

# FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

## PHYSICS IN THE UNIVERSE

**Date: June 2018**

**Proposed Grade Level(s): 10<sup>th</sup>-12<sup>th</sup>**

**Grading: A-F**

**Course Length: 2 Semesters**

**Subject Area: Science**

**Credits: 5 per Semester**

**Prerequisite(s): Concurrent enrollment in Integrated Math 1**

**Intent to Pursue 'A-G' College Prep Status: Yes**

**A-G Course Identifier: D - Laboratory science**

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### **COURSE DESCRIPTION:**

Physics in the Universe is a course in the California Next Generation Science Standards (CA NGSS) Three Course Model and includes the Disciplinary Core Ideas related to Physical Science and integrates a selection of the Earth and Space Science concepts. This course also incorporates the eight Science and Engineering Practices and seven Crosscutting Concepts related to the NGSS. In this course students will explore the following core ideas: forces and motion, energy transfers and conservation, the properties of waves, and the electromagnetic spectrum, and use these ideas to understand the processes that shape earth and space systems. Engineering Core Ideas are used to explore applications of Physics concepts.

### **COURSE GOALS:**

- Students will explore the interconnected nature of science by engaging in the Science and Engineering Practices and applying the Crosscutting Concepts to explore the Disciplinary Core Ideas of physics and earth and space science.
- Students will grow in scientific literacy and mathematical reasoning through alignment of science content with Common Core Standards for Literacy in Science and Technical Subjects and CCSS.
- Students will develop a deeper understanding of physics to prepare for college, careers, and citizenship.

### **DETAILED UNITS OF INSTRUCTION:**

#### **Unit: Kinematics**

*Guiding Questions:*

1. *How are displacement, velocity and acceleration related to the movement of an object?*

Topic/Skills:

- Displacement, velocity and acceleration
- Creating and interpreting graphs
- Area under the curve analysis
- One and two-dimensional motion
- Mathematically predict displacement, velocity and acceleration

#### **Unit: Forces**

*Guiding Questions:*

1. *How do objects interact with their surroundings?*

## 2. *How do forces change the motion of objects?*

### Topic/Skills:

- Newton's three laws of motion
- Conservation of momentum
  - Predict and compare before and after conditions during collisions
- Gravity in relation to forces
- Graph analysis of forces in motion and interactions

### **Unit: Energy**

#### *Guiding Questions:*

1. *What is energy?*
2. *How is energy transformed from one type to another?*
3. *How can the conservation of energy be used to explain energy transformation?*

### Topic/Skills:

- Types of energy (solar, chemical, thermal, potential, mechanical, kinetic etc.)
- Conservation of energy
- Macroscopic level of energy versus particle level of energy
- Energy sources and utilization by societies
- Calculate energy flow in systems

### **Unit: Electromagnetism**

#### *Guiding Questions:*

1. *How do forces behave at a distance?*
2. *How are electricity and magnetism related?*
3. *How is electromagnetism used by society?*

### Topic/Skills:

- Electromagnetism
- Electric and magnetic fields
- Calculate forces within fields
- Technological uses of electromagnetism

### **Unit: Waves and Earth's Processes**

#### *Guiding Questions:*

1. *How are frequency, wavelength and wave speed related?*
2. *How does the Theory of Continental Drift explain the appearance of Earth's surface?*

### Topic/Skills:

- Plate tectonics and convection currents
- Source of heat within Earth's interior
- Types of waves
- Wave propagation and travel
- Mathematical relationship between frequency, wavelength and speed of waves
- Periodic motion

### **Unit: Cosmology**

*Guiding Questions:*

1. *How does light behave?*
2. *What is the Big Bang Theory?*
3. *How do stars generate energy over their life cycle?*

Topic/Skills:

- Wave particle duality
- Electromagnetic spectrum
- Nuclear fusion
- Develop an explanation, using scientifically supported evidence, to support The Big Bang Theory
- Stellar life cycles
- Gravitational effect on orbits

All units will engage students in the following Science and Engineering Practices and Crosscutting Concepts:

Science and Engineering Practices:	Crosscutting Concepts
<ol style="list-style-type: none"><li>1. Asking questions and defining problems.</li><li>2. Developing and using models.</li><li>3. Planning and carrying out investigations.</li><li>4. Analyzing and interpreting data.</li><li>5. Mathematics and computational thinking.</li><li>6. Constructing explanations and designing solutions.</li><li>7. Engaging in argument from evidence.</li><li>8. Obtaining, evaluating, and communicating information.</li></ol>	<ol style="list-style-type: none"><li>1. Patterns</li><li>2. Cause and Effect</li><li>3. Scale, proportion, and quality</li><li>4. System and system models</li><li>5. Energy and matter</li><li>6. Structure and function</li><li>7. Stability and change</li></ol>

**TEXTBOOKS AND RESOURCE MATERIALS:**

**Textbook** (*\*Tentative until formal adoption in 2019/2020*)

*Physics Principles and Problems* by Zitzewitz, Paul, Glencoe, 2005 Edition, 2005.

**Resource Materials**

None at this time

**SUBJECT AREA CONTENT STANDARDS TO BE ADDRESSED:**

**Next Generation Science Standards**

*Physical Science*

- HS-PS2-1. Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, 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-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-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
- 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 position 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-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 advantages of using a digital transmission and storage of information.
- 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-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.

#### *Earth and Space Science*

- 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 that eventually reaches Earth in the form of radiation.
- 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.
- HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.
- HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
- 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.
- HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
- HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

#### *Engineering Design*

- 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.
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

## **COMMON CORE STATE STANDARDS:**

### *Reading Standards for Literacy in Science & Technical Subjects (9<sup>th</sup>-10<sup>th</sup>)*

#### **Key Ideas & Details**

1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

#### **Craft & Structure**

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 9-10 texts and topics*.
5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

#### **Integration of Knowledge & Ideas**

7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

#### **Reading Range / Text Complexity**

10. By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.

### *Writing Standards for Literacy in Science & Technical Subjects (Grades 9-10)*

#### **Text Types and Purposes**

1. Write arguments focused on *discipline-specific content*.

- a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
  - b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
  - c. Use words, phrases and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
  - d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
  - e. Provide a concluding statement or section that follows from or supports the argument presented.
2. Write informative/explanatory texts, including the narration of scientific procedures/experiments, or technical processes.
- a. Introduce a topic and organize ideas, concepts and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
  - b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and example appropriate to the audience's knowledge of the topic.
  - c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
  - d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
  - e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
  - f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

### **Production and Distribution of Writing**

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specified purpose and audience.
6. Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

### **Research to Build and Present Knowledge**

7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question), or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple print and digital sources (primary and secondary), using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
9. Draw evidence from informational texts to support analysis, reflection, and research.

## **Range of Writing**

10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

## *Speaking and Listening Anchor Standards (Grades 9-10)*

### **Comprehension and Collaboration**

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
  - a. Come to discussions prepared having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
  - b. Work with peers to set rules for collegial discussions and decision-making (e.g., informal consensus, taking votes on key issues, and presentation of alternate views), clear goals and deadlines, and individual roles as needed.
  - c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
  - d. Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.
2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.

### **Presentation of Knowledge and Ideas**

4. Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and ensure that the organization, development, and style are appropriate to task, purpose, and audience.
  - a. Plan and deliver an information/explanatory presentation that: presents evidence in support of a thesis, conveys information from primary and secondary sources coherently, uses domain specific vocabulary, and provides a conclusion that summarizes the main points.
  - b. Plan, memorize, and present a recitation (e.g., poem, selection from a speech or dramatic soliloquy) that: conveys the meaning of the selection and includes appropriate performance techniques (e.g., tone, rate, voice modulation) to achieve the desired aesthetic effect.
5. Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.
6. Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

## **DISTRICT ESLRS TO BE ADDRESSED:**

### **Students will be:**

- **Self-Directed Learners:** will take responsibility for their learning by participating in class activities, labs, and discussion.
- **Effective Communicators:** will actively participate in class and small group discussions on a regular basis.
- **Constructive Thinkers:** will participate in many hands-on activities and labs that require them develop models to explain natural phenomenon.

- **Collaborative Workers:** will participate in cooperative groups for laboratory assignments and in class activities.
- **Quality Producers/Performers:** will be guided to be quality performers and producers through ongoing assessment of their class work.
- **Responsible Citizens:** will using their science content knowledge and scientific inquiry to make informed decisions about issues related to science, the world around them, and their daily lives.