St. Lucie County Science Scope and Sequence 2012-2013

Course: Physical Science
Course Code: 2003310

Quarter: 3

Topic(s) of Study: Dynamics and the Law of Conservation of Energy
Bodies of Knowledge: Nature of Science; Physical Science
Standards: Motion, Energy, Interdependence
Essential Questions: Why must a variety of industries take Newton's Laws of Motion into consideration when manufacturing their products? How do the four fundamental forces affect our daily lives? How do scientists design an investigation to answer a scientific question and communicate their findings?

RESOURCES | COMMON CORE | PACING GUIDE

Next Generation Sunshine State Standards	Outline of Content/Concept	Targets
SC.912.P.12.2 Analyze the motion of an object in terms of its position, velocity, and acceleration (with respect to a frame of reference) as functions of time. Cognitive Complexity: High **SC.912.P.12.7** Recognize that nothing travels faster than the speed of light in vacuum which is the same for all observers no matter how they or the light source are moving. Cognitive Complexity: Low **SC.912.P.12.3** Interpret and apply Newton's three laws of motion. Cognitive Complexity: High **SC.912.P.10.10** Compare the magnitude and range of the four fundamental forces (gravitational, electromagnetic, weak nuclear, strong nuclear). Cognitive Complexity: Moderate **SC.912.P.12.4** Describe how the gravitational force between two objects depends on their masses and the distance between them.	**I. Kinematics Overview** A. Defining a coordinate system is the first step in describing the motion of an object in space and time. B. An object's position at any instant in time is the vector drawn from the origin to the object. C. An object's velocity is the rate of change of the object's position with respect to time, and the magnitude of the velocity is the object's speed. D. An object's acceleration is the rate of change of the object's velocity with respect to time. E. If air resistance is negligible, the acceleration due to gravity near the surface of the earth is a constant for all objects in free-fall REGARDLESS OF THE OBJECT'S MASS (heavy objects DO NOT fall faster than light objects). F. To determine if an object's SPEED increases or decreases, the direction of BOTH the velocity and acceleration need to be considered.	**Motion, Force and Work:** • Determine if an object's speed is increasing or decreasing by examining the velocity and acceleration of the object. • Calculate relative velocities of an object in different frames of reference. • Use qualitative or quantitative descriptions of an object's motion to construct the set of motion graphs. • Use a single motion graph to create the remaining two motion graph. • Use individual motion graphs for an object to calculate unknown quantities about the motion of the object. • Describe how light travels and explain why its speed is independent of the source. • Understand the difference between static and dynamic equilibrium, and understand that an object

	II. Kinematic Equations in 1-D If an object maintains a constant acceleration, a set of algebraic equations can be used to describe the subsequent motion of the object. **III. Kinematic Graphs** A. An object's motion can be described using the set of three graphs: position vs. time, velocity vs. time, and acceleration vs. time. **IV. Recognize the contributions of others that paved the way for Newton's concise set of dynamics laws. (e.g. Galileo)** **V. Overview of the laws:** A. Objects at rest will remain at rest and objects in motion will remain in motion with a constant velocity (magnitude and direction) unless acted upon by a net outside force. This resistance to a change in motion that objects have is called inertia. B. If an object is subjected to a net outside force the object will accelerate, and the magnitude of the acceleration will be directly related to the object's mass. (F_{net} = ma) C. For every force exerted ON an object (Action), there is an equal and opposite force exerted BY that object (Reaction) **VI. There are 4 fundamental forces in nature, and every force we perceive is a manifestation of one of these.** A. In order of strength, they are the Strong Nuclear Force, Weak Nuclear Force, Electromagnetic Force, and Gravitational	that is moving with a constant velocity has NO net force on it. • Identify action/reaction pairs of forces. • Understand and apply the different nature of static and kinetic friction. • Draw correct Free Body Diagrams (FBD's) of objects and compute horizontal and vertical components of these forces when necessary. • Use the FBD's and Newton's 2^{nd} Law to solve statics and dynamics problems with and without friction. • Use the FBD's and Newton's 2nd Law to solve uniform circular motion problems • Recognize that an object in uniform circular motion is accelerating and thus it must have a net force on it. • Calculate the gravitational force of attraction between two objects.

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SC.912.P.10.1 Differentiate among the various forms of energy and recognize that they can be transformed from one form to others. Cognitive Complexity: Moderate **SC.912.P.10.2** Explore the law of Conservation of energy by differentiating among open, closed, and isolated systems and explain that the total energy in an isolated system is a conserved quantity. Cognitive Complexity: High **SC.912.L.17.11** Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests. Cognitive Complexity: High	Force. B. All contact forces (pushes, etc.) that we feel ultimately come down to electrostatic repulsion between nuclei of atoms in close proximity. C. Even though the nuclear forces are the strongest, their strength decreases rapidly with distance. **VII. The practical matter of dealing with objects on a macroscopic level forces us to define forces of tension, normal forces, friction, applied forces, weight, etc.** **VIII. Free body diagrams of an object are drawn and used with Newton's 2nd Law to compute an object's acceleration from know forces or an unknown force from an object's acceleration.** **IX. Universal Gravitation** A. Gravity is a universal force of attraction between every pair of objects in the universe. B. The force is directly proportional to each mass and inversely proportional to the square of the distance between the masses. **X. Forms of energy** A. Types B. Can be transformed from one form to another **XI. Law of Conservation of Energy** A. Open System B. Closed System C. Isolated System **XII. Renewable & Non-Renewable energy**	**Energy:** • Compare and contrast the various forms of energy (e.g. nuclear, chemical, mechanical, internal (particle movement), sound, elastic, thermal, electrical (static), electricity, and electromagnetic) and relate them to their type of energy (e.g. potential, kinetic, and radiant) • Validate that various forms of energy can be transformed into one another • Compare and contrast the concepts of open, closed and isolated systems • Validate the Law of Conservation of Energy and how energy is conserved in an isolated system • Compare and contrast renewable and non-renewable resources such as water,

	A. Costs B. Benefits **C.** Availability	energy, fossil fuels, wildlife, and forests.