Agriscience & Physics

Santa Maria Joint Union High School District

asic Course Information

hool(s) Offering This Course:

School Name	Course Learning Environment	Transcript Code(s)	
anta Maria High School (053305)	Classroom Based	**Abbreviation**	**Course Code**
		AGRISCI & PHYSA	AG6200
		AGRISCI & PHYSB	AG6201

Title: Agriscience & Physics

Length of course: Full Year

Subject area: Science (D) / Physics/Earth & Space Sciences

UC honors designation? No

Prerequisites: None

Co-requisites: None

Integrated (Academics / CTE)? Yes

Grade levels: 9th, 10th, 11th, 12th

ourse Description

urse overview:

Agriscience & Physics is a collaborative standards-based laboratory science that fulfills the physical science requirement focusing on college and career readiness. This course gives students a foundation in physics with related earth science and agriculture phenomena in addition to the Science and Engineering Practices. The following units will be covered in this course; Motion, Force, Gravity, Waves, Light Waves, Electricity & Magnetism, Energy & Renewable Energy, and Nuclear Physics & the Earth. This course also provides an opportunity and expectation for students' participation in the National FFA organization including FFA participation and a Supervised Agriculture Experience Project.

Agriscience & Physics fulfills the physical science high school graduation requirement and the UC/CSU "d" laboratory science requirement, in addition to being aligned to the California Next Generation Science Standards (CA NGSS). Students in this course will learn content based on the three dimensions of CA NGSS science: Science and Engineering practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs).

urse content:

Unit 1 –Motion

Students will explain and predict the motion of objects, the process in which the surface of the earth was formed. Students will explain how engineers create stable structures for various conditions found around the planet.

NGSS Performance Expectations

- HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net forces on a macroscopic effect, its mass, and its acceleration.

- HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
- HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision

- HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

- HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

NGSS Science & Engineering Practices

- Analyzing and Interpreting Data
- Developing and Using Models
- Constructing Explanations and Designing Solutions

NGSS Cross-Cutting Concepts

- Stability and Change
- Cause and Effect
- Structure and Function

💻 Unit Assignment(s):

The motion detector lab gives students a kinesthetic experience in the relationships between verbal, graphic, and diagrammatic representations of motion. Students will instantaneously collect data with motion detectors to produce motion vs time graphs. Students will also use Gizmos simulations and academic science readings (CK12 AND NEWSELA) to reinforce the academic skills learned in this unit.

🧪 Unit Lab Activities:

Motion Detector Lab: Explain how the motion detector can be used to determine a target object's position. Students will try to create the position vs. time graphs provided to them by moving with the same motion to recreate the graph on the motion detector. Students will determine from a class discussion that the slope of a position-time graph is the velocity and can then be translated onto a velocity-time graph. Students are producing several different representations of motion: real-life movement, position vs. time graphs, velocity vs. time graphs, written descriptions, and motion maps.

Water Balloon Lab – With the use of a water balloon sling to illustrate how forces and masses affect acceleration, students will analyze data (either student-generated or provided) showing mass, force, and acceleration for an object (accelerations for different masses, accelerations for different forces).

Unit 2 – Force

In this unit, students are introduced to the first half of Newton's Modeling Cycle Students are moving from the realm of descriptive models (kinematical laws of motion) to that of causal models: dynamics. Students will explore the concept that changes in velocity require interaction between an agent and an object. In addition this unit explores Newton's second and third laws of motion. Students collect descriptive and mathematical data to understand the relationship between acceleration, net force, mass, and action-reaction force pairs.

Performance Expectations:

- HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system
- HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision
- HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HSETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Science & Engineering Practices:

- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions

Cross-Cutting Concepts:

- Systems and System Models
- Cause and Effect

💻 Unit Assignment(s):

Students explore forces and changes in motion by moving a bowling ball through an obstacle course with a hand broom. Students produce observational descriptions of forces and motion.

Students collect distance measurements of a free-falling ball using the burst setting on a camera. Students then derive the equation for free fall. Students produce a final data table with position, time, velocity, and acceleration. Students will also use Gizmos simulations and academic science readings (CK12 AND NEWSELA) to reinforce the academic skills learned in this unit.

🧪 Unit Lab Activities:

Free Fall Ball Lab: The purpose of this lab is to determine the relationship between position and time for a freely falling object. The teacher shows the class a ball and asks them what would happen if the ball were to drop? The teacher drops the ball and asks the students, “Does the motion of the ball verify their hypothesis?” Do they have evidence? If not, what do they need to do to verify their hypothesis? The teacher asks the students what they can measure. The students now have experience with measuring position and time for uniformly accelerated motion, so these quantities will occur to them readily. They are also familiar with video labs and have recently completed the Frictionless Incline Lab so the motion analysis should be fresh in their minds.

Agricultural/Natural Resources Application: Students will study the physics behind logging. Students will learn and create force diagrams to justify how the equipment can work on steep slopes and cut down tall trees. Students will create posters to demonstrate that they know how the equipment stays upright.

Students will also learn about how water moves through forests before and after logging. Students will answer the questions: Why do roads/mountain sides collapse during heavy rainstorms. Students will perform a lab to compare the water/soil movements from a planted demonstration table and one that has been “logged.” Students will be able to explain the mechanism and forces behind these movements. Students will be able to explain the impact that plants and soil structure have on an ecosystem.

Unit 3 - Gravity

Students will explore what factors affect Universal Gravitation. Students will explore what the relationship is between orbital period, orbital radius and velocity in an elliptical orbit. Students will explore how satellites are kept in orbit.

NGSS Performance Expectations

- HS-PS2-4: Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects
- HS-ESS1-4: Use mathematical or computational representations to predict the motion of orbiting objects in the solar system
- HS-ETS1-4: Use a computer simulation to model the impact of proposed solutions to complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

NGSS Science & Engineering Practices

- Using Mathematics
- Computational Thinking

NGSS Cross-Cutting Concepts

- Patterns
- Scale Proportion and Quantity

📃 Unit Assignment(s):

Students will analyze tangential velocities and periods for different orbit radii. Given data about planet orbits (period and radius), students will graph and find a relationship between the two. Students will also use Gizmos simulations and academic science readings (CK12 AND NEWSELA) to reinforce the academic skills learned in this unit.

🧪 Unit Lab Activities:

Circular Motion Lab - Students will measure velocity and compare velocity to the centripetal force for a constant radius.

Agriculture & Natural Resource Application Students will explore the relationship between orbital period, orbital radius and velocity in an elliptical orbit. Students will explore how to keep a satellite in orbit. Students will relate to this agriculture and discuss the mechanism behind how information transfers from Auto Farm tractors to a satellite and back to the phone.

Unit 4- Waves

Students will determine the relationship between frequency, wave speed, and wavelength of a wave in a medium. Students will explore how the medium affects the wave properties. Students will explore the advantages and disadvantages of using digital storage and transmission of information. Students will explore how wave behavior is and wave interaction involved in the capture and transmission of information and energy.

NGSS Performance Expectations

- HS-PS4-1: Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media
- HS-PS4-2: Evaluate questions about the advantage of using a digital transmission and storage of information
- HS-PS4-5: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy
- HS-ESS2-3: Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection

NGSS Science & Engineering Practices

- Using Mathematics and Computational Thinking
- Developing and Using Models
- Asking Questions and Defining Problems
- Obtaining, Evaluating, and Communicating Information

NGSS Cross-Cutting Concepts

- Cause and Effect

Stability and Change

Unit Assignment(s):

Students will gather data about damage from an earthquake or seismograph analysis and plot on a map to find the epicenter. Students will also use Gizmos simulations and academic science readings (CK12 AND NEWSELA) to reinforce the concepts of earthquakes.

Class Project - Wave technology timeline, develop a method to transmit a message using light (LEDs, breadboards, buttons, potentiometers, wires, and batteries)

Unit Lab Activities:

Slinky Lab - Students will make waves on a slinky and measure wavelength, speed, and frequency (slow-motion video).

Agricultural/Natural Resources Application: Students will study earthquakes and the impact it has on communities. California is greatly concerned about earthquake damage and has many laws and regulations to prevent damage. Students will study the mechanical waves created during an earthquake and explain how it affects buildings. Students will collect and analyze data from the seismogram website to see how our community is affected.

Unit 5 - Light

Students will explore the nature of light. Students run experiments to learn about the basic concept of what light is, they will study light, the absence of light, speed, intensity, reflection, and refraction. They will be able to use descriptive and mathematical explanations to predict light behavior. Students will explore how stars are made of and how they are moving.

NGSS Performance Expectations

- HS-PS4-3: Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other

- HS-PS4-4: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter

- HS-ESS1-2: Construct an explanation of the Big Bang Theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe

NGSS Science & Engineering Practices

- Engaging in Argument from Evidence
- Obtaining, Evaluating
- Communicating Information
- Constructing Explanations and Designing Solutions

NGSS Cross-Cutting Concepts

- Systems and System Models
- Cause and Effect
- Energy and Matter
- Stability and Change

💻 Unit Assignment(s):

Students will determine the law of reflection by measuring the angles produced from a laser reflecting on several mirrors. Students will produce data tables with initial and final angles and form a common determination of the law of reflection.

Students will perform a diffraction experiment to separate light into waves of interference. They will first mimic the idea in a wave tank to see how waves cause these changes. They will produce sketches and written descriptions of the wave behavior.

🧪 Unit Lab Activities:

Students will make a telescope or microscope using lenses and mirrors; observe and compare emission spectra from different gases, glow sticks, etc.

Agricultural/Natural Resources Application: Students will study and see how agricultural equipment uses lasers to identify high and low-quality fruit. Students will see how optical sorters in the tomato and vineyard industries can sort fruit based on a computer visualizing each piece of fruit. Students will be able to explain how optical sorters work and how it helped

the industry increase the quality of the commodity.

Agricultural/Natural Resources Application: Students will study how light wavelengths are important for plants to absorb energy during photosynthesis. Students will set up a comparison lab at the farm. Students will grow plants under two different wavelengths of light (a blue vs green light). Students will collect growth rate data on the plants under different conditions. Students will graph the data in excel.

Unit 6 - Electricity and Magnetism

Students will explore what factors affect the force between charges. Students will explore which force rules - electric or gravitational. Students will explore how to generate electricity. Students will explore how to can create magnets. Students will explore what factors affect the force between magnets.

NGSS Performance Expectations

- HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects.
- HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
- HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction

NGSS Science & Engineering Practices

- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information
- Constructing Explanations
- Designing Solutions

NGSS Cross-Cutting Concepts

- Systems and System Models
- Cause and Effect
- Energy and Matter
- Stability and Change

Unit Assignment(s):

PhET Simulation - Electrostatics lab (plastic rod, glass rod, fur, silk, pith ball electroscope) - generate charges on the rods and compare their effects on the pith ball,

Students will build a simple compass to determine the direction in addition to the use Gizmos simulations and academic science readings (CK-12) to reinforce the concepts of electricity and magmatism.

Unit Lab Activities:

Agriculture & Natural Resource Application: Students will properly install and wire using common industrial devices on an electrical board using common electronic parts including (wires, LEDs, buttons, batteries, buzzers, motors). Students will practice using common electrical testers.

Unit 7 – Energy & Renewable Energy

Students will be able to explore different types of power plants are there, and how they work including solar and wind energy. Students will be able to describe the journey of energy through a power plant (transfers and transformations). Students will be able to design, build, analyze and refine a device that converts energy from one form to another.

NGSS Performance Expectations

- HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).
- HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
- HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
- HS-ESS3-2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

- HS-ETS1-1: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

- HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

- HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts

NGSS Science & Engineering Practices

- Developing and Using Models
- Using Mathematics and Computational Thinking
- Constructing Explanations and Designing Solutions
- Analyzing Interpreting Data

NGSS Cross-Cutting Concepts

- Systems and Systems Models
- Energy and Matter

Unit Assignment(s):

Flexible Track and Cars - put a track in a U shape and compare starting and ending heights and energies (and speed at the bottom), then put track in a loop and predict how high the car needs to start

Balloon Launcher -Measure the elastic force of the balloon launcher at different compression distances, graph and determine, the work the launcher will do and its spring constant, and use that to predict the launch velocity of the projectile and then test their prediction, measure the motion of a block down an inclined plane and determine the energy transferred to heat due to friction

Unit Lab Activities:

Generator Lab - Students will use hand-crank generators with different types of light bulbs to compare power transfer, use power meters to measure energy use of different electric devices,

Agricultural/Natural Resources Application: Students will install a small solar panel system in various locations. These will be so students can learn how solar panels collect and transform energy into electricity. Examples include but are not limited to: a solar chicken coop, solar electric fencing, etc. Students will also maintain and study solar energy.

Unit 8 – Nuclear Physics & The Earth

Students will explore what happens during fission, fusion, and radioactive decay. Students will explore why nuclear bombs do or power plants, release so much energy. Students will explore what's the oldest rock on earth, and how is it determined. In addition, students will be able to explore where the sun gets its energy and where the elements came from.

NGSS Performance Expectations

- HS-PS1-8: Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
- HS-ESS1-1: Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy in the form of radiation.
- HS-ESS1-3: Communicate scientific ideas about the way stars, over their life cycle, produce elements.
- HS-ESS1-5: Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
- HS-ESS1-6: Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

NGSS Science & Engineering Practices

- Developing and Using Models
- Constructing Explanations and Designing Solutions
- Engaging in Argument From Evidence
- Obtaining, Evaluating, and Communicating Information

NGSS Cross-Cutting Concepts

- Energy and Matter
- Stability and Change
- Patterns
- Scale Proportion, and Quantity

🖳 Unit Assignment(s):

Students will visualize and model what happens when a nucleus decays. Radioactive decay is accompanied by the emission of radiation (alpha, beta, or gamma). Students will also use Gizmos simulations and academic science readings (CK-12) to reinforce the concepts of half-life.

Students will write equations for nuclear reactions (decay sequence of uranium, fission, fusion, etc.) using nuclear symbols and calculate the mass defect and energy released for each reaction.

Unit Lab Activities:

Star & Element Lab: Students will model several stellar nucleosynthesis reactions with pennies, given the reactants and one product, determine the other product.

Agriculture & Natural Resource Application - Students use a rock collection to observe and compare the three types of rocks (igneous, metamorphic, and sedimentary). Students can decipher between the three types of rocks and understand the methods that each of these rocks form under. Students understand the steps of the rock cycle and that it takes a long time to happen and that all rocks can move through the cycle differently than other rocks.

ourse Materials

Textbooks

Title	Author	Publisher	Edition	Website	Primary
he Physics Classroom	Tom Henderson	The Physics Classroom	Online	https://www.physicsclassroom.com/	Yes

Websites

Title	Author(s)/Editor(s)/Compiler(s)	Affiliated Institution or Organization	URL
Gizmo Simulations	Explore Learning	Explore Learning	http://www.explorelearning.com
CK12	CK12 Foundation	CK12 Foundation	http://ck12.org

Title	Author(s)/Editor(s)/Compiler(s)	Affiliated Institution or Organization	URL
NewsELA.com	NewsELA	NewsELA	http://newsela.com
AET (Agriculture Experience Tracker)	National FFA Organization	National FFA Organization	http://theaet.com
PhET Interactive Simulations	University of Colorado, Boulder	University of Colorado, Boulder	http://phet.colorado.edu