Concepts and Challenges
Earth Science

correlated to

New York
Intermediate Level Science Core Curriculum
STANDARD 4: The Physical Setting

KEY IDEA 1:
The Earth and celestial phenomena can be described by principles of relative motion and perspective.

PERFORMANCE INDICATOR 1.1
Explain daily, monthly, and seasonal changes on Earth.

Major Understandings:
1.1a  Stars are like the sun, but so far away that they look like points of light.

   TE/PE:  374-375, 378-379

1.1b  Earth is the third planet from the Sun in a system that includes the Moon, the Sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The Sun, an average-size star, is the central and largest body in the solar system.


1.1c  The Moon’s orbit around Earth, once in about 28 days, changes the part of the Moon that is light by the Sun and how much of that part can be seen from Earth. These changes are called the phases of the Moon.

   TE/PE:  358-359, 360-361
1.1d Most objects in the solar system are in regular and predictable motion. These motions explain such phenomena as the day, the year, phases of the Moon, eclipses, meteor showers, and comets.

LP: 109-112, 115-120

1.1e Gravity is the force that keeps planets in orbit around the Sun and governs the rest of the motion in the solar system.

TE/PE: 332-333, 334-335, 358-359
LP: 111-112

1.1f Seasonal changes result from variations in the amount of the Sun’s energy striking the surface, due to the tilt of Earth’s rotation on its axis and the length of the day.

TE/PE: 352-353

1.1g Like all planets and stars, Earth is approximately spherical in shape. The rotation of Earth on its axis every 24 hours produces the night-and-day cycle. To people on Earth, this turning of the planet makes it seem as though the Sun, Moon, planets, and stars are orbiting Earth once a day.

TE/PE: 20-21, 350-351

KEY IDEA 2:
Many of the phenomena that we observe on Earth involve interactions among components of air, water, and land.

PERFORMANCE INDICATOR 2.1
Explain how the atmosphere (air), hydrosphere (water), and lithosphere (land) interact, evolve, and change.

Major Understandings:
2.1a Earth is composed of mostly rock. Three-fourths of its surface is covered by a relatively thin layer of water (some frozen), and the entire planet is surrounded by a relatively thin blanket of air.

TE/PE: 20-21, 22-23, 190-191, 214-215
TE/PE: Teacher's Edition/Pupil’s Edition
TRB: Teacher’s Resource Book
LP: Laboratory Program
RW: Review Worksheets
EW: Enrichment Worksheets
EP: Evaluation Program
FS: Foreign Language Supplement
2.1b Rock is composed of different combinations of minerals, which are naturally occurring pure substances with specific properties. Smaller rocks come from the breakage and weathering of bedrock and larger rocks.

TE/PE: 46-47, 60-61, 64-65, 68-69, 72-73, 80-81
LP: 39-44

2.1c Soil is made from weathered rock and plant remains, and usually contains many living organisms.

TE/PE: 88-89, 90-91, 92-93

2.1d Water, which covers the majority of Earth’s surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle. Water evaporates from Earth’s surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface, where it collects in lakes, oceans, soil, and in rock underground.

TE/PE: 184-185, 280, 290

2.1e Water is a solvent. As it passes through the water cycle, it dissolves minerals and gases and carries them to the oceans.

TE/PE: 106-107, 184-185, 200-201, 248-249, 282-283
LP: 51-52, 91-92

2.1f The atmosphere is a mixture of nitrogen, oxygen, carbon dioxide, water vapor, and trace gases. The atmosphere has different characteristics at different elevations.

TE/PE: 212-213, 214-215

2.1g Interactions of the lithosphere, hydrosphere, and atmosphere produce changes to Earth’s surface. Some changes are abrupt (such as earthquakes and volcanic eruptions). Some changes happen very slowly (such as uplift and wearing down of mountains).
2.1h Waves, wind, water, and ice shape and reshape Earth’s land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers.

2.1i Rocks (igneous, sedimentary, and metamorphic) are classified on the basis of their origin.

PERFORMANCE INDICATOR 2.2
Describe volcano and earthquake patterns, the rock cycle, and weather and climate changes.

Major Understandings:

2.2a The interior of Earth is hot. Heat flow and movement of material within Earth causes sections of Earth’s crust to move. This may result in earthquakes, volcanic eruption, and creation of mountains and ocean basins.

2.2b Old rocks at earth’s surface weather, forming sediments that are buried, then compacted, heated, and often recrystallized into new rock. Eventually, those new rocks may be brought to the surface by internal forces, continuing the rock cycle.

2.2c Gas and dust from large volcanoes can change the atmosphere, thereby affecting climate and weather.
2.2d Weather is caused by the uneven heating of Earth (lithosphere, hydrosphere, and atmosphere). Cloud cover, temperature, and water vapor concentration affect weather.

**KEY IDEA 3:**
Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

**PERFORMANCE INDICATOR 3.1**
Observe and describe properties of materials, such as density, conductivity, and solubility.

**Major Understandings:**
3.1a Substances have characteristic properties. Some of these properties include color, odor, phase at room temperature, density, solubility, heat and electrical conductivity, hardness, and boiling and freezing points.

3.1b Characteristic properties can be used to identify different materials, and separate a mixture of substances into its components. A magnetic substance can be removed from a mixture by means of a magnet. An insoluble substance can be separated from a soluble substance by such processes as filtration, decantation, and evaporation.

**PERFORMANCE INDICATOR 3.2**
Distinguish between chemical and physical changes.

**Major Understandings:**
3.2a During physical change a substance keeps its chemical composition and properties. Examples of physical changes include freezing, boiling, evaporation, tearing, and crushing.
3.2b Mixtures are physical combinations of materials and can be separated by physical means.

LP: 55-56

3.2c During a chemical change, matter with new chemical composition and properties is formed. Examples of chemical changes include burning of wood, cooking of food, rusting of iron, and souring of milk.

TE/PE: 70-71, 82-83

3.2d Substances react chemically in characteristic ways with other substances to form new substances with different physical and chemical properties. Substances often are placed in categories if they react in similar ways. Examples include metals, nonmetals, and highly unreactive gases.

TE/PE: 42-43, 70-71, 74-75, 82-83
TRB: RW: R21, R28, R34, R36, R37, R39, R46, EW: E12, E17, E18, EP: T7-T12, FS: SS9, SS13, SS14, SS15

3.2e The Law of Conservation of Mass states that during an ordinary chemical reaction matter cannot be created or destroyed, just rearranged. Therefore, in ordinary chemical reactions, the total mass of the reactants equals the total mass of the products.

Related concepts are taught on the following pages:
TE/PE: 42-43, 44-45

PERFORMANCE INDICATOR 3.3
Develop mental models to explain common chemical reactions and changes in states of matter.

Major Understandings:
3.3a All matter is made up of atoms, which are far too small to see with a microscope.

TE/PE: 40-41

3.3b Atoms and molecules are perpetually in motion.

TE/PE: 40-41, 42-43
3.3c The atoms of any one element are alike, but are different from atoms of other elements.

**TE/PE:** 40-41
**TRB:** RW: R20, R28, EW: E11, EP: T7-T8, FS: SS9

3.3d Interactions among atoms result in chemical reactions. Many substances dissolve in water, which may greatly facilitate reactions between them.

**TE/PE:** 42-43
**TRB:** RW: R21, R28, EW: E12, EP: T7-T8, FS: SS9

3.3e Atoms may join together in well-defined molecules or may be packed in large arrays.

**TE/PE:** 42-43, 44-45
**TRB:** RW: R21, R22, R28, EW: E12, EP: T7-T8, FS: SS9

3.3f There are more than 100 elements that combine in a multitude of ways to produce compounds which account for all living and nonliving substances that we encounter. Few elements are found in their pure form.

**TE/PE:** 40-41, 42-43, 44-45
**TRB:** RW: R21-R23, R28, EW: E11, E12, EP: T7-T8, FS: SS9

3.3g The phase (solid, liquid, or gas) for a given sample of matter is related to the position and motion of the particles in the sample.

**TE/PE:** 184-185, 238-239, 240-241, 244-245, 248-249
**LP:** 87-88, 91-92

3.3h During a phase change, heat energy is absorbed or released.

**TE/PE:** 184-185, 238-239, 240-241, 244-245, 248-249
**LP:** 87-88, 91-92

**KEY IDEA 4:**
Energy exists in many forms, and when these forms change energy is conserved.

**PERFORMANCE INDICATOR 4.1**
Describe the sources and identify the transformations of energy observed in everyday life.

**Major Understandings:**
4.1a The Sun (and the wind and water energy derived from it) is a major source of energy for Earth.
4.1b Fossil fuels contain stored solar energy and are considered nonrenewable resources.

4.1c Other sources of energy include nuclear and geothermal energy.

4.1d Most activities in everyday life involve one form of energy being transformed into another. Energy, in the form of heat, is almost always one of the products of energy transformations.

4.1e Energy is a property of many substances and is associated with heat, light electricity, mechanical motion, sound, nuclei, and the nature of the chemical. Energy is transferred in many ways.

4.1f Energy can be considered to be either kinetic energy, which is the energy of motion, or potential energy, which depends on relative position.

PERFORMANCE INDICATOR 4.2
Observe and describe heating and cooling events.

Major Understandings:

4.2a Heat is the total energy of motion of all the particles in a sample of matter. When two samples made of the same material are at the same temperature, the sample with the larger mass will have more heat energy.

Related concepts are taught on the following pages:

TE/PE: 196-197, 216-217, 218-219, 226-227
4.2b Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.

Related concepts are taught on the following pages:
TE/PE: 196-197, 216-217, 218-219, 226-227
TRB: RW: R76, R78, R93, R99, R100, R103, R104, R108, R112, R113, 
LP: 67-68, 79-86

4.2c Heat can be transferred through materials by collisions of atoms (by conduction) or across space by radiation. If the material is fluid, convection currents will be set up in it that aid the transfer of heat by convection.

PERFORMANCE INDICATOR 4.3
Observe and describe energy changes as related to chemical reactions.

Major Understandings:
4.3a In chemical reactions, energy is transferred into or out of a system. Heat, light, electricity, or mechanical motion might all be involved in such transfers.

Related concepts are taught on the following pages:
TE/PE: 70-71, 82-83

PERFORMANCE INDICATOR 4.4
Observe and describe the properties of sound, light, magnetism, and electricity.

Major Understandings:
4.4a There are many forms of energy, such as heat, light, mechanical, sound, nuclear, and chemical.

TRB: RW: R104, R112, R113, R142-R145, R188, R189, R193, R194, 
LP: 83-86

4.4b Light energy makes up the electromagnetic spectrum. Some light energy has short waves and some has long waves. Some examples are visible light, microwaves, X-rays, and ultraviolet rays.
4.4c Light can pass through some materials, sometimes bending in the process. Some materials absorb or reflect light. To see an object, light from that object, emitted by or reflected from it, must enter the eye.

Related concepts are taught on the following pages:
TE/PE: 216-217, 298-299, 388-389, 390-391
TRB: RW: R104, R112, R113, R143-R145, R188, R189, R193, R194, 
EP: T27-T28, T33-T34, T41-T42, FS: SS38, SS50, SS63
LP: 83-86

4.4d Vibrations in materials set up wavelike disturbances that spread away from the source. Sound and earthquake waves are examples. These and other waves move at different speeds in different materials.

TE/PE: 140-141
LP: 61-62

4.4e Electrical energy can be produced from a variety of energy sources and can be transformed into almost any other form of energy.

TE/PE: 296-297, 298-299

4.4f Electrical circuits provide a means of transferring electrical energy.

Related concepts are taught on the following pages:
TE/PE: 296-297, 298-299

PERFORMANCE INDICATOR 4.5
Describe situations that support the principle of conservation of energy.

Major Understandings:
4.5a Energy cannot be created or destroyed, but only changed from one form into another.
4.5b  Energy can change from one form to another, although in the process some energy is always converted to heat. Some systems transform energy with less loss of heat than others.

**KEY IDEA 5:**
Energy and matter interact through forces that result in changes in motion.

**PERFORMANCE INDICATOR 5.1**
Describe different patterns of motion of objects.

**Major Understandings:**

5.1a  The motion of an object is always judged with respect to some other object or point.

5.1b  The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.

5.1c  An object that is not being subjected to a force will continue to move at a constant speed and in a straight line.

5.1d  Changes in speed or direction of motion are caused by force. The greater the force is, the greater the change in motion will be. The more massive an object is, the less effect a given force will have.
5.1e Whenever an object exerts a force on another, an equal amount of force is exerted back on it.

PERFORMANCE INDICATOR 5.2
Observe, describe, and compare effects of forces (gravity, electric current, and magnetism) on the motion of objects.

Major Understandings:
5.2a Whenever an object is seen to speed up, slow down, or change direction, we know that an unbalanced force acts on it.

5.2b Every object exerts gravitational force on every other object. This force depends on how much mass the objects have and on how far apart they are. This force is hard to detect unless at least one on the objects has a lot of mass.

5.2c Electric currents and magnets can exert a force on each other.

5.2d An unbalanced force acting on an object changes its speed or path of motion, or both. If the force acts toward a single center, the object’s path may curve into an orbit around the center.

5.2e Friction is a force that opposes motion.
An object’s motion is the result of the combined effect of all forces acting on the object.

In addition, Earth Science concepts are addressed by the following Major Understandings in STANDARD 4: THE LIVING ENVIRONMENT.

3.2b Changes in environmental conditions can affect the survival of individual organisms with a particular trait. Small differences between parents and offspring can accumulate in successive generations so that descendants are very different from their ancestors. Individual organisms born with certain traits are more likely to survive and have offspring than individuals born without those traits.

3.2c Many thousands of layers of sedimentary rock provide evidence for the long history of Earth and for the long history of changing life-forms whose remains are found in the rocks. More recently deposited rock layers are more likely to contain fossils resembling existing species.

6.2a Photosynthesis is carried on by green plants and some other organisms. In this process, the Sun’s energy is converted into and stored as chemical energy in the form of sugar. It can be demonstrated that the quantity of sugar molecules increases in green plants during photosynthesis in the presence of sunlight.

6.2b The major source of atmospheric oxygen is photosynthesis. It can be demonstrated that carbon dioxide is removed from the atmosphere and oxygen is released during photosynthesis.
6.2c Most organisms use the food (directly or indirectly) and oxygen produced by plants to meet their energy needs.

7.1d The environment may contain dangerous levels of substances that are harmful to organisms (pollutants). Therefore, the good health of environments and individuals requires monitoring the soil, air, and water, and taking steps to keep them safe.

7.2a In ecosystems, balance is the result of interactions between the community members and their environment.

7.2d Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion. The survival of living things on our planet depends on the conservation and protection of Earth’s resources.