Fresno Unified School District

# 2018-19

**H.S. Physics**

## Physics of the Universe (NGSS-aligned Physics)

### Semester 1

#### Quarter 1

**Instructional Segment #1: Forces and Motion**

PS2-1$_2$
PS2-2$_4$
PS2-3$_2$
ETS1-1*
ETS1-2*
ETS1-3*
ETS1-4*

**Instructional Segment #2: Forces at a Distance**

PS2-4$_1$
PS2-6$_7$
ESS1-4$_3$

#### Quarter 2

**Instructional Segment #3: Energy Conversion and Renewable Energy**

PS2-5$_2$
PS3-1$_4$
PS3-2$_5$
PS3-5$_2$
PS3-3$_5$
PS4-5$_2$*
ESS3-2
ESS3-3$_7$
ETS1-1*
ETS1-2*
ETS1-3*
ETS1-4*

### Semester 2

#### Quarter 3

**Instructional Segment #4: Nuclear Processes and Earth History**

PS1-8$_5$
ESS1-5$_1$
ESS1-6$_7$
ESS2-1$_7$*

**Instructional Segment #5: Waves and Electromagnetic Radiation**

PS4-1$_2$
PS4-3$_4$
PS4-4$_2$
PS4-5$_2$*
PS4-2$_7$
ESS2-1$_7$*

#### Quarter 4

**Instructional Segment #6: Stars and the Origins of the Universe**

ESS1-1$_3$
ESS1-2$_5$*
ESS1-3$_5$

** = standard is taught more than once within this course*

| EP&Cs Connections: | ELD Connections: | EP&Cs Connections: | ELD Connections: | EP&Cs Connections: | ELD Connections: | EP&Cs Connections: | CCSS ELD Connections: |
|---|---|---|---|---|---|---|---|
| Principle 5 | ELD.PI.11-12.1,5,6a-b,9,10,11a | Principles 1, 2, 3, 4, 5 | ELD.PI.11-12.1,5,6a-b,9,10,11a | Principles 1, 2, 3, 4, 5 | ELD.PI.11-12.1,5,6a-b,9,10,11a | n/a | ELD.PI.11-12.1,5,6a-b,9,10,11a |
| **CCSS ELA Connections:** SL.11-12.4,5; RST.11-12.1,7,8, WHST.9-12.2.a-e, 9 | **CCSS Math Connections:** N-Q.1-3; A-SSE.1a-b, 3a-c; A-CED. 1, 2, 4; F-IF.7.a-e; S-ID.1; MP.2; MP.4 | **CCSS ELA Connections:** SL.11-12.5; RST.11-12.1, 8, WHST.9-12.2.a-e, 7,8,9 | **CCSS Math Connections:** N-Q.1-3; MP.2; MP.4 | **CCSS ELA Connections:** SL.11-12.4, 5; RST.9-10.8; RST.11-12.1,7, 8, WHST.9-12.2.a-e, 7,8, 9 | **CCSS Math Connections:** MP.2; MP.4, A-SSE.1a-b,3a-c; A-CDED.4; N-Q.1-3 | **CCSS ELA Connections:** SL.11-12.4; RST.11-12.1; WHST.9-12.2.a-e | **CCSS Math Connections:** N-Q.1-3; A-SSE.1a-b; A-CED.2,4; MP.2; MP.4 |

### Science & Engineering Practices (SEPs)

1.) Asking questions and defining problems
2.) Developing and using models
3.) Planning and carrying out investigations
4.) Analyzing and interpreting data
5.) Using mathematics and computational thinking
6.) Constructing explanations and designing solutions
7.) Engaging in argument from evidence
8.) Obtaining, evaluating and communicating information

**Crosscutting Concepts (CCCs)**

1.) Patterns
2.) Cause and Effect
3.) Scale, Proportion, Quantity
4.) Systems and System Models
5.) Energy and Matter
6.) Structure and Function
7.) Stability and Change

| Guiding Questions | | | | | |
|---|---|---|---|---|---|
| ***Instructional Segment #1: Forces and Motion*** | ***Instructional Segment #2: Forces at a Distance*** | ***Instructional Segment #3: Energy Conversion and Renewable Energy*** | ***Instructional Segment #4: Nuclear Processes and Earth History*** | ***Instructional Segment #5: Waves and Electromagnetic Radiation*** | ***Instructional Segment #6: Stars and the Origins of the Universe*** |
| • How can Newton's laws be used to explain how and why things move?<br>• How can mathematical models of Newton's Laws be used to test and improve engineering design? | • How can different objects interact when they are not even touching?<br>• How do interactions between matter at the microscopic scale affect the macroscopic properties of matter that we observe?<br>• How do satellites stay in orbit? | • How do power plants generate electricity?<br>• What engineering designs can help increase the efficiency of electricity production and reduce the negative impacts of using fossil fuels? | • What does $E=mc^2$ mean?<br>• How do nuclear reactions illustrate conservation of energy and mass?<br>• How do we determine the age of rocks and other geologic features? | • How do we know what is inside the Earth?<br>• Why do people get sunburned by UV light?<br>• How can we transmit information over wires and wirelessly? | • How do we know what stars are made out of?<br>• What fuels our sun? Will it ever run out of that fuel?<br>• Do other stars work the same way as our sun?<br>• How do patterns in motion of the stars tell us about the origin of our universe? |

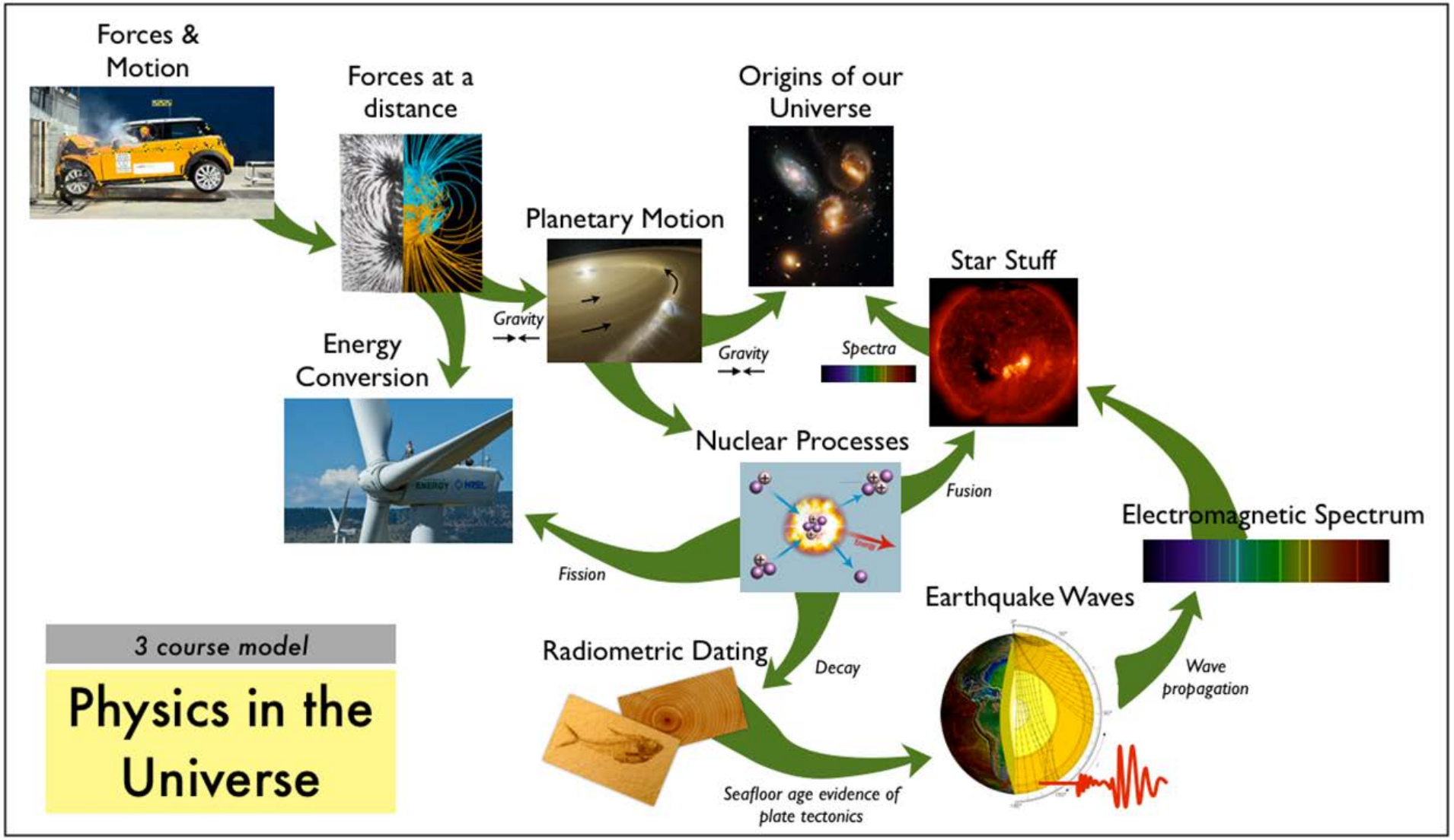
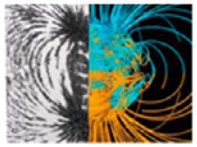
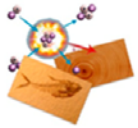
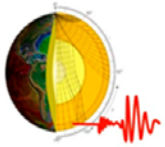

Forces & Motion
Forces at a distance
Origins of our Universe
Planetary Motion
Star Stuff
Gravity
Gravity
Spectra
Energy Conversion
Nuclear Processes
Fusion
Electromagnetic Spectrum
Fission
Earthquake Waves
3 course model
Physics in the Universe
Radiometric Dating
Decay
Wave propagation
Seafloor age evidence of plate tectonics

**Table 7.6. Overview of Instructional Segments for High School Physics of the Universe**

| | | |
|---|---|---|
|  | **1** Forces and Motion | Students make predictions using Newton's Laws. Students mathematically describe how changes in motion relate to forces. They investigate collisions in Earth's crust and in an engineering challenge. |
|  | **2** Forces at a Distance | Students investigate gravitational and electromagnetic forces and describe them mathematically. They predict the motion of orbiting objects in the solar system. They link the macroscopic properties of materials to microscopic electromagnetic attractions. |
|  | **3** Energy Conversion | Students track energy transfer and conversion through different stages of power plants. They evaluate different power plant technologies. They investigate electromagnetism to create models of how generators work and obtain and communicate information about how solar photovoltaic systems operate. They design and test their own energy conversion devices. |
|  | **4** Nuclear Processes | Students develop a model of the internal structure of atoms and then extend it to include the processes of fission, fusion, and radioactive decay. They apply this model to understanding nuclear power and radiometric dating. They use evidence from rock ages to reconstruct the history of the Earth and processes that shape its surface. |
|  | **5** Waves and Electro-magnetic Radiation | Students make mathematical models of waves and apply them to seismic waves traveling through the Earth. They obtain and communicate information about other interactions between waves and matter with a particular focus on electromagnetic waves. They obtain, evaluate, and communicate information about health hazards associated with electromagnetic waves. They use models of wave behavior to explain information transfer using waves and the wave-particle duality. |
|  | **6** Stars and the Origin of the Universe | Students apply their model of nuclear fusion to trace the flow of energy from the Sun's core to Earth. They use evidence from the spectra of stars and galaxies to determine the composition of stars and construct an explanation of the origin of the Universe. |

Resource from: CA Science Framework, Ch. 7, pg. 223-225

| Physics of the Universe- Quarter 1 Overview | | | |
|---|---|---|---|
| **Quarter Topic Focus: *Forces*** | | | |
| **Science & Engineering Practice (SEP)** | **Disciplinary Core Idea (DCI)** | **Crosscutting Concept (CCC)** | **Performance Expectation (PE)** |
| **How** students will demonstrate their understanding… | **What** students will understand… | How students will connect their understanding across units and courses… (**Why** they should know it) | A complete standard **(SEP + DCI + CCC = PE)** ***colors are associated with SEP (see page 1 for key)** |
| 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. (Cause and Effect) | PS2-1 |
| 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. (Systems and System Thinking) | PS2-2 |
| Apply science and engineering ideas to design, evaluate and refine a device that | minimizes the force on a macroscopic object | during a collision. (Cause and Effect) | PS2-3 |
| Analyze a major global challenge (Asking questions and defining problems) | to specify qualitative and quantitative criteria and constraints for solutions that account for | societal needs and wants. (Influence of Science, Engineering, and Technology on Society and the Natural World) | ETS1-1 |
| Design a solution to a complex real-world problem by | breaking it down into smaller, more manageable problems that can be solved through engineering. | n/a | ETS1-2 |
| Evaluate a solution to a complex real-world problem based on criteria and prioritized trade-offs | that account for a range of constraints, including cost, safety, reliability, and aesthetics | as well as possible social, cultural and environmental impacts. | ETS1-3 |

| | | | |
|---|---|---|---|
| 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. | ETS1-4 |
| Use mathematical representations | of Newton's Law of Gravitation and Coulomb's Law to | describe and predict the gravitational and electrostatic forces between objects. (Patterns) | PS2-4 |
| Communicate scientific and technical information about why | the molecular-level structure is important in | the functioning of designed materials. (Structure and Function) | PS2-6 |
| Use mathematical and computational representations | to predict the motion of orbiting objects in the solar system. | (Scale, Proportion and Quantity) | ESS1-4 |

| Physics of the Universe- Quarter 2 Overview | | | |
|---|---|---|---|
| **Quarter Topic Focus: *Energy*** | | | |
| **Science & Engineering Practice (SEP)** | **Disciplinary Core Idea (DCI)** | **Crosscutting Concept (CCC)** | **Performance Expectation (PE)** |
| **How** students will demonstrate their understanding… | **What** students will understand… | How students will connect their understanding across units and courses… (**Why** they should know it) | A complete standard **(SEP + DCI + CCC = PE)** ***colors are associated with SEP (see page 1 for key)** |
| 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. (Cause and Effect) | PS2-5 |
| Create a computational model | to calculate the change in the energy of one component of a system when the change in energy of the other component(s) and energy flows in and out | of the system are known. | PS3-1 |
| Develop and use models to illustrate that | Energy at the macroscopic scale can be accounted for as a combination | Of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects). | PS3-2 |
| 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. (Cause and Effect) | PS3-5 |
| Design, build and refine a device that works within given constraints | to convert one form of energy | into another form of energy. (Energy and Matter) | PS3-3 |

| | | | |
|---|---|---|---|
| Communicate technical information about | how some technological devices use the principles of wave behavior and wave interaction with matter to transmit and capture information and energy. | (Cause and Effect) | PS4-5 |
| Evaluate competing design solutions for | developing, managing, and utilizing energy and mineral resources | based on cost-benefit ratios. | ESS3-2 |
| Create a computational simulation to illustrate | the relationships among the management of natural resources | the sustainability of human populations, and biodiversity. (Stability and Change) | ESS3-3 |
| Analyze a major global challenge (Asking questions and defining problems) | to specify qualitative and quantitative criteria and constraints for solutions that account for | societal needs and wants. (Influence of Science, Engineering, and Technology on Society and the Natural World) | ETS1-1 |
| Design a solution to a complex real-world problem by | breaking it down into smaller, more manageable problems that can be solved through engineering. | n/a | ETS1-2 |
| Evaluate a solution to a complex real-world problem based on criteria and prioritized trade-offs | that account for a range of constraints, including cost, safety, reliability, and aesthetics | as well as possible social, cultural and environmental impacts. | ETS1-3 |
| 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. | ETS1-4 |

| Physics of the Universe- Quarter 3 Overview | | | |
|---|---|---|---|
| **Quarter Topic Focus: *Nuclear Processes and Waves*** | | | |
| **Science & Engineering Practice (SEP)** | **Disciplinary Core Idea (DCI)** | **Crosscutting Concept (CCC)** | **Performance Expectation (PE)** |
| **How** students will demonstrate their understanding… | **What** students will understand… | How students will connect their understanding across units and courses… (**Why** they should know it) | A complete standard **(SEP + DCI + CCC = PE)** *colors are associated with SEP (see page 1 for key) |
| 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. | (Energy and Matter) | PS1-8 |
| 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. | (Patterns) | ESS1-5 |
| 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. (Stability and Change) | ESS1-6 |
| 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. (Stability and Change) | ESS2-1 |
| Use mathematical representations to support a claim regarding | relationships among the frequency, wavelength and speed of waves traveling in various media. | (Cause and Effect) | PS4-1 |

| | | | |
|---|---|---|---|
| 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. (Systems and System Models) | PS4-3 |
| Evaluate the validity and reliability of claims in published materials | of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. | (Cause and Effect) | PS4-4 |
| 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. | (Cause and Effect) | PS4-5 |
| Evaluate questions about | the advantages of using digital transmission and storage of information. | (Stability and Change) | PS4-2 |
| 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. (Stability and Change) | ESS2-1 |

| Physics of the Universe- Quarter 4 Overview | | | |
|---|---|---|---|
| **Quarter Topic Focus: *Space*** | | | |
| **Science & Engineering Practice (SEP)** | **Disciplinary Core Idea (DCI)** | **Crosscutting Concept (CCC)** | **Performance Expectation (PE)** |
| **How** students will demonstrate their understanding… | **What** students will understand… | How students will connect their understanding across units and courses… (**Why** they should know it) | A complete standard **(SEP + DCI + CCC = PE)** ***colors are associated with SEP (see page 1 for key)** |
| Develop a model based on evidence to illustrate | the lifespan 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. | (Scale, Proportion and Quantity) | ESS1-1 |
| 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. | ESS1-2 |
| Communicate scientific ideas about the way | Stars, over their life cycle, | produce elements. (Energy and Matter) | ESS1-3 |