Stockton Unified School District

EDISON HIGH SCHOOL

Home of the Vikings

SUSD

Essential Outcomes Chart: What is it we expect students to learn?

CONTINUING TO IMPLEMENT NEW CURRICULUM FOR 2021-2022!!!! THIS DOCUMENT IS A WORK IN PROGRESS!

GRADE:	10-12	**SUBJECT:**	***Physics***	**SEMESTER:**	1 & 2	**TEAM MEMBERS:**	*Dr. Clark, Dr. Wharry (Fall '21), and Mr. Haynie (SAI/SPED) (Ms. Carranza in Spring '22)*

Adapted from Discovery Education: Physics of the Universe Science Techbook

Instructional Segment 1:

Forces and Motion

CONCEPTS

1.1 Understanding and Describing Motion

The ability to accurately measure and graphically represent an object's motion over time provides data to make predictions on the motion of an object.

How do the displacement, velocity, and acceleration of a runner change as he races from the starting line toward the finish line?

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.

1.2 Using Vectors and Scalars to Describe Motion

Mathematical representation of motion allows scientists and engineers to successfully design solutions to real-world problems.

Vector representation includes both a direction and a magnitude. A scalar representation only provides a magnitude.

Why is the total velocity of a roller coaster zero at the end of the ride? How does its speed vary with its location?

HS-PS2-3
Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on macroscopic object during a collision.

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

1.3 Newton's Laws

Newton’s laws govern the motion of objects based on the mass and forces applied on the object(s).

HS-ETS1-3
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

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.

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.

1.4 Conservation of Momentum

Momentum is the relationship of mass and velocity of a moving object. The total momentum of a system can change, depending on the interactions within and outside the system being studied.

How does the momentum of a soccer ball change as it travels from player to player?

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-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.

Instructional Segment 2:
Forces at a Distance

CONCEPTS

2.1 Fundamental Forces

Matter and energy that make up our universe interact based on patterns related to four key forces: gravity, electromagnetic force, strong nuclear force, and weak nuclear force.

The forces play a role at the microscopic level to produce predictable patterns of macroscopic properties.

How do electromagnetism and gravitation differ from the strong and weak nuclear forces?

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.

2.2 Nuclear Forces

Strong nuclear force binds protons and neutrons in atomic nuclei. Weak nuclear force allows protons to become neutrons.

Fission and fusion are reactions that occur in an atom’s nucleus and release massive amounts of energy. This energy can be used to power various human-designed systems.

What forces hold an atom together, and how are those forces involved in nuclear reactions?

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-PS2-6

Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

2.3 Electric Forces

An electric force exists between all charged objects. Atoms, molecules, and objects can attract or repel one another based on net charge. The electric force is directly proportional to the product of the charges.

What is Coulomb’s Law?

HS-PS2-6

Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

2.4 Gravity

Newton’s law of universal gravitation is a mathematical representation describing the gravitational force between two objects. The force’s magnitude is related to the mass of the objects and their distance from one another.

What evidence is there that gravity affects Earth and the sun?

HS-ESS1-4

system.

Use mathematical or computational representations to predict the motion of orbiting objects in the solar

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.

2.5 Movements in Space

Ancient civilizations have studied the movement of objects in space to identify patterns that drive r daily life, including the calendar.

As technology has evolved, scientists can collect quantitative data to construct refined models of patterns related to the motion of objects in space.

Kepler’s laws of planetary motion and Newton’s law of gravitation allow us to mathematically represent the relationship of an object’s orbital period, mass, and distance to predict its motion.

How is the way scientists monitor the movements of the Sun, Moon, and stars today similar to the way ancient cultures monitored them?

HS-ESS1-4

system.

Use mathematical or computational representations to predict the motion of orbiting objects in the solar

Instructional Segment 3:

Energy Conversion and Renewable Energy

CONCEPTS

3.1 Types of Energy

Energy exists in two forms: kinetic and potential. Kinetic energy is the energy of motion and can be found at the smallest scale in microscopic molecules and large-scale systems, such as a spinning wind turbine. Potential energy is associated with the location of an object.

What steps are involved in converting potential energy to kinetic energy, or kinetic energy to potential energy?

HS-ESS3-3
Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

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-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

3.2 Conservation of Energy

Within a system, energy is converted between potential and kinetic energy. To determine the efficiency of energy conservation within a system, one can measure the total kinetic and potential energy entering and exiting the system.

How is energy transferred between objects or systems?

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-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.

3.3 Laws of Thermodynamics

Systems involve the transfer and conversion of energy. Heat is the transfer of thermal energy. The internal energy of a system is the sum of the kinetic and potential energy within the system. The internal energy of an object increases with the temperature of the object.

How do the laws of thermodynamics determine the function and efficiency of various technology systems?

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-PS3-4
Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

3.4 Electricity and Magnetism

Moving electric charges induce magnetic fields, whereas accelerating electric charges emit electromagnetic waves. Power generators operate under the principle that an electric field is produced by moving a magnetic field. The mutual interaction between electric and magnetic fields is electromagnetism.

How have electric and magnetic forces shaped the world in which we live?

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-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.

3.5 Conductors and Insulators

Different materials allow electrons to move more or less freely. Superconductors are materials that conduct electricity with no resistance.

How does the structure of a material explain its behavior as a conductor or an insulator?

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-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.

Instructional Segment 4:
Nuclear Processes

CONCEPTS

4.1Nuclear Physics

Isotopes of the same element have the same number of protons inside the nucleus. However, they have different numbers of neutrons.

While some isotopes of elements are stable, others decay radioactively, emitting particles at fixed rates characteristic of that isotope.

Nuclear fission breaks apart a large atom, such as uranium, into smaller particles. Nuclear fusion combines two smaller atoms into a larger

atom. Both nuclear fission and nuclear fusion release large amounts of energy.

How do the nuclei of radioactive elements break down, and how can we make use of the process?

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.

4.2 Radiometric Dating

Scientists use radiometric dating techniques to find the absolute age of rocks. Radiometric dating involves measuring the ratios of radioactive isotopes in a material.

Understanding radiometric dating requires understanding the structure of atoms and isotopes.

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-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.

Instructional Segment 5:
Waves and Electromagnetic Radiation

CONCEPTS

5.1Wave Characteristics

A wave is a disturbance that transmits energy through space. It is important to note that waves transfer energy; they do not transfer matter.

Waves possess speed, wavelength, frequency, and amplitude, and they can be either mechanical or electromagnetic.

The electromagnetic spectrum is the range of frequencies and wavelengths of all electromagnetic waves.

How do you know that the waves sent from the sun to Earth are not mechanical waves?

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-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

HS-PS4-3
Evaluate questions about the advantages of using a digital transmission and storage of information.

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.

5.2 Reflection and Refraction

Reflection is the bouncing of light off objects, while refraction is the process by which a wave bends as it passes through a boundary between two media.

Lenses use refraction to focus light to produce an image.

How does light from a headlamp use a lens and a mirror to produce a narrow beam?

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.

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-PS4-5
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.

5.3 Seismic Waves

Earthquakes produce body seismic waves that travel through Earth's interior and surface seismic waves that travel only along the ground.

Scientists can use information from seismic waves to make inferences about Earth's internal structure.

What kinds of waves do earthquakes produce, how are they measured, and what evidence do they provide about Earth's interior?

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
convection.
Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal

5.4 Earthquakes and Their Impacts

Movement at tectonic plate boundaries is the major cause of earthquakes. A fault is a fracture in the crust where fault blocks move next to each other.

The uncertainty of an earthquake emergency can be tempered by creating a plan.

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-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-PS4-1
Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

Instructional Segment 6:
Stars and the Origins of the Universe

CONCEPTS

6.1 Understanding the Universe

Scientists estimate that the universe is approximately 13.7 billion years old.

The big bang theory is the generally accepted theory about the origin of the universe, stating that the universe formed during a single event in which all matter and energy suddenly expanded from an extremely small point.

How has technology been used to collect evidence that verifies the scientific theory of the Big Bang?

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.

6.2 Stars and Galaxies

Stars are bodies in space that emit vast amounts of energy because of nuclear fusion that originates in their cores.

The properties of a star as it proceeds through its life cycle depend on the initial mass of the star.

Galaxies are groupings of billions of stars.

What is the nature of stars, and how do they populate a galaxy?

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.