Physics Unit 07: Momentum

Unit #:	APSDO-00019207	Duration:	2.0 Week(s)	Date(s):	

Team:
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Grades:
11
Subjects:
Science

Unit Focus

In this unit, students will study impulse and momentum. The law of conservation of momentum will used to predict the motion of objects involved in various types of collisions. Students will also use their knowledge of the engineering process to design, construct, and test packaging to protect an egg during a collision. Summative assessments may include: written tests/quizzes composed of application problems and modelling questions which assess students' understanding of how impulse, time and forces effect the momentum of an object; as well as lab reports composed of experimental design, laboratory practice, and data analysis components; and an engineering project. Primary instructional materials may include an online physics textbook (linked from teacher webpage), supplemental online and print resources, and related equipment and materials.

Stage 1: Desired Results - Key Understandings

Established Goals

Next Generation Science Standards (DCI)
Science: 11

- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system. *PS2.9.A3*
- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. *PS2.9.A2*

Transfer

T1

Integrate knowledge from a variety of disciplines and apply it to new situations to make sense of information, formulate insightful questions, and/or solve problems

T2

Design an investigation or model using appropriate scientific tools, resources, and methods

T3

Collect, analyze and evaluate the quality of evidence in relation to a question

T4

	such as available resources, materials, and societal considerations.	
	Acquisition of Knowledge and Skill	
	Knowledge	**Skills**
	K1 Students will be able to explain the relationship between impulse and momentum **K2** Students will be able to differentiate between elastic, inelastic, and perfectly inelastic collisions	**S1** Students will be able to calculate the momentum of an object **S2** Students will be able to predict the motion of an object following an explosion or collision

predictions, and to solve problems.

Meaning	
Understandings	**Essential Questions**
U1 (6-12) Objects in motion remain in straight-line motion at constant speed, and objects at rest remain at rest unless acted upon by unbalanced forces. (Newtons 1st law). [PS2.A]	**Q1** (6-12) What causes particular objects to remain at rest, move at a constant speed, turn, speed up, or slow down?

Acquisition of Knowledge and Skill	
Knowledge	**Skills**
K1 Students will be able to differentiate between linear and angular quantities (displacement, velocity, and acceleration) **K2** Students will recognize that a centripetal force is necessary to maintain circular motion **K3** Students will be able to find the center of mass of an object **K4** Students will understand how the distribution of mass in an object effects the rotational inertia	**S1** Students will be able to find the center of mass of an object **S2** Students will be able to predict the motion of an object when a torque is applied **S3** Students will be able to apply the concept of rotational kinetic energy to predict the motion of a rolling object

formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. (HS-ESS1-2),(HS-ESS1-3) *2000823*

- The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. (HS-ESS1-2) *2000819*
- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1) *2000825*
- The study of stars light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. (HS-ESS1-2),(HS-ESS1-3) *2000820*

Use mathematics to represent physical variables and their relationships, to make quantitative predictions, and to solve problems.

Meaning

Understandings

U1

(5-12) The gravitational force of the earth pulls objects towards its center. [PS2.B]

U2

(6-12) Electromagnetism and gravity are fundamental forces in our universe which are represented by fields whose strength is determined by a variety of factors (e.g. distance, mass, charge). [PS2.B]

U3

(6-12) How do the fundamental forces of the universe explain the behavior and interactions of objects (e.g. particles, people, stars, planets)?

U4

(K-12) The movements of the sun, Earth and moon cause observable and predictable patterns, such as seasons, eclipses, sunrises/sunsets. ESS1.B

U5

(9-12) Long-term cyclical changes in the orbit and tilt of the Earth contribute to changes in climate. ESS1.B

U6

Essential Questions

Q1

(5-12) Why, how, and where do all objects fall?

Q2

(6-12) How do the fundamental forces of the universe explain the behavior and interactions of objects (e.g. particles, people, stars, planets)?

Q3

(4-12) What are the predictablepatterns caused by Earths movement in the solar system?

Q4

(6-12) What factors affect the arrangement and movement of the objects that make up our universe?

Q5

(9-12) How does the study of light provide evidence about the formation and evolution of the universe?

Q6

(9-12) How do stars change the chemical composition of our universe?

	Students will understand the structure of our solar system, galaxy, and the universe **K4** Students will be able to explain how the configuration and motion of objects in our solar system influence Earth's tides, seasons, and other phenomena	**S3** Students will be able to explain and apply Kepler's Three Laws of Planetary Motion **S4** Students will be able to apply circular motion equations to predict the motion of an object in orbit

electrons. *PS1.9.A1*

- Newton''s law of universal gravitation and Coulomb''s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. *PS2.9.B2*
- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. *PS1.9.A2*
- When two objects interacting through a field change relative position, the energy stored in the field is changed. *PS3.9.C1*

T5

Use mathematics to represent physical variables and their relationships, to make quantitative predictions, and to solve problems.

Meaning

Understandings

U1

(8-12) Atoms are comprised of subatomic particles held together by fundamental forces and their quantity and arrangement determines the atom's properties, identity, and behavior. [PS1.A]

U2 (U462) Energy that is stored in an electric, magnetic, or gravitational field is dependent upon the position of the objects in the field.
U3 (U429) Electric and magnetic forces depend on properties of the material such as their position and orientation relative to one another and do not require that the objects are touching each other.
U4 (U453) The current produced in an electrical circuit is dependent on the voltage applied, the resistance of the materials, and the manner in which the materials (e.g., wires) are connected together.

Essential Questions

Q1 (Q436) How do the fundamental forces of the universe explain the behavior and interactions of objects (e.g., particles, people, stars, planets)?
Q2 (Q454) What factors influence the flow of electricity?
Q3 (Q461) How can position of an object in a field affect the amount of energy it has stored?

Acquisition of Knowledge and Skill

Knowledge

K1

Students will be able to describe the structure of an atom and how the configuration or movement of electrons affects the charge of

Skills

S1

Students will be able to construct and analyze simple parallel and series circuits