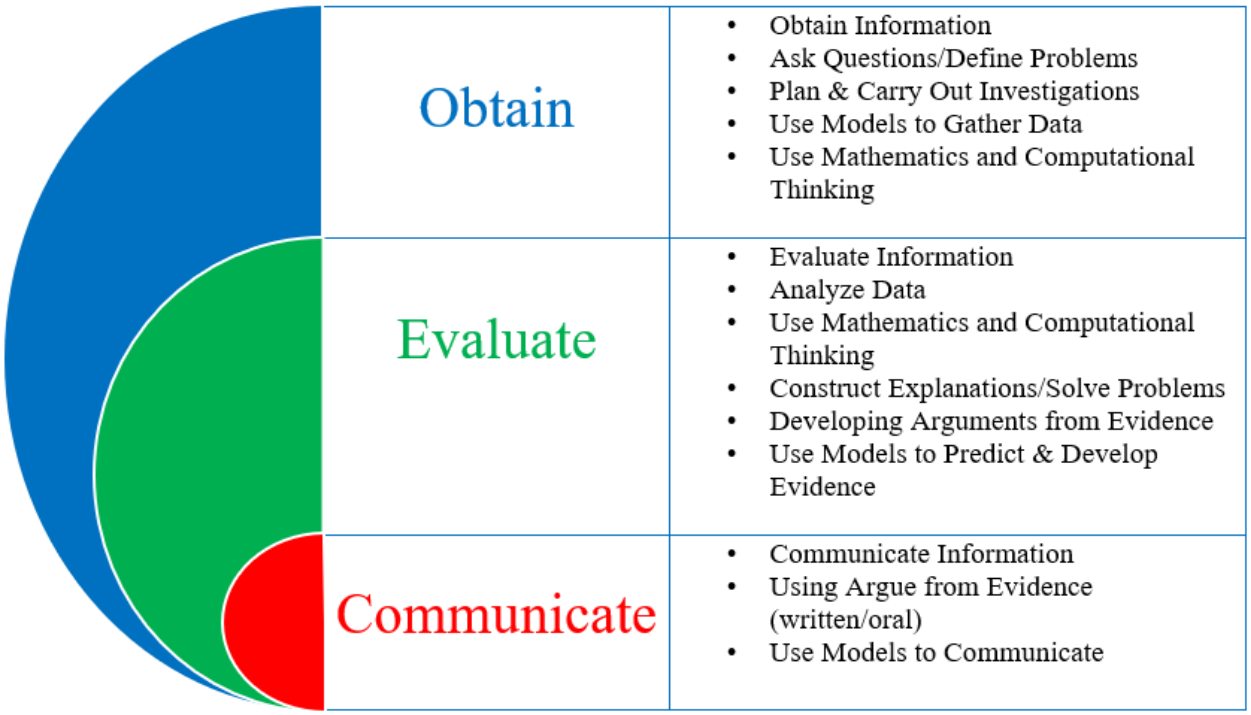
Color-coded Georgia Standards of Excellence

Each standard in K-12 science courses begin with "Obtain, evaluate, and communicate…" The common language was intended by writers to provide consistency throughout courses, highlight the science practices, and incorporate scientific literacy. Simply put, it is what scientists do.

Science and engineering practices:

- Asking questions (science) and defining problems (engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics, information and computer technology, and computational thinking
- Constructing explanations (science) and designing solutions (engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

The color-coded standards are a visual of how the specific elements of science standards engage *students* in obtaining, evaluating, and communicating information.



Various practices require students to obtain, evaluate, and communicate information simultaneously; see the following example of 7th grade life science:

S7L4c. Analyze and interpret data to provide evidence for how resource availability, disease, climate, and human activity affect individual organisms, populations, communities, and ecosystems. The first part of the science practice involves *evaluating* information as students analyze and interpret data; in addition, since they are providing evidence, this practice also requires students to *communicate* their findings and analysis.

Biology

SB1. Obtain, evaluate, and communicate information to analyze the nature of the relationships between structures and functions in living cells.

a. Construct an explanation of how cell structures and organelles (including nucleus, cytoplasm, cell membrane, cell wall, chloroplasts, lysosome, Golgi, endoplasmic reticulum, vacuoles, ribosomes, and mitochondria) interact as a system to maintain homeostasis.
b. Develop and use models to explain the role of cellular reproduction (including binary fission, mitosis, and meiosis) in maintaining genetic continuity.
c. Construct arguments supported by evidence to relate the structure of macromolecules (carbohydrates, proteins, lipids, and nucleic acids) to their interactions in carrying out cellular processes.
(*Clarification statement:* The function of proteins as enzymes is limited to a conceptual understanding.)
d. Plan and carry out investigations to determine the role of cellular transport (e.g., active, passive, and osmosis) in maintaining homeostasis.
e. Ask questions to investigate and provide explanations about the roles of photosynthesis and respiration in the cycling of matter and flow of energy within the cell (e.g., single-celled alga).
(*Clarification statement:* Instruction should focus on understanding the inputs, outputs, and functions of photosynthesis and respiration and the functions of the major sub-processes of each including glycolysis, Krebs cycle, electron transport chain, light reactions, and Calvin cycle.)

SB2. Obtain, evaluate, and communicate information to analyze how genetic information is expressed in cells.

a. Construct an explanation of how the structures of DNA and RNA lead to the expression of information within the cell via the processes of replication, transcription, and translation.
b. Construct an argument based on evidence to support the claim that inheritable genetic variations may result from:
   - new genetic combinations through meiosis (crossing over, nondisjunction);
   - non-lethal errors occurring during replication (insertions, deletions, substitutions); and/or
   - heritable mutations caused by environmental factors (radiation, chemicals, and viruses).
c. Ask questions to gather and communicate information about the use and ethical considerations of biotechnology in forensics, medicine, and agriculture.
(*Clarification statement:* The element is intended to include advancements in technology relating to economics and society such advancements may include Genetically Modified Organisms.)

SB3. Obtain, evaluate, and communicate information to analyze how biological traits are passed on to successive generations.

a. Use Mendel's laws (segregation and independent assortment) to ask questions and define problems that explain the role of meiosis in reproductive variability.
b. Use mathematical models to predict and explain patterns of inheritance.
(*Clarification statement:* Students should be able to use Punnett squares (monohybrid and dihybrid crosses) and/or rules of probability, to analyze the following inheritance patterns: dominance, codominance, incomplete dominance.)

c. Construct an argument to support a claim about the relative advantages and disadvantages of sexual and asexual reproduction.

SB4. Obtain, evaluate, and communicate information to illustrate the organization of interacting systems within single-celled and multi-celled organisms.

a. Construct an argument supported by scientific information to explain patterns in structures and function among clades of organisms, including the origin of eukaryotes by endosymbiosis. Clades should include:
   - archaea
   - bacteria
   - eukaryotes
     - fungi
     - plants
     - animals

   (*Clarification statement:* This is reflective of 21st century classification schemes and nested hierarchy of clades and is intended to develop a foundation for comparing major groups of organisms. The term 'protist' is useful in describing those eukaryotes that are not within the animal, fungal or plant clades but the term does not describe a well-defined clade or a natural taxonomic group.)

b. Analyze and interpret data to develop models (i.e., cladograms and phylogenetic trees) based on patterns of common ancestry and the theory of evolution to determine relationships among major groups of organisms.

c. Construct an argument supported by empirical evidence to compare and contrast the characteristics of viruses and organisms.

SB5. Obtain, evaluate, and communicate information to assess the interdependence of all organisms on one another and their environment.

a. Plan and carry out investigations and analyze data to support explanations about factors affecting biodiversity and populations in ecosystems.
   (*Clarification statement:* Factors include population size, carrying capacity, response to limiting factors, and keystone species.)

b. Develop and use models to analyze the cycling of matter and flow of energy within ecosystems through the processes of photosynthesis and respiration.
   - Arranging components of a food web according to energy flow.
   - Comparing the quantity of energy in the steps of an energy pyramid.
   - Explaining the need for cycling of major biochemical elements (C, O, N, P, and H).

c. Construct an argument to predict the impact of environmental change on the stability of an ecosystem.

d. Design a solution to reduce the impact of a human activity on the environment.
   (*Clarification statement:* Human activities may include chemical use, natural resources consumption, introduction of non-native species, greenhouse gas production.)

e. Construct explanations that predict an organism's ability to survive within changing environmental limits (e.g., temperature, pH, drought, fire).

SB6. Obtain, evaluate, and communicate information to assess the theory of evolution.

a. Construct an explanation of how new understandings of Earth's history, the emergence of new species from pre-existing species, and our understanding of genetics have influenced our understanding of biology.
b. Analyze and interpret data to explain patterns in biodiversity that result from speciation.
c. Construct an argument using valid and reliable sources to support the claim that evidence from comparative morphology (analogous vs. homologous structures), embryology, biochemistry (protein sequence) and genetics support the theory that all living organisms are related by way of common descent.
d. Develop and use mathematical models to support explanations of how undirected genetic changes in natural selection and genetic drift have led to changes in populations of organisms.
(*Clarification statement:* Element is intended to focus on basic statistical and graphic analysis. Hardy Weinberg would be an optional application to address this element.)
e. Develop a model to explain the role natural selection plays in causing biological resistance (e.g., pesticides, antibiotic resistance, and influenza vaccines).