

## Ninth Grade

### Enduring Understanding

#### Life:

#### Physical:

#### MATTER & ENERGY:

High school students will continue to grow in their ability to describe properties of materials. They should begin to discover patterns and periodicity in the physical world, in addition to those in the living world. Groups of elements are related to each other by their common physical and chemical properties. Students will be familiar with the concept of periodicity which will enable them to describe how families (columns) of the elements are related by common properties. The Periodic Table shows patterns and regularities among elements.

Students will be able to use resources and gather information about household and agricultural materials and to make risk/benefit analyses in order that long term interests for society are best served.

Scientifically literate high school students will recognize that all of the more than 100 elements known to exist have the same basic structural parts. Atoms are composed of a central nucleus formed from positively charged protons and neutral neutrons surrounded by a cloud of lighter negatively charged electrons. The number of electrons in each atom matches the number of protons. Elements will have different properties based on the number of protons and electrons in their atoms.

High school students can demonstrate how a conductor moving through a magnetic field can produce an electric current, which is the principle behind electric generators. High school students should be able to describe that electricity and magnetism are related. Students should also be able to construct and explain series and parallel circuits.

#### CHANGES IN MATTER:

Students at the high school level will become more quantitative in their analysis of what happens during physical and chemical changes. In physical changes, the form of the material is changed. In chemical changes, through the breaking of bonds, all the atoms within the molecules that form the reactants appear again as products, but rearranged into different molecules. Students will understand how mass and energy are conserved in chemical and physical changes.

Students will identify physical changes as those which involve little change in energy while chemical reactions involve moderate energy changes. In nuclear reactions, new atoms are formed which involve extremely large changes in energy. Students need to be able to distinguish between nuclear reactions such as fission, fusion, and radioactive decay.

Students will be able to explain changes in matter and energy and how they relate to convection, conduction, or radiation.

#### **MOTION OF OBJECTS:**

Students in high school will be able to analyze patterns of force and motion in complex machines. They will be able to apply this analysis to practical applications.

High school students will be able to identify the forms of energy most commonly associated with moving objects and with machines, including the energy of motion (also called kinetic or mechanical energy), heat, gravitational, chemical, and electrical energy.

#### **VIBRATIONS AND WAVES:**

Students need to be able to describe and compare sound waves in terms of frequency and amplitude and to understand how our ears can detect sound .

Students will know that we see color because objects reflect some wavelengths of light and absorb others. If an object appears black, it is not reflecting any light; if an object appears white, it is reflecting all wavelengths of light.

All waves, mechanical and electromagnetic, can be described in terms of the same basic properties, including frequency, wavelength, amplitude, and wave velocity.

Mechanical waves include sound, ultrasound, water waves, and seismic waves. Electromagnetic waves differ from mechanical waves in that the "vibrations" occur not in some form of matter, but in electrical and magnetic fields. Unlike mechanical waves, electromagnetic waves can travel through a vacuum. Visible light, ultraviolet and infrared light ("heat waves"), microwaves, radio waves and television signals, X-rays, and gamma rays are all electromagnetic waves. In combination, they make up the electromagnetic spectrum. While human senses are limited in their ability to detect electromagnetic radiation, devices such as photographic film, "night vision" devices, Geiger counters, and radio receivers allow detection of many other wavelengths.

#### **Earth:**

### **Benchmarks**

#### **Life:**

**Physical:****MATTER AND ENERGY:**

1. Analyze properties of common household and agricultural materials in terms of risk/benefit balance.
2. Identify properties of common families of elements.
3. Explain how elements differ, in terms of the structural parts and electrical charges of atoms.
4. Explain how current is controlled in simple series and parallel circuits.
5. Describe how electric currents can be produced by interacting wires and magnets, and explain applications of this principle.

**CHANGES IN MATTER:**

1. Explain chemical changes in terms of the breaking of bonds and the rearrangement of atoms to form new substances.
2. Explain why mass is conserved in physical and chemical changes.
3. Contrast nuclear fission, nuclear fusion, and natural radioactivity.
4. Describe energy transformations involved in physical, chemical and nuclear changes, and contrast their relative magnitudes.
5. Explain changes in matter and energy involving heat transfer.

**MOTION OF OBJECTS:**

1. Analyze patterns of force and motion in the operation of complex machines.
2. Explain energy conversions in moving objects and machines.

**WAVES AND VIBRATIONS:**

1. Relate characteristics of sounds that we hear to properties of sound waves.
2. Explain how we see colors of objects.
3. Describe waves in terms of their properties.
4. Describe different types of waves and their technological applications.

**Earth:**