some items of clothing/hair styles (long/short hair styles, hijabs, natural hair styles, halloween costumes, uniforms & dress codes). Include inappropriate appropriation of clothing styles as part of the discussion.

Journal entry: *Describe in your own words what the word variable means.*

- Ask students to share their writing with an elbow partner.
- Connect the root word: vary (change) to the mathematical use of variables and explain that variables allow programmers to implement programs allowing multiple values for the same variable.

Introduce the project

- Students will create a program that displays pictures of items of clothes. Each item is given a point value chosen by the student: positive or negative, depending on what students think about the item: Whether it is appropriate for the celebration, whether it is practical,.... Students accumulate points by selecting multiple items to complete an outfit. The total score for the chosen outfit will be displayed after each choice. The program starts “when the green flag is clicked” and ends when the stop button is selected. (15 minutes)

Day 2

Introduce the blocks & program outline needed to complete the project

- Explain, create & name a variable, set & change my variable.
- Discuss the importance of choosing variable names that reflect their function/use in the program.
- Discuss that each variable needs to have an initial value that can be set using the “set my variable block”.
- Discuss that the value of the variable can be increased/decreased by using the “change my variable block” throughout the execution of the program.

Explain the program outline

- When the green flag is clicked, the variable: outfit_score is set to zero
- When a picture of a clothing item is clicked the outfit_score will increase/decrease by an amount of points chosen by each student to reflect their opinion about this item.
- When the picture of a stop-button is clicked, the program stops.

Complete the project

- Circulate, answer questions, encourage students to test the program multiple times as they add point values for each picture representing items of clothing. Halfway through the work time, ask students to test one project that is not theirs and give quick feedback to project owners.

Reflect on the project

- Why did the students appoint positive / negative values to certain items of clothing?
- What biases do these values reflect?
- How are these biases are reflected in everyday life & interactions with others.

Resources

- Clip from The Devil Wears Prada. The scene highlights the bias implicit in fashion choices and the influences of elite fashion (https://www.youtube.com/watch?v=-rDTRuCOs9g)

Teacher Reflection Notes

Lesson 7. Days 16-18

Topic Description: Students explore cultural milestones and their associated responsibilities and privileges. Students build a point-value system using conditional statements and explore the inherent built-in inequities in these systems.

Objectives:

The student will be able to:

- Explain the concept of conditionals, use it to build a program that responds differently depending on conditions evaluating to true or false
- Understand the built-in inequities in systems that depend on point values to make decisions

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry. (15 minutes) • Participate in discussion of conditions. (15 minutes) • Review Age sample solution & plan your program (25 minutes)	• Explore age related rituals, responsibilities & privileges across cultures. • Understand how conditionals work in Scratch • Plan to apply conditionals in a program that ties jobs & responsibilities during their celebration event (from lessons 5) to the age of a participant
Day 2 • Create your own program (35 minutes) • Participate in discussion about their decisions of choosing age related jobs and whether the choices are equitable in terms of difficulty & complexity (20 minutes)	• Complete the program • Connect the idea that their coded choices of age dependent jobs become permanent in the program and affect everyone using the program
Day 3 • Enhance the Jobs program using point system tied to each job (35 minutes) • Discuss the impacts of coded point systems on lives. (20 minutes)	• Enhance the program from day 1 by adding a point system to each job and keeping a tally of the total points depending on jobs chosen. • Discuss the built-in inequities in point systems used to determine college applications, loan applications,...decisions.

Student Activities

Day 1

- Complete journal entry.
- Participate in discussion of conditions.
- Review Age sample solution & create your own program

Day 2

- Enhance the variable example.
- Discuss the impacts of coded point systems on lives.

Teaching & learning strategies:

Journal entry: *From your personal experience, what rituals, responsibilities & privileges are tied to your age?*

- Sample answers: Can get driver permit at 15, have bar mitzvah at 12, can vote at 18.
- Students share with elbow partner

Participate in discussion of conditions.

- Ask students: How can you express your privilege, ritual or responsibility using an if statement? example answers: if I am 15 or older, I can get a driving permit.
- Choose some students to write their if statements on the board to compile a list of at least 8-10 if statements representing different situations/identities and discuss why/how age is used in different cultures to determine milestones.

Develop a Jobs program.

- Ask students to think back on your celebration/event from previous lessons (celebration animation). Identify a list of jobs/responsibilities that can be done and categorize them by age. Example: if age > 6, you can set the table. If age > 12, you are responsible for drinks,....
- Show the if..then block and discuss that the condition is hexagonal shape that fits between if & then. Explain that the action will be executed if-and-only-if the condition evaluates to true.

Review Jobs sample solution & plan your program

- Students think about the celebration logistics and choose 3-4 age values, develop 2-3 job responsibilities to be assigned during the celebration.

Day 2

Create your own program. Students use their plan from day 1 to finish the program.

- Students use the pair-programming model to finish the program. they should check their plans from day 1 to match the appropriate jobs to ages.

- **Participate in discussion about their decisions** of choosing age related jobs and whether the choices are equitable in terms of difficulty & complexity.
  - **Discuss:** Do all job responsibilities in the same age category have the same level of difficulty?

How can the responsibilities be assigned to guarantee fairness?
- What consequences would unfair distribution of jobs coded in the program have on someone using it?

Day 3

Enhance the Jobs program using point system tied to each job:

- Explain that they will enhance their program by adding points to each job chosen. They will add a point value for each job on the list of jobs. The program will ask about the job a person has chosen to do and display the points earned.

Discussion

- How did you choose the point value for each job responsibility?
- Are the points of each job reflective of its importance, value, complexity?
- College admission decisions, loan application approval, and other situations depend on an automated point system similar to the one you created in your program. Who makes the decisions about the point values? How do these decisions positively or adversely impact lives?

Resources

- Enhance the Jobs Program Project

Teacher Reflection Notes

Enhance the Jobs Program Project

- Add a variable points and set it to 0
- Ask about which job they chose
- Use if–then blocks to assign point values to each job in your program from day 2.
- Your program will ask about the job a person has chosen to do and display the points earned.

Lesson 8. Days 19-21

Topic Description: Students will use all they have learned so far to develop a story about a current event that is important to them and/or community. Students discuss the positives & negatives of using Scratch to implement stories.

Objectives:

The student will be able to:

- The student will be able to identify & choose a current event/ issue important to them and/or their community and create a scratch program to tell the story incorporating everything they learned so far.
- Plan & execute a story using Scratch

Outline of Lesson:

Segment	Reason/Purpose
Day 1 • Introduction of project (15 minutes) • Journal Entry (10 minutes) • Review of brainstorming (10 minutes) • Develop storyboard (20 minutes)	• Students identify current event/social justice issue that affects them and/or community connect to problem solving, unit 2) • Plan the project (connect to problem solving, unit 2)
Day 2 • Scratch story project (40) • Peer review and discussion (15)	• Revise / check the plan/execution (connect to problem solving unit 2) • Execute the plan (connect to problem solving, unit 2)
Day 3 • Completion of Scratch story project (20 minutes) • Presentation of stories (20 minutes) • Discussion about the limitations of telling stories using a medium such as scratch (15 minutes)	• Students discuss the constraints and allowances of telling stories using programming

Student Activities

Day 1

- Complete journal entry.
- Participate in discussion of brainstorming.
- Develop a storyboard.

Day 2

- Develop Scratch story project.
- Participate in peer review and discussion.

Day 3

- Complete Scratch story project.
- Present stories.
- Discussion about the limitations of telling stories using a programming language such as scratch

Teaching/Learning Strategies:

Day 1

Introduction of project

- Reflect back on your identity website you developed earlier. You will work for the next 3 days on creating a story about a current event you care about/affects you and/or your community using all the blocks you learned so far. You will brainstorm ideas of the project, plan it, execute it and present it to the class. To start we will watch this project: Color Divide Trailer (See resources.) to spark your interest. Remind students this project took the creator several weeks.
- Ask students to identify programming elements that were used to convey a meaningful message and encourage them to discuss their initial reactions to the trailer.
- Discuss with students scratch elements used to effectively tell the story: Choice of sprites, sequencing of events and scene changes.

Journal entry: *Think about a current event/social justice issue (within the last year) that resonated/affected you and/or your community. What is the event? How did it affect you?*

- Students name events and the teacher writes them on the board.
- Use a whole group discussion to emphasize the diverse range of current events and encourage students to choose themes that they identify with to tell a Scratch story.
- **Show rubric:** Story rubric in resources
- Emphasize that they will make a small presentation along with showing their story. Presentations will be about one scene from the story and the choices they made to implement it

Review of brainstorming

- Split students into groups of 3-4.
- Have students rotate so that each student will share brainstorms and receive feedback/ suggestions from the other students. Students should give specific feedback about: connections of the chosen event to the student's identity & community and the relevance of the chosen event.
- Emphasize that students should respect each other's ideas and give meaningful feedback.

Develop the story

- Each student finalizes their selection of the event/issue they choose for the story.
- Paired discussion. Reflect on your journal entry and share with your partner. Do you and your partner share a common idea, identity or theme? Which of your ideas would make a good story? How do you determine which to showcase? Finalize your topic.
- Student pairs outline their story. Outline should include: Issue/event chosen, why it is important to them, how does it affect them /their community

Discuss: The importance of inclusive language and imagery.

- Have students discuss how their stories can be relatable to others or provide a different perspective.

Students create a storyboard that includes:

- specific background choices
- specific sprite choices
- scene transitions
- dialogue (Should use people first language, e.g. person of color, person who is neurodivergent)
- animation action
- soundtrack ideas
- Optional: Have students incorporate multilingual elements or narration.
- Be creative and have fun! Can you recreate your scene using existing sprites and backgrounds? Constraint breeds creativity.

Day 2

Scratch story project Implementation

- After the teacher approves the storyboard, permit students to begin working on their project code.
- Circulate the room and help students with projects.
- If students are having difficulties, ask questions that help them to recognize some of these possible strategies:
    - Develop their story further on paper.
    - Make a title screen or a first scene.
    - Break the project into smaller parts and focus on the next part that they can complete.

Peer review and discussion

- Elbow partners-these are not the partners they do the project with following the pair-programming model- review each other's projects to date, checking the rubric to see which features are complete and which need additional work.
- Elbow partners discuss the reviews. Make notes for changes to be made.
- The feedback forms will be submitted along with other parts of the project. Students will receive points both for the feedback provided and the responses to feedback.

Day 3

Completion of Scratch story project that

- Circulate room and respond to questions.
- Collect projects, rubrics and peer review forms.
- Provide guidance as students prepare their presentations.

Presentation of stories

- Presentations will be about one scene from the story and the choices they made to implement it:
    - Being able to explain choice of sprite(s)& backgrounds: from scratch files / original / from the web
    - Explain where they integrated different programming elements from previous lessons in the Unit
    - Explain choice of dialogue
    - What they would add to the scene if they had more time

Discussion about the limitations of telling stories using a medium such as scratch

- Students discuss the impact of the scratch element choices they made such as sprites, backgrounds on the overall perception of their stories. They discuss which of the story details were included and which were left out and why. They discuss the limitations of using a programming language such as scratch to represent a real-life event or social justice issue.

Resources

- Sample Story: Color Divide (https://scratch.mit.edu/projects/70058680)
- Your Story Project
- Story Project Sample Rubric
- Peer Review Sheet

Teacher Reflection Notes

Create Your Own Story

Directions: You will work for the next 3 days on creating a story about a current event you care about/ affects you and/or your community using all the scratch blocks you learned so far.

You will work together with a partner using the driver–navigator protocol. Partners will present their stories to the class.

- First, outline your story. Outline should include:
  - Issue/event chosen
  - Why it is important to you
  - How does it affect you /your community

Before you get started coding, you will need to create a storyboard and have it approved. Your storyboard should include:

- specific background choices
- specific sprite choices
- scene transitions
- dialogue (Should use inclusive language)
- animation action
- soundtrack ideas
- Optional: Have students incorporate multilingual elements or narration.
- Be creative and have fun! Can you recreate your scene using existing sprites and backgrounds? Constraint breeds creativity.

Story Project Sample Rubric

Presenter Names: _____

Do You Have?	Points Possible	YES	NO	Points Earned
Completed storyboard with detail demonstrating story, programming elements and action	5			
At least 3 scenes	10			
At least 3 different sprites	10			
At least 8 say or think boxes	10			
Animate the movement of your characters	5			
Broadcast changes scenes in your story	10			
The characters take turns speaking to each other	5			
At least one conversation between characters	5			
A title scene with your name on it	5			
Story initializes itself	4			
The entire story plays once you click	4			
Presentation- Explain an example from your story of how events (broadcast) were used to transition from one scene to another.	10			
Peer Review Sheets	12			
Extra Credit for Creativity	5			
Total	100			

Peer Review Sheet

Reviewer Names: _____

Do You Have?	YES	NO	Notes
Completed storyboard with detail demonstrating story, programming elements and action			
At least 3 scenes			
At least 3 different sprites			
At least 8 say or think boxes			
Animate the movement of your characters			
Broadcast changes scenes in your story			
The characters take turns speaking to each other			
At least one conversation between characters			
A title scene with your name on it			
Story initializes itself			
The entire story plays once you click			
Conveys Cultural Significance			
Dialogue uses appropriate language & conveys accurate meaning			

Additional Feedback:

Lesson 9. Days 22-24

Topic Description: Students write decision-making programs using the logical operators AND & OR. Students reflect on AI tools that make complex decisions.

Objectives

The student will be able to:

- Apply knowledge of logical operators AND & OR to combine conditions
- Students explore the effect of building complex programs on outcomes and connect their experience to AI models used to make decisions

Outline of the Lesson:

Segment	Reason/Purpose
• Day 1 • Journal entry (10 minutes) • And/Or discussion (10 minutes) • Introduction of program adding complexity (15 minutes) • Plan the enhanced program (20 minutes)	• Discuss / learn about AND, OR & random in English • Model AND & OR concepts with a kinesthetic activity • Each job chosen will have a follow up question resulting in a different point value to introduce complexity in the calculation of the final point tally
• Day 2 • Test the program plan (15 minutes) • Work on the program (40 minutes)	• Use problem solving steps
• Day 3 • Test the program (20 minutes) • Test other's programs (15 minutes) • Discussion about AI systems (20 minutes)	• Explore how AI systems determine outcomes such as job hiring, advertisements shown on a webpage,... using Large Language Models.

Student Activities

Day 1

- Complete journal entry.
- Participate in And/Or discussion
- Ask questions about adding complexity program
- Plan program

Day 2

- Test the program plan.
- Work on the program.

Day 3

- Test the program
- Test others' programs
- Participate in discussion about AI systems

Teaching/Learning Strategies:

Day 1

Journal entry: *What's the difference between "I am wearing black AND white items of clothes" and "I am wearing black OR white items of clothes"?*

- Students write then share with elbow partner
- Example answers: AND means both conditions are true, while OR means only one condition or both conditions are true.

And/Or discussion/Activity

- Kinesthetic And/Or Activity. (Following is a possible set of conditions.)
  - The following is an example of the use of AND & OR to create complex decision structures. Teachers should use similar examples from their classrooms.
    - Say: If (you have shoelaces AND you are wearing blue) stand up.
    - Find someone who has shoelaces who is not wearing blue and is
    - sitting. Ask: Why are you sitting since you have shoelaces?
    - Ask: How many parts of the condition must be true for you to stand up if
    - it is an AND?
    - Say: If (you do not have shoelaces OR you are wearing blue) stand up.
    - Find someone who has shoelaces who is standing but is not wearing
    - blue. Ask: Why are you standing if you are NOT wearing blue?
    - Ask: How many parts of the condition must be true for you to stand up if
    - it is an OR?
    - Ask: If both parts of the condition are true for an OR, is it ok to stand?
    - Emphasize: In computer science OR is inclusive. For example, in English class, if you say, "Would you like chocolate ice cream or vanilla ice cream?" you are allowed only one flavor.

- However, if you ask the same question in computer science, you may choose chocolate, vanilla, or both!
- Show the students the “and” and “or” blocks in Scratch.
- Emphasize how they are hexagon shaped and take two other hexagons.

Introduction of program

- Review the input & output from the enhanced Jobs Program from Lesson # 7.
  - 1st input: Age
  - 1st output: list of jobs/responsibilities during the celebration suitable for the input age
  - 2nd input: a job/responsibility selected from the above
  - 2nd output: a point value associated with the selected job
- Explain that students will enhance the program by adding multiple inputs allowing students to select multiple jobs (each with its own points value) & include other factors/questions to get a points tally at the end. The program will output both the point tally and a privilege selected randomly from a list of privileges.
  - Input: Age
  - Output: list of jobs/responsibilities during the celebration suitable for the input age
  - Iterate:
    - Ask: What job do you want to do?
    - Ask: a question related to the job. Example: Did you do this job before? Yes / No
    - Award different points depending on yes / No answers
  - Ask 2-3 more questions:
    - Example: How many celebrations/events have you attended before? ..... awarding different number of points to different answers
  - Output: Final tally of points and a privilege selected randomly from a list
    - Example: You have earned a total of 9 points and you can host a sleepover with 2 friends next weekend.

Plan the enhanced program

- Students plan follow-up Yes / No questions for each job and the different point values for each answer.
- Students plan a set of privileges to be awarded randomly at the end of the program

Day 2

- Test the plan from day 1 by following multiple different paths during the program
  - Encourage students to revise their point systems as they mock-execute their plan with different inputs to reach as fair as possible program outputs.
- Work on the program
  - Circulate and offer help to students

Day 3

Test the program

- Encourage students to test as many variations of answers as possible to check the accuracy of calculations

Test other's programs

- Students take notes about whether they think the point system & privileges awarded are fair or not and whether they reflect real life situations

- **Participate in discussion about AI systems: "**How do they make decisions?"
  - Revisit Unit 1 concepts of what a computer is, connect inputs and outputs to AI prompts and returns.
  - AI tools such as job interview tools are complex programs that use thousands of decisions and are trained on large sets of data to determine final decisions.
  - AI-powered interview tools use voice and facial expression analysis to determine a candidate's tone, demeanor, and emotional state, combining them with the content of the candidate's answer to provide a more comprehensive understanding of their personality and fit for the job.
    - How do you think the AI tools quantify tone? demeanor? emotional state?
    - What effects do the personal choices of the programmers of the AI tools have on the final decisions the tool makes?
    - What effects do the data sets used to train the AI tools have on the final decisions the tool makes?

Resources

- Enhanced Jobs Program
- Scratch Files (www.exploringcs.org/curriculum)

Teacher Reflection Notes

Lesson 10. 25-26

Topic Description: Students explore the importance of customization in programming by using abstraction and user-defined blocks in Scratch to create and customize a themed dance party animation.

Objectives

The student will be able to:

- Understand and apply the concept of abstraction in programming.
- Create user-defined blocks to represent specific dance moves and party planning tasks.
- Explore the significance of customization in programming and its impact on user experience.
- Connect to identities & culture by customizing party themes & dance moves according to personal preferences.

Outline of the Lesson: (Include approximate time required for each segment.)

Segment	Reason/Purpose
Day 1 • Introduce abstraction and custom blocks (10 minutes) • Dance party storyboard (15 minutes) • Dance party project (30 minutes)	• Students understand abstraction as an important aspect of programming and discuss ways it reduces complexity and helps manage large projects. • Students learn how to make custom blocks and how components can be reused. • Students continue to develop their party, then brainstorm and storyboard actions and dance moves • Students use abstraction to create custom blocks • students use custom blocks to create their animations • Students discuss the customization of their party
Day 2 • Dance party project (55 minutes)	

Student Activities

Day 1

- Participate in discussion of abstraction and custom blocks.
- Complete dance party storyboard.
- Complete Dance Party Project.

Day 2

- Complete Dance Party Project.

Teaching/Learning Strategies:

Day 1

Introduce abstraction and custom blocks

- Facilitate discussion using Think-Pair-Share to answer: Why/when students might want to create their own blocks. Students explain where there were situations in previous programs when creating their own custom block would have been helpful?
- Facilitate discussion using Think-Pair-Share to answer: What are some reasons for creating custom blocks? What are the benefits? Sample answers could be:
  - to make our algorithm easier to read and understand
  - to make our code less complex
  - to make modifying our programs easier
  - when we need to reuse code sequences in several places throughout our programs

Dance party storyboard

Journal entry: *Thinking back on your map route activity, what party would you like to plan for your community? Whom will you invite?*

- Ask students to reflect on their community walk project and in pairs ask them to choose an appropriate theme for a community party. offer examples of party themes such as: Birthday party for a child under 5, Birthday party for a 60 year old, Sweet 16 party, quinceañera celebration, anniversary party for a married couple, ...
- Students could also choose to explore and represent a dance style from a specific culture, researching the movements and the cultural significance to add depth to their animations.
- Students discuss in pairs who will be invited to the party and choose/design a dance appropriate for party attendees.
- Remind students that storyboarding is an efficient problem-solving strategy.
- Ask students in pairs to create a storyboard for a dance appropriate to their chosen party theme. The storyboard should have the following details:
  - number of dancers
  - at least 4 moves such as: spin, moonwalk, jump, raise the roof, Lindy hop, hokey-pokey, line dance, etc.
  - soundtrack / music

Dance Animation Project

- Discuss the assignment requirements and rubric. (Creating a rubric with the students
- may help them to better understand how to develop the program.)
- Remind students of the driver–navigator protocol for programming.
- Circulate the room while students complete the project, answering questions.

Day 2

Dance Animation Project

- Remind students of the driver–navigator protocol for programming.
- Circulate the room while students complete the project, answering questions.

Resources

- Dance Animation Project
- Scratch Files (www.exploringcs.org/curriculum)

Teacher Reflection Notes

Dance Animation Project

Design your own dance!

- Create a program with custom blocks to make a sprite perform your very own dance.
- Each custom block will represent a dance move; for example: spin, moonwalk, jump, raise the roof, Lindy hop, hokey-pokey, line dance, etc.
- Your program should include a soundtrack matching the length of the dance.
    - This will require you to use the sound editing tools in Scratch.

Lesson 11. Days 27-28

Topic Description: This lesson builds on previous concepts to create a timer. Students will also explore the cultural relevance of their party and discuss the impact of cultural representation in technology.

Objectives

The student will be able to:

- Create a timer.
- Create and implement a timer block with a parameter.
- Explore and discuss the cultural relevance of the chosen themes for the dance parties.
- Reflect on how cultural representation in programming can influence perceptions and inclusivity.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Discussion of cultural themes (15 minutes) • Introduction of custom blocks with variable parameters (10 minutes) • Creation of a timer with input (15 minutes) • Review of Timer solutions (5 minutes) • Adding a dance move (10 minutes)	• Introduce the students to the new idea using role play • Discuss role of cultural representations • Discuss appropriation vs. appreciation • Apply the new idea of custom blocks with parameters
Day 2 • Revise adding a dance move (10 minutes) • Program a dance move (30 minutes) • Discussion of the dance move program (15 minutes)	• Incorporate the idea of custom blocks with variable parameters into a program

Student Activities

Day 1

- Participate in discussion of cultural themes.
- Participate in role play
- Complete timer project in pairs.
- Share different solutions.

Day 2

- Participate in reviewing the dance move.
- Students pick themes for dance moves.
- Students program their dance moves.
- Students participate in reflection on the dance move program.

Teaching/Learning Strategies:

Day 1

Discussion

- Have students share the cultural themes they've developed for their parties.
- Guided discussion questions- Students should be able to grasp the idea that their personality is infused in the projects they create and that representation of cultures in programming is important. They should be able to discuss why programmers should represent a diverse range of people.
    - How does the dance party reflect your themes?
    - What specific elements did you have to create to showcase these themes?
    - How did you ensure cultural elements were represented accurately?
    - What personal connections do you have to the cultures you represented in your project?
    - How did this influence your design choices?
    - Why do you think it is important to have diverse cultural representations in computer science?
    - How can cultural representations impact a viewer's perception?
    - What challenges did you face when trying to represent your culture accurately?
    - How did you address those challenges?
    - How does the way we represent cultures in media and computer science influence society's perceptions and behaviors regarding those cultures?
    - How can students show appreciation without appropriating cultures?

Introduction to custom blocks with parameters

- Discuss making a block with inputs (called parameters). (See Custom Blocks Tutorial: https//scratch.mit.edu/projects/68924432.)
- Examples: an action done a number of times: the number will be the input, a custom greeting that uses a name of a different person each time: the name of the person is the input, ...
- Try a role play by having students physically act out sending inputs to a block. (See Role Play Of Custom Blocks With Inputs.) Make sure students understand that the sender and receiving parameters need to agree on the type of information they will exchange

- Discuss the various types of input.
- Ask students to think of examples of blocks that might need extra input. Use the above examples (an action done a number of times, a custom greeting that uses a name of a different person each time, ….) and explain that inputs have different formats: numbers, text (string),….Allow students to share their own ideas.
- Show students Make a Block and Make a Block with Inputs in the Tips section of the editor.

Creation of a timer with input.

- Explain to students that they will make a timer that will count down from some number of seconds.
- Show students Timer Project.
- Pairs complete Timer Project.

Review of Timer solutions

- Allow students to share their own unique solutions.
- Review timer solution a.sb3 and timer solution b.sb3.
- Extra Fun – asking the player to enter the amount of time

Day 2

Introduce the dance move

- Explain that students will choose a specific dance move to incorporate into their party. The dance move should be reflective of the culture or tradition they are representing. The dance move will appear for a specific length of time and the player should click on it before it stops or disappears. Students earn points for clicking the correct traditional dances. Just remember, the moves don't need to be formal, traditional dances like a haka or sangeet; they can be the trendy dance their parents did at their wedding, or their aunt that won't stop dabbing, or their ballet class.
- Have students help build an example. (See reaction game solution.sb3.)
- Add requirements for other user blocks.
- Discuss when students should create their own blocks:
    - To make our algorithm easier to read and understand.
    - To make our code less complex by representing a sequence of commands.
    - To make modifying our programs easier.
    - When we need to reuse code sequences in several places throughout our programs.
- Ask students about instances when previous assignments could have been implemented with user-defined blocks.
- Students share out.
- Consider having students work as driver-navigator pairs.

Reaction dance theme

- Circulate room and help students develop their Reaction dance moves. Encourage students to think about the culture and celebrations they are showcasing in the party.

Discussion:

- How does adding those dances help us understand and appreciate the culture being showcased?
- How does it help us learn about our classmates?
- What role can technology play in preserving and sharing traditions?
- How does technology oversimplify cultures?
- What did the dance teach you about the culture or people represented?

Resources

- Custom Blocks Tutorials (https://scratch.mit.edu)
- Timer Project

Teacher Reflection Notes

Role Play of Custom Blocks with Inputs

Common misunderstandings for students when creating custom blocks with an input are how the value is sent and where it goes. Physically demonstrating this process by passing numbers written on a piece of paper will help students to better understand input variables in custom blocks.

Start by drawing or printing a custom block definition on larger paper. (See sample below: “Twirl Around” definition.) Make it large enough so students will be able to see from their desks. Attach post-it notes below the input variable, “number-of-times”. Draw or print the custom block “Twirl Around” on larger paper. (Suggestion: Attach string to the paper so that students can wear them like a sign around their necks.) Make a sign of the repeat block on larger paper, also attaching a blank post-it under the variable “number-of-times” Role play:

1. Ask for four student volunteers: a student to be the custom block, a student to be the definition block, a student to be the repeat block, and another student to act out the twirls.
2. Write a number on a post-it note and stick it to empty circle on the custom block “Twirl Around”.
3. Have custom block student, turn to definition block student and write the same number on the post-it under the input variable “number-of-times”.
4. Make it clear to students that the custom block has sent or communicated the value to the definition block via “number-of-times” variable.
5. Have definition block place the post-it note on the repeat block sign under “number-of-times”.
6. Now the student actor will twirl around the prescribed number of times.
7. Repeat steps again with new volunteers with a student now directing the process.

How to make a timer in Scratch

1. Create a variable called timer.
2. When the flag is clicked, initialize the timer block input to 10.
3. Continually, wait 1 second and check if the timer = 0.
    a. Output the current time either with a sprite or just show the variable.
    b. If the timer = 0 make either the background or a huge sprite say “Time’s Up.”
3. When the flag is clicked, everything should start over.
4. Be creative as to what you want your program to look like.
5. Make sure the timer stops at 0 and does not continue into negatives.

Lesson 12. Days 29-31

Topic Description: Students explore the issue of limited resources and how they affect decisions by creating a program that uses a budget to plan a community event.

Objectives

The student will be able to:

- Understand the effect of limited resources on decisions
- Create a program that helps them plan a community event/celebration.
- Connect to problem solving steps in unit 2.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (20 minutes) • Introduce the "Plan a celebration" program (10 minutes) • Plan the program (25 minutes)	• Make connections to unit 1 & financial decisions' effects on our lives.
Day 2 • Groups exchange plans & give feedback (10 minutes) • Complete the "Plan a celebration" program (35 minutes)	• Connect unit 2 problem solving and programming
Day 3 • Gallery walk: test & reflect (10 minutes) • Revise the program using comments from gallery walk. (10 minutes) • Participate in journal prompt & discussion: AI systems determining loan approval or denial decisions (35 minutes)	• Connect to social justice inequities created by AI systems used to determine approval or denial decisions on loan applications

Student Activities

Day 1

- Participate in journal writing & discussion
- Introduce the “Plan a celebration” program
- Plan the program

Day 2

- Groups exchange plans & give feedback
- Complete the “Plan a celebration” program

Day 3

- Gallery walk: test & reflect
- Revise the program using comments from gallery walk.
- Participate in journal prompt & discussion: AI systems determining loan approval or denial decisions

Teaching/Learning Strategies

Day 1

Participate in journal writing & discussion

Journal prompt: *Remembering the “Computer buying project” from unit 1: How did the set budget for your scenario affect the choice of the device you chose to buy?*

- What do you know about using loans and / or credit cards to buy something ?
- How are interest rates for loans & credit cards set?

Introduce the Plan a Celebration Program (See resources.)

- You will create a program that tells you whether your plan for a community event/celebration is feasible or not depending on the budget.
- See the “Plan a celebration” project steps in resources section

Plan the program

- Encourage students to develop a list of at least 5 - 7 items they need to consider when budgeting for their celebration and research costs for each item.
- Think about sprites they will use to represent items for their plan: buttons, pictures,....

Day 2

- Groups exchange plans & give feedback
- Complete the “Plan a celebration” program

Day 3

- Gallery walk
  - Students test at least 2 programs and give feedback to project owners
- Revise the program
  - Students use comments from gallery walk.

Participate in journal prompt & discussion

- **Set the stage:** Financial institutions such as banks, car dealerships use AI systems to determine loan approval or denial decisions. These AI systems use many factors to approve or deny loans and determine the interest rates for approved loans. Factors such as income, employment history, debt-to-income ratio, loan purpose, and even social media data are used.

Journal entry: *Choose a character who is applying for a loan to buy a car:*

- *Recent college graduate*
- *Single mother of 2 small children*
- *A retiree*

Would you rather have a human evaluate your application or an AI system? What are the pros and cons of each?

What factors would you consider adding to the AI tool to provide equitable access to loans.

Discuss student responses.

Resources

- Plan a Celebration Project

Teacher Reflection Notes

Plan A Celebration Project

- "When the Green Flag is clicked", the program asks for the budget of the event.
- The program displays sprites representing all the items needed to plan for the event:
  - Renting a venue, food & refreshments (different sprites representing different numbers of invited guests), decorations, sending invitations, Hiring a DJ, ...
  - Research the cost in your community associated with each item and include it in your code
- When sprites are clicked, the program adds the cost to the overall cost of the event.
- The program will display any of the following:
  - You are on budget you can start inviting guests: if total cost = budget
  - You are under budget by .....$: if total cost < budget
  - You are over budget by .....$: if total cost > budget

Lesson 13. Day 32

Topic Description: In this lesson students will plan their final project. Students use problem solving steps to plan and execute the project. Students must utilize scratch blocks learned throughout the unit

Objectives:

The student will be able to:

- Make an appropriate choice for the final project.
- Plan the final project.

Outline of the Lesson:

Segment	Reason/Purpose
• Discussion of introduction projects—review topics, themes & rubrics (25 minutes) • Start final projects. (30 minutes)	• Answer questions/clarify any misconceptions • Students choose topic & execution format of final project

Student Activities
• Participate in discussion of introduction to projects. • Start final projects: Understand the problem

Teaching/Learning Strategies

Discussion of introduction to projects.

- Review topics, themes, and rubrics (See resources.)
- Students refer to and examine their website project from unit 1 to determine a focus / topic for their project
- Explain that they will be using problem solving steps to complete their project.
  - Steps for the project using problem solving steps:
    - **Understand the problem**
      - Choose your topic (My Community Project, My Career Project, My Dreams Project, Who am I Project) & how are you going to present it in scratch (Game, Presentation, storytelling or other teacher approved method).

- **Plan the solution**
  - Use a storyboard to outline your project & have it reviewed by a peer.
  - Update the storyboard using feedback from peer review
  - Select appropriate Scratch blocks to execute your storyboard
- **Execute the plan**
  - Write a scratch program using all blocks that you learned in the unit
- **Test & reflect**
  - Test & debug your code
  - Record the challenges you had writing the code
  - Prepare for gallery walk
- **Start final projects**
  - Students choose from options offered or get approval for any new topics (Understand the problem)

Resources

- Final Project
- Final Project Sample Rubric

Teacher Reflection Notes

Final Project

Your task is to create a Scratch program that does one of the following

- Creates a game
- Creates a presentation
- Uses Storytelling
- Option of your choice (reviewed by teacher)

You may choose any one of the following topics (or a topic of your choice that is teacher approved).

1. My Community Project

Decide on at least one positive thing that you want to highlight and at least one thing you want to improve about your community.

- Examples of issues to address about communities:
  - Sidewalks & bike lanes availability to connect popular community destinations
  - Green spaces, parks, playgrounds, libraries availability / accessibility
  - Public transportation options connecting community destinations
  - Accessibility to hospitals, health care facilities & pharmacies
  - Access to fast & affordable internet connections
  - Accessibility to fast emergency response: fire stations, EMT's, police station
- Research and use statistics to back up your conclusions. (Cite your findings.)
- Include personal comments/recording.
- Include at least one picture.
- Include a peer observation about your topic in the program.
- Use at least 6 of the 8 block options.
- Multiple scenes (3+)
- Show/hide sprites
- Create user-defined blocks when/where appropriate.

2. My Career Project

Choose a career or two you are interested in.

- Research and present criteria and requirements of the career(s)
- Points to include in research:
  - Why did you choose this career(s))
  - Training / degree required for this career
  - Future earnings/job growth prospects
  - Where would you work
  - Role models you want to follow
- Include at least one picture.
- Include a peer observation about your topic in the program.
- Use at least 6 of the 8 block options.
- Multiple scenes (3+)
- Show/hide sprites
- Create user-defined blocks when/where appropriate.

3. My Dreams Project

If you had no limitations what is your biggest dream(s).

- Research and present information that relates to your topic.
- Points to include in research:
    - What is your dream?
    - Why is it important to you?
    - What/who inspired you?
    - How would you achieve your dream?
    - How would your life / your family's life change if you achieve your dream?
- Include personal comments/recording.
- Include at least one picture.
- Include a peer observation about your topic in the program.
- Use at least 6 of the 8 block options.
- Multiple scenes (3+)
- Show/hide sprites
- Create user-defined blocks when/where appropriate.

4. Who am I? Project

Introduce your unique self to someone who does not know you.

- Research and present information that relates to your topic.
- Points to include in research:
    - What is your culture / family history?
    - What is the most important thing to know about you?
    - What is a challenge you overcame?
    - What do you want to achieve in your future?
- Include personal comments/recording.
- Include at least one picture.
- Include a peer observation about your topic in the program.
- Use at least 6 of the 8 block options.
- Multiple scenes (3+)
- Show/hide sprites
- Create user-defined blocks when/where appropriate.

Final Project Sample Rubric

Name: _____

Do You Have?	Points Possible	YES	NO	Points Earned
The Plan	10			
Storyboard detailing your project choice	5			
Peer review for storyboard	5			
Outline of scratch blocks to execute the project	5			
Record of challenges executing the project	5			
The Content				
3 or more scenes	10			
1 or more topics discussed	5			
Information cited	5			
Statistics to back up your conclusions	5			
A personal comment/recording	5			
A personal picture	5			
A comment/recording from a peer observation in the class	5			
The Program				
Use at least 6 of 8 block types (emphasis on control blocks, e.g.; broadcast, decision, iteration). Also used user defined blocks as appropriate.	10			
Scenes only show sprites that are supposed to be in that scene	10			
Program starts and restarts when green flag is clicked	10			
The Presentation				
Show and explain the contents of each scene in your project & your choice of Scratch blocks to execute it	9			
Explain how each scene changes (how the program works)	9			
Peer Grading	**12**			
Total:	**130**			

Lesson 14. Days 33-35

Topic Description: Complete final projects.

Objectives:

The student will be able to:

- Incorporate all objectives in the unit into the final project.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Work on the final project: plan / research the project: Create storyboard. (40 minutes) • Participate in peer review and discussion at the end of the first day of work.(15 minutes)	• Students follow problem solving steps to complete work • Students assess and give feedback to elbow mates
Day 2 • Work on the final project. (55 minutes)	• Students use feedback to continue work
Day 3 • Complete final project (55 minutes)	• Students continue work

Student Activities
Day 1 • Work on the final project: plan / research the project: • Create storyboard (Include Scratch Blocks you will use) • Ask questions & check rubrics for completion • Participate in peer review and discussion at the end of the first day of work. **Day 2** • Work on the final project. **Day 3** • Complete final project.

Teaching/Learning Strategies:

Day 1

Work on the final project.

- Circulate the room and help students with projects.

Participate in peer review and discussion.

- Elbow partners review each others' projects to date, checking the rubric to see which
- features are complete and which need additional work.
- Elbow partners discuss the reviews. Make notes for changes to be made.
- The peer review forms will be submitted along with other parts of the project. Students will receive points both for the feedback provided and the responses to feedback.
- Circulate the room and make sure students understand the rubric and what they still need to accomplish to finish their project.

Day 2

Work on the final project.

- Based on peer reviews from the first day, students work on the project. Teachers circulate the room and help students with projects.

Day 3

Complete final project.

- Students complete the project. Teachers circulate the room and help students with projects.

Resources

- Peer Review Sheet
- Final Project
- Final Project Sample Rubric

Teacher Reflection Notes

Sample Peer/Student Review Sheet

Name: _____

Do You Have?	YES	NO	Notes
The Plan			
Who reviewed your storyboard?			
Is your record of challenges attached?			
The Content			
3 or more scenes			
1 or more topics discussed			
Information cited			
Statistics to back up your conclusions			
A personal comment/recording			
A personal picture			
A comment/recording from someone else in the class			
The Program			
Use at least 6 of 8 block types (emphasis on control blocks, e.g.; broadcast) Also used user defined blocks as appropriate.			
Scenes only show sprites that are supposed to be in that scene			
Program starts and restarts when green flag is clicked			
The Presentation			
Show and explain the contents of each scene in your project			
Explain how each scene changes (how the program works)			

Feedback:

Lesson 15. Days 36-37

Topic Description: Students present final projects. Students reflect on learning by revisiting KWL chart from the start of the unit

Objectives:

The student will be able to:

- Incorporate all objectives of the unit into the final project.
- Present their final project
- Reflect on learning

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Final project presentations (55 minutes)	• Celebrate learning/ progress
Day 2 • Complete final project presentations as needed (35 minutes) • KWL chart revisit (20 minutes)	• Reflect on learning progress

Student Activities
Day 1 • Teams present final projects. **Day 2** • Teams complete presenting final projects. • Complete L column in KWL chart and share out.

Teaching/Learning Strategies:

Day 1

Teams present final projects

- Follow the presentation part of the rubric.
- Students reflect on the process of creating their final projects in their journals by listing 1-2 successes and challenges they encountered while working to share with peers as part of their presentations.
- Depending on the size of the class, teachers may decide that students present to the whole class or divide the students into groups of 3-4 to present within their small groups. Presentations include both successes & struggles encountered during the project.
- Teams watching: write responses to at least 2 of these sentences in journal:
    - I liked .....
    - I wonder why did you choose.....?
    - How could you have implemented..... differently?
- Teacher chooses 1 - 2 watching teams to share journal responses with the presenting team and allow the presenting team to respond.

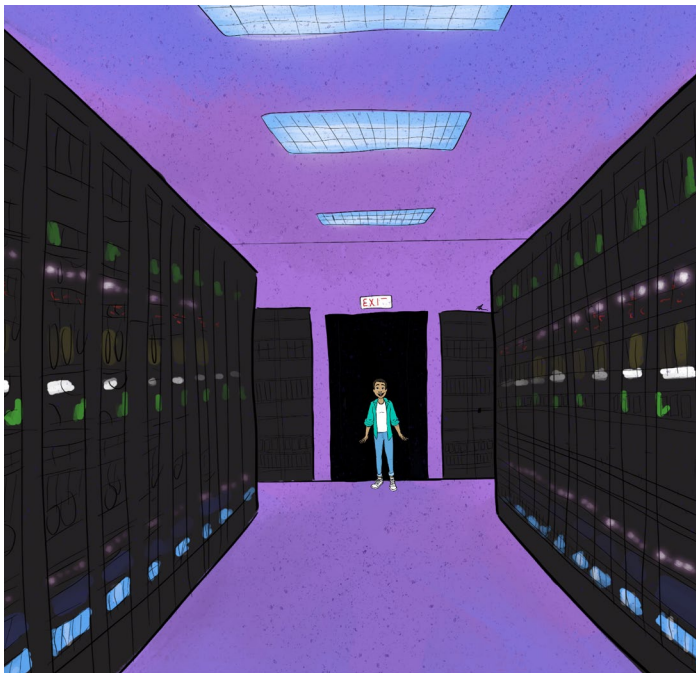
Day 2

- Complete team presentations
- KWL chart revisit
    - Individual students complete the L column from the KWL chart and share one item from their L column with class.

Resources

- Final Project
- Final Project Sample Rubric

Teacher Reflection Notes



Unit 4: Data and Computing

Introduction

This unit not only equips students with the skills to navigate and interpret complex datasets but also emphasizes the importance of recognizing and addressing biases that can significantly impact people and communities. Where there are humans, there is bias. Computing has enabled researchers to use data to explore questions related to large global issues such as climate change, health care, government, education and human behavior.

Data, in its many forms, is a powerful tool for insight and progress. This unit has been designed to allow students the opportunity to experience the process of data collection, and to analyze real-world contexts such as climate change and healthcare. Students will develop the ability to analyze, visualize and draw conclusions from large data sets and see how critical it is to computing. While there are many different uses for big data and it is often used to improve services and help people, its collection and use can raise ethical concerns. Big data involves the collection of data, often without the data subject's awareness. It is important that students are aware of and feel able to discuss the ethics of big data.

Students are encouraged to delve into the ethical implications of their work, understanding how data-driven decisions can affect diverse populations differently. The curriculum integrates real-world examples and case studies, highlighting how biased data can lead to adverse impacts on marginalized communities, influence public policy, and shape societal norms. This unit is designed to equip students with a deep awareness of their responsibility to ensure that data serves to enhance rather than harm the communities it aims to inform.

Students will explore what different techniques are used to combine different types of data and extract meaning from them with issues they face in their communities. While it may not be possible to utilize tools that are suitable for very large data sets and/or all of the analysis features discussed in this unit, every effort should be made to do multiple types of analysis and to discuss trade offs in the tools used. Students need to be able to use whatever tools are chosen in appropriate ways to manipulate the data, but the focus should be on conceptual understanding of data analysis—making appropriate inferences, using data to make a case or inform a discovery, and being able to justify conclusions.

The unit is divided into three main sections.

- Overview of the final project, data collection, and validating claims with data (Days 1–6)
- Data analysis techniques (Days 7–21)
- Final project (Days 22–26)

The goal is to prepare students to collect rich data, formulate queries that will inform whatever project is chosen, and use that information to either make a case or facilitate a discovery.

The data sets provided are examples. Teachers should choose data sets and examples that will be appropriate for their local contexts. Attention should be paid to ensuring that the chosen data sets exercise the same data analysis techniques as those currently provided.

Specific topics for each instructional day are listed in the overview chart below.

Daily Overview Chart

Lesson	Instructional Day	Topic
1	1	This lesson introduces “Big Data” and its impact on our world. Students will investigate “Big Data” sets and analyze their characteristics, scope, and effects on our society.
2	2-3	Students will analyze how data is used to solve problems and explore the pitfalls and challenges of combining and managing large sets of data. An overview of the final project is provided.
3	4-5	In this lesson students will investigate data sets and discuss findings.
4	6	In this lesson students will predict how useful particular data would be in answering research questions.
5	7-8	This lesson provides an opportunity for students to explore commonalities and differences of cultures and communities by using images as a data source to communicate these stories.
6	9-10	Students will evaluate rural and urban medical facilities by analyzing data and presenting their findings.
7	11-12	Students will investigate how to transform raw data into visualizations.
8	13-14	In this lesson students will communicate stories about their local communities, histories or relevant issues by collecting, analyzing, and visualizing data.
9	15-17	Students will explore Bar plots and the differences between categorical and continuous data. Mosaic plots are introduced as a vehicle for comparing categorical data and looking for trends in data.
10	18-19	In this lesson, students will identify what data they create online is of interest to organizations that analyze big data, and determine how it could be used and the role it plays in society.
11	20-21	Students extract data from datasets and discuss how the use of big data might be helpful or harmful.
12	22-26	In this lesson students review their data collection and begin composing their final projects. Students will have one week to work on and complete their final project and present them.

Instructional Lessons

Lesson 1. Day 1

Topic Description: This lesson is designed to introduce "Big Data" and its impact on our world. Students will investigate "Big Data" sets and analyze its characteristics, scope, and effects on our society. Government, healthcare, education and other industries rely on "Big Data." Big data is all around us and has revolutionized the way we live and work.

Objectives

The student will be able to:

- Define "Big Data" and its characteristics.
- Understand the complexities of collecting, processing, and managing large sets of data.
- Identify real-world applications of big data in various fields.
- Make connections between sustainability and technology.
- Analyze and discuss the value of big data.

Outline of the Lesson:

Segment	Reason/Purpose
• Journal entry (10 minutes) • Big Data Search (15 minutes) • Big Data Search Discussion/Review (10 minutes) • Google Data Center Video and Discussion (5 minutes) • Data Center PDF (10 minutes) • Wrap-Up Review/Discuss (5 minutes)	• Define "Big Data" and make real world connection • Analyze the size and scope of "Big Data".

Student Activities
• Complete Journal entry • Big Data Search • Big Data Search Review • Data Center PDF • Review/Discuss

Teaching/Learning Strategies:

Journal entry: *What is Big Data? Who creates it?*

- Students may reflect on data they use and create every day. How might your daily activities lead to large amounts of data? What might be the consequences?
- Explain how their day-to-day data combined with vast amounts of other data creates "Big Data". Example: Driver's license, State ID, and Passport info is personal data; however, combining everyone's ID data creates "Big Data".
- At this point It is okay if they do not grasp the full scope of Big Data. The following parts of this lesson will go into more depth.

Big Data Search Discussion

- Activity should define Big Data and its characteristics. There is a difference between "Big Data" and individual data sets. Please note some items are individual data sets. Individual data sets combine to form "Big Data". Discuss the "Five V" characteristics of Big Data: Volume, Variety, Velocity, Veracity, and Value. Students should make more connections in addition to those on the list.
  - Volume: Big data is immense (The number of Visa purchases per minute)
  - Variety: Types of data (text, images, audio)
  - Veracity: Data is reliable and factual
  - Velocity: Data is generated and processed
  - Value: Data is useful
- The Big Data Search Activity (See resources.) provides real-world data examples. Students may elect to use a simple Google search, Google Gemini or any tool. Students will gather information, analyze findings, and discuss:how big is "BIG Data"? Is there a difference from initial thoughts? Where is this data? Where is it stored? Does anyone manage the data?

Google Data Center Videos

- Show two videos. (See resources.)
- The first video: What is a Data Center should lead to career topics and "The Cloud".
  - Students can include data, the cloud, cookies, and careers.
  - Make sure the following questions are answered through discussion. Really, how big is "BIG Data"? Is there a difference from initial thoughts? Where is this data? Who stores it? The purpose of this activity is to create a visualization of the scope of Big Data. Discussions about careers in Data Science should be mentioned (Data Analyst, Engineer, and Data Administrator).
  - Data Center.pdf should be given after the Google Data Center Video. The discussions and findings should reinforce subjects taught in previous units and provide new revelations to the term "Big Data". Allow students to research careers and list the pros and cons of data centers. This should broach the environmental issues as well as security and privacy.
  - The second video should invoke conversations about conservation and water use. Students should make connections between the environment and sustainability.

Wrap-Up Review/Discuss

- Review the concepts and characteristics of "Big Data".

Note: The differences between personal data such as personal data merged creates “Big Data”. Example one personal social media account’s value and volume versus the entire platform users.

Resources

- Big Data Search Activity
- What is a Data Center? (https://youtu.be/lnJsWEoppo8?si=nAVXQGygtYPv1cFo)
- Data centers seek sustainable solutions to rising water consumption (https://youtu.be/XZmGGAbHqa0?si=v3TPvL7vWK7p6LBD)
- Data Center.pdf (https://drive.google.com/file/d/1yHf7bOAyAU0sHkg4zrPKLqN4St6A9Nh-/view?usp=sharing)

Teacher Reflection Notes

Big Data Search Activity

Complete the chart below to help determine if the data is “Big Data”

Data	**Variety** (Format: text, images, video)	**Volume** (enormous size # of users)	**Velocity** (Generated rapidly Y/N)	**Veracity** (Accuracy Y/N)	**Value** (potential usefulness Y/N)	**Big Data** (Y/N)
Google Searches (per day)						
Google Document						
Youtube (users per day)						
Siri/Alexa (daily requests)						
Personal Email						
Personal Social Media Account						
Text book						
Airport Website						
GPS App						

Lesson 2. Days 2-3

Topic Description: This lesson provides an opportunity to analyze how data is used to solve problems. Students explore the pitfalls and challenges of combining and managing large sets of data.

Objectives:

The student will be able to:

- Brainstorm possible topics for the final project.
- Understand the key steps involved in a research project.
- Select topic for the final project.
- Identify and discuss the considerations that must be made for a large data set to be useful.
- Consider how various types of data (numbers, text, dates, etc.) lend themselves to processing.
- Collaborate with others to create, manage, and maintain a large set of data.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • How to research preview (10 minutes) • Topic Narrowing Discussion (20 minutes) • Discussion and Review (20 mins)	• Identify broad areas of student interest. • Analyze and formulate research questions. • Understand the difference between open and closed research questions.
Day 2 • Journal entry (5 mins) • Data and Research (20 minutes) • Gallery Walk (10 minutes) • Possible Research Projects (10 minutes) • Discussion (5 mins)	• Students will narrow broad area interests • Students will formulate research questions

Student Activities

Day 1

- Complete journal entry.
- Formulate a Research Topic and Question
- Topic Narrowing Discussion
- Discussion and Review

Day 2

- Data and Research Poster
- Gallery Walk
- Possible Research Project
- Discussion.
- Student Activities
- Data Research Poster

Teacher/Learning Strategies

Day 1

Journal entry: *What are some exciting advancements you've seen in computer science recently?*

- Encourage brief discussions about recent innovations such AI, Big Data and Data Science, Alexa, GPS. Explain that research isn't limited to science labs but solving problems.

How to Research Preview

- Explain that their final project will be a research project.
  - Preview the Final Project Description and Rubric and explain that they will be preparing for it throughout the unit, including today.
  - Describe the format in which you want students to keep track of their notes related to the final project each day.
- Review and discuss from start to finish the key stages of a research project.
- Outline your project-
  - introduce the topic,
  - question
  - Body *supporting information, and tools such as surveys, images, AI, etc.
  - References
- Remind students about the algorithmic process of Unit 2 Problem Solving lessons. Reiterate that they will be doing activities each day that will prepare them for the different stages of their final project.

How to Formulate a Research Question:

- Begin by discussing the importance of research in academics and in everyday life.
  - Explain that research starts with a topic, and a good topic leads to a good question.
  - Stress that research should ideally start with something that the student is interested in.

        - Encourage students to think broadly (e.g., climate change, technology, social justice, sports, art).
        - Explain that broad topics are too general for research (Such as Weather, Government, Animal Cruelty etc. Topics stated alone leave more questions than answers. Briefly review the process of narrowing down topics.
    - Provide time for students to choose a broad topic and potential questions based on the Final Project Description. Some topics might be bullying, healthcare and climate.
    - Ask students to share some of their narrowed topics.
        - The role of technology in education.
- As a wrap up reiterate the research stages and connect them specifically to each part of the final project
    - Choose a topic -topic should be something that interests you. You can build on your final project from Unit 2.
    - Develop a research question- research should answer or solve a problem
    - Locate credible sources- use credible sites such as academic journals, .gov., or .org etc.
    - Outline your project- introduce the topic, question, *supporting information, and tools such as surveys, images, AI, etc.
    - Write the project
- *supporting information, and tools such as surveys, images, AI, etc. Discuss the different types of data and tools that research may include.
    - Types of Data
        - Text - often unstructured datasets that exist through surveys, images, social media
        - Spatial - Data related to a geographical area or region
        - Qualitative -open-ended questions that often reflect one's opinion or belief. Example: How did you feel about your shopping experience or How did you find us?
        - Quantitative- data in the form of numbers and statistical value
        - Students should complete a Google search of data terms.

Day 2

Data and Research

- Divide the class into small groups, students may use Google, Gen-AI platforms, or any reliable website to investigate their topic. Provide students with one of the following Research topics: The Problem of Homelessness or The Problem of Drug Abuse or another topic that is of interest to them. Each group must design a poster outlining their research. Explain that this is a short project to help them practice choosing a topic and questions in preparation for choosing their final project topic.
    - Locate credible sources- such as academic journals, .gov., or .org etc.
    - Outline your project-
        - introduce the topic,
        - question
        - Body *supporting information, and tools such as surveys, images, AI, etc.
    - References
    - The outline should only consist of brief statements or labels, a more detailed outline will come later in the Unit.

- Posters may include labels, images etc. Not all posters will look the same; however, encourage students to note what is needed in a Research project.

Note: AI is not the data itself but a tool and a way to access data. Discuss the uses of AI in finding credible sources, topics, and data analysis. Beware of possible fake AI images and videos. AI should not be used to plagiarize. Briefly discuss and remind students of other ramifications and ethical violations around using AI tools.

Gallery Walk

- Allow students to analyze the posters and leave comments. After a brief moment, students should return to their seats and discuss each groups' poster.

Possible Research

- Introduce students to possible research topics for the final project by using the suggested videos or other high-interest and engaging resources. (See resources.) They might also choose to build on their final project topic from Unit 2. The goal is to spark their interest and desire to learn more about the topic and to brainstorm how they can be citizen scientists on the topics.
- Resources for the topics are included in Sample Final Project Topics. Additional resources related to these topics are included in later lessons. The primary data file for each topic is located in the ECS Unit 5 Potential Final Projects.

Journal entry: *Thinking about the possible topics covered, which would you choose for a project and why?*

- Students should formulate some interest in a Research topic. Discuss and review available topics again if needed. Remind students that choosing a topic is the first initial stage of research and that they should also set aside a document, notebook or folder for their project as they will work throughout the unit on their research.

Resources

- Bullying
  - StopBullying.gov (www.stopbullying.gov)
  - Division of Adolescent and School Health (DASH) (https://www.cdc.gov/healthyyouth/about/index.htm)
- Healthcare
  - Adolescent and School Health (https://www.cdc.gov/healthyyouth/index.htm)
  - Suicidal Thoughts and Behaviors Among High School Students — Youth Risk Behavior Survey, United States, 2021 (https://www.cdc.gov/mmwr/volumes/72/su/su7201a6.htm)
- Pollution/Climate
  - World Bank Group - Polution page (https://www.worldbank.org/en/topic/pollution)
  - EPA Pollution Prevention (P2) page (https://www.epa.gov/p2)
  - NOAA: Ocean pollution and marine debris (https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-pollution)
  - National Geogrphic Pollution article (https://education.nationalgeographic.org/resource/pollution/)

Teacher Reflection Notes

Lesson 3. Days 4-5

Topic Description: Understanding the complexities of collecting, processing, and analyzing large data sets can be cumbersome and challenging. In this lesson students will learn how to analyze and effectively use data tools. Students learn how to navigate and filter big data.

Objectives:

The student will be able to:

- Understand big data and its characteristics
- Utilize tools to analyze large data sets
- Draw conclusions about the data set selected
- Identify issues related to the topic or aspects of the topic of particular interest to the groups.
- Discuss methods of collecting and validating data
- Collaborate with others to create products
- Understand and discuss data bias

Outline of the Lesson: (Include approximate time required for each segment.)

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Census Data Scavenger Hunt (20 minutes) • Census Data History Article (15 minutes) • Developing Research Questions (10 minutes) • Journal entry (5 mins)	• Students will analyze and draw conclusions from data. • Discuss methods of collecting and validating data. • Review and discuss the story of data
Day 2 • Journal entry (5 minutes) • Creating Research Tools (15 minutes) • Building Surveys (20 minutes) • Gallery Walk (15 minutes)	• Review and allow students to share their thoughts about the previous day. • Decide on topic research question • Collaborate with others to create and analyze products and discover new facts about data

Student Activities

Day 1

- Complete journal entry.
- Complete Census Data Scavenger Hunt.
- Read the census data history article.
- Develop research questions.
- Complete journal entry.

Day 2

- Complete journal entry.
- Build surveys.
- Participate in a gallery walk.

Teaching/Learning Strategies:

Day 1

Journal entry: *Thinking about the future, how is data growing or evolving?*

- The purpose of the question is to provoke thoughts about the data. Data is evolving and changing to meet the needs of society. Each new innovation is the result of data. Data revealed a need and that need produced an innovation, the innovation produces data

US Census Scavenger Hunt

- Lead students through the navigation of the Census site (See resources.). Follow the instructions below pointing out features and information as you go. Allow time to search and analyze the site and data. Explaining the concepts of data filtering -selecting specific data based on certain criteria.
- Visit US Census Data site
- USA Overview
  - Type USA in the search bar
  - Click the View Profile link on the left
- Population
  - Type USA in the search bar
  - Click the View Profile link on the left
- Education
  - Type Education in the search bar
  - Select Education Attainment
  - Point out the search bar and navigation panes. Illustrate how to navigate the site. Allow students time to review data and draw conclusions.
    - Does the data inform?
    - What does the data reflect?
    - What data tools did you see on the site?
    - What type of data was used.

Census Data History Article

- Allow students to read the Census Data History article (See resources.) and discuss their findings. The purpose of the article is to show students that some data may not reflect the whole society. The data may or may not include all stakeholders. Who determines what is data and how it is used? Data sets are open to individual interpretations as to what data should be included.

Journal entry: *What research tools can you use to collect data? What data types? How could you ensure that collected data is representative of diverse voices and perspectives as relevant to their contexts?*

- Ask a few students to share their responses as a preview for the discussion about surveys.

Day 2

Journal entry: *What is bias and how can it affect the integrity of data?*

- This prompt is a reflection of the previous day's lesson. Methods used to collect data are just as important as the data itself.

Creating Research Tools

- Survey Notes
  - Types of Survey Questions:
    - Multiple Choice: Provide multiple answer choices and are great for getting data quickly
    - Yes or No: Simple and clear-cut answers
    - Open Ended: Allow users to share personal ideas and experiences
- Questions should be clear, unbiased, and to the point.
- Explain to students that surveys are one of the ways they will be collecting data for their final projects.
- Visit the US Census.gov and navigate to the Measuring Maternal Mortality. (See resources.) Allow students a few minutes to read the document and share information that stood out. Make note to address "Issues to Consider in Questionnaire Design" at the end of the document.

Building Surveys

- Have students create a survey based on the Scavenger's Hunt they completed. Questions can address any problem, issue, or attraction; however, it must contain all three types of survey questions.
- Remind students that this will be practice for creating the survey needed for their final projects.

Gallery Walk

- Place posters around the room and allow students to view and post ideas from their surveys.

Resources

- US Census Data (https://data.census.gov/)
- US Census Scavenger Hunt Notes
- Census Data History The U.S. Census Has a Long History of Discrimination | Fortune (https://fortune.com/2019/06/20/2020-us-census-question/)
- Measuring Maternal Mortality | Census Bureau (https://www.census.gov/content/dam/Census/programs-surveys/international-programs/stic/maternal-mortality-english.pdf)

Teacher Reflection Notes

US Census Scavenger Hunt Notes

US Census Scavenger Hunt (https://data.census.gov/)

	What does the data show?	Data Type and Tool
Type USA in the search bar Click the View Profile link on the left		
Education Type Education in the search bar Select Education Attainment		
Population Type USA in the search bar Click the View Profile link on the left		

Lesson 4. Day 6

Topic Description: In this lesson, students work together in the role they have been assigned and take on their responsibility to work through understanding the goal of answering the research questions. Create meaningful and effective survey prompts. Students will implement guidelines from the US Census Bureau and construct an electronic survey.

Objectives:

The student will be able to:

- Collaborate with group members to create effective prompts for a survey about the Final Project.
- Utilize tools to create an electronic survey to collect data.
- Determine if questions are easily understood.
- Predict how useful the data would be in answering the research question.
- Understand the goal of answering the research questions.

Outline of the Lesson:

Segment	Reason/Purpose
• Journal entry (15 minutes) • Review of US Census Bureau Resource: Measuring Maternal Mortality (5 minutes) • Group activity: creating survey prompts using guidelines. (20 minutes) • Creating electronic survey (15 minutes)	• Discuss important factors presented in the resource document. • Investigate survey tools. • Communicate final project guidelines. • Groups identify specific variables and develop data collection survey questions.

Student Activities
• Complete Journal entry. • Review and discuss Measuring Maternal Mortality. • Project Groups create survey prompts using guidelines. • Review the traits of “good” questions for effective surveys. • Groups create electronic survey

Teaching/Learning Strategies:

Students should plan to collect some data prior to Day 7 and then before day 8 data check-in to use as a base for discussion. They should use the survey they create in this lesson for the final project.

Journal entry: *Groups identify specific variables and develop data collection survey questions.*

- Review the traits of "good" questions for effective surveys that will reveal the information needed to answer research questions.
- Explain to students that everyone in the group is accountable for the work on the various stages of the final project and that they need to alternate roles. They also need to come to consensus on decisions related to data collection, questions for analysis, etc.
- Provide students with dates for the data check-ins/analysis with their own data. (These may need to be revised if sections take longer than anticipated.) Students should plan to collect some data prior to Day 7 and then before day 8 data check-in to use as a base for discussion.
- Identify research questions or describe the stories or discoveries that can be made through analysis of data. It is important that every group member contributes a few ideas before the group refines the ideas and selects, by consensus, one or two research questions.
- Groups identify the specific variables needed to analyze the data in order to answer their research questions.

Think-Pair-Share:

Journal entry: *Students will brainstorm, making a list in their journals.*

- **Pair:** students will share their lists with an elbow partner
- **Share:** Teacher will facilitate a round-robin, with each pair providing a response. Teachers will write these on the board. As a class, discuss what each guideline means.

Review or Measuring Maternal Mortality

- Use this as an example of issues to consider in questionnaire design. Remind students of previous discussion

Survey Tool Presentation

- Teachers will demonstrate how to use the survey tool to create their surveys. A link to creating a survey in Google forms is provided in the resources, but any survey tool that you have access to will work.

Group Work

- Groups will begin researching and investigating effective prompts for their project.
- They will record these prompts using the electronic survey tool of choice. (See example in resources.)
- Group members each complete the survey and evaluate the effectiveness of the initial survey questions.

Data Collection Students will use the last part of the class to plan how they will collect data for Final Project

- Class will review the data collection guidelines. Students should plan to collect an initial small sample prior to the next class.

Note: Remind students each day of the unit that they should be continuing to collect data.

Resources

- Measuring Maternal Mortality: ISSUES TO CONSIDER IN QUESTIONNAIRE DESIGN; U.S. Census Bureau (https://www.census.gov/content/dam/Census/programs-surveys/international-programs/stic/maternal-mortality-english.pdf)
- Google Forms: Creating a survey (https://support.google.com/surveys/answer/2372144?h)

Teacher Reflection Notes

Lesson 5. Days 7-8

Topic Description: Using Photos as a data source. In Units 1 and 2, we examined how data shapes our communication and decisions, primarily through text and numbers. This unit shifts our focus to images, demonstrating how diverse data forms can reveal cultural stories.

Objectives

The student will be able to:

- Analyze and interpret non-traditional data sources.
- Students will be able to identify and comprehend the various forms of data, including images, sounds, and smells, and understand how these non-text and non-numeric data types can convey information and stories.
- Explore the impact of data on communication and decision-making.
- Students will be able to recognize and discuss how data, in its various forms, influences the way we communicate and make daily decisions.
- Apply data analysis techniques to tell stories about their communities.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Think Pair Share: Researching Photos (20 minutes) • Groups planning time (25 minutes)	• Analyze and interpret photos/images as data sources • Groups narrow their project idea/theme, fine-tune their survey, and make a plan for further collection of data
Day 2 • Dollar Street Investigation (25 minutes) • Groups research project (30 minutes)	• Reactions to Dollar Street • What did they learn from the photos • Groups work together on their final project plan

Student Activities

Day 1

- Complete Journal entry.
- Research photos.
- Groups refine plans for final project

Day 2

- Investigate Dollar Street (See resources.) a website to help anyone to understand the world through photos. (25 minutes) Show TED Talk by Anna Rosling Rönnlund creator of Dollar Street.
- Students return to their groups to continue work on their projects. (30 minutes)

Teaching/Learning Strategies

Day 1

Journal entry: *"A picture is worth a thousand words." What does this mean to you? When have you heard it?*

- A photo/image can have a greater impact than words or numbers. An example is 1 billion dollars. We hear "a billion dollars" so frequently in the media so often now, it seems very normal. But, how big is a billion dollars actually? Have students do an image search to find out.
  - A photo/image can communicate multiple meanings and ideas.

Researching Photos

- This activity provides practice gathering photos as data related to a particular topic in preparation for gathering photos for their final projects.
- Find a free or royalty free photo to show the students.
- Ask each student to write a quick description about what they see and what they think the photo is communicating.
- Do a quick share out. Are there any common themes from the responses? What additional information is communicated by the photo?
- With an elbow partner, have students find a photo they feel conveys a thousand words.
  - Partners will write a description of what the photo shows and other information or meaning the photo conveys.
  - Have partners share their image and comments with the class. After each presentation, ask if any students see a different or additional message.

Group planning for final project

- Photos As Data for Final project
- Explain that this is an opportunity to look at the data they collected already, compare with their group members and decide on any revisions needed to make the data entry more consistent and useful in answering their proposed research questions. Then they will begin to collect images for their final project.

Note: This activity will continue at the end of the next set of activities, so they should prioritize finishing the survey revisions and fine tuning their topic.

    - Groups merge the data they collected and make revisions to survey as needed.
    - Groups will fine tune their topic and research questions.
    - Groups will collect images from online, newspaper archives, or record their own for their final project. Remind students that they may choose to create a slide presentation, a poster, website, or video for their final project presentation.
  - Teacher will monitor student groups answering questions and helping groups decide on a topic.
  - Prior to the end of class, remind students that they should continue collecting data.

Day 2

- Investigate Dollar Street (See resources.), a website to help anyone to understand the world through photos.
  - Show TED Talk by Anna Rosling Rönnlund creator of Dollar Street (See resources.).
    - Possible TED Talk discussion prompts:
      1. How do the images and perceptions of the world we see in the media influence our understanding of global income disparities and living conditions?
      2. What insights can we gain from comparing everyday items in homes across different income groups and countries, as shown in the Dollar Street project?
      3. How does it challenge stereotypes and preconceived notions about different cultures?
      4. How does the use of visual data, such as photos and videos, enhance our understanding of global living conditions, income levels, and daily life? What are the advantages and limitations of using visual data in this context?
      5. In what ways can the Dollar Street project be used to promote empathy and understanding between people of different backgrounds? How might it inspire action or change in the way we perceive and address global issues?
- Students return to their groups to continue work on their projects.
  - Groups should continue from where they ended prior to the Dollar Street activities.
  - Groups should focus on what type of images they need to collect: from the internet, newspaper archives, or capturing their own images and video.
- Remind students to continue to collect data and add ideas to their notes on the final project throughout the remainder of the unit.

Resources

- Dollar Street (https://www.gapminder.org/dollar-street)
- TED Talk by Anna Rosling Rönnlund creator of Dollar Street (https://www.ted.com/talks/anna_rosling_ronnlund_see_how_the_rest_of_the_world_lives_organized_by_income)

Teacher Reflection Notes

Lesson 6. Days 9–10

Topic Description: Using data to solve problems. This lesson is reflective of Unit 2 Problem Solving process lessons. Students will understand the importance of data and how it contributes to the problem-solving process. Groups will evaluate rural and urban medical facilities comparing contrasting data. Analyze data and develop products then present their findings.

Objectives:

The student will be able to:

- Understand the complexities of collecting, processing, and analyzing data sets.
- Identify the specific variables needed to analyze the data
- Interpret data and draw conclusions to solve problems
- Identify stakeholders and issues of particular populations
- Understand the problem-solving process

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Hospitals and Communities Site Preview (20 minutes) • Hospitals and Communities Presentation (20 minutes) • Wrap up (5 minutes)	• Students will reflect on previous lessons and form conclusions. • Understand the problem-solving process • Acclimate students to the data. • Evaluate the data and draw a conclusion • Interpret data and design product • Collect thoughts and materials
Day 2 • Med-PaLM, our expert-level medical LLM|Research Med-PaLM (5 minutes) • US Health Presentation (25 minutes) • Gallery Walk Presentations/ Discussions (20 minutes) • Wrap Up (5 minutes)	• Understand the complexities of collecting and using data to solve problems • Evaluate the data and draw a conclusion • Interpret data and design product • Review visual interpretations of different states • Discuss findings

Student Activities

Day 1

- Complete journal entry.
- Hospital and Communities Site Preview
- Present Hospital and Communities project.
- Participate in wrap up

Day 2

- Watch Med-paLM Video.
- US Health Presentation
- Participate in gallery Walk Presentations/Discussions
- Participate in wrap up (5 minutes)

Teaching/Learning Strategies

Journal entry: *What are some ways you could use data to find solutions?*

- As students reflect on the journal prompt, discuss situations where possible racial disparities and socioeconomic factors could exist. Use the discussion to transition to the next activity.

Hospital and Communities Preview

- Intro: Provide the Rural Health Information Hub (See resources.)
- Select the Topic & States tab,
- select Healthcare Access in Rural Communities link,
- Allow students a few mins to read the page. You may ask students to take note of the frequently asked questions sections.
- Briefly discuss how this problem could be solved?

Hospitals and Communities Presentation

- Create poster presentation
- Rural Health Information Hub website (http://www.ruralhealthinfo.org)
- Each group must prepare a poster representing their thoughts on the State's rural healthcare system. Assign states to groups and allow each group to complete
- Select the Topic & States tab, then select State Guide, choose State. Posters should reflect their view on the state's current healthcare systems and how to solve the problem. Encourage students to be original as the differences should all reflect different interpretations and approaches to solving the problem. Point back to Unit 2.

Wrap up

- Remind students to continue collecting data and add to their final project notes.

Day 2

Google Palm Video (See resources.)

- Students should keep in mind the benefits and issues that may arise from this technology. The video should be shown before assigning the presentation.

US Health Presentation

- Reflecting on yesterday's lesson, divide the class into small groups.
- Provide the link to either US Pregnancy Related Deaths or AI told me I had cancer (See resources.)
- Today's Poster should address the problem and a possible solution. Students are encouraged to review the page and present their findings and representation on the poster.
  - Questions Who, What, How should be answered. Students can present their data as images, tables, text, etc. Search US Pregnancy-related deaths on The Rise, July 2023 or see resources for link.
    - U.S. pregnancy-related deaths on the rise | NHLBI, NIH

Gallery walk review and discussion

- Groups will present their posters on the walls allowing students to view each other's work leaving comments on sticky notes. Teachers should encourage students to leave notes about the presentation or any thoughts the poster may provoke. Groups share out and discuss. Allow each group to discuss their findings.

Journal entry: *What new knowledge was gained from interpreting data? Do you see any connections with your final project?*

Wrap-up and closing

- Show students a map of a metro city's area hospitals and clinics (example: Chicago. See resources.) What stood out or is significant about the data?
- What does the data on the screen mean?
- Remind students to continue to collect data and add to their final project notes.

Resources

- Med-PaLM, our expert-level medical LLM|Research Med-PaLM (https://youtu.be/k_-Z_TkHMqA?si=1Q1RIdBpk3DwCT6O)
- AI told me I had cancer (https://www.wired.com/story/artificial-intelligence-cancer-detection/)
- U.S. pregnancy-related deaths on the rise | NHLBI, NIH (https://www.nhlbi.nih.gov/news/2023/us-pregnancy-related-deaths-rise)
- Rural Health Information Hub (http://www.ruralhealthinfo.org)
- HRSA High Need Mapping Tool (https://data.hrsa.gov/maps/health-equity)
- KFF State Health Facts (https://www.kff.org/statedata/)

Teacher Reflection Notes

Lesson 7. Days 11-12

Topic Description: This topic will equip you with the essential skills to transform raw data into map visuals, revealing hidden patterns and insights. Visualizing data with maps is a skill that is essential for various fields, including urban planning, public health, marketing analysis, environmental science, and more. This topic will empower you to tell compelling stories with maps and data.

Objectives

The student will be able to:

- Translate addresses into latitude/longitude.
- Sort files of data.
- Create subsets of data.
- Read location data from a file and plot points on maps.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Think-Pair-Share: Location data: maps, data sets, longitude and latitude, metadata included in photos (15 minutes) • Introduction to creating a Google Map layer from a Google Sheet, from a CSV file (30 minutes)	• Think-Pair-Share; reflect on experiences reading map visualizations and data • Brainstorm various ways to find locations in your neighborhood, on your phone, and on a map. What data is needed/helpful • By investigating layers in Google Maps, students will learn how to create their own maps
Day 2 • Adding images to a map layer (25 minutes) • Pinning information to a map using longitude and latitude. (30 minutes)	• Students will practice creating a layered map by pinning images to a Google Map. They will use metadata from their own photos. • Students will use either Google Sheets or MSExcel to create a map using an existing data set which includes longitude and latitude data.

Student Activities

Day 1

- Complete Journal entry.
- Think-Pair-Share: Map Location Brainstorming.
- Create Google Map layers by pinning locations to a Google map from an open data source.

Day 2

- Investigate information available on Google maps.
- Create a map layer about a topic of their choice.

Teaching/Learning Strategies:

Day 1

Complete journal entry: *Consider the data that you have been collecting for the final project. How might seeing the data on a map help you analyze it?*

Note: Before beginning this activity, become familiar with Google My Maps. (See resources.) This may require you to have a Google Gmail account.

Think-Pair-Share: Map Location Brainstorming

- Ask students to write down the types of information they might need to find a location on a map. This may include locations in the school, community, city/town, state, etc.
    - Location data may include: maps, GPS apps and devices, data sets, longitude and latitude, metadata included in photos, etc.
- Share with a partner
- Partners share with the class

Creating map layers in Google maps.

- Students will investigate how to add (pin) locations to a layer in Google maps by importing longitude and latitude data from a csv file, gathering location metadata from photos, and using street addresses.
    - Many municipalities, counties and states post open data sources online for the public. Before the lesson, locate several of these open-source sites and identify a variety of files containing longitude and latitude data to use for demonstration with the class.
    - Student investigation
- While working with a partner, have students research an open data source of interest containing longitude and latitude information. Students will create a map layer and place the location data on the map.
- Remind students to continue to collect data and add to their final project notes.

Day 2

Adding images to a map

- Using Google (or any available browser), ask students to do a search for their home address and locate the pin on the Google map. What happens when they mouse over the pin? What happens when they click on the pin? What information is available about their home address?
- Now ask students to do a search for a specific type of place in your community or city. For example, students might search for city parks, a fast-food chain, grocery stores, schools, movie theaters, etc. Encourage students to search for an item that will have multiple instances in your community or city. What information is available when they mouse over the pin or click on the pin? Do other types of businesses/locations appear on the map? What are they? Why do you think they were included in your search?

Pinning images to a map

- Ask students to collect at least 4 photos of favorite locations in their communities. Add them to a layer on a Google Map. (Students may use previous maps they created if they wish.) Add information to the map pins about the location and why it is a favorite place. Show students how to save the maps. Are they able to share the maps? Ask students what kind of maps they might make and share?

Note: Think back to previous problem solving and programming units, data privacy, and ethical issues.

- Extra Fun: Ask students to pretend they are going on a trip to another city/country. Have students create a map of sites they will want to visit.

Note: Remind students to continue to collect data and add to their final project notes.

Resources

- Google Maps (https://www.google.com/mymaps)

Teacher Reflection Notes

Lesson 8. Days 13-14

Topic Description: Visualizing data with maps and bubble charts are skills that are essential for various fields, including urban planning, public health, marketing analysis, environmental science, and more. This topic will empower you to tell compelling stories with maps and data.

Objectives:

The student will be able to:

- Read location data from a file and plot points on maps.
- Create bubble plots on a map.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Final project check in (10 minutes) • Bubble Maps Investigation (15 minutes) • Creating a Bubble Map with collected data (30 minutes	• Updates on final project status • Bubble maps are an effective way to visualize a multidimensional data set. • students will create bubble charts and analyze them
Day 2 • Gallery Walk: Data Storytelling using Maps and Bubble Maps (55 minutes)	• Student pairs will share their/present their visualizations with neighbor partners.

Student Activities
Day 1 • Final project check in • Investigate Bubble Chart guide and examples • With a partner, students will search an open data source to use to create a Bubble Chart or Bubble Map **Day 2** • Gallery Walk: Partners will present their Bubble Charts/maps to another group. Then they will switch and provide feedback to that group.

Teaching/Learning Strategies

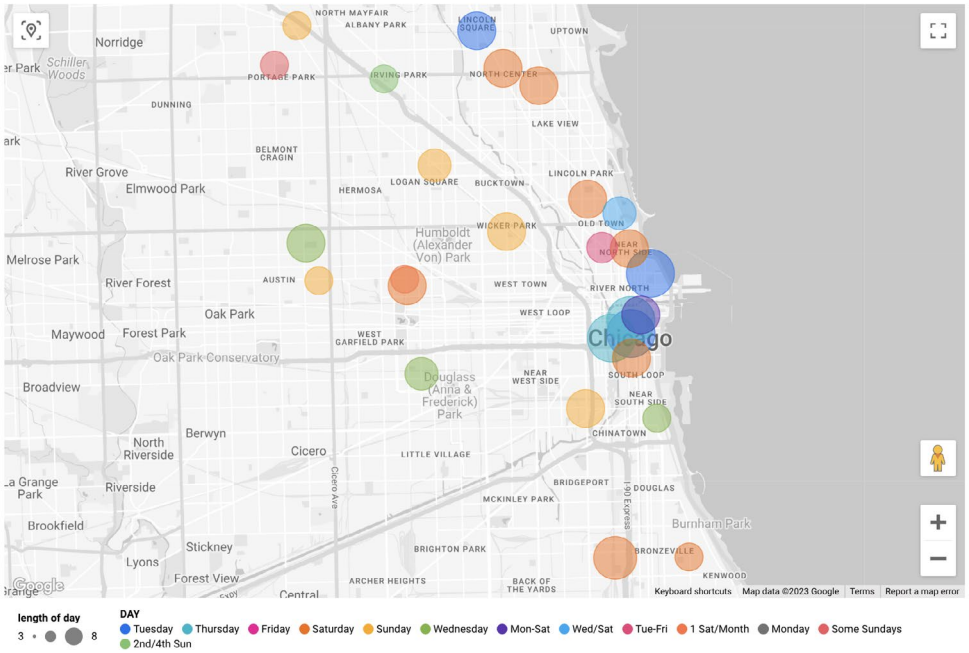
Day 1

Final project check in

- Give final project groups a few minutes to compose one or two questions they have at this stage of their work
- Check in with each group
- Remind students that the activities they are doing are practice for doing the analysis for their projects This set of activities is about Bubble Charts and maps.

Investigate Bubble Charts & maps

- A bubble chart/map visualization combines 3 related types of data to communicate information. These fields typically combine: location, size, and color. Users can communicate data similarities and contrasts by the size, color and location (coordinate access or map) of a bubble (circle). For example, a bubble map could be used to show schools in a city. The size of the circle might be determined by the number of students, the color could be determined by the type of school (pre-K, K-5, 6-8, and 9-12) and its orientation on the map will show its location.
- Example: Farmers Markets in Chicago (See additional resources.)



Bubbles: Color represents day of the week; size represents hours open.

- Provide students with a link to an open data source from your community, city, county, or state. Have students search for a data set to use to create a bubble map. Their data set should include either longitude and latitude data or postal addresses. In order to save time, you can suggest a theme for the map, or preselect several data sets that contain compatible data of a bubble map visualization.

Day 2

Gallery Walk

- Each partner group will prepare a short presentation about their map and their bubble map.
- Half of the class will stay at their computers to present, while the other half visits 2 different groups. Each station will present to one group at a time. Next the groups will switch roles and the first presenting group will visit the other half of the class, listening to 2 presentations.

- Remind students to continue to collect data and add to their final project notes.

Resources

- Famers Market Map (https://lookerstudio.google.com/reporting/d3e3fd39-24bf-434a-8c7c-efbe03cf79ac)
- Chicago Data Portal Farmers Markets Map (https://data.cityofchicago.org/Environment-Sustainable-Development/Farmers-Markets-Map/atzs-u7pv)
- A Complete Guide to Bubble Charts. (https://www.atlassian.com/data/charts/bubble-chart-complete-guide)

Teacher Reflection Notes

Lesson 9. Days 15-17

Topic Description: Bar plots and the differences between categorical and continuous data are explored. Mosaic plots are introduced as a vehicle for comparing categorical data and looking for trends in data.

Objectives

The students will be able to:

- Read and Interpret a bar plot.
- Create bar plots.
- Differentiate between categorical and continuous data.
- Look for trends by analyzing various plots.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Birth Months Bar Plot (30 minutes) • Final project group session (20 minutes)	• Students discuss how they will be grouped according to their birth month. • Form your outline for your final project. Collect data to use with your final project.
Day 2 • Journal entry (10 minutes) • Public Agenda Bar Plot Activity (45 minutes)	• Experiment with bar plots.
Day 3 • Journal entry (5 minutes) • Public Agenda Data and Mosaic Plots • (35 minutes) • Final project group session (15 minutes)	• Categorical data. • Experiment with Mosaic Plots • Incorporate plots into the final project.

Student Activities

Day 1

- Complete journal entry.
- Participate in the Birth Month Bar Plot discussion.
- Experiment with bar plots commands.
- Work on outline for final project.

Day 2

- Complete journal entry.
- Public Agenda Bar Plot Activity.
- Respond to questions during guided discussion.

Day 3

- Complete journal entry.
- Complete questions in Public Agenda Data and Mosaic Plots Activity.
- Group Session

Teaching/Learning Strategies:

Review Public Agenda link prior to class. (See resources.) You will share this at the beginning of class with the students. Explain what it is and how it is used. You may want to relate it to something in your own school to give the students an additional example of how a survey data file holds data collected by the private group Public Agenda. Remind students that the day's activities are examples to practice in preparation for including these ideas in their final projects.

Day 1

Journal entry: *If everyone was going to be put in a different group based on the MONTH in which they were born, how many groups would there be? Which group do you think would have the most people?*

Birth Month Bar Plot

- Tell students that you are going to create a bar plot (also called a bar graph or bar chart) of everyone's birth month to answer the journal question.
- Have students help you create the skeleton of a bar plot like Sample Birth Month Bar Plot. You should end up with a similar chart, but without any counts (bars).
- Ask each student what their birth month is. Increase the height of the corresponding bar by one until the entire class has responded.
- The bar plot should be used for categorical data only.
- Categorical data is expressed in terms of specific category values or labels (e.g., days of the week, answers to a multiple-choice survey).

- Explain to the students that if we tried to do a bar plot of every student's exact height (example of 68.901 inches), we would most likely end up with a bar plot with a bar for every student each with a height of one. This type of data is quantitative (e.g., decimal numbers).

Final project group session

- Final project groups consider how they might use the information learned today in their final projects and what data they have collected themselves or found from other sources would be appropriate
- Remind students to continue to collect data and add to their final project notes.

Day 2

Journal entry: *Do you think there is a relationship between grades and effort? If so, what type of relationship do you think grades and effort might have?*

Public Agenda Bar Plot Activity

- Explain that the survey data file holds data collected by a private research group called Public Agenda (www.publicagenda.org). It is a survey of high school students and their parents designed to see if both groups have the same view of what's working (or not) with our schools. The people in the survey were identified by random selection from a list of all high school students in the United States. Respondents were asked over 100 questions—the file that will be used is a small subset.
- Have students load the survey data file. Ask questions such as: How many different students are represented? (1293.) How many different questions were asked of a student. (Survey contains four (4) of the over 100 questions.)
  - Ask: What are the variables?
  - "year" is their year in school
  - "effort" describes how hard they are working at doing well in school
  - "homework" describes their view of the amount of homework they are getting, and
  - "grades" records how well they said they are doing in school
- Highlight the type of each variable and possible values that are assigned to each variable.
- Demonstrate how to create a bar plot. Point out that a bar plot is a graphical representation of the table and each bar should correspond to the count in the table.
- Have students complete Public Agenda Bar Plot Activity individually.
- Lead a discussion of the answers to Public Agenda Bar Plot Activity.
  - Each of the responses should generate a discussion beyond the simple solutions. Ask questions that encourage students to provide justifications for their conclusions and highlight possibilities for additional research.

Depending on your classroom engagement this lesson may be completed or carried on to the next day.

Day 3

Journal entry: *Which items in the data you are collecting are categorical?*

- Allow students to provide a response.

Public Agenda Data and Mosaic Plot

- Reload the survey data file, if necessary.
- Demo looking at two variables at once with mosaic plots and guide a discussion with students.
- Note that in the previous section, bar plots about grades and effort were looked at separately.
- A good question to ask is "are the two related?" If so, how?
    - **Discuss** the journal entry.
- Create a contingency table with data to show the relationship between the answers to the two questions.
    - Ask students to explain what the items in the table mean. For example, there are 311 students that earned an A and are trying their best to do well in school. To represent this graphically, we can use a mosaic plot.
- Demo how to create a mosaic plot to graphically compare the 2 categorical variables grade and effort.
- How to interpret the mosaic plot:
    - The wider the columns, the more responses there are in that category.
    - Point out that the labels may not line up correctly.
    - Allow students time to respond individually to questions such as the following before discussing them as a group.
    - What grade is the most common?
    - What grade is the least common?
    - Does that reflect the numbers in the table?
- Within each column, the taller the row, the more responses there are in that category.
- Allow students time to respond individually to questions such as the following before discussing them as a group.
    - Within those students with A's, are most of them trying their best or could they try harder?
    - Within those students with B's, are most of them trying their best or could they try harder?
    - All the sizes are proportional to the numbers in the tables. So if twice as many respond a certain way, then the height would be twice as tall in the mosaic plot.
    - Looking at the mosaic plot as a whole, is there a trend? What story does it tell?
- Have students complete the Public Agenda Data and Mosaic Plots Activity individually.
- Discuss student responses and ask probing questions that will lead to discussion of the data.

Final Project group session

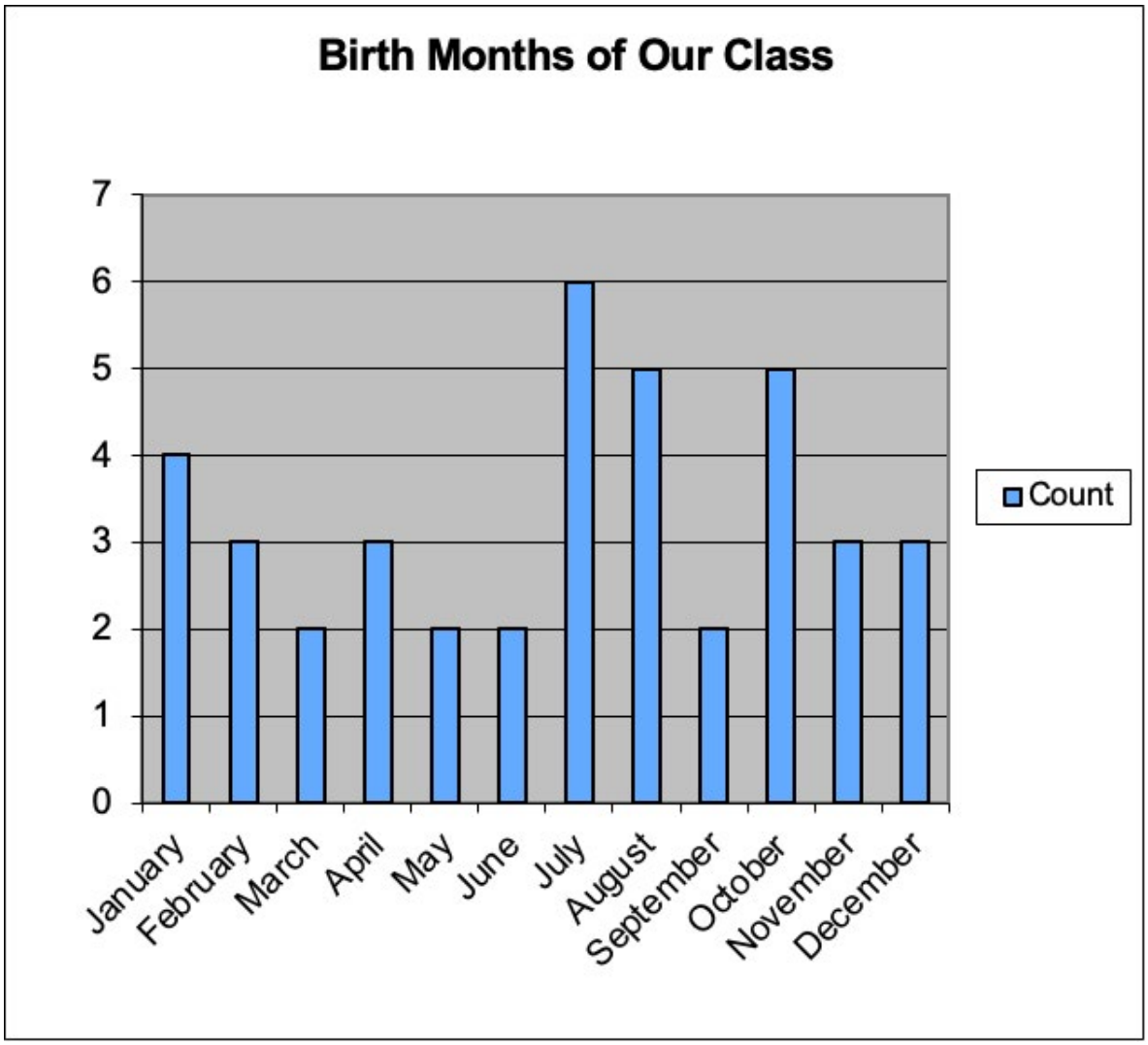
- Students think about their final project and discuss which of these visualizations they might use and why. Reflect- how might the activities in these lessons be used with your final project?
- Remind students to continue to collect data and add to their final project notes.

Resources

- Public Agenda (www.publicagenda.org)
- Sample Birth Month Bar Plot
- Public Agenda Bar Plot Activity
- Public Agenda Data and Mosaic Plots Activity

Teacher Reflection Notes

Sample Birth Month Bar Plot



Public Agenda Bar Plot Activity

1. Create a bar plot for effort.
   - Copy the plot to a document.
   - How does the effort of the students that responded compare?
2. Create a bar plot for homework.
   - Copy the plot to a document.
   - How much homework did most students respond to that they have?
   - How do you think that compares with students at your school?
   - If you think responses about homework are different from those at your school, why do you think students in this survey might have responded as they did? How could you test your assumption?
3. Create a bar plot for grades.
   - Copy the plot to a document.
   - What grade is most common?
   - How do you think that compares with students at your school?
   - If you think grades are different from those at your school, why do you think students in this survey might have responded as they did? How could you test your assumption?

Public Agenda Mosaic Plot Activity

1. Create a contingency table with effort as the row and grade as the column.
   - How does this table compare to the one with grade as the row and effort as the column?
2. Create a mosaic plot with (effort, grades)
   - What do you see in this plot?
   - Compare your plot to the one done previously. Does it tell a different story? Justify your answer with features of the plot.

Try making mosaic plots with three different combinations of the available variables: year, effort, homework, grades. Choose one of these other plots, describe what you see, and explain what story it tells.

Lesson 10. Days 18-19

Topic Description: In this lesson students explore how stakeholders use big data and why. Students will see how data is collected and how it is used then determine whether its use is ethical or unethical.

Objectives

The student will be able to:

- Investigate the stakeholders who use big data and why
- Explain how data is collected on and how it is used
- Discuss the ethics of big data use

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (10 minutes) • Discuss Big Data characteristics (30 minutes) • Data collection (15 minutes)	• Different types of data companies collect from your online activities • Revisit Unit 4 Day 2, how Big Data is characterized by the five V's.
Day 2 • Journal entry (10 minutes) • Discuss Big Data uses (30 minutes) • Final Project group session (15 minutes)	• Why do companies want to collect data from us? • Explore ways Big Data is used. • Extracting data from data sets

Student Activities
Day 1 • Complete journal entry. • Discuss Big Data characteristics. • Explore data collection. **Day 2** • Complete Journal entry • Discuss what big data is used for. • Participate in final project group session

Teaching/Learning Strategies:

Day 1

Big Data is large data sets that are analyzed in order to identify patterns and trends, often used by organizations to better understand their customers

Journal entry: *How many different types of data and what kind of data do you think companies collect on you from your online activities? Have you given explicit permission to them to collect your data?*

- Have students write responses to the question in their journals and then share the response with their elbow partner.
- Ask a few student pairs to share their responses.

Exploring data collection

- Some students may have only stated Purchases, Location, and Search History while others may have recognized other examples to share.
  - A selection of possible examples: (Examples of ways data is collected include: mouse movement, contact details, which advertisements you have watched or clicked on, demographic information (e.g., age, gender, job), conversation, computer characteristics (e.g., browser, battery life, screen size). This might be a useful discussion point, either now or later in the lesson.
  - Divide students into groups of 3 or 4. Ask the students to discuss additional
  - examples of ways data is collected. Have students write their examples on post-its and add them to a large chart at the front of the room or have groups make a list on flipchart paper and tape their list somewhere in the classroom.

- Reflect back to Unit 5 Day 1 Understanding what is 'Big Data'. Revisit the concept of Big Data, the 5 V's of Big Data (Volume, Variety, Veracity, Velocity and Value).
  - Big data is defined as:
    - Large data sets which are analyzed in order to identify patterns and trends, often used by organizations to better understand their customers.
  - Big data is characterized by the five V's:
    - Volume: the amount of data in the data set
    - Variety: the different types of data in the data set
    - Velocity: the speed at which the data set is produced and how long it remains accurate
  - Remind students to continue to collect data and add to their final project notes.

Day 2

Journal entry: *Why do you think companies or organizations might want to collect data from you?*

- Have students share their responses with their elbow partner.

Big Data Use Activity

- Have partner pairs share their responses and add them to a running list. (Some possible response: improve or streamline services, targeted advertisement, optimize project management, identify criminal activity,, identify voter behavior,
- Have each pair choose 3-4 of the responses and then answer the following questions:
    - What are 2 organizations that you think might use the data this way?
    - For each organization what data would they need?
    - Are there any privacy issues with this data collection? Other concerns or unintended consequences.
- Students share their responses with the class
    - ***Can you think of an organization that might use big data in this way?***
    - Improve and streamline service
    - Target advertisements towards customers
    - Optimize project management
    - Identify criminal activity
    - Predict voter behavior
- Remind students to continue to collect data and add to their final project notes.

Resources

- No additional resources needed.

Teacher Reflection Notes

Lesson 11. Days 20-21

Topic Description: In this lesson, students will be presented with several simplified and scaled-down big data sets. They will be asked to extract information they consider to be useful from these data sets. Students will discuss how the use of big data might be helpful or harmful.

Objectives:

The student will be able to:

- Define data analytics
- Discuss what data analytics might involve.
- Understand machine learning and how it works
- Complete the data sets on Activity 1 worksheet.
- Discuss what useful information comes from StreamNow and BuyOnline.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Define Data Analytics (5 minutes) • Data collection (10 minutes) • Discussion what data analytics might involve (15 minutes) • Watch Machine Learning Video (2 minutes) • Data analytics - Activity 1 (15 minutes)	• Explore different techniques that are used to combine different types of data and extract meaning from them?
Day 2 • Journal entry (5 minutes) • Ethic of Big Data Use (15 minutes) • Discuss is big data ethical? (15 minutes) • Big data ethic activity (5 minutes) • Discuss misuse of big data sets (15 minutes)	• Students will articulate their perspectives on the ethical considerations surrounding the use of big data. • Discuss privacy violations, discrimination, inaccuracies and data theft.

Student Activities

Day 1

- Complete Journal entry
- Define data analytics
- Discussion what data analytics might involve
- Understand how machine learning works
- Complete Data analytics - Activity 1

Day 2

- Complete journal entry
- Ethics of Big Data use
- Big Data ethics
- Discuss is Big Data ethical
- Discuss misuse of Big Data sets

Teaching/Learning Strategies:

Day 1

Journal entry: *What different techniques are used to combine different types of data and extract meaning from them?*

- Have students write responses to the question in their journals and then share the response with their elbow partner.
- Ask a few student pairs to share their responses.
- How might they use these techniques in their final projects?

What is data analytics

- Big data sets are analyzed using data analytics. These are the techniques used to combine different types of data and extract meaning from them.

Data Analytics

Introduce the concept of data analytics and the process of extracting meaning from data. To do this, you can discuss the following analysis techniques (your students do not need to understand how to put them into practice, but an understanding of the theory behind them may help with the next task). Have students describe in their own words what they think each of these includes.

- Data analytics might involve:
  - Machine learning: Revisit what is machine learning that was covered in Unit 1
  - Text analysis
  - Predictive analysis
  - Optimization problems
  - Cleaning and combining data sets: Revisit the initial data collection they did and the process of merging

Data analytics Activity

- Present your students with a few data sets of your choice—these can be ones they have seen in prior lessons of new ones. For each data set, what useful information can they extract?
  - Students will take a look at the data sets. For each data set, have them explain what useful information they can extract?
    - Big data involves the collection of data, often without the data subject's awareness. While there are many different uses for big data, and it is often used to improve services and help people, its collection and use can raise ethical concerns. It is important that students are aware of, and feel able to discuss, the ethics of big data.
  - In pairs, ask students to discuss what they think about the examples they have just analyzed. Do they feel comfortable with companies collecting these forms of data about them and using it in this way?
    - Have students write their thoughts in their journals to be revisited later

Note: Remind students to continue to collect data and add to their final project notes. Let them know what day they will begin working on the final project.

Day 2

Journal entry: *"What ethical concerns might arise from the use of big data?"*

Have students discuss with their partner the examples of data sets they have just analyzed and decide whether they think it is OK for data to be used in this way. Each pair should address the following questions: Which of the data sets would you be happy for your data to be included in?

- Are you comfortable with the way the data was used?
- What rules do you think there should be to regulate how data is analyzed?
- What useful information could you learn from them, if you were:
  - StreamNow?
  - AmazonOnline?
- Were the practices you used in your own data collection ethical? Why or why not?

Is big data ethical?

- Big data sets have sometimes been misused. Some examples of misuse are:
  - Privacy violations
  - Discrimination
  - Inaccuracies
  - Data theft
- Have students work with their final project partners to examine the list of datasets they are planning to use in their final project analysis in addition to the data they collected themselves.
  - For each dataset have them identify potential misuses of the data that was collected to create the dataset and indicate specific examples.
- Have each group share their findings with the whole class.
  - After each presentation ask questions to continue probing the ethical use of data

To wrap up the conversation, have students consider the discussion they have just had and consider: ***Do you believe that big data is ethical? Do you agree with this statement? Summarize your thoughts in your journal.***

Resources

- What is Machine Learning? video (https://www.youtube.com/watch?v=QghjaS0WQQU)

Teacher Reflection Notes

Lesson 12. Days 22-26

Topic Description: In this lesson students will show how each group member has contributed by working together and composing their final project.

Objectives

The student will be able to:

- Incorporate all objectives of the unit into the final project.

Outline of the Lesson:

Segment	Reason/Purpose
Day 1 • Journal entry (5 minutes) • Review final project description and rubric (5 minutes) • Group Session (35 minutes) • Wrap up (10 minutes)	• Organize the collection of data you have. Form a draft for your final project.
Day 2 • Journal Entry (5 minutes) • Group Session (50 minutes)	• Identify the specific variables needed to analyze the data that will support their research questions.
Day 3 • Group Session (55 minutes)	• Students use class time to work on their final project.
Day 4 • Group Session (55 minutes)	• Analyze and refine findings as needed and create presentations.
Day 5 • Group Session (55 minutes)	• Groups present their findings.

Student Activities

Day 1

- Complete journal entry.
- Participate in discussion of final project description and rubric.
- Participate in a group session.

Day 2

- Participate in discussion.
- Participate in a group session.

Day 3

- Work on the final project.

Day 4

- Complete final project.

Day 5

- Present final project findings.

Teaching/Learning Strategies:

Students are in the beginning phases of developing their final project. You will have one week to complete your final project and then you will present.

Process:

1. Start writing your final project.
2. Reflect on the data collection you have kept record of up until this point.
3. Develop and Outline to help guide you through this process.
4. Document any changes you wish you could make to your original research questions and surveys.
5. Document the steps you take in your analysis and creation of your presentation.

Day 1

Journal entry: *Think about the information you've gathered. What did you learn from the data analytics discussion that will help you in completing your final project?*

- Review Final Project Analyzing Data and Final Project Sample Rubric (See resources.)
- Groups discuss roles and responsibilities.
  - Everyone in the group is accountable for the work on the various stages and that they need to alternate roles.
- Groups review the research questions they formulated in Lesson # 4 and any refinements they made along the way and predict how useful the data they have will be in answering the

research questions.
- Groups identify the specific variables needed to analyze the data in order to answer their research questions.
- Groups document how they would revise the survey questions to better fit the goal of answering the research questions.
- Document as they proceed.

Day 2

Journal entry: *How will the variables you chose help you analyze the data and answer the questions you posed?*

- Groups choose one or two research questions to answer and document what analysis needs to be done with their data.

Day 3

- Groups conduct analysis on their data, documenting their steps.

Day 4

- Groups finalize analysis.
- Groups create project presentations.

Day 5

- Final project presentations
  - Student teams present their findings to the class.
  - Other teams ask questions and participate in the discussion.

Resources

- Final Project Analyzing Data
- Final Project Sample Rubric

Teacher Reflection Notes

Final Project

Analyzing Data

In the course of the past few weeks, your group has analyzed data. Now it is your turn to tell an interesting story based on the data. You will present your story to the class (it can be a series of web pages or a Scratch program). You must include plots/graphics that support the story.

You may include data from any of the other data sets you've seen in the lessons. However, these data cannot be the primary source of your story.

You will have access to data from your classmates as well as students in other classes that have also collected data. Keep in mind that you have already done some analysis on your data. This is your opportunity to pull it all together, modify as necessary and tell a compelling story that makes a case or highlights a discovery.

Final Project Sample Rubric

Name: _____

Do You Have?	Points Possible	YES	NO	Points Earned
The Project				
• A title with your group members' names	5			
• Clear statements detailing the purpose based on your data? (Your project should show how this data supports your story.)	10			
• 2 or more descriptive plots	10			
• Other types of visuals	10			
• A description of why you chose the visuals you did	10			
• Address how you can use this data to make a difference	10			
• Bring in data from an outside source that supports your story	10			
The Presentation				
• The number of items are in your data sets based on how valid your story is and an explanation.	10			
• An explanation of what you learned in this unit (analysis techniques, etc.)	10			
• Final project uses appropriate features for the medium	10			
Total	100			

Unit 5: Robotics

For the 2025-26 Academic Year, use ECS v9.0 Unit 6: Robotics