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

field
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
- Periodic Table - http://www.rsc.org/periodic-table