PHYSICS

Students should be able to use science and engineering practices and understand the following content:

Science and Engineering Practices

- Development of habits of mind that are necessary for scientific thinking and that allow students to engage in science in ways similar to those used by scientists and engineers
- Asking and answering questions about the natural world
- Developing and using models to (1) build understanding of phenomena, processes and relationships, (2) test devices or solutions, or (3) communicate ideas to others
- Conducting structured investigations to answer scientific questions, test predictions, and develop explanations
- Collecting and analyzing data from investigations to construct explanations and communicate results
- Using mathematical and computational thinking in collecting and communicating data
- Using technology to collect data and in communication of results

Physics (Interactions and Forces)

- Demonstrate an understanding of how the interactions among objects and their subsequent motion can be explained and predicted using concept forces
- Plan and conduct investigations on the straight line motion of an object
- Explain an object's change in motion using one-dimensional vector addition
- Use mathematical and computational thinking to apply formulas related to displacement, constant and average velocities, and acceleration
- Develop and use models to represent an object's displacement, velocity, and acceleration
- Plan and conduct investigations to determine net force on an object, its mass, and its acceleration (Newton's Second Law of Motion)
- Use a free-body diagram to represent the forces on an object
- Use Newton's Third Law of Motion to explain phenomena (hammer hitting a nail, rocket engine thrust, a book at rest on a table)
- Use mathematical and computational thinking to derive the relationship between impulse and Newton's Second Law of Motion
- Plan and conduct investigations to support the Law of Conservation of Momentum (p=mv)
- Apply physics principles to design a device that minimizes the force on an object during a collision; also defend the design
- Develop and use models of Newton's Second Law of Motion to construct explanations in various situations
- Construct explanations for practical applications of torque
- Use a free-body diagram to represent the normal, tension, applied, and frictional forces on an object
- Plan and conduct investigations to determine the variables that can affect the kinetic and static friction
- Use mathematical and computational thinking to apply $F_{net} = ma$ to analyze problems involving contact interactions and gravity
- Develop and use models to explain how neutral objects can become charged, how objects repel or attract, and how a charge is conserved
- Use mathematical and computational thinking to apply Newton's Law of Universal Gravitation
- Explain the factors that affect gravitational attraction
- Use mathematical and computational thinking to predict the relationships among charges on two particles (Coulomb's Law)
- Construct explanations for how the non-contact forces of gravity, electricity, and magnetism can be modeled
- Develop and use models to explain the relationship between an electrical current and magnetic forces and fields

Physics (Interactions and Energy)

- Demonstrate an understanding of how the interactions among objects can be explained and predicted using the concept of conservation of energy
- Use mathematical and computational thinking to determine the work done by a constant force (W=Fd)
- Communicate how energy is conserved in elastic and inelastic collisions
- Determine the power output of the human body
- Describe the efficiency of everyday machines
- Develop and use models that illustrate transformation of mechanical energy
- Use energy formulas to support a discussion of the applications of conservation of mechanical energy
- Plan and conduct investigations to determine the variables that affect the rate of heat transfer between two objects
- Describe the thermal conductivity of different materials
- Develop and use models to illustrate how mechanical waves are transferred through a medium (sound transmission)
- Describe examples of resonance (human voice, musical instruments)
- Describe and explain the Doppler effect
- Use mathematical and computational thinking to analyze problems that relate to frequency, period, amplitude, wavelength, velocity, and energy of sound waves
- Use Ohm's law to describe the relationships among voltage, resistance, and current in complex circuits
- Develop and use models to explain how electric circuits work
- Use mathematical and computational thinking to analyze problems dealing with current, electric potential, resistance, and electric charge
- Analyze problems dealing with the power output of electrical devices
- Plan and investigate resistors and parallel and series circuits
- Describe the relationships between electricity and magnetism
- Describe the applications for devices using electricity and magnetism
- Design a simple motor and explain the energy transformations involved
- Explain and discuss arguments that support a wave model of light and those that support a particle model
- Plan and conduct investigations that determine the interactions between visible light and various objects (mirrors, lenses, diffraction gratings); use ray diagrams; and provide explanations
- Use mathematical and computational thinking to analyze problems that relate to frequency, period, amplitude, wavelength, velocity, and energy of light

PHYSICS

- Describe the technologies that use light and other forms of electromagnetic energy
- Develop and use models to represent basic atomic structure
- Compare and contrast nuclear fission and fusion
- Describe and discuss applications for fission and fusion

Activities:

- Go online and search for sites with tutorials and simulations related to the various content in the standards.
- Make a list of all the forms of energy that you use.
- Visit a science museum.
- Many simple toys can be used to illustrate physics concepts.
- Investigate the medical application of various forms of energy.
- Try bowling and analyze motion.

Web Sites:

- American Chemical Society - http://www.acs.org/content/acs/en.html
- American Physics Society - http://www.aps.org
- Periodic Table http://www.rsc.org/periodic-table
- Physics Simulations - http://phet.colorado.edu/en/simulations/category/physics