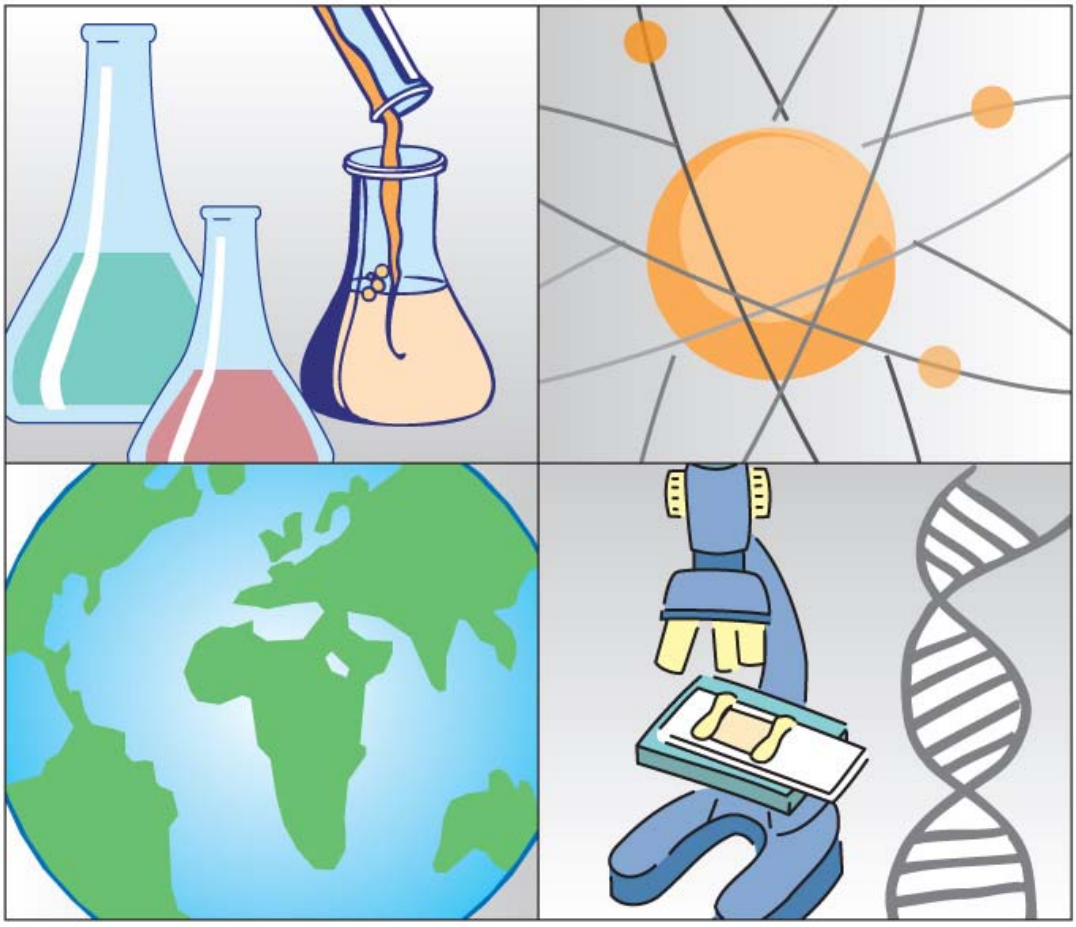
CURRICULUM GUIDE
to the Alabama Course of Study:

Science Grades K-12



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2006
Joseph B. Morton, State Superintendent of Education
Alabama Department of Education

Curriculum Guide
Alabama Course of Study
Science

T a b l e o f C o n t e n t s

Acknowledgments

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Introduction

The 2006 *Curriculum Guide to the Alabama Course of Study: Science* is a companion document to the Grades K-12 *Alabama Course of Study: Science* (Bulletin 2005, No. 20). The *Alabama Course of Study: Science* was developed by members of the Science State Course of Study Committee and Task Force and was adopted by the Alabama State Board of Education in February, 2005. Content standards contained within the course of study document may be accessed on the Alabama Department of Education Web site at www.alsde.edu. On the home page, select Sections and then Classroom Improvement. Click on Publications, scroll down to Courses of Study, and click on Science.

Educators are reminded that content standards indicate minimum content—what all students should know and be able to do by the end of each grade level or course. Local school systems may have additional instructional or achievement expectations and may provide instructional guidelines that address content sequence, review, and remediation.

The *Curriculum Guide to the Alabama Course of Study: Science* prepares students for study of the grade-level and course content standards through the teaching of prerequisite and enabling skills necessary for learning each content standard. This allows students to work toward grade-level and course content standards while working at individual ability levels. By identifying the prerequisites and enabling skills for each standard, teachers may plan instruction to address the achievement gap experienced by some students while still working with all students toward achievement of the same standards. Educators are encouraged to use the curriculum guide to:

- Develop lesson plans,
- Plan for Building-Based Student Support Teams (BBSSTs),
- Develop Individual Educational Programs (IEPs),
- Prepare for collaborative teaching,
- Design tutorials,
- Plan for instructional grouping,
- Plan for parent information and conferences,
- Develop curriculum-based assessments, and
- Prepare for state assessments.

Organization of the Curriculum Guide

The organizational components of this guide include content standards, bullets, examples, and instructional objectives. **Content standards** are statements that define what all students should know and be able to do at the conclusion of a course or grade. Content standards contain minimum required content and complete the phrase "*Students will*."

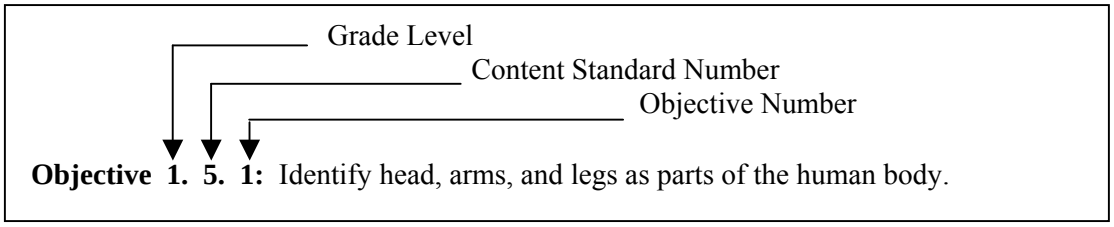
Content standards for a grade level or course should be clearly written, reasonable, measurable, developmentally appropriate, and sufficiently rigorous to enable Alabama students to achieve at levels comparable to other students in the nation and the world. The standards provide proportional emphasis to the essential knowledge, skills, and processes of a given grade level or course.

Bullets denote content that is related to the standards and required for instruction. Bulleted content is listed under a standard.

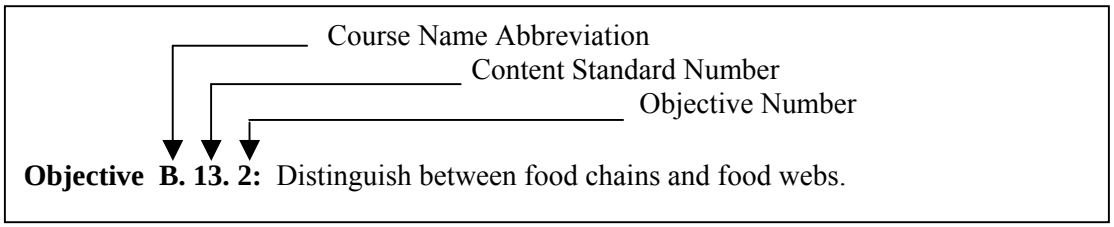
Examples clarify certain components of content standards or bullets. They are illustrative but not exhaustive. Examples are not part of the minimum required content.

Instructional objectives divide the standards into smaller instructional units that serve as foundational skills for the standards. Instructional objectives are useful in lesson planning, classroom instruction, and IEP development. Utilization of instructional objectives facilitates having all students working toward grade-level standards while also working at individual ability levels. Instructional objectives preceded by a diamond shape (♦) indicate content required for earning Grades 9-12 course credit for the *Alabama Occupational Diploma (AOD)*..

Instructional objectives for Grades K-8 content within this document are numbered according to grade level, content standard number, and the order in which the instructional objective is listed. The numbering system for Instructional Objective 1.5.1. from Grade 1 is shown below.



Instructional objectives for Grades 9-12 content within this document are numbered according to course name rather than grade level. Course names are abbreviated (**PS** for Physical Science, **B** for Biology, **C** for Chemistry, **P** for Physics, **ESS** for Earth and Space Science, **ES** for Environmental Science, **G** for Genetics, and **HAP** for Human Anatomy and Physiology) and are followed by the content standard number and the number indicating the order in which the instructional objective is listed. As an example, the system for numbering Instructional Objective B.13.2 from the Grades 9-12 Biology Core is shown below.



How Can Teachers Most Effectively Use This Document?

- Become familiar with the *Alabama Course of Study: Science* (Bulletin 2005, No. 20).
- Review the supporting 2006 *Curriculum Guide to the Alabama Course of Study: Science* for Grades K-12.
- Correlate standards and instructional objectives in the guide with the *Compendium Supplement for the Stanford Achievement Test, 10th Edition*.
- Correlate the standards and instructional objectives in the guide with the *Item Specifications for Science* for the *Alabama High School Graduation Exam.*
- Use the guide and correlations for instructional planning.
- Teach all content specified in the course of study for each grade level or course.
- Emphasize the importance of vocabulary in all content areas.
- Connect students' prior knowledge to science concepts.
- Develop curriculum-based assessments based on the standards.
- Make content relevant to real-life situations.
- Use the instructional objectives followed by a diamond-shape (♦) as the required course content for earning Grades 9-12 course credit for the *AOD*.
- Emphasize the importance of collaborative teaching and planning between general and special education faculty.
- Plan and implement activities that address all learning styles—auditory, visual, kinesthetic, and tactile.
- Provide opportunities for cooperative learning.
- Use graphic organizers, hands-on activities, and other active learning experiences to increase student understanding.
- Provide both guided and independent practice.

KINDERGARTEN

Physical Science

Students will:

1. **Classify objects as solids or liquids.**

   Objective K.1.1: Define solid and liquid**.**
   Objective K.1.2: Describe objects as being solid or liquid.

2. **Identify the sun as Earth's source of light and heat.**

   Objective K.2.1: Define sun and Earth.
   Objective K.2.2: Recognize sources of light.
   Examples: sun, electric lights, flashlights
   Objective K.2.3: Recognize sources of heat.
   Examples: sun, stove, furnace

   Additional content to be taught:
   - Predicting the effect of the sun on living and nonliving things
   - Identifying relationships between light and shadows
   - Predicting the occurrence of shadows

3. **Relate a variety of sounds to their sources, including weather, animal, and transportation sounds.**
   Examples: weather—thunder,
   animal—dog bark,
   transportation—truck horn

   Objective K.3.1: Explain that sounds come from many sources.
   Objective K.3.2: Imitate sounds produced from a variety of sources, including weather, animal, and transportation sounds.

4. **Identify properties of motion, including change of position and change of speed.**

   Objective K.4.1: Identify a variety of positions, including up, down, forward, backward, and sideways.
   Objective K.4.2: Describe motions, including push and pull.
   Objective K.4.3: Describe speeds, including fast and slow.

5. **Predict whether an object will be attracted by a magnet.**

   Objective K.5.1: Recognize uses of magnets.
   Objective K.5.2: Identify items at home and at school that contain magnets.
   Examples: can openers, refrigerator magnets, magnetic games
   Objective K.5.3: Identify items at home and at school that are attracted by magnets.
   Examples: coins, nails, keys, paper clips

K

Life Science

6. **Compare size, shape, structure, and basic needs of living things.**

Objective K.6.1: Group living things based on size.
Objective K.6.2: Group living things based on shape and structure.
Examples: leaves that are round, leaves that are oval, leaves with a fuzzy texture, leaves with a smooth texture
Objective K.6.3: List basic needs of living things, including air, water, sun, and food.

Additional content to be taught:
- Identifying similarities of offspring and their parents

7. **Classify objects using the five senses.**

Objective K.7.1: Recognize sensory descriptors.
Examples: sweet, sour, bitter, salty, soft, rough, cold, hot, loud, quiet
Objective K.7.2: Identify the sense organs.
Objective K.7.3: Identify the five senses.

Additional content to be taught:
- Grouping objects according to color, shape, size, sound, taste, smell, texture, and temperature

Earth and Space Science

8. **Identify features of Earth as landmasses or bodies of water.**

Objective K.8.1: Identify a globe as a model of Earth.
Objective K.8.2: Identify landmasses and bodies of water on a globe or map..

9. **Identify the seasons of the year.**

Objective K.9.1: Describe typical weather on a summer and on a winter day in Alabama.
Objective K.9.2: Describe appropriate clothing for hot weather and for cold weather.

Additional content to be taught:
- Describing seasonal changes in the weather

10. **Identify objects observed in the day sky with the unaided eye, including the sun, clouds, moon, and rainbows.**

Objective K.10.1: Identify the sun and clouds in the day sky.
Objective K.10.2: Describe a rainbow.

FIRST GRADE

Physical Science

Students will:

1. **Select appropriate tools and technological resources needed to gather, analyze, and interpret data.**
   Examples: platform balances, hand lenses, computers, maps, graphs, journals

   Objective 1.1.1: Identify types of data needed to create a chart or graph.
   Examples: rainy and sunny days for a weather graph, birth dates for a birthday graph, height measurements for a tallness graph
   Objective 1.1.2: Identify types of tools needed to create a chart or graph.
   Examples: rain gauge, calendar, ruler

2. **Identify basic properties of objects.**
   Examples: size, shape, color, texture

   Objective 1.2.1: Describe the shape, size, and texture of objects using the terms *big*, *little*, soft, hard, round, square, rough, and smooth.
   Objective 1.2.2: Classify objects according to size.
   Objective 1.2.3: Classify objects according to color.

3. **Describe effects of forces on objects, including change of speed, direction, and position.**

   Objective 1.3.1: Describe ways objects can be moved.
   Objective 1.3.2: Identify properties of motion, including change of position and change of speed.
   Objective 1.3.3: Demonstrate that an object can be moved by a push or pull.

Life Science

4. **Describe survival traits of living things, including color, shape, size, texture, and covering.**

Objective 1.4.1: List ways plants and animals protect themselves.
Objective 1.4.2: Identify basic needs of plants and animals, including air, water, food, and shelter.
Objective 1.4.3: Categorize plants and animals by color, shape, size, texture, and covering.

Additional content to be taught:
- Classifying plants and animals according to physical traits
  Examples: animals—six legs on insects,
  plants—green leaves on evergreen trees
- Identifying developmental stages of plants and animals
  Examples: plants—seed developing into seedling, seedling developing into tree;
  animals—piglet developing into pig, kid developing into goat
- Describing a variety of habitats and natural homes of animals

5. **Identify parts of the human body, including head, neck, shoulders, arms, spine, and legs.**

Objective 1.5.1: Identify head, arms, and legs as parts of the human body.
Objective 1..5.2: Identify parts of the human body from an illustration.

Additional content to be taught:
- Recognizing the importance of a balanced diet for healthy bones
- Discussing the relationship of muscles and bones to locomotion
- Discussing the relationship of bones to protection of vital organs
  Example: protection of brain by skull
- Identifying technology used by scientists to study the human body
  Examples: X-ray images, magnetic resonance imaging (MRI)

6. **Recognize evidence of animals that no longer exist.**

Objective 1.6.1: Define fossil.
Objective 1.6.2: Recognize dinosaurs as animals that no longer exist.

Earth and Space Science

7. **Identify components of Earth's surface, including soil, rocks, and water.**

Objective 1.7.1: Differentiate between soil and rocks.
Objective 1.7.2: Illustrate components of Earth's surface, including soil, rocks, and water..

8. **Recognize daily changes in weather, including clouds, precipitation, and temperature.**

   Objective 1.8.1: Define precipitation and temperature.
   Objective 1.8.2: Identify rain, snow, and hail as forms of precipitation.
   Objective 1.8.3: Identify appropriate clothing for different types of weather.
   Objective 1.8.4: Describe seasonal changes in the weather.

   Additional content to be taught:
   - Recognizing instruments used to observe weather
     Examples: thermometer, rain gauge, wind sock, weather vane
   - Recording weather data using weather journals, charts, and maps

9. **Identify ways to conserve Earth's resources.**
   Example: turning off lights and water when not in use

   Objective 1.9.1: Define conserve.
   Objective 1.9.2: Identify the sun, water, and wind as examples of Earth's resources.

10. **Describe uses of recycled materials.**
    Examples: manufacture of paper products from old newspapers, production of mulch from trees

    Objective 1.10.1: Define recycle.
    Objective 1.10.2: List materials that can be recycled.

11. **Compare the day sky to the night sky as observed with the unaided eye.**

    Objective 1.11.1: Identify the moon and stars as objects in the night sky.
    Objective 1.11.2: Identify the sun, clouds, and rainbows as objects in the day sky.

SECOND GRADE

Physical Science

Students will:

1. **Identify states of matter as solids, liquids, and gases.**

   Objective 2.1.1: Identify basic properties of objects.
   Examples: size, shape, color, texture
   Objective 2.1.2: Identify ways states of matter are similar and ways they are different.
   Examples: similar—gases and liquids assuming the shape of their containers, different—solids not assuming the shape of their containers

   Additional content to be taught:
   - Describing objects according to physical properties, including hardness, color, and flexibility
   - Describing changes between states of matter
     Examples: solid to liquid—melting,
     gas to liquid—condensing,
     liquid to gas—evaporating,
     liquid to solid—freezing
   - Measuring quantities of solids and liquids

2. **Identify vibration as the source of sound.**

   Objective 2.2.1: Relate a variety of sounds to their sources, including weather, animal, and transportation sounds.
   Objective 2.2.2: Identify different sounds produced by vibrations in the environment.
   Examples: rustling sound of leaves caused by blowing wind, buzzing sound of bees caused by rapid wing movement, whirring sound of helicopters caused by rotation of propellers

   Additional content to be taught:
   - Identifying pitch and volume as properties of sound
   - Distinguishing between pitch and volume of sound

3. **Recognize that light travels in a straight line until it strikes an object.**

   Objective 2.3.1: Define reflect and shadow.
   Objective 2.3.2: Identify relationships between light and shadows.

   Additional content to be taught:
   - Recognizing that light can be reflected

4. **Describe observable effects of forces, including buoyancy, gravity, and magnetism.**
   Examples: buoyancy—boat floating on water,
   gravity—apple falling from tree,
   magnetism—magnets adhering to metal

Objective 2.4.1: Define gravity.
Objective 2.4.2: Identify items that float in water.
Objective 2.4.3: Identify items that are attracted by a magnet.

Additional content to be taught:
- Identifying simple machines, including the inclined plane, lever, pulley, wedge, screw, and wheel and axle

Life Science

5. **Identify the relationship of structure to function in plants, including roots, stems, leaves, and flowers.**

Objective 2.5.1: Identify plant roots, stems, leaves, and flowers, including how they benefit the plant.
Objective 2.5.2: Identify plant needs for growth.

6. **Identify characteristics of animals, including behavior, size, and body covering.**

Objective 2.6.1: Identify animal behaviors and characteristics that help them survive.
Objective 2.6.2: Describe physical traits of animals, including color, shape, and size.

Additional content to be taught:
- Comparing existing animals to extinct animals
  Examples: iguana to stegosaurus, elephant to wooly mammoth
- Identifying migration and hibernation as survival strategies

Earth and Space Science

7. **Identify geological features as mountains, valleys, plains, deserts, lakes, rivers, and oceans.**

Objective 2.7.1: Identify features of Earth as landmasses or bodies of water.
Objective 2.7.2: Identify mountains, valleys, plains, and deserts as landmasses.
Objective 2.7.3: Identify rivers, lakes, and oceans as bodies of water.

Additional content to be taught:
- Identifying local landforms and bodies of water
- Identifying components of soil, including sand, clay, and silt

8. **Identify evidence of erosion and weathering of rocks.**

   Objective 2.8.1: Define erosion and weathering.
   Objective 2.8.2: Compare rock samples for evidence of weathering.

9. **Describe evaporation, condensation, and precipitation in the water cycle.**

   Objective 2.9.1: Define water cycle, evaporation, condensation, and precipitation.
   Objective 2.9.2: Name components of the water cycle, including the sun, clouds, and rain.
   Objective 2.9.3: Identify forms of precipitation, including rain, snow, sleet, and hail.

10. **Identify the impact of weather on agriculture, recreation, the economy, and society.**

    Objective 2.10.1: Identify the impact of weather on daily activities.
    Objective 2.10.2: Describe ways that weather can influence recreational activities.
    Objective 2.10.3: Explain how weather affects availability and cost of certain food items.
    Example: hard freeze damaging peach crops resulting in scarcity of peaches and rise in cost of peaches

    Additional content to be taught:
    - Recognizing the importance of science and technology to weather predictions

11. **Identify basic components of our solar system, including the sun, planets, and Earth's moon.**

    Objective 2.11.1: Define planets and solar system.
    Objective 2.11.2: Illustrate basic components of our solar system, including the sun, planets, and Earth's moon.

THIRD GRADE

Physical Science

Students will:

1. **Classify substances as soluble or insoluble.**
   Examples: soluble—sugar in water, powdered drink in water;
   insoluble—sand in water, oil in water

   Objective 3.1.1: Define soluble and insoluble.
   Objective 3.1.2: Identify substances that dissolve in a liquid.

2. **Identify physical and chemical changes of matter.**
   Examples: physical—chopping wood,
   chemical—burning wood

   Objective 3.2.1: Define matter..
   Objective 3.2.2: Demonstrate physical changes of matter.
   Examples: burning of a candle resulting in melted wax, freezing of water resulting in formation of ice
   Objective 3.2.3: Describe chemical changes of matter.
   Examples: logs burning in a fireplace and turning in ashes, cake batter baking in an oven and turning into a cake, steel wool pads soaking in water and turning into rust

3. **Describe ways energy from the sun is used.**
   Examples: plant growth, light, heat

   Objective 3.3.1: Define energy.
   Objective 3.3.2: Illustrate how energy from the sun affects plants.
   Example: recording growth stages of a plant on a chart or graph
   Objective 3.3.3: Describe changes in the growth of a plant when exposed to variations in light and heat.

   Additional content to be taught:
   - Identifying fossil fuels as a source of energy

4. **Define force and motion.**

Objective 3.4.1: Describe observable effects of forces on objects, including buoyancy, gravity, and magnetism.
Objective 3.4.2: Describe observable effects of motion on objects, including change of speed and direction..

Additional content to be taught:
- Identifying forces that change an object's position or motion
  Examples: lifting, pushing, pulling
- Identifying sources of friction
  Examples: rubbing hands together, applying sandpaper to wood
- Describing the force of gravity

5. **Identify the relationship of simple machines to compound machines.**
   Example: pencil sharpener composed of a wheel and axle, inclined plane, and wedge

Objective 3.5.1: Define simple and compound machines.
Objective 3.5.2: Identify examples of simple machines.
Objective 3.5.3: Identify examples of compound machines.

Life Science

6. **Identify structures and functions of the muscular and skeletal systems of the human body.**

Objective 3.6.1: Distinguish between muscles and bones.
Objective 3.6.2: Discuss the relationship of muscles and bones to movement.

7. **Describe the life cycle of plants, including seed, seed germination, growth, and reproduction.**

Objective 3.7.1: Define germination.
Objective 3.7.2: Illustrate the life cycle of a plant on a chart or graph.
Example: recording the growth of a plant, including seed planting, germination, growth, and reproduction

Additional content to be taught:
- Describing the role of plants in a food chain
- Identifying plant and animal cells
- Describing how plants occupy space and use light, nutrients, water, and air
- Classifying plants according to their features
  Examples: evergreen or deciduous, flowering or nonflowering
- Identifying helpful and harmful effects of plants
  Examples: helpful—provide food, control erosion;
  harmful—cause allergic reactions, produce poisons
- Identifying how bees pollinate flowers
- Identifying photosynthesis as the method used by plants to produce food

8. **Identify how organisms are classified in the Animalia and Plantae kingdoms.**

   Objective 3.8.1: Identify characteristics of plants and animals.
   Objective 3.8.2: Classify plants and animals according to physical traits.

9. **Describe how fossils provide evidence of prehistoric plant life.**
   Example: plant fossils in coal or shale providing evidence of existence of prehistoric ferns

   Objective 3.9.1: Define fossil and prehistoric.
   Objective 3.9.2: Describe survival traits of plants, including color, shape, size, texture, and covering.

10. **Determine habitat conditions that support plant growth and survival.**
    Examples: deserts support cacti, wetlands support ferns and mosses

    Objective 3.10.1: Define plant habitats.
    Objective 3.10.2: Describe habitat conditions of a variety of plant habitats.

Earth and Space Science

11. **Describe Earth's layers, including inner and outer cores, mantle, and crust.**

    Objective 3.11.1: Identify geological features of Earth's surface, including mountains, valleys, plains, deserts, lakes, rivers, and oceans.
    Objective 3.11.2: Label Earth's layers, including inner and outer cores, mantle, and crust.

    Additional content to be taught:
    - Classifying rocks and minerals by characteristics, including streak, color, hardness, magnetism, luster, and texture

12. **Identify conditions that result in specific weather phenomena, including thunderstorms, tornadoes, and hurricanes.**

    Objective 3.12.1: Recognize daily changes in weather, including clouds, precipitation, and temperature.
    Objective 3.12.2: Describe how weather forecasters predict weather events, including thunderstorms, tornadoes, and hurricanes.
    Objective 3.12.3: Describe various weather-warning signals that designate the onset of dangerous weather events.

    Additional content to be taught:
    - Identifying cloud types associated with specific weather patterns
    - Identifying positive and negative effects of weather phenomena
      Examples: positive—flooding depositing good soil when waters recede,
      negative—flooding killing crops
    - Identifying technology used to record and predict weather, including thermometers, barometers, rain gauges, anemometers, and satellites
    - Explaining symbols shown on a weather map
    - Organizing weather data into tables or charts

13. Describe ways to sustain natural resources, including recycling, reusing, conserving, and protecting the environment.

Objective 3.13.1: Define conservation.
Objective 3.13.2: Describe uses of recycled materials.
Objective 3.13.3: Describe efforts to conserve and protect the environment in the community.

Additional content to be taught:
- Recognizing the impact of society on human health and environmental conditions

14. Describe the position of Earth, the moon, and the sun during the course of a day or month.

Objective 3.14.1: Define axis, rotate, revolve, and orbit.
Objective 3.14.2: Describe the position of the sun in relation to Earth during the course of a day.
Objective 3.14.3: Describe data collected over a designated period of time regarding the position of the sun in relation to the location of the classroom.

Additional content to be taught:
- Describing various forms of technology used in observing Earth and its moon

FOURTH GRADE

Physical Science

Students will:

1. **Describe how electrical circuits can be used to produce light, heat, sound, and magnetic fields.**

   Objective 4.1.1: Define electrical circuit.
   Objective 4.1.2: Identify objects and materials that conduct electricity and objects and materials that are insulators of electricity.

   Additional content to be taught:
   - Identifying ways to use and conserve electrical energy
   - Identifying characteristics of parallel and series circuits
   - Classifying materials as conductors, nonconductors, and insulators of electricity and heat
   - Identifying relationships among charge, current, and potential energy
   - Identifying components of a circuit

2. **Compare different pitches of sound produced by changing the size, tension, amount, or type of vibrating material.**

   Objective 4.2.1: Define pitch and volume.
   Objective 4.2.2: Identify vibration as the source of sound.
   Objective 4.2.3: Distinguish between high and low pitches.

   Additional content to be taught:
   - Describing the relationship between the structure of the ear and hearing

3. **Recognize how light interacts with transparent, translucent, and opaque materials.**
   Examples: transparent—most light passes through,
   translucent—some light passes through,
   opaque—no light passes through

   Objective 4.3.1: Identify objects that are transparent, translucent, and opaque.
   Objective 4.3.2: Demonstrate how light interacts with transparent, translucent, and opaque materials.

   Additional content to be taught:
   - Predicting the reflection or absorption of light by various objects

4. **Describe effects of friction on moving objects.**

Objective 4.4.1: Define friction.
Objective 4.4.2: Identify sources of friction.
Objective 4.4.3: Describe useful sources of friction.
Examples: friction between brakes and tires causing bicycle to slow down, friction between rubber soles on shoes and floor preventing persons from slipping

Additional content to be taught:
- Identifying momentum and inertia as properties of moving objects
- Identifying ways to increase or decrease friction

Life Science

5. **Describe the interdependence of plants and animals.**

Objective 4.5.1: Define dependence and interdependence.
Objective 4.5.2: List ways plants and animals help each other.

Additional content to be taught:
- Describing behaviors and body structures that help animals survive in particular habitats
  Examples: behaviors—migration, hibernation, mimicry;
  body structures—quills, fangs, stingers, webbed feet
- Describing life cycles of various animals to include incomplete and complete metamorphosis
  Examples: damsel fly, mealworms
- Tracing the flow of energy through a food chain
  Example: producer, first-level consumer, second-level consumer, and third-level consumer
- Identifying characteristics of organisms, including growth and development, reproduction, acquisition and use of energy, and response to the environment

6. **Classify animals as vertebrates or invertebrates and as endotherms or ectotherms.**

Objective 4.6.1: Define vertebrates and invertebrates.
Objective 4.6.2: Identify characteristics of vertebrates and invertebrates.
Objective 4.6.3: Define endotherm and ectotherm.
Objective 4.6.4: Identify characteristics of endotherms and ectotherms.

Additional content to be taught:
- Describing the organization of cells into tissues, organs, and organ systems
- Describing the grouping of organisms into populations, communities, and ecosystems
- Classifying common organisms into kingdoms, including Animalia, Plantae, Protista, Fungi, Archaebacteria, and Eubacteria

Earth and Space Science

7. **Describe geological features of Earth, including bodies of water, beaches, ocean ridges, continental shelves, plateaus, faults, canyons, sand dunes, and ice caps.**

   Objective 4.7.1: Define ocean ridge, continental shelf, plateaus, and faults.
   Objective 4.7.2: Identify various geological features of Earth on a model, map, or picture.

8. **Identify technological advances and other benefits of space exploration.**
   Examples: laser, pacemaker, dehydrated food, flame-retardant clothing, global positioning system (GPS), satellite imagery, global weather information, diagnostic imagery

   Objective 4.8.1: Define technology and space exploration.
   Objective 4.8.2: Describe various forms of technology used in observing Earth and its moon.

   Additional content to be taught:
   - Listing highlights of space exploration, including satellites, manned moon missions, the unmanned Mars mission, and an inhabited space station
   - Identifying Alabama's contribution to the space industry

9. **Describe the appearance and movement of Earth and its moon.**

   Objective 4.9.1: Describe the positions of Earth, the moon, and the sun during the course of a day or month.
   Objective 4.9.2: Explain the relationship of Earth's moon and sun during the full moon.

   Additional content to be taught:
   - Identifying the waxing and waning of the moon in the night sky
   - Identifying lunar and solar eclipses

10. **Describe components of our solar system.**

    Objective 4.10.1: Define solar system.
    Objective 4.10.2: Identify basic components of our solar system, including the sun, planets, and Earth's moon.
    Objective 4.10.3: Compare the sun to a planet in our solar system.

    Additional content to be taught:
    - Defining comets, asteroids, and meteors

FIFTH GRADE

Physical Science

Students will:

1. **Identify evidence of chemical changes through color, gas formation, solid formation, and temperature change.**
   Example: combining vinegar and baking soda to produce a gas

   Objective 5.1.1: Define chemical change.
   Objective 5.1.2: Describe differences between chemical changes and physical changes.
   Objective 5.1.3: Chart or graph chemical and physical changes over time, including color change, temperature change, and change from liquid to solid.

2. **Define mass, volume, and density.**

   Objective 5.2.1: Define matter..
   Objective 5.2.2: Identify objects with a large mass and objects with a small mass.
   Objective 5.2.3: Explain the relationship between mass and density.
   Example: blown-up balloon having less mass than a marble, marble having more density than a balloon

   Additional content to be taught:
   - Identifying the atom as the basic building block of matter
   - Relating temperature changes to particle motion
     Example: movement of colored dye in hot and cold water
   - Relating density to the sinking or floating of an object in a liquid

3. **Use everyday indicators to identify common acids and bases.**
   Examples: using grape juice to determine that vinegar is an acid, using juice from boiled red cabbage to determine that baking soda is a base

   Objective 5.3.1: Define indicator, acid, and base.
   Objective 5.3.2: Identify everyday substances used as indicators of acids and bases.

4. Describe forms of energy, including chemical, heat, light, and mechanical.

Objective 5.4.1: Identify forms of energy, including chemical, heat, light, and mechanical.
Objective 5.4.2: Describe uses of the sun's energy..

Additional content to be taught:
- Identifying types of potential and kinetic energy
  Examples: potential—water behind a dam, battery;
  kinetic—water moving across turbine blades
- Describing alternatives to the use of fossil fuels
  Examples: solar energy, geothermal energy, windmill, hydroelectric power, biomass
- Identifying the transfer of energy by conduction, convection, and radiation
  Examples: conduction—hot plate heating a pan,
  convection—space heater heating air,
  radiation—sun heating Earth's surface

5. Contrast ways in which light rays are bent by concave and convex lenses.

Objective 5.5.1: Identify concave and convex lenses.
Objective 5.5.2: Demonstrate how light rays bend.
Objective 5.5.3: Recognize that light travels in a straight line until it strikes an object.

Additional content to be taught:
- Describing how a prism forms a visible spectrum
- Explaining why different objects have different colors
- Describing how mirrors reflect light
  Example: discussing differences in the reflection of light by convex and concave mirrors
- Describing the relationship between the structure of the eye and sight
- Identifying types of corrective lenses used to correct different sight problems
  Examples: convex—farsightedness,
  concave—nearsightedness
- Identifying the contribution of van Leeuwenhoek to the development of the microscope

6. Compare effects of gravitational force on Earth, on the moon, and within space.

Objective 5.6.1: Define gravity and gravitational force.
Objective 5.6.2: Describe the effect of gravity on Earth, on the moon, and within space.

Additional content to be taught:
- Identifying contributions of Newton to the study of gravity
- Describing how a spring scale is used to measure weight
- Explaining how air resistance affects falling objects

Life Science

7. **Identify common parts of plant and animal cells, including the nucleus, cytoplasm, and cell membrane.**

   Objective 5.7.1: Define nucleus, cytoplasm, and cell membrane..
   Objective 5.7.2: Identify a cell.

   Additional content to be taught:
   - Comparing unicellular and multicellular organisms
   - Comparing plant and animal cells

8. **Identify major body systems and their functions, including the circulatory system, respiratory system, excretory system, and reproductive system.**

   Objective 5.8.1: Label the major body systems.
   Objective 5.8.2: Identify the main functions of the circulatory and respiratory systems.
   Objective 5.8.3: Identify the main function of the excretory system.
   Objective 5.8.4: Identify the main function of the reproductive system..

9. **Describe the relationship of populations within a habitat to various communities and ecosystems.**

   Objective 5.9.1: Define population, habitat, community, and ecosystem.
   Objective 5.9.2: Identify habitat conditions that support plant growth and survival.
   Examples: temperature, precipitation, availability of food, effects of humans
   Objective 5.9.3: Identify habitat conditions that support animal well-being and survival.

   Additional content to be taught:
   - Describing the relationship between food chains and food webs
   - Describing symbiotic relationships

Earth and Space Science

10. **Identify spheres of Earth, including the geosphere, atmosphere, and hydrosphere.**

    Objective 5.10.1: Define geosphere, atmosphere, and hydrosphere.
    Objective 5.10.2: Illustrate the spheres of Earth, including the geosphere, atmosphere, and hydrosphere.

    Additional content to be taught:
    - Describing technology used to investigate Earth
      Examples: sonar, radar, seismograph, weather balloons, satellites
    - Describing the rock cycle

11. Compare distances from the sun to the planets in our solar system.

Objective 5.11.1: Identify the components of our solar system.
Objective 5.11.2: List the order of the planets relative to their position from the sun.

Additional content to be taught:

- Relating the size of Earth to the size of other planets in our solar system
- Identifying technology used to study planets
  Examples: Hubble Space Telescope, space probes, Mars Exploration Rover

SIXTH GRADE

Earth and Space Science

Students will:

1. **Identify global patterns of atmospheric movement, including El Niño, the Gulf Stream, the jet stream, the Coriolis effect, and global winds that influence local weather.**

   Objective 6.1.1: Define El Niño and the Coriolis effect.
   Objective 6.1.2: Identify daily changes in weather based on the jet stream and global winds.

   Additional content to be taught:
   - Predicting local weather and weather patterns
     Examples: cold and warm fronts, high and low pressure areas
   - Describing the function of instruments and technology used to investigate Earth's weather, including barometers, thermometers, wind socks, weather vanes, satellites, radar, weather balloons, and rain gauges
   - Using lines of latitude and longitude to locate areas of specific weather events
   - Interpreting weather data through observations collected over time
     Example: calculating annual precipitation and average temperature

2. **Describe factors that cause changes to Earth's surface over time.**
   Examples: earthquakes, volcanoes, weathering, erosion, glacial erosion or scouring, deposition, water flow, tornadoes, hurricanes, farming and conservation, mining and reclamation, deforestation and reforestation, waste disposal, global climate changes, greenhouse gases

   Objective 6.2.1: Identify how natural disasters, including earthquakes and hurricanes, can affect the surface of Earth.
   Objective 6.2.2: Describe how living organisms, including man, animals, and plants, can change the surface of Earth.

   Additional content to be taught:
   - Comparing constructive and destructive natural processes and their effects on land formations
     Examples: constructive—volcanic and mountain-building processes; destructive—erosion by wind, water, and ice
   - Distinguishing rock strata by geologic composition
     Examples: predicting relative age of strata by fossil depth, predicting occurrence of natural events by rock composition in a particular strata

3. **Describe water and carbon biogeochemical cycles and their effects on Earth.**

   Objective 6.3.1: Define biogeochemical cycle.
   Objective 6.3.2: List the steps of the water cycle..
   Objective 6.3.3: List the steps of the carbon cycle.

4. **Explain the plate tectonic theory.**
   Example: using terminology such as *continental drift*, *seafloor spreading*, *lava*, *magma*, *eruption*, *epicenter*, *focus*, *seismic wave*, and *subduction zone*

   Objective 6.4.1: Define plate tectonics.
   Objective 6.4.2: Identify land and water features of Earth created by tectonic activity.

   Additional content to be taught:
   - Describing types of volcanoes and faults
   - Determining energy release through seismographic data
     Example: using data from the Mercalli scale and the Richter scale

5. **Describe layers of the oceanic hydrosphere, including the pelagic zone, benthic zone, abyssal zone, and intertidal zone.**

   Objective 6.5.1: Define hydrosphere, pelagic zone, benthic zone, abyssal zone, and intertidal zone.
   Objective 6.5.2: List characteristics of various bodies of saltwater and freshwater, including lakes, streams, and oceans.
   Objective 6.5.3: Identify the layers of the oceanic hydrosphere.

6. **Describe regions of the oceanic lithosphere, including the continental shelf, continental slope, and abyssal plain.**

   Objective 6.6.1: Define oceanic lithosphere, continental slope, and abyssal plain.
   Objective 6.6.2: Label a diagram of the regions of the oceanic lithosphere.

7. **Describe Earth's biomes.**
   Examples: aquatic biomes, grasslands, deserts, chaparrals, taigas, tundras

   Objective 6.7.1: Define biome and climate.
   Objective 6.7.2: Identify various types of biomes.
   Objective 6.7.3: Describe characteristics of one of Earth's biomes, including climate, location, plants, animals, and soil type.

   Additional content to be taught:
   - Identifying geographic factors that cause diversity in flora and fauna, including elevation, location, and climate

8. **Describe how Earth's rotation, Earth's axial tilt, and distance from the equator cause variations in the heating and cooling of various locations on Earth.**

   Objective 6.8.1: Define rotation, axial tilt, revolution, and equator.
   Objective 6.8.2: Relate the variations in heating and cooling on Earth to seasonal changes**.**

9. **Identify the moon's phases.**

   Objective 6.9.1: Illustrate the phases of the moon during the course of a lunar cycle..
   Objective 6.9.2: Describe the positions of Earth, the moon, and the sun during the course of a day or lunar cycle.

   Additional content to be taught:
   - Describing lunar and solar eclipses
   - Relating effects of the moon's positions on oceanic tides

10. **Describe components of the universe and their relationships to each other, including stars, planets and their moons, solar systems, and galaxies.**

    Objective 6.10.1: Identify characteristics of the major components of the universe..
    Examples: galaxy, solar system, planet, moon
    Objective 6.10.2: Sequence the planets in order according to distance from the sun.
    Objective 6.10.3: Identify the moon's influence on Earth.
    Examples: gravity, weight, oceanic tides

    Additional content to be taught:
    - Identifying the impact of space exploration on innovations in technology
      Examples: MRI, microwave, satellite imagery, GPS
    - Mapping seasonal changes in locations of constellations in the night sky
    - Describing the life cycle of a star
      Example: H-R diagram

11. **Describe units used to measure distance in space, including astronomical units and light years.**

    Objective 6.11.1: Define astronomical unit and light year.
    Objective 6.11.2: Compare distances from the sun to planets in our solar system.

SEVENTH GRADE

Life Science

Students will:

1. **Describe characteristics common to living things, including growth and development, reproduction, cellular organization, use of energy, exchange of gases, and response to the environment.**

   Objective 7.1.1: Identify common parts of plant and animal cells, including nucleus, cytoplasm, and cell membrane.
   Objective 7.1.2: Identify how cell division helps living things grow.
   Objective 7.1.3: Explain conditions essential for growth and development of living things.

   Additional content to be taught:
   - Identifying homeostasis as the process by which an organism responds to its internal or external environment
   - Predicting how an organism's behavior impacts the environment
   - Identifying unicellular organisms, including bacteria and protists, by their methods of locomotion, reproduction, ingestion, excretion, and effects on other organisms
   - Identifying the structure of a virus

2. **Identify functions of organelles found in eukaryotic cells, including the nucleus, cell membrane, cell wall, mitochondria, chloroplasts, and vacuoles.**
   Example: mitochondria releasing energy for use in cellular respiration

   Objective 7.2.1: Define eukaryotic cells, organelle, mitochondria, chloroplasts, and vacuoles.
   Objective 7.2.2: Identify the organelles of animal and plant cells..

   Additional content to be taught:
   - Identifying components of the cell theory
   - Identifying cells as prokaryotic or eukaryotic
   - Listing the sequence of the mitotic cell cycle

3. **Relate major tissues and organs of the skeletal, circulatory, reproductive, muscular, respiratory, nervous, and digestive systems to their functions.**

   Objective 7.3.1: Describe the hierarchy of life from cells, tissues, and organs to the body systems.
   Objective 7.3.2: Identify the major tissues and organs of each of the body systems.

   Additional content to be taught:
   - Arranging in order the organizational levels of the human body from the cell through organ systems

4. **Describe organisms in the six-kingdom classification system by their characteristics.**

   Objective 7.4.1: Define kingdom and classification system..
   Objective 7.4.2: List the six kingdoms.
   Objective 7.4.3: Identify the characteristics of each kingdom.
   Objective 7.4.4: Match an organism to its corresponding kingdom.
   Example: paramecium to Protista kingdom

   Additional content to be taught:
   - Recognizing genus and species as components of a scientific name
   - Identifying contributions of Aristotle and Linnaeus to the early history of taxonomy

5. **Identify major differences between plants and animals, including internal structures, external structures, methods of locomotion, methods of reproduction, and stages of development.**

   Objective 7.5.1: Identify major characteristics of plants.
   Objective 7.5.2: Identify major characteristics of animals..

   Additional content to be taught:
   - Describing the processes of photosynthesis and cellular respiration

6. **Describe evidence of species variation due to climate, changing landforms, interspecies interaction, and genetic mutation.**
   Examples: fossil records over geologic time, rapid bacterial mutations due to environmental pressures

   Objective 7.6.1: Define species variation, adaptation, and mutation.
   Objective 7.6.2: List adaptations that occur due to climate, changing landforms, interspecies interaction, and genetic mutation.

7. **Describe biotic and abiotic factors in the environment.**
   Examples: biotic—plants, animals;
   abiotic—climate, water, soil

   Objective 7.7.1: Define biotic and abiotic.
   Objective 7.7.2: List examples of living things.
   Objective 7.7.3: List examples of nonliving things..

   Additional content to be taught:
   - Classifying organisms as autotrophs or heterotrophs
   - Arranging the sequence of energy flow in an ecosystem through food webs, food chains, and energy pyramids

8. **Describe the function of chromosomes.**

   Objective 7.8.1: Define chromosomes.
   Objective 7.8.2: Define deoxyribonucleic acid (DNA), heredity, genetics, genes, and allele.
   Objective 7.8.3: Identify common parts of plant and animal cells, including the nucleus, cytoplasm, and cell membrane..

   Additional content to be taught:
   - Identifying genes as parts of chromosomes that carry genetic traits

9. **Identify the process of chromosome reduction in the production of sperm and egg cells during meiosis.**

   Objective 7.9.1: Define meiosis, gamete, and zygote.
   Objective 7.9.2: Compare mitosis and meiosis.

10. **Identify differences between deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).**
    Examples: DNA—double helix, contains thymine;
    RNA—single stranded, contains uracil

    Objective 7.10.1: Define nitrogen bases..
    Objective 7.10.2: Identify nitrogen bases, including thymine, uracil, adenine, guanine, and cytosine.
    Objective 7.10.3: Illustrate the structure of a strand of DNA..

    Additional content to be taught:
    - Identifying Watson and Crick as scientists who discovered the shape of the DNA molecule

11. **Identify Mendel's laws of genetics.**

    Objective 7.11.1: Define gene, inherited trait, dominant trait, and recessive trait.
    Objective 7.11.2: Discuss the scientific contributions of Gregor Mendel.

    Additional content to be taught:
    - Recognizing Down's syndrome and sickle cell anemia as inherited genetic disorders
    - Using a monohybrid Punnett square to predict the probability of traits passed from parents to offspring

EIGHTH GRADE

Physical Science

Students will:

1. **Identify steps within the scientific process.**

   Objective 8.1.1: Define experiment, control, independent variable, dependent variable, and data.
   Objective 8.1.2: Distinguish among hypothesis, theory, and scientific law.

   Additional content to be taught:
   - Applying process skills to interpret data from graphs, tables, and charts
   - Identifying controls and variables in a scientific investigation
   - Measuring dimension, volume, and mass using *Système International d'Unités* (SI units)
   - Identifying examples of hypotheses
   - Identifying appropriate laboratory glassware, balances, time measuring equipment, and optical instruments used to conduct an investigation

2. **Describe the structure of atoms, including the location of protons, neutrons, and electrons.**

   Objective 8.2.1: Define atom, nucleus, proton, neutron, electron, and electron cloud..
   Objective 8.2.2: Label the parts of an atom, including the electron cloud..

   Additional content to be taught:
   - Identifying the charge of each subatomic particle
   - Identifying Democritus and Dalton as contributors to the atomic theory

3. **Determine the number of protons, neutrons, and electrons, and the mass of an element using the periodic table.**

   Objective 8.3.1: Define terms related to the periodic table.
   Examples: atomic number, mass number, chemical symbols, element families, periods
   Objective 8.3.2: Describe the structure and function of the periodic table..

   Additional content to be taught:
   - Locating metals, nonmetals, metalloids, and noble gases on the periodic table
   - Using data about the number of electrons in the outer shell of an atom to determine its reactivity

4. State the law of conservation of matter.

Objective 8.4.1: Define chemical reaction..

Additional content to be taught:
- Balancing chemical equations by adjusting coefficients

5. Differentiate between ionic and covalent bonds.

Objective 8.5.1: Define chemical bond, ionic bond, and covalent bond..
Objective 8.5.2: Draw electron dot diagrams using the periodic table.

Additional content to be taught:
- Illustrating the transfer or sharing of electrons using electron dot diagrams

6. Define solution in terms of solute and solvent.

Objective 8.6.1: Define solution, solute, and solvent.
Objective 8.6.2: Identify mixtures and compounds..
Examples: mixture—sugar and water,
compound—salt
Objective 8.6.3: Recognize solutions as liquid, gaseous, or solid..

Additional content to be taught:
- Defining diffusion and osmosis
- Defining isotonic, hypertonic, and hypotonic solutions
- Describing acids and bases based on their hydrogen ion concentration

7. Describe states of matter based on kinetic energy of particles in matter.

Objective 8.7.1: Define kinetic energy and the kinetic theory of matter.
Objective 8.7.2: List characteristics of the states of matter.

Additional content to be taught:
- Explaining effects of temperature, concentration, surface area, and catalysts on the rate of chemical reactions

8. Identify Newton's three laws of motion.

Objective 8.8.1: Define mass and force..
Objective 8.8.2: Describe Newton's contributions to the scientific community..

Additional content to be taught:
- Defining terminology such as action and reaction forces, inertia, acceleration, momentum, and friction
- Interpreting distance–time graphs

9. **Describe how mechanical advantages of simple machines reduce the amount of force needed for work.**

   Objective 8.9.1: Define mechanical advantage.
   Objective 8.9.2: Describe the six types of simple machines..

   Additional content to be taught:
   - Describing the effect of force on pressure in fluids
     Example: increasing force on fluid leading to increase of pressure within a hydraulic cylinder

10. **Differentiate between potential and kinetic energy.**
    Examples: potential—rock resting at top of hill,
    kinetic—rock rolling down hill

    Objective 8.10.1: Define potential energy..
    Objective 8.10.2: Define kinetic energy.

11. **Explain the law of conservation of energy and its relationship to energy transformation, including chemical to electrical, chemical to heat, electrical to light, electrical to mechanical, and electrical to sound.**

    Objective 8.11.1: Describe various forms of energy.
    Examples: heat, light, sound, electrical, mechanical, nuclear
    Objective 8.11.2: Discuss the law of conservation of energy..
    Objective 8.11.3: Identify examples of energy transformations.
    Examples: chemical to electrical—battery,
    chemical to heat—candle flame,
    electrical to heat—light bulb,
    electrical to mechanical—motor,
    electrical to sound—loudspeaker

12. **Classify waves as mechanical or electromagnetic.**
    Examples: mechanical—earthquake waves;
    electromagnetic—ultraviolet light waves, visible light waves

    Objective 8.12.1: Define wave, mechanical wave, and electromagnetic wave..
    Objective 8.12.2: Label a wave, including length, amplitude, period, crest, trough, and frequency.

    Additional content to be taught:
    - Describing how earthquake waves, sound waves, water waves, and electromagnetic waves can be destructive or beneficial due to the transfer of energy
    - Describing longitudinal and transverse waves
    - Describing how waves travel through different media
    - Relating wavelength, frequency, and amplitude to energy
    - Describing the electromagnetic spectrum in terms of frequencies
      Example: electromagnetic spectrum in increasing frequencies—microwaves, infrared light, visible light, ultraviolet light, X rays

PHYSICAL SCIENCE CORE

Students will:

1. **Recognize periodic trends of elements, including the number of valence electrons, atomic size, and reactivity.**

   - ♦ **Objective PS.1.1:** Identify patterns of properties of elements on the periodic table.
   - ♦ **Objective PS.1.2:** Explain the organization of the periodic table.

   Additional content to be taught:
   - Categorizing elements as metals, nonmetals, metalloids, and noble gases
   - Differentiating between families and periods
   - Using atomic number and mass number to identify isotopes

2. **Identify solutions in terms of components, solubility, concentration, and conductivity.**

   - ♦ **Objective PS.2.1:** Describe the relationship between concentration and solubility of solutions..
   - ♦ **Objective PS.2.2:** Identify the solvent and solute in a given solution.
   - ♦ **Objective PS.2.3:** Identify solutions as unsaturated, saturated, or supersaturated.

   Additional content to be taught:
   - Comparing saturated, unsaturated, and supersaturated solutions
   - Comparing characteristics of electrolytes and nonelectrolytes
   - Describing factors that affect solubility and rate of solution, including nature of solute and solvent, temperature, agitation, surface area, and pressure on gases

3. **Contrast the formation of ionic and covalent bonds based on the transfer or sharing of valence electrons.**

   - ♦ **Objective PS.3.1:** Define valence electron and electron dot diagram.
   - **Objective PS.3.2:** Recognize that valence electrons are involved in the formation of bonds.
   - ♦ **Objective PS.3.3:** Explain how the number of valence electrons determines the type of bond among elements.

   Additional content to be taught:
   - Demonstrating the formation of positive and negative monatomic ions by using electron dot diagrams

4. Use nomenclature and chemical formulas to write balanced chemical equations.

Objective PS.4.1: Associate the oxidation number with a given element.
- **Objective PS.4.2:** Identify symbols of elements from the periodic table with element names.
- **Objective PS.4.3:** State the meaning of coefficients and subscripts.
- **Objective PS.4.4:** Identify a chemical equation as balanced or unbalanced.

Objective PS.4.5: Write a chemical formula given the compound name.

Additional content to be taught:
- Explaining the law of conservation of matter
- Identifying chemical reactions as composition, decomposition, single replacement, or double replacement
- Defining the role of electrons in chemical reactions

5. Describe physical and chemical changes in terms of endothermic and exothermic processes.

- **Objective PS.5.1:** Define endothermic and exothermic process.
- **Objective PS.5.2:** Distinguish between physical and chemical changes.

Objective PS.5.3: Use the kinetic theory of matter to describe phase changes of matter as endothermic or exothermic.

6. Identify characteristics of gravitational, electromagnetic, and nuclear forces.

Objective PS.6.1: Differentiate between strong and weak nuclear forces.
- **Objective PS.6.2:** Identify the components of an electromagnetic force.
- **Objective PS.6.3:** List factors that determine the strength of gravitational force between two objects..

7. Relate velocity, acceleration, and kinetic energy to mass, distance, force, and time.

- **Objective PS.7.1:** Apply the formula for velocity, $v = d/t$, where v represents velocity, d represents distance, and t represents time..
- **Objective PS.7.2:** Apply Newton's second law, $a = F/m$, where a represents acceleration, F represents accelerating force, and m represents mass accelerated..
- **Objective PS.7.3:** Apply the formula for kinetic energy, $KE = \frac{1}{2} mv^2$, where KE represents kinetic energy, m represents mass, and v represents velocity.

Additional content to be taught:
- Interpreting graphic representations of velocity versus time and distance versus time
- Solving problems for velocity, acceleration, force, work, and power
- Describing action and reaction forces, inertia, acceleration, momentum, and friction in terms of Newton's three laws of motion
- Determining the resultant of collinear forces acting on a body
  Example: solving problems involving the effect of a tailwind or headwind on an airplane
- Solving problems for efficiency and mechanical advantage of simple machines

8. Relate the law of conservation of energy to transformations of potential energy, kinetic energy, and thermal energy.

Objective PS.8.1: Define the law of conservation of energy.
- ♦ **Objective PS.8.2:** Explain the law of conservation of energy and its relationship to energy transformation.
- ♦ **Objective PS.8.3:** Differentiate between potential and kinetic energy.

Additional content to be taught:
- Identifying the relationship between thermal energy and the temperature of a sample of matter
- Describing the flow of thermal energy between two samples of matter
- Explaining how thermal energy is transferred by radiation, conduction, and convection
- Relating simple formulas to the calculation of potential energy, kinetic energy, and work

9. Compare methods of energy transfer by mechanical and electromagnetic waves.

- ♦ **Objective PS.9.1:** Define electromagnetic and mechanical waves.
- ♦ **Objective PS.9.2:** Identify the characteristics of waves.

Objective PS.9.3: Classify waves as mechanical or electromagnetic.

Additional content to be taught:
- Distinguishing between transverse and longitudinal mechanical waves
- Relating physical properties of sound and light to wave characteristics

Examples: loudness to amplitude, pitch to frequency, color to wavelength and frequency

10. Explain the relationship between electricity and magnetism.

Example: using a moving charge to create a magnetic field and using a moving magnetic field to induce a current in a closed wire loop

- ♦ **Objective PS.10.1:** Identify an illustration of a magnetic field.

Objective PS.10.2: Identify how moving electrical charges are the source of magnetic fields.

Objective PS.10.3: Explain how fluctuating magnetic fields create electrical currents.

Additional content to be taught:
- Differentiating between induction and conduction
- Identifying mechanical, magnetic, and chemical methods used to create an electrical charge

Examples: mechanical—rubbing materials together,
magnetic—moving a closed loop of wire across a magnetic field,
chemical—using batteries

- Describing electrical circuits in terms of Ohm's law

11. Describe the nuclear composition of unstable isotopes and the resulting changes to their nuclear composition.

- ♦ **Objective PS.11.1:** Define isotope.
- ♦ **Objective PS.11.2:** Relate the number of protons and neutrons to the stability of elements.

Additional content to be taught:

- Identifying types of nuclear emissions, including alpha particles, beta particles, and gamma radiation
- Differentiating between fission and fusion
- Identifying uses and possible negative side effects of nuclear technology

  Examples: uses—nuclear power generation, medical applications, space travel; negative effects—radioactive contamination, nuclear fuel waste and waste storage

12. Identify metric units for mass, distance, time, temperature, velocity, acceleration, density, force, energy, and power.

- ♦ **Objective PS.12.1:** State the fundamental SI units..
  Objective PS.12.2: Compare fundamental and derived units..

BIOLOGY CORE

Students will:

1. **Select appropriate laboratory glassware, balances, time measuring equipment, and optical instruments to conduct an experiment.**

   - ♦ **Objective B.1.1:** Match laboratory equipment to their uses in scientific experimentation.
   - ♦ **Objective B.1.2:** Identify problems that can be solved using scientific processes.

   Additional content to be taught:
   - Describing the steps of the scientific method
   - Comparing controls, dependent variables, and independent variables
   - Identifying safe laboratory procedures when handling chemicals and using Bunsen burners and laboratory glassware
   - Using appropriate SI units for measuring length, volume, and mass

2. **Describe cell processes necessary for achieving homeostasis, including active and passive transport, osmosis, diffusion, exocytosis, and endocytosis.**

   - ♦ **Objective B.2.1:** Define homeostasis.
   - ♦ **Objective B.2.2:** Identify types of active transport as exocytosis and endocytosis.
   - ♦ **Objective B.2.3:** Identify types of passive transport as osmosis, diffusion, and facilitative diffusion.

   Additional content to be taught:
   - Identifying functions of carbohydrates, lipids, proteins, and nucleic acids in cellular activities
   - Comparing the reaction of plant and animal cells in isotonic, hypotonic, and hypertonic solutions
   - Explaining how surface area, cell size, temperature, light, and pH affect cellular activities
   - Applying the concept of fluid pressure to biological systems
     Examples: blood pressure, turgor pressure, bends, strokes

3. **Identify reactants and products associated with photosynthesis and cellular respiration and the purposes of these two processes.**

   - ♦ **Objective B.3.1:** Identify the function of photosynthesis and cellular respiration.
   - ♦ **Objective B.3.2:** Describe photosynthesis and cellular respiration, including their reactants and products.
     Objective B.3.3: Recognize the relationship between reactants and products associated with photosynthesis and cellular respiration.
   - ♦ **Objective B.3.4:** Recognize a given formula as either photosynthesis or cellular respiration..

4. **Describe similarities and differences of cell organelles, using diagrams and tables.**

   - ♦ **Objective B.4.1:** Define prokaryotic and eukaryotic cells.
   - ♦ **Objective B.4.2:** Identify cellular organelles illustrated in diagrams.
   - ♦ **Objective B.4.3:** Relate organelles to their functions.

   Additional content to be taught:
   - Identifying scientists who contributed to the cell theory
     Examples: Hooke, Schleiden, Schwann, Virchow, van Leeuwenhoek
   - Distinguishing between prokaryotic and eukaryotic cells
   - Identifying various technologies used to observe cells
     Examples: light microscope, scanning electron microscope, transmission electron microscope

5. **Identify cells, tissues, organs, organ systems, organisms, populations, communities, and ecosystems as levels of organization in the biosphere.**

   - ♦ **Objective B.5.1:** Trace the progression from cells to ecosystems within the biosphere.
     Objective B.5.2: Recognize the levels of cellular organization as levels of hierarchy within the biosphere.

   Additional content to be taught:
   - Recognizing that cells differentiate to perform specific functions
     Examples: ciliated cells to produce movement, nerve cells to conduct electrical charges

6. **Describe the roles of mitotic and meiotic divisions during reproduction, growth, and repair of cells.**

   - ♦ **Objective B.6.1:** Define mitosis and meiosis.
   - ♦ **Objective B.6.2:** Recognize the difference in the number of daughter cells for mitosis and meiosis.
     Objective B.6.3: Identify from a diagram the stages of mitosis and meiosis.
   - ♦ **Objective B.6.4:** Compare somatic cells and reproductive cells.
     Examples: somatic cells—body cells that compose the tissues, organs, and parts of an individual other than the reproductive cells;
     reproductive cells— gametes or the sperm or egg

   Additional content to be taught:
   - Comparing sperm and egg formation in terms of ploidy
     Example: ploidy—haploid, diploid
   - Comparing sexual and asexual reproduction

7. Apply Mendel's law to determine phenotypic and genotypic probabilities of offspring.

Objective B.7.1: Identify Mendel's laws, including segregation and independent assortment.

- **Objective B.7.2:** Recognize the relationship between genotypes and phenotypes..
- **Objective B.7.3:** Determine phenotypic and genotypic ratios using Punnett squares.

Additional content to be taught:

- Defining important genetic terms, including dihybrid cross, monohybrid cross, phenotype, genotype, homozygous, heterozygous, dominant trait, recessive trait, incomplete dominance, codominance, and allele
- Interpreting inheritance patterns shown in graphs and charts
- Calculating genotypic and phenotypic percentages and ratios using a Punnett square

8. Identify the structure and function of DNA, RNA, and protein.

- **Objective B.8.1:** Define DNA and RNA.
- **Objective B.8.2:** Explain the roles of DNA and RNA in protein synthesis.
- **Objective B.8.3:** List the nitrogen bases of DNA and RNA.

Objective B.8.4: Match complementary nitrogen bases.

Examples: DNA—adenine = thymine (A = T), cytosine = guanine (C = G);
RNA—adenine = uracil (A = U), cytosine = guanine (C = G)

Additional content to be taught:

- Explaining relationships among DNA, genes, and chromosomes
- Listing significant contributions of biotechnology to society, including agricultural and medical practices
  Examples: DNA fingerprinting, insulin, growth hormone
- Relating normal patterns of genetic inheritance to genetic variation
  Example: crossing-over
- Relating ways chance, mutagens, and genetic engineering increase diversity
  Examples: insertion, deletion, translocation, inversion, recombinant DNA
- Relating genetic disorders and disease to patterns of genetic inheritance
  Examples: hemophilia, sickle cell anemia, Down's syndrome, Tay-Sachs disease, cystic fibrosis, color blindness, phenylketonuria (PKU)

9. Differentiate between the previous five-kingdom and current six-kingdom classification systems.

Objective B.9.1: List the five kingdoms in the previous five-kingdom classification system.
Objective B..9.2: Identify Monera as the kingdom that branched off to form the sixth kingdom.
Objective B.9.3: Name the newly established kingdom as Archeabacteria.
Objective B.9.4: Explain why habitat differences led to the formation of the new kingdom.
♦ **Objective B.9.5:** Differentiate among the major characteristics of the six kingdoms.

Additional content to be taught:
- Sequencing taxa from most inclusive to least inclusive in the classification of living things
- Identifying organisms using a dichotomous key
- Identifying ways in which organisms from the Monera, Protista, and Fungi kingdoms are beneficial and harmful
  Examples: beneficial—decomposers,
  harmful—diseases
- Justifying the grouping of viruses in a category separate from living things
- Writing scientific names accurately by using binomial nomenclature

10. Distinguish between monocots and dicots, angiosperms and gymnosperms, and vascular and nonvascular plants.

♦ **Objective B.10.1:** Define monocots, dicots, angiosperms, gymnosperms, and vascular and nonvascular plants.
Objective B.10.2: List traits of monocots, dicots, angiosperms, gymnosperms, and vascular and nonvascular plants.

Additional content to be taught:
- Describing the histology of roots, stems, leaves, and flowers
- Recognizing chemical and physical adaptations of plants
  Examples: chemical—foul odor, bitter taste, toxicity;
  physical—spines, needles, broad leaves

11. Classify animals according to type of skeletal structure, method of fertilization and reproduction, body symmetry, body coverings, and locomotion.

Examples: skeletal structure—vertebrates, invertebrates;
fertilization—external, internal;
reproduction—sexual, asexual;
body symmetry—bilateral, radial, asymmetrical;
body coverings—feathers, scales, fur;
locomotion—cilia, flagella, pseudopodia

- ♦ **Objective B.11.1:** Define the types of symmetry as bilateral, radial, or asymmetrical.
- ♦ **Objective B.11.2:** List types of body coverings and locomotion found in animals.
- ♦ **Objective B.11.3:** Distinguish between vertebrates and invertebrates.
- ♦ **Objective B.11.4:** Differentiate between external and internal fertilization..
- ♦ **Objective B.11.5:** Describe the types of reproduction as asexual or sexual..

12. Describe protective adaptations of animals, including mimicry, camouflage, beak type, migration, and hibernation.

- ♦ **Objective B.12.1:** Define adaptations.
  Objective B.12.2: List examples of animal adaptations, including mimicry, camouflage, beak type, migration, and hibernation.
- ♦ **Objective B.12.3:** Differentiate between mimicry and camouflage.
- ♦ **Objective B.12.4:** Describe evidence of species variation due to climate, changing landforms, interspecies interaction, and genetic mutation.

Additional content to be taught:

- Identifying ways in which the theory of evolution explains the nature and diversity of organisms
- Describing natural selection, survival of the fittest, geographic isolation, and fossil record

13. Trace the flow of energy as it decreases through the trophic levels from producers to the quaternary level in food chains, food webs, and energy pyramids.

- ♦ **Objective B.13.1:** Differentiate between biotic and abiotic factors in the environment.
- ♦ **Objective B.13.2:** Distinguish between food chains and food webs.
- ♦ **Objective B.13.3:** Distinguish among the different types of consumers, including primary, secondary, tertiary, and quaternary.
- ♦ **Objective B.13.4:** Recognize that the amount of energy decreases as it is passes through the food web.
  Example: lower levels having more energy than upper levels on energy pyramids

Additional content to be taught:

- Describing the interdependence of biotic and abiotic factors in an ecosystem
  Examples: effects of humidity on stomata size, effects of dissolved oxygen on fish respiration
- Contrasting autotrophs and heterotrophs
- Describing the niche of decomposers
- Using the ten percent law to explain the decreasing availability of energy through the trophic levels

14. Trace biogeochemical cycles through the environment, including water, carbon, oxygen, and nitrogen.

- ♦ **Objective B.14.1:** Recognize illustrations of the water, carbon, oxygen, and nitrogen cycles.
  Objective B.14.2: Identify factors that change Earth, its life forms, and its physical and chemical structure.
- ♦ **Objective B.14.3:** Sequence the steps of ecological succession from pioneer species to climax community.

Additional content to be taught:

- Relating natural disasters, climate changes, nonnative species, and human activity to the dynamic equilibrium of ecosystems
  Examples: natural disasters—habitat destruction resulting from tornadoes;
  climate changes—changes in migratory patterns of birds;
  nonnative species—exponential growth of kudzu and Zebra mussels due to absence of natural controls;
  human activity—habitat destruction resulting in reduction of biodiversity, conservation resulting in preservation of biodiversity
- Describing the process of ecological succession

15. Identify biomes based on environmental factors and native organisms.
Example: tundra—permafrost, low humidity, lichens, polar bears

- ♦ **Objective B.15.1:** Name the characteristics of each major biome.

16. Identify density-dependent and density-independent limiting factors that affect populations in an ecosystem.

Examples: density-dependent—disease, predator-prey relationships, availability of food and water;
density-independent—natural disasters, climate

- **Objective B.16.1:** Define density-dependent factors and density-independent factors.
- **Objective B.16.2:** Recognize the interdependence of biotic and abiotic factors.

Additional content to be taught:

- Discriminating among symbiotic relationships, including mutualism, commensalism, and parasitism

CHEMISTRY CORE

Students will:

1. **Differentiate among pure substances, mixtures, elements, and compounds.**

   Objective C.1.1: Define substance, mixture, element, and compound.
   Objective C.1.2: Compare mixtures and compounds.

   Additional content to be taught:
   - Distinguishing between intensive and extensive properties of matter
   - Contrasting properties of metals, nonmetals, and metalloids
   - Distinguishing between homogeneous and heterogeneous forms of matter

2. **Describe the structure of carbon chains, branched chains, and rings.**

   Objective C.2.1: Describe types of covalent bonding between carbon atoms as single, double, or triple bonds.

3. **Use the periodic table to identify periodic trends, including atomic radii, ionization energy, electronegativity, and energy levels.**

   Objective C.3.1: Define atomic radii, ionization energy, electronegativity, and energy levels.
   Objective C.3.2: Recognize periodic trends of elements, including the number of valence electrons, atomic size, and reactivity.

   Additional content to be taught:
   - Utilizing electron configurations, Lewis dot structures, and orbital notations to write chemical formulas
   - Calculating the number of protons, neutrons, and electrons in an isotope
   - Utilizing benchmark discoveries to describe the historical development of atomic structure, including photoelectric effect, absorption, and emission spectra of elements
     Example: Thompson's cathode ray, Rutherford's gold foil, Millikan's oil drop, and Bohr's bright line spectra experiments

4. Describe solubility in terms of energy changes associated with the solution process.

Objective C..4.1: Define solute, unsaturated, supersaturated, exothermic, exergonic, and endogonic.
Objective C.4.2: Identify solute and solvent particle interactions as energy-releasing processes.
Objective C.4.3: Relate energy release to the solvating process.

Additional content to be taught:
- Using solubility curves to interpret saturation levels
- Explaining the conductivity of electrolytic solutions
- Describing acids and bases in terms of strength, concentration, pH, and neutralization reactions
- Describing factors that affect the rate of solution
- Solving problems involving molarity, including solution preparation and dilution

5. Use the kinetic theory to explain states of matter, phase changes, solubility, and chemical reactions.

Example: water at 25 degrees Celsius remains in the liquid state because of the strong attraction between water molecules while kinetic energy allows the sliding of molecules past one another

Objective C.5.1: State the kinetic theory of matter.
Objective C.5.2: Describe states of matter based on kinetic energy of particles in matter.
Objective C.5.3: Describe phase changes in terms of energy absorption or release.
Objective C.5.4: Explain the effect of temperature on solubility and rate of reaction.

6. Solve stoichiometric problems involving relationships among the number of particles, moles, and masses of reactants and products in a chemical reaction.

Objective C.6.1: Define stoichiometry, reactant, and products.
Objective C.6.2: Explain the law of conservation of mass.
Objective C.6.3: Explain the concept of mole in terms of Avogadro's number.

Additional content to be taught:
- Predicting ionic and covalent bond types and products given known reactants
- Assigning oxidation numbers for individual atoms of monatomic and polyatomic ions
- Identifying the nomenclature of ionic compounds, binary compounds, and acids
- Classifying chemical reactions as composition, decomposition, single replacement, or double replacement
- Determining the empirical or molecular formula for a compound using percent composition data

7. **Explain the behavior of ideal gases in terms of pressure, volume, temperature, and number of particles using Charles's law, Boyle's law, Gay-Lussac's law, the combined gas law, and the ideal gas law.**

   Objective C.7.1: Relate gas laws to the appropriate formula.
   Objective C.7.2: Explain the effect of a change in pressure, volume, or temperature on other quantities in each formula.

8. **Distinguish among endothermic and exothermic physical and chemical changes.**
   Examples: endothermic physical—phase change from ice to water,
   endothermic chemical—reaction between citric acid solution and baking soda,
   exothermic physical—phase change from water vapor to water,
   exothermic chemical—formation of water from combustion of hydrogen and oxygen

   Objective C.8.1: Define endothermic and exothermic.
   Objective C.8.2: Describe physical and chemical changes in terms of endothermic and exothermic processes.
   Objective C.8.3: Compare chemical and physical properties of matter..
   Objective C.8.4: Differentiate between chemical and physical changes of matter..

   Additional content to be taught:
   - Calculating temperature change by using specific heat
   - Using Le Châtelier's principle to explain changes in physical and chemical equilibrium

9. **Distinguish between chemical and nuclear reactions.**

   Objective C..9.1: Describe the structure of atoms, including the location of protons, neutrons, and electrons.
   Objective C.9.2: Describe the nuclear composition of unstable isotopes and the resulting changes to their nuclear composition.
   Objective C.9.3: Identify the role of electrons in chemical reactions.
   Objective C.9.4: Identify nuclear reactions as those types involving nuclear particles, including alpha particles, beta particles, and gamma rays.

   Additional content to be taught:
   - Identifying atomic and subatomic particles, including mesons, quarks, tachyons, and baryons
   - Calculating the half-life of selective radioactive isotopes
   - Identifying types of radiation and their properties
   - Contrasting fission and fusion
   - Describing carbon-14 decay as a dating method

PHYSICS CORE

Students will:

1. **Explain linear, uniform circular, and projectile motions using one- and two-dimensional vectors.**

   Objective P.1.1: Define vector..
   Objective P.1.2: List characteristics, including examples, of linear, uniform circular, and projectile motions.
   Objective P.1.3: Demonstrate Newton's second law using linear vectors..
   Objective P.1.4: Resolve a vector into horizontal and vertical components..

   Additional content to be taught:
   - Explaining the significance of slope and area under a curve when graphing distance-time or velocity-time data
     Example: slope and area of a velocity-time curve giving acceleration and distance traveled
   - Describing forces that act on an object
     Example: drawing a free-body diagram showing all forces acting on an object and resultant effects of friction, gravity, and normal force on an object sliding down an inclined plane.

2. **Define the law of conservation of momentum.**

   Objective P.2.1: Define momentum..
   Objective P.2.2: Identify examples of the law of conservation of momentum.

   Additional content to be taught:
   - Calculating the momentum of a single object
   - Calculating momenta of two objects before and after collision in one-dimensional motion

3. **Explain planetary motion and navigation in space in terms of Kepler's and Newton's laws.**

   Objective P.3.1: Describe the components and arrangement of our solar system..
   Objective P.3.2: Describe the motion of planets and satellites..
   Objective P.3.3: Describe an ellipse..
   Objective P.3.4: State Kepler's and Newton's laws of universal gravitation..

4. **Describe quantitative relationships for velocity, acceleration, force, work, power, potential energy, and kinetic energy.**

   Objective P.4.1: Define velocity, acceleration, force, mass, work, power, potential energy, and kinetic energy..
   Objective P.4.2: Solve problems using the formula for velocity, $v = d/t$, where v represents velocity, d represents distance, and t represents time.
   Objective P.4.3: Solve problems using the formula for acceleration, $a = F/m$, where a represents acceleration, F represents accelerating force, and m represents mass accelerated..
   Objective P.4.4: Solve problems using the formula for work, $W = Fd$, where W represents work, F represents force, and d represents displacement..
   Objective P.4.5: Solve problems using the formula for power, $P = W/t$, where P represents power, W represents work, and t represents time..
   Objective P.4.6: Solve problems using the formula for gravitational potential energy, $Ug = mgh$, where Ug represents gravitational potential energy, m represents mass, g represents acceleration due to gravity, and h represents height.
   Objective P.4.7: Solve problems using the formula for kinetic energy, $KE = \frac{1}{2} mv^2$, where KE represents kinetic energy, m represents mass, and v represents velocity..

5. **Explain the concept of entropy as it relates to heating and cooling, using the laws of thermodynamics.**

   Objective P.5.1: Define entropy.
   Objective P.5.2: State the kinetic theory of matter..
   Objective P.5.3: Relate temperature to kinetic energy of particles..
   Objective P.5.4: State the laws of thermodynamics..

   Additional content to be taught:
   - Using qualitative and quantitative methods to show the relationship between changes in heat energy and changes in temperature

6. **Describe wave behavior in terms of reflection, refraction, diffraction, constructive and destructive wave interference, and the Doppler effect.**

   Objective P.6.1: Define wave, including the parts of a wave.
   Objective P.6.2: Define wave characteristics.
   Examples: frequency, period
   Objective P.6.3: Relate wave frequency to perceived qualities.
   Examples: pitch, color
   Objective P.6.4: Compare constructive and destructive wave interference..

   Additional content to be taught:
   - Explaining reasons for differences in speed, frequency, and wavelength of a propagating wave in varying materials
   - Describing uses of different components of the electromagnetic spectrum, including radio waves, microwaves, infrared radiation, visible light, ultraviolet radiation, X rays, and gamma radiation
   - Demonstrating particle and wave duality
   - Describing the change of wave speed in different media

7. Describe properties of reflection, refraction, and diffraction.

Examples: tracing the path of a reflected light ray, predicting the formation of reflected mages through tracing of rays

Objective P.7.1: Define reflection, refraction, and diffraction..
Objective P.7.2: Sketch light rays to show propagation of light waves in particular directions.
Objective P.7.3: Compare the effects of reflection, refraction, and diffraction on light ray paths.
Objective P.7.4: Compare formation and properties of real and virtual images..

Additional content to be taught:

- Demonstrating the path of light through mirrors, lenses, and prisms
  Example: tracing the path of a refracted light ray through prisms using Snell's law
- Describing the effect of filters and polarization on the transmission of light

8. Summarize similarities in the calculation of electrical, magnetic, and gravitational forces between objects.

Objective P.8.1: Describe an inverse-square relationship..
Objective P.8.2: Use the correct unit for each quantity in formulas.
Objective P.8.3: Write formulas for calculating electrical, magnetic, and gravitational forces..
Objective P.8.4: Identify characteristics of gravitational and electromagnetic forces..

Additional content to be taught:

- Determining the force on charged particles using Coulomb's law

9. Describe quantitative relationships among charge, current, electrical potential energy, potential difference, resistance, and electrical power for simple series, parallel, or combination direct current (DC) circuits.

Objective P.9.1: Define charge, current, electrical potential energy, potential difference, electrical resistance, electrical power, circuit, series circuit, parallel circuit, and combination circuit..
Objective P.9.2: Interpret, through illustrations, circuits using schematic symbols..
Objective P.9.3: Use Ohm's law to determine voltage, current, or resistance in a circuit containing one electrical load..
Objective P.9.4: Recognize, through illustrations, series and parallel circuits..
Objective P.9.5: Use Ohm's law to solve problems involving series and parallel circuits..
Objective P.9.6: Calculate power in series and parallel circuits using the formula for power, $P = VI$, where P represents power, V represents voltage, and I represents current..

EARTH AND SPACE SCIENCE ELECTIVE CORE

Students will:

1. **Describe sources of energy, including solar, gravitational, geothermal, and nuclear.**

   - **Objective ESS.1.1:** Explain alternative sources of energy, including geothermal and nuclear.
     Examples: geysers, volcanoes
   - **Objective ESS.1.2:** Describe the role of the sun in providing energy for Earth..

2. **Describe effects on weather of energy transfer within and among the atmosphere, hydrosphere, biosphere, and lithosphere.**

   - **Objective ESS.2.1:** Identify global patterns of atmospheric movement that influence local weather.
   - **Objective ESS.2.2:** Identify the spheres of Earth, including the geosphere, atmosphere, and hydrosphere.

   Additional content to be taught:
   - Describing the energy transfer related to condensation in clouds, precipitation, winds, and ocean currents
   - Describing characteristics of the El Niño and La Niña phenomena
   - Using data to analyze global weather patterns
     Examples: temperature, barometric pressure, wind speed and direction

3. **Explain how weather patterns affect climate.**

   - **Objective ESS.3.1:** Describe how the amount of sunlight determines climate.
   - **Objective ESS.3.2:** Describe the function of instruments and technology used to investigate Earth's weather.
   - **Objective ESS.3.3:** Describe how the amount and type of precipitation determines climate.

   Additional content to be taught:
   - Explaining characteristics of various weather systems, including high and low pressure areas or fronts
   - Interpreting weather maps and symbols to predict changing weather conditions
   - Identifying technologies used to obtain meteorological data

4. Describe the production and transfer of stellar energies.

- ♦ **Objective ESS.4.1:** Define fusion.
- ♦ **Objective ESS.4.2:** Describe the conversion of solar energy into electricity.

Additional content to be taught:
- Describing the relationship between life cycles and nuclear reactions of stars
- Describing how the reception of solar radiation is affected by atmospheric and lithospheric conditions

  Example: volcanic eruptions and greenhouse gases affecting reflection and absorption of solar radiation

5. Discuss various theories for the origin, formation, and changing nature of the universe and our solar system.

Objective ESS.5.1: Describe the life cycle of a star.
Objective ESS.5.2: Explain the role of the Hubble Space Telescope in developing theories related to the origin of the universe.
- ♦ **Objective ESS.5.3:** Describe the components of the expanding universe and their relationships to each other.

Additional content to be taught:
- Explaining the nebular hypothesis for formation of planets, the big bang theory, and the steady state theory
- Relating Hubble's law to the concept of an ever-expanding universe
- Describing the impact of meteor, asteroid, and comet bombardment on planetary and lunar development

6. Explain the length of a day and of a year in terms of the motion of Earth.

Objective ESS.6.1: Describe how the wobble of Earth's axis causes changes in the seasons.
- ♦ **Objective ESS.6.2:** Distinguish between rotation and revolution.

Additional content to be taught:
- Explaining the relationship of the seasons to the tilt of Earth's axis and its revolution about the sun

7. Explain techniques for determining the age and composition of Earth and the universe.

- ♦ **Objective ESS.7.1:** Identify the geologic time scale.
  Objective ESS.7.2: Describe the expansion constant using the expanding universe measurement..
- ♦ **Objective ESS.7.3:** Differentiate between radiometric dating and relative dating.

Additional content to be taught:
- Using radiometric age methods to compute the age of Earth
- Using expanding universe measurements to determine the age of the universe
- Identifying techniques for evaluating the composition of objects in space

8. **Explain the terms astronomical unit and light year.**

- ♦ **Objective ESS.8.1:** Identify the distances of the planets from the sun.
- ♦ **Objective ESS.8.2:** Differentiate between a light year and a standard Earth year.
- **Objective ESS.8.3:** Describe units used to measure distance in space.

9. **Relate the life cycle of stars to the H-R diagram.**

- **Objective ESS.9.1:** Define nova, supernova, and black hole.
- ♦ **Objective ESS.9.2:** Explain the use of an H-R Diagram.
- **Objective ESS.9.3:** Describe the formation and stages of the life cycle of a star.

Additional content to be taught:

- Explaining indicators of motion by the stars and sun in terms of the Doppler effect and red and blue shifts
- Describing the relationship of star color, brightness, and evolution to the balance between gravitational collapse and nuclear fusion

10. **Identify scientists and their findings relative to Earth and space, including Copernicus, Galileo, Kepler, Newton, and Einstein.**

- **Objective ESS.10.1:** Define heliocentric universe.
- **Objective ESS.10.2:** Discuss technology used to study the universe.
- ♦ **Objective ESS.10.3:** Distinguish between refracting and reflecting telescopes.

Additional content to be taught:

- Identifying classical instruments used to extend the senses and increase knowledge of the universe, including optical telescopes, radio telescopes, spectroscopes, and cameras

11. **Describe pulsars, quasars, black holes, and galaxies.**

- ♦ **Objective ESS.11.1:** Define quasars and pulsars.
- ♦ **Objective ESS.11.2:** Distinguish among the three groups of galaxies.
- **Objective ESS.11.3:** Describe how a black hole affects local gravitational force.

12. **Describe challenges and required technologies for space exploration.**

- **Objective ESS.12.1:** Discuss the positive and negative aspects of space exploration.
- **Objective ESS.12.2:** Identify efforts made to achieve the speed of light.
- ♦ **Objective ESS.12.3:** Describe the Van Allen Radiation Belts.

Additional content to be taught:

- Identifying long-term human space travel needs, including life support
- Identifying applications of propulsion technologies for space travel
- Identifying new instrumentation and communication technologies needed for space information gathering
  Examples: Mars Exploration Rover, Cassini spacecraft and Huygens probe, Gravity Probe B
- Identifying benefits to the quality of life that have been achieved through space advances
  Examples: cellular telephone, GPS
- Identifying new technology used to gather information, including spacecraft, observatories, space-based telescopes, and probes

ENVIRONMENTAL SCIENCE ELECTIVE CORE

Students will:

1. **Identify the influence of human population, technology, and cultural and industrial changes on the environment.**

   - ♦ **Objective ES.1.1:** Explain the concept of ecosystem balance, including how humans might affect that balance.
   - ♦ **Objective ES.1.2:** List major advances in technology as related to the environment.

   Objective ES.1.3: List examples of cultural and industrial changes that affect the environment.

   Additional content to be taught:
   - Describing the relationship between carrying capacity and population size

2. **Evaluate various fossil fuels for their effectiveness as energy resources.**

   Objective ES.2.1: Define fossil fuel.
   - ♦ **Objective ES.2.2:** Identify renewable and nonrenewable resources.

   Examples: renewable—trees;
   nonrenewable—oil, water, air, coal
   - ♦ **Objective ES.2.3:** List characteristics of common fossil fuels.

   Additional content to be taught:
   - Describing the formation and use of nonrenewable fossil fuels
   - Identifying by-products of the combustion of fossil fuels, including particulates, mercury, sulfur dioxide, nitrogen dioxide, and carbon dioxide
   - Identifying chemical equations associated with the combustion of fossil fuels
   - Describing benefits of abundant, affordable energy to mankind
   - Identifying effects of fossil fuel by-products on the environment, including ozone depletion; formation of acid rain, brown haze, and greenhouse gases; and concentration of particulates and heavy metals

3. **Evaluate other sources of energy for their effectiveness as alternatives to fossil fuels.**

   - ♦ **Objective ES.3.1:** Identify energy sources other than fossil fuels.

   Objective ES.3.2: List characteristics of alternative energy sources.

   Objective ES.3.3: Provide examples of how a fossil fuel can be replaced by another energy source.

   Additional content to be taught:
   - Comparing nuclear fission and nuclear fusion reactions in the production of energy
   - Comparing energy production and waste output in generating nuclear energy
   - Differentiating between renewable and nonrenewable energy resources
   - Identifying local energy sources
     Examples: landfill gas, wind, water, sun
   - Identifying ways the law of conservation of energy relates to fuel consumption
     Examples: development of hybrid cars, construction of energy-efficient homes

4. **Identify the impact of pollutants on the atmosphere.**

   Objective ES.4.1: Define pollution.
   - **Objective ES.4.2:** Identify characteristics of pollutants..
   - **Objective ES.4.3:** Describe the result of banning chlorofluorocarbons (CFCs) as related to social, political, and economic aspects of the environment.

   Additional content to be taught:
   - Identifying layers of the atmosphere and the composition of air
   - Describing the formation of primary, secondary, and indoor air pollutants
   - Relating pollutants to smog and thermal inversions
   - Investigating the impact of air quality on the environment
   - Interpreting social, political, and economic influences on air quality

5. **Describe properties of water that make it a universal solvent.**

   - **Objective ES.5.1:** Define solution in terms of solute and solvent.
   Objective ES.5.2: Define polar and nonpolar molecules.
   - **Objective ES.5.3:** Differentiate between chemical and physical properties of water.
   Examples: chemical—nonflammable;
   physical—clear, wet, slippery

6. **Identify sources of local drinking water.**

   - **Objective ES.6.1:** Identify the parts of the water cycle.
   Objective ES.6.2: Distinguish between potable and nonpotable water.

   Additional content to be taught:
   - Determining the quality of fresh water using chemical testing and bioassessment
   - Describing the use of chemicals and microorganisms in water treatment
   - Describing water conservation methods
   - Describing the process of underground water accumulation, including the formation of aquifers
   - Identifying major residential, industrial, and agricultural water consumers
   - Identifying principal uses of water

7. **Identify reasons coastal waters serve as an important resource.**
   Examples: economic stability, biodiversity, recreation

   - **Objective ES.7.1:** Identify types of revenue generated by coastal water areas that directly impact the economy.
   - **Objective ES.7.2:** List recreational activities associated with coastal water areas.
   - **Objective ES.7.3:** List natural benefits of coastal water areas in terms of biodiversity.
   - **Objective ES.7.4:** Identify the role that coastal water areas play in the water cycle.

   Additional content to be taught:
   - Classifying biota of estuaries, marshes, tidal pools, wetlands, beaches, and inlets
   - Comparing components of marine water to components of inland bodies of water

8. **Identify major contaminants in water resulting from natural phenomena, homes, industry, and agriculture.**

   - ♦ **Objective ES.8.1:** Define contaminants.
   - ♦ **Objective ES.8.2:** List examples of natural phenomena, including tornados, floods, and volcanic eruptions.
   - ♦ **Objective ES.8.3:** List major types of contaminants.

   Objective ES.8.4: Describe ways contaminants impact the underground transport of water.

   Additional content to be taught:
   - Describing the eutrophication of water by industrial effluents and agricultural runoffs
   - Classifying sources of water pollution as point and nonpoint

9. **Describe land-use practices that promote sustainability and economic growth.**
   Examples: no-till planting, crop rotation

   - ♦ **Objective ES.9.1:** Describe the process of no-till planting and crop rotation.
   - ♦ **Objective ES.9.2:** List the economic benefits of no-till planting and crop rotation.

   Objective ES.9.3: Identify the benefits of contour terracing.

   Objective ES.9.4: Identify land-use practices such as fallow, skip row, and tree farming.

   Additional content to be taught:
   - Defining various types and sources of waste and their impact on the soil
     Examples: types—biodegradeable, nonbiodegradeable, organic, radioactive, nonradioactive;
     sources—pesticides, herbicides
   - Identifying ways to manage waste, including composting, recycling, reusing, and reclaiming

10. **Describe the composition of soil profiles and soil samples of varying climates.**

    Objective ES.10.1: Define soil profile and soil sample.

    - ♦ **Objective ES.10.2:** List types of soil found in various climates.
      Examples: rainforest—thin, infertile upper layer of soil;
      temperate grasslands—fertile upper layer of soil

    Additional content to be taught:
    - Identifying various processes and activities that promote soil formation
      Examples: weathering, decomposition, deposition
    - Relating particle size to soil texture and type of sand, silt, or clay

11. **Describe agents of erosion, including moving water, gravity, glaciers, and wind.**

    - ♦ **Objective ES.11.1:** Define erosion.
    - ♦ **Objective ES.11.2:** Differentiate between natural and artificial erosion.

    Additional content to be taught:
    - Describing methods for preventing soil erosion
      Examples: planting vegetation, constructing terraces, providing barriers

12. Identify positive and negative effects of human activities on biodiversity.

- **Objective ES.12.1:** Define biodiversity.
- **Objective ES.12.2:** List examples of human activities that affect biodiversity.

Additional content to be taught:

- Identifying endangered and extinct species locally, regionally, and worldwide
- Identifying causes for species extinction locally, regionally, and worldwide

GENETICS ELECTIVE CORE

Students will:

1. **Explain how the Hardy-Weinberg principle provides a baseline for recognizing evolutionary changes in gene frequency due to genetic drift, gene flow, nonrandom mating, mutation, and natural selection.**

   - **Objective G.1.1:** Define the Hardy-Weinberg principle.
   - **Objective G.1.2:** Define genetic drift, gene flow, nonrandom mating, and natural selection.
   - **Objective G.1.3:** Determine genotypic ratios using a Punnett square.

2. **Describe factors such as radiation, chemicals, and chance that cause mutations in populations.**

   - **Objective G.2.1:** Describe how chance and mutagens cause changes in populations.
   - **Objective G.2.2:** Describe environmental factors that affect native organisms in various biomes.
   - **Objective G.2.3:** Describe organisms in the five- and six- kingdom classification systems.
   - **Objective G.2.4:** Describe how limiting factors affect populations.
   - **Objective G.2.5:** Describe the flow of energy in ecosystems.
   - **Objective G.2.6:** Compare biogeochemical cycles to demonstrate ways they affect populations.
   - **Objective G.2.7:** Describe chemical and physical adaptations of plants.
   - **Objective G.2.8:** Identify protective adaptations of animals.

   Additional content to be taught:
   - Describing effects of genetic variability on adaptations

3. **Describe the significance of Mendel's work to the development of the modern science of genetics, including the laws of segregation and independent assortment.**

   - **Objective G.3.1:** Define Mendel's law of segregation, Mendel's law of independent assortment, and Mendel's law of dominance.
   - **Objective G.3.2:** Identify Mendel's laws for determining phenotypic and genotypic probabilities of offspring.
   - **Objective G.3.3:** Determine phenotypic and genotypic probabilities of offspring, including skeletal structure, body symmetry, body coverings, and locomotion..
   - **Objective G.3.4:** Identify genetic differences between monocots and dicots, angiosperms and gymnosperms, and vascular and nonvascular plants.

4. **Describe the process of meiosis and the cell cycle, including the hereditary significance of each.**

- ♦ **Objective G.4.1:** Define cell cycle..
- ♦ **Objective G.4.2:** Compare sperm and egg formation in terms of ploidy.
  Examples: haploid, diploid
- ♦ **Objective G.2.3:** Compare various cell organelles and functions.
- ♦ **Objective G.2.4:** Compare the roles of meiosis and mitosis.
- ♦ **Objective G.2.5:** Compare cell processes involved in maintaining homeostasis.
- ♦ **Objective G.2.6:** Compare methods of fertilization and reproduction in plants and animals.

Additional content to be taught:
- Comparing spermatogenesis and oogenesis using charts

5. **Describe inheritance patterns based on gene interactions.**

- ♦ **Objective G.5.1:** Interpret inheritance patterns illustrated in graphs and charts.
- ♦ **Objective G.5.2:** Differentiate among incomplete dominance, codominance, and multiple allelism.

Additional content to be taught:
- Predicting patterns of heredity using pedigree analysis
- Identifying incomplete dominance, codominance, and multiple allelism

6. **Describe occurrences and effects of sex linkage, autosomal linkage, crossover, multiple alleles, and polygenes.**

- ♦ **Objective G.6.1:** Define sex linkage and autosomal linkage.
- ♦ **Objective G.6.2:** Define multiple alleles and polygenes.
  Objective G.6.3: Define crossover.

7. **Describe the structure and function of DNA, including replication, translation, and transcription.**

- ♦ **Objective G.7.1:** Define replication, translation, and transcription.
  Objective G.7.2: Describe the relationship among DNA, genes, and chromosomes.
- ♦ **Objective G.7.3:** Compare the structure and function of DNA, RNA, and protein.

Additional content to be taught:
- Applying the genetic code to predict amino acid sequence
- Describing methods cells use to regulate gene expression
- Defining the role of RNA in protein synthesis

8. **Explain the structure of eukaryotic chromosomes, including transposons, introns, and exons.**

  Objective G.8.1: Define transposons.
- ♦ **Objective G.8.2:** Compare eukaryotic and prokaryotic cells.

9. **Differentiate among major areas in modern biotechnology, including plant, animal, microbial, forensic, and marine.**
   Examples: hybridization, cloning, insulin production, DNA profiling, bioremediation

   ♦ **Objective G.9.1:** Define biotechnology.
   ♦ **Objective G.9.2:** Identify agricultural and medical practices derived from advances in biotechnology.

   Additional content to be taught:
   - Describing techniques used with recombinant DNA
     Examples: DNA sequencing, isolation of DNA segments, polymerase chain reaction, gel electrophoresis

10. **Explain the development and purpose of the Human Genome Project.**

    ♦ **Objective G.10.1:** Describe the Human Genome Project.
    Objective G.10.2: Identify the goals of the Human Genome Project.

    Additional content to be taught:
    - Analyzing results of the Human Genome Project to predict ethical, social, and legal implications
    - Describing medical uses of gene therapy, including vaccines and tissue and antibody engineering

11. **Describe the replication of DNA and RNA viruses, including lytic and lysogenic cycles, using diagrams.**

    Objective G.11.1: Describe lytic and lysogenic cycles.
    ♦ **Objective G.11.2:** Identify DNA and RNA viruses.

HUMAN ANATOMY AND PHYSIOLOGY ELECTIVE CORE

Students will:

1. **Use appropriate anatomical terminology.**
   Examples: proximal, superficial, medial, supine, superior, inferior, anterior, posterior

   Objective HAP.1.1: Identify anatomical terminology used in a diagram.
   Objective HAP.1.2: Distinguish between superior and inferior.
   Objective HAP.1.3: Distinguish between anterior and posterior.
   ♦ **Objective HAP.1.4:** Distinguish among proximal, distal, and medial.

2. **Identify anatomical body planes, body cavities, and abdominopelvic regions of the human body.**

   Objective HAP.2.1: Define abdominal and pelvic.
   ♦ **Objective HAP.2.2:** Define anatomical body planes, including sagittal, frontal, and transverse.
   Objective HAP.2.3: Identify body cavities as dorsal or ventral.

3. **Classify major types of cells, including squamous, cuboidal, columnar, simple, and stratified.**

   Objective HAP.3.1: Define squamous cells.
   ♦ **Objective HAP.3.2:** Discuss health implications related to squamous cells.

4. **Classify tissues as connective, muscular, nervous, or epithelial.**

   ♦ **Objective HAP.4.1:** Identify connective tissue.
   ♦ **Objective HAP.4.2:** Identify muscular tissue.
   ♦ **Objective HAP.4.3:** Identify epithelial tissue.

5. **Identify anatomical structures and functions of the integumentary system.**

   Objective HAP.5.1: Define integumentary system.
   ♦ **Objective HAP.5..2:** Discuss health implications related to the integumentary system.

   Additional content to be taught:
   - Identifying accessory organs
   - Recognizing diseases and disorders of the integumentary system
     Examples: decubitus ulcer, melanoma, psoriasis

6. Identify bones that compose the skeletal system.

- ♦ **Objective HAP.6.1:** Identify major bones of the human skeletal system, including the cranium, sternum, clavicle, scapula, ribs, humerus, radius, ulna, pelvis, femur, patella, tibia, fibula, and vertebra.
- ♦ **Objective HAP.6.2:** Discuss health implications related to the skeletal system.

Additional content to be taught:
- Identifying functions of the skeletal system
- Identifying subdivisions of the skeleton as axial and appendicular skeletons
- Classifying types of joints according to their movement
- Identifying the four bone types
- Identifying various types of skeletal system disorders
  Examples: fractures, arthritis

7. Identify major muscles, including origins, insertions, and actions.

- ♦ **Objective HAP.7.1:** Identify the three types of muscles.
- ♦ **Objective HAP.7.2:** Discuss health implications related to the muscular system.

Additional content to be taught:
- Describing common types of body movements, including flexion, extension, abduction, and adduction
- Classifying muscles based on functions in the body, including prime movers, antagonists, synergists, and fixators
- Comparing skeletal, smooth, and cardiac muscles based on their microscopic anatomy
- Identifying diseases and disorders of the muscular system
  Examples: muscular dystrophy, multiple sclerosis, strain

8. Identify structures of the nervous system.

- ♦ **Objective HAP.8.1:** Identify major structures of the nervous system, including the brain, spinal cord, and peripheral nerves.
- ♦ **Objective HAP.8.2:** Discuss health implications related to the nervous system.

Additional content to be taught:
- Explaining differences in the function of the peripheral nervous system and the central nervous system
- Labeling parts of sensory organs, including the eye, ear, tongue, and skin receptors
- Recognizing diseases and disorders of the nervous system
  Examples: Parkinson's disease, meningitis

9. **Identify structures and functions of the cardiovascular system.**

- ♦ **Objective HAP.9.1:** Identify components of the cardiovascular system.
- ♦ **Objective HAP.9.2:** Explain the major function of the cardiovascular system.
- ♦ **Objective HAP.9.3:** Discuss health implications related to the cardiovascular system.

Additional content to be taught:
- Tracing the flow of blood through the body
- Identifying components of blood
- Describing blood cell formation
- Distinguishing among human blood groups
- Describing common cardiovascular diseases and disorders
  Examples: myocardial infarction, mitral valve prolapse, varicose veins, arteriosclerosis

10. **Identify structures and functions of the digestive system.**

- ♦ **Objective HAP.10.1:** Identify components of the gastrointestinal (GI) tract.
  Objective HAP.10.2: Identify the accessory digestive organs.
- ♦ **Objective HAP.10.3:** Discuss health implications related to the digestive system.

Additional content to be taught:
- Tracing the pathway of digestion from the mouth to the anus using diagrams
- Identifying disorders affecting the digestive system
  Examples: ulcers, Crohn's disease, diverticulitis

11. **Identify structures and functions of the respiratory system.**

- ♦ **Objective HAP.11.1:** Identify major structures of the respiratory system, including the nose, pharynx, larynx, trachea, and bronchi.
- ♦ **Objective HAP.11.2:** Discuss health implications related to the respiratory system.

Additional content to be taught:
- Tracing the pathway of the oxygen and carbon dioxide exchange
- Recognizing common disorders of the respiratory system
  Examples: asthma, bronchitis, cystic fibrosis

12. **Identify structures and functions of the reproductive system.**

- ♦ **Objective HAP.12.1:** Identify major organs of the male reproductive system.
- ♦ **Objective HAP.12.2:** Identify major organs of the female reproductive system.
- ♦ **Objective HAP.12.3:** Discuss health implications related to the reproductive system.

Additional content to be taught:
- Differentiating between male and female reproductive systems
- Recognizing stages of pregnancy and fetal development
- Identifying disorders of the reproductive system
  Examples: endometriosis, sexually transmitted diseases, prostate cancer

13. Identify structures and functions of the urinary system.

- ♦ **Objective HAP.13.1:** Identify major structures of the urinary system, including kidneys, ureter, bladder, and urethra..
- ♦ **Objective HAP.13.2:** Discuss health implications related to the urinary system.

Additional content to be taught:
- Tracing the filtration of blood from the kidneys to the urethra
- Recognizing diseases and disorders of the urinary system
  Examples: kidney stones, urinary tract infections

14. Identify the endocrine glands and their functions.

- ♦ **Objective HAP.14.1:** Describe major endocrine glands, including the hypothalamus and the pituitary glands.
- ♦ **Objective HAP.14.2:** Discuss health implications related to the endocrine glands.

Additional content to be taught:
- Describing effects of hormones produced by the endocrine glands
- Identifying common disorders of the endocrine system
  Examples: diabetes, goiter, hyperthyroidism

15. Identify physiological effects and components of the immune system.

- ♦ **Objective HAP.15.1:** Identify the function of the immune system.
  Objective HAP.15.2: Describe the roles of lymphocytes and macrophages in the immune system.
- ♦ **Objective HAP.15.3:** Discuss health implications related to the immune system.

Additional content to be taught:
- Contrasting active and passive immunity
- Evaluating the importance of vaccines
- Recognizing disorders and diseases of the immune system
  Examples: acquired immunodeficiency syndrome (AIDS), acute lymphocytic leukemia

Alabama Occupational Diploma
Science Course Requirements for High School

Students pursuing the *Alabama Occupational Diploma* (*AOD*) must earn four credits in science to fulfill part of the requirements for graduation from high school. Students must successfully complete Life Skills Science I: Physical Science (one credit) in Grade 9 and Life Skills Science II: Biology (one credit) in Grade 10. In Grades 11 and 12, students must successfully complete two additional life skills science courses from those listed below to satisfy the remaining two science credits required for graduation. The following chart provides additional information regarding the required science courses and credits to be earned by students in Grades 9-12 who are pursuing the *AOD*..

GRADE LEVEL	SCIENCE COURSE REQUIREMENTS*	*AOD* CREDITS
9	Life Skills Science I: Physical Science	1
10	Life Skills Science II: Biology	1
11 or 12	Life Skills Science III: Earth and Space Science Life Skills Science: Genetics** Life Skills Science IV: Environmental Science Life Skills Science: Human Anatomy and Physiology**	2

The following subject codes and course descriptions provide further information regarding the *AOD* science course requirements for high school graduation. This information is also available on the Alabama Department of Education Web site at www.alsde.edu.

Grade 9

654101 **Life Skills Science I: Physical Science**
This course is designed to provide students with a practical knowledge of physical science including scientific process and application skills; the periodic table; solutions; bonding; chemical formulas; physical and chemical changes; gravitational, electromagnetic, and nuclear forces; motion; energy; energy transformation; electricity and magnetism; nuclear science; and metric units.

Grade 10

654102 **Life Skills Science II: Biology**
This course is designed to provide students with a practical knowledge of biology including scientific process and application skills, cell processes, cell theory, photosynthesis and cellular respiration, genetics, classification, plants, animals, ecology, and biogeochemical cycles.

*Bulleted (♦) items in the *Curriculum Guide to the Alabama Course of Study: Science* indicate content required for earning Grades 9-12 science course credit for the *AOD*..
**Denotes additional science courses developed from the science elective cores found in the *Alabama Course of Study: Science* (Bulletin 2005, No. 20) that may be used to satisfy the Grades 11 and 12 *AOD* science course requirements.

Appendix A

Grade 11 or 12

654103*
654204**

Life Skills Science III: Earth and Space Science

This course is designed to provide students with a practical knowledge of earth and space science including scientific process and application skills; energy in the Earth system; weather; seasons; theories for origin and age of the universe; stars, pulsars, quasars, black holes, and galaxies; earth and space scientists; and space exploration.

654103*
654204**

Life Skills Science: Genetics

This course is designed to provide students with the biological basis of genetics including scientific process and application skills, scientific principles, molecular and cellular foundations, heredity, mutation, genetic techniques, bioethics, and the Humane Genome Project..

654103*
654204**

Life Skills Science IV: Environmental Science

This course is designed to provide students with a practical knowledge of environmental science including scientific process and application skills, natural and human impact on the environment, carrying capacity, renewable and nonrenewable energy resources, properties and importance of water, land use practices, and composition and erosion of soil.

654103*
654204**

Life Skills Science: Human Anatomy and Physiology

This course is designed to provide students with a practical knowledge of human anatomy and physiology including scientific process and application skills; anatomical terminology; structure and function of cells, tissues, and body systems; biochemistry; and system regulation and integration.

*Subject code to be used for Grade 11 course.
**Subject code to be used for Grade 12 course.

Alabama High School Graduation Exam
Science Standards and Objectives

STANDARD I: The student will understand concepts dealing with the nature of science.

OBJECTIVE

1. Analyze the methods of science used to identify and solve problems.

ELIGIBLE CONTENT

- Use process skills to interpret data from graphs, tables, and charts.
- Identify and distinguish between controls and variables in a scientific investigation.
- Identify safe laboratory procedures when handling chemicals, using Bunsen burners, and using laboratory glassware.
- Identify and use appropriate *Système International d'Unités* (SI) units for measuring dimensions, volume, and mass.
- Define and identify examples of hypotheses.
- Order the proper sequence of steps within the scientific process.
- Select appropriate laboratory glassware, balances, time measuring equipment, and optical instruments to conduct an investigation.

STANDARD II: The student will understand concepts dealing with matter.

OBJECTIVE

1. Trace the transfer of matter and energy through biological systems.

ELIGIBLE CONTENT

- Identify, define, and distinguish among producers (autotrophs), consumers, and decomposers (heterotrophs).
- Trace the flow of energy through food chains, food webs, and energy pyramids.
- Identify the reactants and products associated with photosynthesis and cellular respiration and the purpose of these two processes.
- Describe the carbon, nitrogen, and water cycles—including transpiration and respiration.

STANDARD II (Continued): The student will understand concepts dealing with matter.

OBJECTIVE

2. Relate particle motion to the states of matter (solids, liquids, and gases).

ELIGIBLE CONTENT

- Identify states of matter in terms of molecular (particle) movement, density, and kinetic energy associated with each phase/state of a given type of matter.

Appendix B

STANDARD II (Continued): The student will understand concepts dealing with matter.

OBJECTIVE

3. Apply information from the periodic table and make predictions using the organization of the periodic table.

ELIGIBLE CONTENT

- Determine the number of protons, neutrons, electrons, and mass of an element using the periodic table.
- Use the periodic table to identify and locate metals, nonmetals, metalloids, and noble gases.
- Use data about the number of electrons in the outer electron shell of an atom, including simple dot diagrams, to determine its stability/reactivity and to be able to predict ionic charge resulting from reactions.

STANDARD II (Continued): The student will understand concepts dealing with matter.

OBJECTIVE

4. Identify how factors affect rates of physical and chemical changes.

ELIGIBLE CONTENT

- Demonstrate knowledge that some factors and substances can affect the rate at which physical and chemical changes occur in living and nonliving systems such as the digestive process.

Note: Factors and substances include such things as temperature, concentration, surface area, and catalysts—including enzymes.

STANDARD III: The student will understand concepts of the diversity of life.

OBJECTIVE

1. Distinguish among the taxonomic groups by major characteristics.

ELIGIBLE CONTENT

- Recognize the correct sequence or taxonomic classification of organisms from the most inclusive level to the least inclusive level—may include use of a chart to compare two species and to identify the classification level at which one species no longer shares common characteristics with other species.
- Classify organisms into the five kingdoms based on recognizing two or more characteristics associated with organisms in a given kingdom.
- Recognize properly written scientific names using binomial nomenclature.

STANDARD III (Continued): The student will understand concepts of the diversity of life.

OBJECTIVE

2. Differentiate structures, functions, and characteristics of plants.

ELIGIBLE CONTENT

- Identify various plants as being vascular or nonvascular and describe the basic mechanisms by which vascular and nonvascular plants sustain themselves.
- Identify the distinguishing characteristics of angiosperms and gymnosperms in terms of their structures and reproduction.
- Identify reproductive structures and their functions in angiosperms.
- Demonstrate knowledge of which characteristics/traits would be best suited for plants growing in different environments and/or exposed to different pests.

STANDARD III (Continued): The student will understand concepts of the diversity of life.

OBJECTIVE

3. Differentiate structures, functions, and characteristics of animals.

ELIGIBLE CONTENT

- Distinguish characteristics of vertebrates and invertebrates in terms of a broad but basic range of physical and reproductive traits.
- Explain how animals are adapted to their environment such as protective coloration, mimicry, claws, beaks, etc.

STANDARD IV: The student will understand concepts of heredity.

OBJECTIVE

1. Recognize heritable characteristics of organisms.

ELIGIBLE CONTENT

- Identify physical traits that are passed from parents to offspring.
- Recognize how genetic traits including diseases and disorders are passed from one generation to the next—may include family pedigrees and monohybrid Punnett squares.
- Identify what happens to the DNA code when a mutation occurs and identify the major causes of mutations.
- Recognize and evaluate the harms and benefits that result when mutations occur.

Appendix B

STANDARD IV (Continued.): The student will understand concepts of heredity.

OBJECTIVE

2. Explain how the DNA molecule transfers genetic information from parent to offspring.

ELIGIBLE CONTENT

- Describe the relationships among DNA, genes, and chromosomes.
- Describe in basic terms the structure and function of DNA.
- Define the genetic purpose for meiosis from generation to generation.
- Define and distinguish between dominant and recessive genes and how each is expressed in parents and offspring.

STANDARD V: The student will understand concepts of cells.

OBJECTIVE

1. Distinguish relationships among cell structures, functions, and organization in living things.

ELIGIBLE CONTENT

- Define and identify representations of diffusion and osmotic systems and what substances are transported by these processes—may include graphic representations.
- Recognize differences between active and passive transport of substances and the energy requirements associated with these transport systems.
- Identify and define similarities and differences between plant and animal cells.
- Classify organisms as prokaryotic or eukaryotic; identify and define similarities and differences between prokaryotic and eukaryotic cells.
- Describe cell locomotion by means of cilia and flagella and recognize some organisms that depend on one or the other of these means of locomotion.
- Identify cell organelles and define functions of cell organelles—may include graphic representations.
- Distinguish and identify examples of cellular organization at the cell, tissue, organ, system, and organism level.

STANDARD V (Continued.): The student will understand concepts of cells.

OBJECTIVE

2. Differentiate between mitosis and meiosis.

ELIGIBLE CONTENT

- Define, contrast, and compare mitosis and meiosis—may include events needed to prepare the cell for these processes.
- Describe the purpose of mitotic and meiotic divisions during different life stages of organisms such as asexual and sexual reproduction and growth and repair.

STANDARD VI: The student will understand concepts of interdependence.

OBJECTIVE

1. Demonstrate an understanding of factors that affect the dynamic equilibrium of populations and ecosystems.

ELIGIBLE CONTENT

- Describe the harmful/beneficial consequences of introducing a nonnative species into an ecosystem.
- Identify species that are competing for resources and predict outcomes of that competition.
- Identify and define biotic and abiotic components of different environments.
- Determine how viruses, bacteria, and parasites affect the dynamic equilibrium of populations.
- Identify human activities that affect the dynamic equilibrium of populations and ecosystems.
- Identify factors and relationships such as predator/prey that affect population dynamics and ecosystems.
- Explain why diversity within a species is important and how heritable traits ensure survival.

STANDARD VII: The student will understand concepts of energy.

OBJECTIVE

1. Relate the law of conservation of energy to energy transformations.

ELIGIBLE CONTENT

- Describe how energy—mechanical, electrical, chemical, light, sound, and heat—can be transformed from one form to another.
- Show understanding that energy transformations result in no net gain or loss of energy, but that in energy conversions less energy is available due to heat loss during the transformations.
- Apply the concept of conservation and transformation of energy within and between organisms and the environment such as food chains, food webs, and energy pyramids.

STANDARD VII (Continued): The student will understand concepts of energy.

OBJECTIVE

2. Relate waves to the transfer of energy.

ELIGIBLE CONTENT

- Relate wavelength to energy.
- Describe how waves travel through different kinds of media.
- Describe how waves— earthquake waves, sound waves, water waves, and electromagnetic waves—can be destructive/beneficial due to the transfer of energy.

Appendix B

STANDARD VIII: The student will understand concepts of force and motion.

OBJECTIVE

1. Relate Newton's three laws of motion to real-world applications.

ELIGIBLE CONTENT

None specified.

STANDARD VIII (Continued.): The student will understand concepts of force and motion.

OBJECTIVE

2. Relate force to pressure in fluids.

ELIGIBLE CONTENT

- Relate force to pressure in fluids. (Note: Formulas will be provided, where needed, to calculate fluid force in closed systems.)
- Apply the concept of fluid pressure to biological systems such as in strokes, aneurysms, the bends, blood pressure, lung function, equalization of pressure on the eardrum, and turgor pressure.

Appendix C

Reading Skills for Science

Examine the Textbook

Preview the Textbook. Have students review the table of contents of the textbook and laboratory manual along with the science course outline. Tell them to compare the table of contents of the textbook and the laboratory manual with the course outline. This process helps students become familiar with the organization of the science textbook and laboratory manual as well as with the organization of the science course content.

Preview Textbook Assignments. Before students begin a reading assignment in the science textbook, be certain they understand the purpose for which they are reading. Have them read the introduction of the assigned chapter from the textbook or the assigned section from the laboratory manual. Tell them to connect topics in the introductions to topics from previous assignments or to prior knowledge of the topic. Encourage them to read all directions, headings, subheadings, summaries, and review questions to help them gain a better understanding about the content of the assignment as well as to help guide them during reading. Tell them to jot down questions or ideas that occur to them during reading and bring these to class for discussion..

Preview Textbook Visuals. Tell students to look carefully at pictures, tables, diagrams, photographs, and other visuals provided in the textbook and in the laboratory manual. Visuals are designed to facilitate understanding of the written text and to help students understand more about what they read.

Check the Vocabulary

Preview Vocabulary.. Encourage students to focus on vocabulary prior to reading. Have them identify basic scientific word roots, prefixes, and suffixes. Tell them to look for context clues to gain understanding of the concepts contained in the reading material and to link new terms to experiments, diagrams, demonstrations, equipment, or prior learning experiences.

Utilize Glossaries, Dictionaries, and Encyclopedias. Reference materials help students understand science concepts and increase science vocabulary. Encourage students to use textbook glossaries and indexes as well as dictionaries and encyclopedias when they encounter an unknown word. Tell them to jot down these words and their meanings to be used later to make vocabulary flash cards.

Create Vocabulary Flash Cards. Have students make science vocabulary flash cards for each textbook chapter. Instruct them to write the science word or term on the front of the flash card and the definition or explanation or an illustration on the back. Tell them to practice science vocabulary with the flash cards until they have mastered all words and concepts.

Appendix C

Analyze for Comprehension

Preview Textbook Structure. It is important for students to identify cues that indicate the writing pattern used in their science textbook. Writing patterns may include those of classification, process-description, factual-statement, problem-solving, experiment-instruction, or a combination of patterns.. The following is an explanation of these patterns..

- Classification Pattern. This pattern of writing is used in science to group and subgroup various things, objects, or areas. For example, a discussion about the structure of a plant may be broken down into various subheadings having to do with the parts of a plant such as plant roots, stems, leaves, and flowers. These subheadings let the reader know that these are the important parts of a plant.

- Process-Description Pattern. This pattern is used to tell what the scientific process is and to describe how the process works. In this writing pattern, it is important to distinguish between what information identifies the scientific process and what information explains how the scientific process works..

- Factual-Statement Pattern. This is a writing pattern in which facts are used to define, compare, and provide examples or illustrations about science concepts and terms. In science, a factual statement refers to a statement that, because of scientific observation and experimentation, defines or explains something that has not been disproved.

- Problem-Solving Pattern. This pattern is used to describe or recount past science problems and their discoveries resolved through experimentation. When confronted with the problem-solving pattern, the following questions are useful in helping students understand and analyze the passages: "What is the question or problem?" "How was the question answered?" "How do we know it was answered?"

- Experiment-Instruction Pattern. This pattern of writing is used to assist students in carrying out scientific experiments. The following questions help students follow instructions for an experiment.

    1) What is the purpose of the experiment?
    2) What equipment is needed?
    3) What are the basic steps involved?
    4) What is the order of the steps?
    5) What are the results?

As students conduct the experiment, they may find they need to alternate between reading the instructions for the experiment and conducting the experiment itself. If they have answered the above questions before beginning the experiment and have these questions and answers in mind, the experiment will go more smoothly.

- Combination Pattern. Sometimes a science textbook may use a combination of writing patterns rather than one single pattern.. For instance, a reading passage may begin with a factual-statement of definition of a term, move to a classification or subgrouping of the components or parts of the term, and conclude with a description of a process involving the term..

Appendix C

Synthesize for Understanding

Take Notes. Note-taking is important for several reasons. Note-taking helps students:

- Pay closer attention to and keep their minds on the information they are reading,
- Retain the information they are reading for longer periods of time,
- Identify information that is important for review,
- Connect the author's ideas with their own ideas and knowledge, and
- Record their own thoughts and reactions regarding the information they are reading.

Make Textbook Notations.. Encourage students to develop a notation system to use to mark the important parts of what they are reading. The following list contains suggestions for students to incorporate into their own notation systems..

- Underline the main idea in each paragraph.
- Circle important words or phrases.
- Draw boxes around names of important persons or places.
- Put a check mark in the margin next to important statements that are opinions rather than facts.
- Underline minor but important facts or statistics with broken lines.
- Use numbers or letters in the margin to indicate chronology or a series of items.
- Use margins to write down anything that may be important for future reference.

As students read, they may have questions about the reading assignment. Tell them to write their questions in the book on "sticky notes" so they will remember to ask questions in class. Suggest that they use margins to write any reactions they may have about what they read, and tell them to note any page numbers where related subjects are discussed in the text.

Transfer Notations From Textbook to Notebook. Tell students to transfer the notes they mark in the textbook to their science notebooks. Guidelines for transferring notes to the notebook are included in the following list..

- Copy the title of the book, chapter, date, and assigned page numbers.
- Write the main ideas of the passages as the major headings, and list the minor ideas or facts under them.
- Use the writing pattern of the author to write notes (if the author defines a term, notes should contain a good definition of the term; if the author compares ideas, notes should also compare ideas; if the author classifies, notes should contain an outline).
- Use their own words and avoid copying the exact wording used in the text.
- Make a list of unfamiliar words to look up and add to their science vocabulary flash cards.

Appendix C

Prepare for the Test. There are several things students should do to prepare themselves for the science test. The following list provides suggestions for teachers to use when instructing students about how to study for the test.

- Write down possible science test questions and answers.
- Ask for help with answers to difficult science questions.
- Write a brief summary or commentary for each chapter studied in the science textbook.
- Recite important names, theories, dates, terms, and other relevant information connected with science topics studied in class.
- Review science vocabulary flash cards.
- Organize information learned from lectures, class, and readings both within and outside the science class.
- Review the most recent science test to determine the kinds of questions to be expected as well as to review teacher comments regarding the recent test.

Take the Test. Be certain that directions for taking the test are clearly stated. Tell students to carefully read all directions before marking answers. Tell students to ask for help if they do not understand a question. Review with students the grading system for the test. Encourage them to devote more time and effort to questions worth the most points. Remind them to keep track of the time. Encourage them to explore all questions and to begin by answering the easiest questions first. (This usually helps students recall additional information that may be helpful in answering the more difficult questions.) Finally, remind students to save some time at the end of the testing period for filling in any blanks and for proofreading answers.

Some of this information regarding reading skills for science can be found on http://www.academic.cuesta.cc.ca.us/acasupp/AS/621.htm. Additional information is also available on this site regarding strategies for textbook study, previewing textbooks, a study system using SQ4R, surveying a chapter, marking a text, paragraph patterns, effective textbook study, finding the main idea, and other useful strategies for reading.

Appendix D

Web Sites for Science Teachers and Students

Academy of Natural Sciences	http://www.acnatsci.org/index.html
Access America	http://www.accessexcellence.org/
Agriculture in the Classroom	http://www.agclassroom.org/
Alternative Strategies for Science Teaching and Assessment	http://science.uniserve.edu.au/school/support/strategy.html
American Zoo and Aquarium Association	http://www.aza.org/
Annenberg Case Studies in Science Education	http://www.learner.org/resources/series21.html
Ask a Scientist	http://www.newton.dep.anl.gov/archive.htm
Bill Nye: The Science Guy	http://www.billnye.com/
Black Hold Gang	http://www.blackholegang.com/
comPADRE: Resources for Physics and Astronomy Education	http://www.compadre.org/portal/index.cfm
Discovery Channel	http://www.discovery.com/
Earth Awareness Program	http://www.earthballoon.com/
Earthweek	http://www.earthweek.com/
Educator's Reference Desk	http://www.eduref.org/cgi-in/lessons.cgi/Science
Fermilabryrinth	http://www-ed.fnal.gov/projects/labyrinth/games
Frank Potter's Science Gems	http://www.sciencegems.com/
Gamequarium.com	http://www.gamequarium.com/science.htm
Geology.com – Reading Science for Comprehension	http://geology.com/articles/reading-science.shtml
Hubble Space Telescope Site	http://hstsci.gsfc.nasa.gov/
Instructional Materials in Science Education	http://www.ncsu.edu/imse/
Jack Horkheimer: Star Gazer	http://www.starhustler.com/
Jefferson Lab Science Education – Reading Comprehension Passages	http://education.jlab.org/reading/index.html
Lesson Planet	www.lessonplanet.com
Marc Sheehan's Educational Resource Page	http://www.halcyon.com/marcs/ed.html
Modeling for Understanding in Science Education	http://www.wcer.wisc.edu/ncisla/muse/teaching/index.html

Appendix D

Museum for Teaching Science	http://www.mits.org/
NASA Space Science News	http://science.msfc.nasa.gov/
National Air and Space Museum	http://www.nasm.si.edu/
National Geographic Xpeditions	http://www.nationalgeographic.com/xpeditions/
National Science Digital Library (NSDL)	http://nsdl.org
National Science Education Standards	http://www.nap.edu/readingroom/books/nses/html/3.html
National Science Foundation	http://www.nsf.gov/
NOVA Teachers	http://www.pbs.org/wgbh/nova/teachers/
Oceanlink	http://oceanlink.island.net/
Outstanding Science Trade Books	http://www.nsta.org/ostbc
Palomar Observatory	http://www.astro.caltech.edu/palomarpublic/
Physical Sciences Resource Center	http://www.compadre.org/psrc/
Science Learning Network	http://www.sln.org/
Science Master	http://www.sciencemaster.com
Science NetLinks	http://www.sciencenetlinks.com
Science Page	http://sciencepage.org
Science Projects Made Simple	http://www.sciencemadesimple.com/
SEGway Science Education	http://cse.ssl.berkeley.edu/SegwayEd/index.html
SMILE Programs: Science and Mathematics Initiative for Learning Enhancement	http://www.iit.edu/~smile
Southwest Biotechnology and Information Center (SWBIC) Educational Resources	http://www.swbic.org/education/education.php
Teaching Plastics	http://www.handsonplastics.com/
Tech Museum of Innovative Design Challenge	http://www.thetech.org/education/teachers/curriculum.php
Tramline's Virtual Field Trips	http://www.field-guides.com/trips.htm
U.S. Geological Survey Learning Web	http://education.usgs.gov/
Volcano Web	http://www.mcli.dist.maricopa.edu/tut/tut23_ex/
Why Files	http://whyfiles.org
Windows to the Universe	http://www.windows.ucar.edu/

In addition to these Web sites, the Alabama Learning Exchange (ALEX) contains hundreds of sites and links for teachers and students. You may access ALEX at http://alex.state.al.us.

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Glossary

Abdominal. Pertaining to the abdomen.

Abdomen. The part of the body that lies between the thorax and pelvis and encloses the stomach, intestines, liver, spleen, and pancreas; also called belly.

Abiotic. A term to describe any nonliving thing.

Abrasive. A gritty substance used for rubbing or grinding.

Absorb. To soak up; for example, a sponge absorbs liquid.

Abyssal plain. The deepest of the oceanic hydrosphere.

Abyssal zone. The deep sea (2000 meters or more) where there is no light..

Acceleration. The rate of change of velocity with respect to time.

Acid. Any of a class of substances whose aqueous solutions are characterized by a sour taste. The ability to turn blue litmus red, and the ability to react with bases and certain metals to form salts; a substance that yields hydrogen ions when dissolved in water; a substance that can act as a proton donor; a substance that can accept a pair of electrons to form a covalent bond.

Action force.. A push or a pull upon an object that results from its interaction with another object. Forces result from interactions and are called *action* and *reaction* forces. These two forces are the subject of Newton's third law of motion. Newton's third law states that "For every action, there is an equal and opposite reaction."

Acceleration. The rate of change of velocity with respect to time.

Acid. Characteristic of chemicals containing hydrogen. Weak acids have a sour taste. Strong acids produce a burning sensation if they make contact with the skin. Acids dissolve or corrode many metals and turn litmus paper red.

Acoustics. The study of sound and sound waves; also refers to the properties of a building relating to how well sounds such as speech and music may be heard clearly.

Acrylic. Acrylic compounds are manufactured as plastics, fibers, or resins. Acrylic compounds soften when heated and harden when cooled.

Adapt. To change in order to better fit new conditions or circumstances.

Adaptation. A trait that makes a living thing better able to survive.

Adenine. A purine base, $C_5H_5N_5$, that is the constituent involved in base pairing with thymine in DNA and with uracil in RNA.

Aerodynamics. The study of the forces acting on an object as it moves through air or some other gas; forces that act on airplanes and any other object moving through the air.

Agate. Semiprecious hard stone; often marked with stripes, bands, or swirls of color.

Air. Invisible gases that surround Earth; a mixture of nitrogen, oxygen, and small amounts of other gases.

Air pressure. Pressure caused by the movement of molecules in air. Air that is forced into a given space, such as a tire, balloon, or basketball, increases the pressure inside the space.

Albumen. Part of the egg of a bird and some reptiles; referred to as the egg white. It is watery and lies between the shell and the yolk.

Algae. Moisture-loving plants that live in water. They make their own food using light energy. Algae may be green, brown, or red.

Alkaline. Describes the characteristics of chemicals that form salts when combined with acids; also referred to as a base substance. Weak alkalis are soapy to touch. Strong alkalis are caustic (or corrosive).

Allele. A copy of a gene..

Allergy. A major reaction to a substance to which the body has become sensitive. Asthma, hay fever, hives, and eczema are examples of allergic reactions.

Aluminum. A silvery grey, lightweight metal. It is used to make drink cans, aircraft, and cooking utensils. It can be rolled out thinly to make foil.

Amber. Hard yellow-brown fossil resin produced by certain trees millions of years ago. It can contain preserved insects, flowers, or leaves that were trapped by the sticky surface; occurs throughout the world in various rocks; acquires an electrical charge when rubbed; also used for making jewelry and ornaments.

Amphibian. An animal that lives both on land and in water; for example, a frog, toad, newt, and salamander. Its skin is moist and slimy.

Anatomy. The structure of the bodies of plants or animals; the study of the structure of the bodies of plants or animals.

Anemometer. An instrument for measuring the speed of wind and, sometimes, its direction.

Angiosperm. A plant whose ovules are enclosed in an ovary; a flowering plant.

Animal. A living thing that feeds on other living things. Most animals are able to move about. Commonly divided into invertebrate (animal without a backbone) and vertebrate (animal with a backbone).

Ant. An insect that lives in a community known as a colony. It has a narrow waist between its thorax and abdomen.

Antenna. The sense organ or feeler found in pairs on the heads of insects, crabs, and other invertebrates; wire or aerial used to send or receive signals, as in a television or radio antenna.

Antibiotic. A drug used to kill bacteria and fungi that cause or carry disease; produced by living organisms such as a fungi. The first antibiotic used was penicillin.

Antiseptic. A chemical used on a surface, such as the skin, to kill tiny organisms that could produce infection.

Aorta. The major artery that carries blood away from the left side of the heart to the rest of the body.

Apparatus. A collection of machines and tools especially used to perform scientific experiments.

Aquatic biome.. Aquatic means taking place in or on water. The aquatic biome is all the water on Earth. It is the largest biome on our planet.

Arachnid. An arthropod with eight legs and two major body parts. Spiders and scorpions are examples of arachnids.

Arch. A curved structure that helps provide support; it may form an entrance or doorway.

Argon. A colorless, odorless, nonreactive gas called an inert gas. It is used in electric light bulbs. Argon makes up about one percent of Earth's atmosphere.

Arsenic. An element occurring naturally in the earth and sea in very small amounts. In larger quantities, it is a powerful poison. It has been used as a pest killer.

Artery.. A blood vessel that carries blood from the heart to other parts of the body.

Arthropod. An invertebrate animal. It has pairs of jointed limbs and a segmented body. The hard outer casing is shed in order for the animal to grow. It includes insects, spiders, crabs, millipedes, and shrimp.

Asexual reproduction. Relating to, produced by, or involving reproduction that occurs without the union of male and female gametes, as in binary fission or budding.

Asteroid. Minor planets of rock and iron. Most have orbits that lie between the orbits of Mars and Jupiter. Ceres is the largest-known asteroid. There may be as many as 100,000 asteroids in the solar system.

Astronomical unit. A unit of length used in measuring astronomical distances within the solar system equal to the mean distance from Earth to the sun, approximately 150 million kilometers (93 million miles).

Astronaut. A person especially trained to travel and work in space.

Asymmetrical. Having no balance or symmetry.

Atmosphere. The mixture of gases that surround Earth, appearing in set layers.

Atom. Tiny particles that make up matter. Carbon is made of carbon atoms; oxygen of oxygen atoms. Atoms are the smallest particles of chemical elements. They consist of a small nucleus of protons and neutrons surrounded by moving electrons.

Atomic number. The number of protons in the nucleus of an atom.

Atomic radii. The distance between the outermost occupied probability region of an atom and its nucleus.

Attract. To draw closer or pull something, as steel is pulled to a magnet.

Autosomal linkage. Refers to genes being on the same chromosome. These genes tend to show up together in the same combinations in the offspring. However, recombination, which occurs in Prophase I of meiosis, can split the two alleles inherited from a parent, giving recombinant types. These tend to be in smaller proportions than the parental, linked types. The percentage of offspring showing the recombinant types can give an estimate of how close the two genes are to each other on the chromosome. The closer the genes are, the fewer recombinant types that should occur. This is due to the fact that the chance of recombination occurring in the right location to split the two decreases as they get closer and closer together. This estimate is referred to as the number of map units separating the two genes, which is the percentage of recombinant types seen in the offspring.

Autotroph.. An organism capable of synthesizing its own food from inorganic substances using light or chemical energy. Green plants, algae, and certain bacteria are autotrophs.

Avogadro's number. The number of molecules in a mole of a substance, approximately 6.0225×10^{23}.

Axial tilt. An astronomical term regarding the inclination angle of a planet's rotational axis in relation to its orbital plane; also called axial inclination or obliquity.

Axis. A straight line about which a body or geometric object rotates or may be conceived to rotate.

Axle. A rod or bar on which a wheel rotates.

Backbone. The column of bones forming the spine.

Bacteria. Microscopic organisms without a nucleus. They are grouped, according to their shape, into spheres, rods, or spirals.

Bacteriology. The study of bacteria.

Balance. A device for measuring weight or mass; the ability to stand upright or in equilibrium, as in "I can balance on my skates."

Bark. The woody outer covering of tree trunks and branches.

Barometer. An instrument that measures the pressure of the atmosphere. It is used to show changes in weather conditions.

Basalt. The most common volcanic rock. It is formed when lava cools on Earth's surface.

Base. A term used to describe alkaline substances.

Battery. A device made by joining electric cells to provide electricity. Examples of common batteries are dry batteries (used in most household items), acid batteries (such as a car battery), and lithium batteries (used to power some heart pacemakers and computers).

Beaufort wind scale. A scale from 0-12 that is used to measure wind strength; devised by Francis Beaufort in 1806. It is based on observed effects in the environment.

Beetle. A type of insect with front wings forming a hard wing covering; an example is a ladybug beetle.

Benthic zone. The benthic zone is the lowest level of a body of water such as an ocean or a lake.. It is inhabited mostly by organisms that tolerate cool temperatures and low oxygen levels, called benthos or benthic organisms. The profundal, limnetic, and littoral zones can be found above the benthic zone. No light other than bioluminescence is found in the benthic zone; it is part of the aphotic zone.

Big bang. The theory that the universe began about 15 billion years ago from the explosion of a single point. According to this theory, matter spreading outward from that explosion formed the galaxies, stars, and planets that fill the universe today.

Bilateral symmetry. Symmetrical arrangement, as of an organism or a body part, along a central axis, so that the body is divided into equivalent right and left halves by only one plane.

Binoculars. An instrument with a pair of lenses that makes distant objects appear larger and closer.

Biodegradable. Able to be broken down by microscopic organisms such as bacteria and fungi.

Biodiversity. The number and variety of organisms found within a specified geographic region.

Biogeochemical. The study of the relationship between the geochemistry of a region and the animal and plant life in that region.

Biology. The study of the structure, function, and development of living things.

Biome. A large region that has a particular climate and distinct plant and animal life such as a desert. Biomes may be on land or in the water. On land, factors such as rainfall, elevation, temperature, and soil type help determine the organisms that make up the biome.

Biosphere. The regions of Earth where life exists. The biosphere includes some of Earth's surface (lithosphere), its waters (hydrosphere), and the lower atmosphere.

Biotechnology. Manipulation of living organisms to form useful products.

Biotic. A term to describe any living thing.

Black hole. A relatively small object in space that has a mass so large that its gravity prevents light from escaping. Such objects appear black to observers on Earth.

Blood. Fluid that circulates through the body carrying oxygen and nutrients and removing wastes. Blood is primarily composed of blood cells and water.

Bodies of water. Parts of Earth's surface covered with water such as a river, lake, or ocean.

Boil. To react to heat; to change from a liquid to a gas when heated. Liquid water turns into steam, a gas, when heated.

Boiling point. The temperature at which a liquid boils. Water boils at 100 degrees Celsius or 212 degrees Fahrenheit.

Bone. Hard tissue that makes up the skeletons of most vertebrates.

Botany. The study of plants.

Bowel. A long tube-like organ in the body that is part of the digestive system; also known as the large intestine. Water is absorbed through the bowel.

Boyle's law. The principle that at a constant temperature the volume of a confined ideal gas varies inversely with its pressure.

Brain. The soft tissue inside the skull; the control center of the body.

Bronze. A shiny metal made by combining copper and tin.

Buoyancy. The tendency to float or rise up on water.

Calcium. A soft, silvery metal; a substance that is found in bone and teeth.

Camouflage. Commonly used to describe the way in which a creature blends with its surroundings using color, pattern, or shape.

Canyons. A narrow chasm with steep cliff walls, cut into the earth by running water; a gorge.

Carbohydrate. One group of chemicals including sugars and starches; present in all living things. Bananas, potatoes, cereal, pasta, and bread are examples of foods rich in carbohydrates.

Carbon cycle. The combined processes, including photosynthesis, decomposition, and respiration, by which carbon as a component of various compounds cycles between its major reservoirs—the atmosphere, oceans, and living organisms.

Carbon-nitrogen cycle. A chain of thermonuclear reactions in which nitrogen isotopes are formed in intermediate stages and carbon acts essentially as a catalyst to convert four hydrogen atoms into one helium atom with the emission of two positrons. The entire sequence is thought to generate significant amounts of energy in the sun and certain other stars.

Cell. The smallest structural unit of an organism that is capable of independent functioning, consisting of one or more nuclei, cytoplasm, and various organelles, all surrounded by a semipermeable cell membrane.

Cell membrane. The semipermeable membrane that encloses the cytoplasm of a cell.

Cell cycle. The phases of growth and division in cells.

Cell theory. The theory that cells form the fundamental structural and functional units of all living organisms; proposed in 1838 by Matthias Schleiden and Theodor Schwann.

Cellular respiration. The series of metabolic processes by which living cells produce energy through the oxidation of organic substances.

Celsius scale. A scale for measuring temperature. The symbol is C.

Classification. A grouping of objects or information based on similarities.

Chaparrals. A biome characterized by hot, dry summers and cool, moist winters and dominated by a dense growth of mostly small-leaved evergreen shrubs, as that found in the foothills of California.

Charge. A fundamental property of matter. Protons and the nuclei of atoms have a positive charge; electrons have a negative charge; neutrons have no charge. Normally, each atom has as many protons as it has electrons and thus has no net electrical charge; in other words, it is neutral. Charged substances have an imbalance of positive and negative charges, a net charge that exerts a force on other charged substances. Charges that are both positive or both negative repel each other; charges that are different attract.

Charles's law. The physical law that the volume of a fixed mass of gas held at a constant pressure varies directly with the absolute temperature.

Chemical bond. The combining of atoms of elements to form new substances.

Chemical change. Any process determined by the atomic and molecular composition and structure of the substances involved.

Chemical reaction. When two or more substances combine to produce new substances.

Chemical symbol. Abbreviation for representing an element.

Chlorophyll. The pigment that gives the green color to parts of plants such as that in the stems and the leaves of plants. It traps and absorbs energy from sunlight that plants use to make food.

Chloroplast.. A chlorophyll-containing plastid found in algal and green plant cells.

Chromosome. Small, threadlike bodies that can be seen in the nucleus of a cell when it divides. Chromosomes direct the activities of the cell. They are composed of many genes that carry heredity information. The number of chromosomes in a cell is a characteristic of each species. Humans, for example, have 23 pairs of chromosomes.

Chromosome reduction. The first meiotic division, in which the chromosome number is reduced; also called reduction division.

Circuit. A path over which electric current flows or is intended to flow.

Circulatory system. The bodily system consisting of the heart, blood vessels, and blood that circulates blood throughout the body, delivers nutrients and other essential materials to cells, and removes waste products; also called cardiovascular system.

Clavicle. Either of two slender bones in humans that extend from the manubrium of the sternum to the acromion of the scapula; also called collarbone.

Climax community. A stage in ecological development in which a community of organisms, especially plants, is stable and capable of perpetuating itself.

Codominance. A condition in which both alleles of a gene pair in a heterozygote are fully expressed, with neither one being dominant or recessive to the other.

Columnar. Having the shape of a column.

Combination circuit. One that has a combination of series and parallel paths for electricity to flow.

Combined gas law. A gas law that combines Charles's law, Boyle's law, and Gay-Lussac's law. In each of these laws, pressure, temperature, and volume, respectively, must remain constant for the law to be true. In the combined gas law, any of these properties can be found mathematically. The law states that the product of the volume of a gas and its pressure over the temperature is equal to a constant.

Community. A group of plants and animals living and interacting with one another in a specific region under relatively similar environmental conditions; the region occupied by a group of interacting organisms.

Composition chemical reaction. The ability or power to conduct or transmit heat, electricity, or sound; the conductance of a material; the conductibility of a structure, especially the ability of a nerve to transmit a wave of excitation.

Compound.. Consisting of two or more substances, ingredients, elements, or parts.

Compound machines. Compound machines are two or more simple machines working together.

Concave. Curved like the inner surface of a sphere.

Condensation. The process by which a gas or vapor changes to a liquid.

Connective tissue. Tissue arising chiefly from the embryonic mesoderm that is characterized by a highly vascular matrix and includes collagenous, elastic, and reticular fibers, adipose tissue, cartilage, and bone. It forms the supporting and connecting structures of the body.

Conserve. To use carefully or sparingly, avoiding waste.

Conservation. Wise and careful use of natural resources.

Contaminant. One that contaminates, pollutes.

Continental drift. Theory that the continents were at one or more times a single landmass that broke apart and eventually moved into the positions they are in today..

Continental shelf. Part of a continent that slopes gently away from the shoreline..

Continental slope. Part of a continent between the continental shelf and the ocean floor.

Convection. Heat transfer in a gas or liquid by the circulation of currents from one region to another.

Control. The part of an experiment that remains the same.

Convex. Having a surface or boundary that curves or bulges outward, as the exterior of a sphere.

Core. Innermost region of Earth.

Coriolis effect. Bending of Earth's winds and ocean currents by Earth's rotation.

Covalent bond. Chemical bonding in which electrons are shared.

Cranium. The portion of the skull enclosing the brain; the braincase.

Crossover. A characteristic resulting from the exchange of genetic material between homologous chromosomes during meiosis.

Crust. Solid, thin outer layer of Earth.

Cuboidal. Having the approximate shape of a cube.

Current. The amount of electric charge flowing past a specified circuit point per unit time.

Cytoplasm. The protoplasm outside the nucleus of a cell.

Cytosine. A pyrimidine base, $C_4H_5N_3O$, that is the constituent of DNA and RNA involved in base pairing with guanine.

Data. Recorded observations and measurements.

Decomposer. An organism, often a bacterium or fungus, that feeds on and breaks down dead plant or animal matter, thus making organic nutrients available to the ecosystem.

Decomposition. In chemistry, it refers to the separation into constituents by chemical reaction; in biology, it refers to the breakdown or decay of organic materials.

Density. The mass per unit volume of a substance under specified conditions of pressure and temperature.

Dependent variable. In an experiment, a condition that results from changes in the independent variable..

Deoxyribonucleic acid (DNA). A molecule that makes up genes and determines the traits of living things..

Desert. A dry, often sandy region of little rainfall, extreme temperatures, and sparse vegetation.

Dicot. The common shortened form of the term *dicotyledon*; a flowering plant with two embryonic seed leaves or cotyledons that usually appear at germination.

Diffraction. Change in the directions and intensities of a group of waves after passing by an obstacle or through an aperture whose size is approximately the same as the wavelength of the waves.

Diffusion. The scattering of incident light by reflection from a rough surface; the transmission of light through a translucent material.

Diploid cell. A cell that has pairs of chromosomes and, therefore, has two genes at each location on a chromosome.

Distal. Anatomically located far from a point of reference, such as an origin or a point of attachment.

Dominant gene. A gene that is expressed phenotypically in heterozygous or homozygous individuals.

Doppler effect. A change in the observed frequency of a wave, as of sound or light, occurring when the source and observer are in motion relative to each other, with the frequency increasing when the source and observer approach each other and decreasing when they move apart. The motion of the source causes a real shift in frequency of the wave, while the motion of the observer produces only an apparent shift in frequency.

Dorsal. Of, toward, on, in, or near the back or upper surface of an organ, part, or organism.

Double replacement reaction. In a chemical double displacement reaction (double replacement, metathesis, or ion exchange reactions) two compounds exchange ions, effectively displacing each other to form two new compounds, thus the name. The general formula is $AX + BY \rightarrow BX + AY$.

Ecosystem. An ecological community together with its environment, functioning as a unit.

El Niño.. A warming of the ocean surface off the western coast of South America that occurs every 4 to 12 years when upwelling of cold, nutrient-rich water does not occur. It causes die-offs of plankton and fish and affects Pacific jet stream winds, altering storm tracks and creating unusual weather patterns in various parts of the world.

Electrical power. Energy dissipated in an electrical or electronic circuit or device per unit of time. The electrical energy supplied by a current to an appliance enables it to do work or provide some other form of energy such as light or heat. Electric power is usually measured in watts, kilowatts (1,000 watts), and megawatts (1,000,000 watts).

Electrical resistance. A material's opposition to the flow of electric current; measured in ohms..

Electrical potential energy.. Potential energy due to electric effects, neglecting other forces such as gravity.

Electrolyte.. Substance that dissolves in water to form a conducting solution; substance that conducts an electric current when it is dissolved in water.

Electromagnetic force (electromagnetic interaction). Electromagnetic interaction is a fundamental force of nature and is felt by charged leptons and quarks. Its exchange particle is the photon (symbol γ) and the many forms of electromagnetic radiation are a manifestation of this interaction.

Electromagnetic wave. A wave that is both electric and magnetic in nature.

Electron. Subatomic particle with a negative charge.

Electronegativity. Tendency for an atom to attract a pair of electrons that it shares with another atom.

Electron cloud. Space in which electrons are likely to be found.

Electron dot diagram. A model that shows only the valence electrons in an atom. Electron dot diagrams can help predict how atoms might bond.

Element. A substance composed of atoms having an identical number of protons in each nucleus. Elements cannot be reduced to simpler substances by normal chemical means.

Element families. Column of elements in the periodic table.

Ellipse. A plane curve, especially a conic section whose plane is not parallel to the axis, base, or generatrix of the intersected cone; the locus of points for which the sum of the distances from each point to two fixed points is equal.

Endocytosis. A process of cellular ingestion by which the plasma membrane folds inward to bring substances into the cell.

Endogonic. Changes that absorb energy.

Endotherm. The innermost of the three primary germ layers of an animal embryo, developing into the gastrointestinal tract, the lungs, and associated structures; also called hypoblast.

Endothermic process. Absorbs heat and cools the surroundings.

Energy. The capacity for work or vigorous activity; vigor; power.

Energy level.. A definite stable energy that a physical system can have; used especially of the state of electrons in atoms or molecules..

Energy pyramid. A graphic representation of the structure of a food chain, depicted as a pyramid having a broad base formed by producers and tapering to a point formed by end consumers. Between successive levels, total biomass decreases as energy is lost from the system.

Energy transformation. The notion that energy can change forms and mass, and energy may even change into each other, but the total quantity remains the same. This fact is called the principle of conservation of energy, or the first law of thermodynamics.

Entropy. A quantitative measure of the amount of thermal energy not available to do work for a closed thermodynamic system.

Epicenter. Place on Earth's surface directly above the focus.

Epithelial tissue. The collection of cells that form coverings for the surfaces of the body.

Erosion. The group of natural processes, including weathering, dissolution, abrasion, corrosion, and transportation, by which material is worn away from Earth's surface.

Equator. Imaginary line that runs around the center of Earth's surface and divides it into the Northern and Southern hemispheres.

Equinox. The day the sun shines directly on the equator.

Eukaryote. Unicellular or multicellular organisms that contain a true nucleus and membrane-bound organelles.

Evaporation. The process by which any substance is converted from a liquid state into, and carried off in, vapor; as, the evaporation of water, of ether, of camphor; the transformation of a portion of a fluid into vapor, in order to obtain the fixed matter contained in it in a state of greater consistence.

Evolution. Any gradual change in heredity over time.

Eukaryote. A single-celled or multicellular organism whose cells contain a distinct membrane-bound nucleus.

Excretory system. The excretory system is the system of an organism's body that performs the function of excretion, the bodily process of discharging wastes.

Exergonic. One that releases energy from the system, of which it is a part, to the surroundings.

Expanding universe measurement. During the 1920's and 30's, Edwin Hubble discovered that the universe is expanding, with galaxies moving away from each other at a velocity given by an expression known as Hubble's law or $V = H_0D$. Here V is the observed velocity of the galaxy away from us, H is a constant of proportionality called Hubble's constant, and D is the distance to the galaxy.

Experiment. A way to test a hypothesis..

External fertilization. Form of fertilization in which a sperm cell is united with an egg cell external to the body of the female.

Exocytosis. A process of cellular secretion or excretion in which substances contained in vesicles are discharged from the cell by fusion of the vesicular membrane with the outer cell membrane.

Exotherm. The amount of heat given off.

Exothermic process. Releases heat and causes the temperature of the immediate surroundings to rise.

Fallow. Plowed but left unseeded during a growing season..

Faults. Fractures in the continuity of a rock formation caused by a shifting or dislodging of Earth's crust, in which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture; also called shift.

Fauna. A collective term for animal life, as distinct from flora (plant life).

Femur. A bone of the leg situated between the pelvis and knee in humans. It is the largest and strongest bone in the body.

Flora. Plants considered as a group, especially the plants of a particular country, region, or time.

Food chain. A succession of organisms in an ecological community that constitutes a continuation of food energy from one organism to another as each consumes a lower member and in turn is preyed upon by a higher member.

Food web. A complex of interrelated food chains in an ecological community.

Force. The capacity to do work or cause physical change; energy, strength, or active power: the force of an explosion.

Fossil. A remnant or trace of an organism of a past geologic age, such as a skeleton or leaf imprint, embedded and preserved in Earth's crust.

Fossil fuel. A hydrocarbon deposit, such as petroleum, coal, or natural gas, derived from living matter of a previous geologic time and used for fuel.

Force. Any push or pull that gives energy to an object.

Frontal. Of, relating to, directed toward, or situated at the front.

Friction. A force that resists the relative motion or tendency to such motion of two bodies in contact.

Full moon. The time when the moon is fully illuminated.

Fusion. Something produced by mixing.

Galaxy. Any of numerous large-scale aggregates of stars, gas, and dust that constitute the universe, containing an average of 100 billion (10^{11}) solar masses and ranging in diameter from 1,500 to 300,000 light-years; also called nebula.

Gamete. A reproductive cell having the haploid number of chromosomes; a mature sperm or egg capable of fusing with a gamete of the opposite sex to produce the fertilized egg.

Gay-Lussac's law. The density of an ideal gas at constant pressure varies inversely with the temperature..

Genetic drift. Population change that occurs when events such as natural disasters or chance events alter their gene pool in random ways.

Genetics. The study of how traits are inherited..

Gene. Segment of a chromosome containing DNA.

Gene flow. Transfer of genes from one population to another of the same species, as by migration or the dispersal of seeds and pollen.

Gene pool. Combined genetic information of all the members of a population.

Genetic trait. Small parts of the phenotype of an organism, such as the red color seen in flower petals.

Genetic mutation. A change of the DNA sequence within a gene or chromosome of an organism resulting in the creation of a new character or trait not found in the parental type; the process by which such a change occurs in a chromosome, either through an alteration in the nucleotide sequence of the DNA coding for a gene or through a change in the physical arrangement of a chromosome.

Geologic time scale. Scale used by geologists and other scientists to describe the timing and relationships between events that have occurred during the history of Earth.

Geosphere. The solid part of Earth.

Geothermal energy. Energy obtained by tapping underground reservoirs of heat, usually near volcanoes or other hot spots on the surface of Earth.

Genotype. An individual organism's specific combination of alleles.

Germination. The process of germinating; the beginning of vegetation or growth in a seed or plant; the first development of germs, either animal or vegetable.

Grasslands. Temperate and tropical regions with 25 centimeters to 75 centimeters of precipitation each year that are dominated by climax communities of grasses; ideal for growing crops and raising cattle and sheep..

Gravitational energy. Energy of two or more masses or other forms of energy-momentum gravitationally interacting with each other; because gravity is attractive force, this energy is always negative.

Gravitational interaction. A weak, fundamental interaction between two physical objects due to their mass and energy; especially an interaction occurring between elementary particles.

Gravity. A force that pulls things down to the ground; causes things to fall unless something is holding supporting them.

Guaine. A purine base, $C_5H_5ON_5$, that is an essential constituent of both RNA and DNA.

Gymnosperm.. A plant, such as a cycad or conifer, whose seeds are not enclosed within an ovary.

H-R diagram. A graph of the absolute magnitude of stars plotted against their surface temperature or color; used in the study of stellar evolution, also called the Hertzsprung-Russell diagram.

Habitat. The place where a particular species lives and grows.

Haploid cells. Cells that have just a single gene to direct the production of each protein.

Hardy-Weinberg principle. Allele frequencies in a population's gene pool remain the same from one generation to the next unless they are affected by mutations, migration into or out of the population, effects of genotype on survival, effects of genotype on mating choices, or effects of genotype on successful reproduction.

Homeostatis. The ability or tendency of an organism or cell to maintain internal equilibrium by adjusting its physiological processes.

Heliocentric universe. Based on the theory that the sun is at the center of the universe and/or the solar system.

Heredity. Passing of characteristics from parents to offspring.

Heterotroph. An organism that cannot synthesize its own food and is dependent on complex organic substances for nutrition.

Human Genome Project. A massive technological effort to reveal the entire DNA blueprint of a human. All DNA within one cell of an organism makes up a genome, hence the name, Human Genome Project (HGP). HGP is creating large databases of DNA sequences that researchers and product developers in every county can access.

Humerus. The long bone of the arm or forelimb, extending from the shoulder to the elbow.

Hydrosphere. All the water on Earth's surface.

Hypertonic solution.. Having the higher osmotic pressure of two solutions.

Hypothesis. A tentative explanation for an observation, phenomenon, or scientific problem that can be tested by further investigation.

Hypotonic solution.. Having the lower osmotic pressure of two fluids.

Hypothesis. Proposed solution to a scientific problem..

Ice cap. A dome-shaped mass of water and ice that covers less than 50,000 square kilometers of land area; usually covers a highland area..

Incomplete dominance. A heterozygous condition in which both alleles at a gene locus are partially expressed, often producing an intermediate phenotype.

Ideal gases. Gases that, when kept at a constant temperature, would obey the gas laws exactly. No known gas is an ideal gas.

Ideal gas law. The amount of gas is determined by its pressure, volume, and temperature.

Independent variable. A condition that is changed because it affects the outcome of the experiment. The ideal gas law can be proved using the Boyle, Charles, and Gay-Lussac laws.

Integumentary system. The bodily system consisting of the skin and its associated structures such as hair, nails, sweat glands, and sebaceous glands.

Indicator. In chemistry, refers to any of various substances, such as litmus or phenolphthalein, that indicate the presence, absence, or concentration of another substance or the degree of reaction between two or more substances by means of a characteristic change, especially in color. In ecology, refers to a plant or animal whose existence in an area is strongly indicative of specific environmental conditions.

Inertia. The tendency of a body to resist acceleration; the tendency of a body at rest to remain at rest or of a body in straight line motion to stay in motion in a straight line unless acted on by an outside force.

Inherited. Qualities that are transmitted from parent to offspring in the genes.

Interdependence. A logical or natural association between two or more things..

Ionic bond. Chemical bonding that involves a transfer of electrons.

Insoluble. Cannot be dissolved.

Isotonic solution.. Having the same concentration of solutes as the blood.

Interference. The variation of wave amplitude that occurs when waves of the same or different frequency come together.

Internal fertilization. A form of animal fertilization of an ovum by spermatozoon within the body of an inseminated animal, whether female or hermaphroditic.

Intertidal zone. The area of a shore that lies between the average high tide mark and the average low tide mark.

Intron.. A noncoding sequence of DNA that is initially copied into RNA, but is cut out of the final RNA transcript.

Inverse-square relationship.. The fundamental law of electrostatics stating that the force between two charged particles is directly proportional to the product of their charges and inversely proportional to the square of the distance between them.

Invertebrate. An animal such as an insect or mollusk that lacks a backbone or spinal column.

Ionization energy. The energy required to strip an atom of an electron. It is centrally significant in physical chemistry as a measure of the reluctance of an atom or of a molecule to surrender an electron, or the strength by which the electron is bound.

Isotope.. One of two or more atoms having the same atomic number but different mass numbers.

Kepler's laws. The first law states that the shape of each planet's orbit is an ellipse with the sun at one focus. The sun is thus off-center in the ellipse and the planet's distance from the sun varies as the planet moves through one orbit. The second law specifies quantitatively how the speed of a planet increases as its distance from the sun decreases. If an imaginary line is drawn from the sun to the planet, the line will sweep out areas in space that are shaped like pie slices. The second law states that the area swept out in equal periods of time is the same at all points in the orbit. When the planet is far from the sun and moving slowly, the pie slice will be long and narrow; when the planet is near the sun and moving fast, the pie slice will be short and fat. The third law establishes a relation between the average distance of the planet from the sun (the semimajor axis of the ellipse) and the time to complete one revolution around the sun (the period): the ratio of the cube of the semimajor axis to the square of the period is the same for all the planets including Earth.

Kinetic energy. Energy in motion.

Kinetic theory of matter. A theory concerning the thermodynamic behavior of matter, especially the relationships among pressure, volume, and temperature in gases. It is based on the dependence of temperature on the kinetic energy of the rapidly moving particles of a substance. According to the theory, energy and momentum are conserved in all collisions between particles, and the average behavior of the particles can be deduced by statistical analysis.

Kingdom. The largest group of living things in classification.

Landmasses. Large unbroken areas of land.

Law of conservation of mass. A principle in classical physics stating that the total mass of an isolated system is unchanged by the interaction of its parts.

Law of conservation of matter. States that energy cannot be created or destroyed; however, energy can change forms, and energy can be transferred from one object to another in the same way that a baton is transferred from one runner to another runner.

Law of conservation of momentum. The total amount of momentum of all the things in the universe will never change . Conservation of momentum is a consequence of the homogeneity of space. In an isolated system (one where external forces are absent) the total momentum will be constant; this is implied by Newton's first law of motion. Newton's third law of motion, the law of reciprocal actions, which dictates that the forces acting between systems are equal in magnitude, but opposite in sign, is due to the conservation of momentum.

Laws of thermodynamics.. The laws of thermodynamics, in principle, describe the specifics for the transport of heat and work in thermodynamic processes. Since their conception, however, these laws have become some of the most important in all of physics and other branches of science connected to thermodynamics. They are often associated with concepts far beyond what is directly stated in the wording.

Le Châtelier's principle. Chemical principle that states that if a system in equilibrium is disturbed by changes in determining factors, such as temperature, pressure, and concentration of components, the system will tend to shift its equilibrium position so as to counteract the effect of the disturbance.

Lichen.. A fungus, usually of the class Ascomycetes, which grows symbiotically with algae, resulting in a composite organism that characteristically forms a crustlike or branching growth on rocks or tree trunks.

Light year. Unit of measurement equal to about 10 trillion kilometers.

Linear motion. Motion along a straight line path.

Lithosphere. Rigid layer of Earth made of the crust and the mantle..

Lunar eclipse. Passing of the moon through Earth's shadow.

Lysogenic cycle. When the infecting virus does not destroy the host cell, the injected viral DNA integrates into the host chromosome and remains dormant; the host cell does not transcribe it, but rather, when the host cell divides, it replicates the viral DNA along with its own DNA.

Lytic cycle. Once a host cell has been tricked into making abundant amounts of viral DNA and protein, these materials assemble into new viruses. The whole process, called a lytic cycle, takes about 15 minutes and culminates when the viral enzymes destroy the host cell membrane and cell wall, releasing hundreds of new viral particles.

Magnetism. The force exerted by a magnetic field.

Mantel. Thick layer of rock below the crust.

Mass. Amount of matter in an object.

Mass number. Sum of protons and neutrons in the nucleus of an atom.

Matter. Anything that has mass and volume.

Mechanical advantage. Number of times a machine multiples the effort force.

Mechanical wave. A wave that needs a medium in order to propagate itself. Mechanical waves cannot exist in a vacuum. This is the factor that distinguishes them from electromagnetic waves.

Meiosis. A kind of cell reproduction that produces eggs and sperm.

Membrane. A thin, pliable layer of tissue covering surfaces or separating or connecting regions, structures, or organs of an animal or a plant.

Mendel's law of independent assortment. The movement of factors of one pair does not depend on how the factors of any other pair move in meiosis.

Mendel's law of segregation. Mendel's law of segregation, also known as Mendel's first law, essentially has four parts. Part I: Alternative versions of genes account for variations in inherited characters. This is the concept of alleles.. Alleles are different versions of genes that impart the same characteristic. Each human has a gene that controls height, but there are variations among these genes in accordance with the specific height the gene "codes." Part II: For each character, an organism inherits two genes, one from each parent. This means that when somatic cells are produced from two gametes, one allele comes from the mother, one from the father. These alleles may be the same or different. Part III: If the two alleles differ, then one, the dominant allele, is fully expressed in the organism's appearance; the other, the recessive allele, has no noticeable effect on the organism's appearance**..** In other words, the dominant allele is expressed in the phenotype of the organism. However this does not always hold true. There are several examples that disprove this "law." An example is *Mirabilis jalapa*, or the "Japanese wonder flower." This is called incomplete dominance. There is also codominance on a molecular level. An example is when normal and sickle-shaped red blood cells mix and prevent malaria in people with sickle cell anemia. Part IV: The two genes for each character segregate during gamete production. This is the last part of Mendel's generalization. The two alleles of the organism are separated into different gametes, ensuring variation.

Medial. Relating to, situated in, or extending toward the middle.

Metalloid.. A nonmetallic element, such as arsenic, that has some of the chemical properties of a metal; a nonmetallic element, such as carbon, that can form an alloy with metals.

Metal.. Any of a category of electropositive elements that usually have a shiny surface, are generally good conductors of heat and electricity, and can be melted or fused, hammered into thin sheets, or drawn into wires. Typical metals form salts with nonmetals, basic oxides with oxygen, and alloys with one another.

Microbial. Of, pertaining to, or caused by, microbes; as microbial growth, the microbian theory, or a microbian disease.

Mimicry. The resemblance of one organism to another or to an object in its surroundings for concealment and protection from predators.

Mitochondria. Spherical or rod-shaped structures of the cell. Mitochondria contain genetic material (DNA and RNA) and are responsible for converting food to energy.

Mitosis. The division of the nucleus of a cell.

Mixture. A composition of two or more substances that are not chemically combined with each other and are capable of being separated.

mRNA. Messenger RNA.

Mole. The amount of a substance that contains as many atoms, molecules, ions, or other elementary units as the number of atoms in 0.012 kilogram of carbon 12; the mass in grams of this amount of a substance, numerically equal to the molecular weight of the substance; also called gram-molecular weight.

Momentum. The product of the mass and velocity of an object.

Monocot. A shortened form of the word *monocotyledon*; a flowering plant having a single cotyledon in the seed.

Moon. A natural satellite revolving around a planet.

Multiple allelism. The existence of several known alleles of a gene.

Muscular tissue. Provides for all body movement; contracting muscles cause body parts to move.

Mutation. Any change in genetic code or DNA.

Natural selection. The process by which the organisms that are best suited to an environment tend to survive and reproduce while less well-adapted organisms tend to die out.

Neutron. Subatomic particle with no charge.

Newton's three laws of motion. First law: An object at rest will remain at rest unless acted upon by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force. This law is often called "the law of inertia." Second law: Acceleration is produced when a force acts on a mass. The greater the mass of the object being accelerated, the greater the amount of force needed to accelerate the object. Third law: For every action there is an equal and opposite reaction.

Nitrogen bases. The chemicals that form the rungs of a DNA molecule.

Noble gas.. Any of the elements in Group O of the periodic table, including helium, neon, argon, krypton, xenon, and radon, which are monatomic and with limited exceptions chemically inert; also called inert gas.

Nomenclature. A system of names used in an art or science as in the *nomenclature of mineralogy*; the procedure of assigning names to the kinds and groups of organisms listed in a taxonomic classification as in the *rules of nomenclature in botany*.

Nonelectrolyte.. A substance whose molecules in solution do not dissociate to ions and thus do not conduct an electric current.

Nonmetal.. Any of a number of elements, such as oxygen or sulfur, which lack the physical and chemical properties of metals.

Nonpolar. Not ionizing when dissolved in water.

Nonpotable. Not fit for drinking.

Nonvascular plant. Name for a group of plants comprising the green algae as well as those land plants without a vascular system, including the Bryophyta, the Hepaticophyta, and the Anthocerotophyta.

Nova. A star that suddenly becomes much brighter and then gradually returns to its original brightness over a period of weeks to years.

Nuclear energy. The energy released by a nuclear reaction, especially by fission or fusion.

Nuclear force. The nuclear force or nucleon-nucleon interaction or residual strong force is the force between two or more nucleons.. It affects the binding of nucleons into nuclei and the scattering of two nucleons. The force depends not only on the distance between two nucleons, but also on their relative velocity and on their isospin.

Nucleus. Positively charged center of an atom composed of neutrons and positively charged protons.

Ocean ridge. An underwater mountain range formed by plate tectonics.

Oceanic crust/lithosphere. The part of Earth's lithosphere that underlies the ocean.

Oceanic tide.. The periodic variation in the surface level of the oceans caused by gravitational attraction of the moon and sun.

Ohm's law. The law stating that the direct current flowing in a conductor is directly proportional to the potential difference between its ends. It is usually formulated as $V = IR$, where V is the potential difference, or voltage; I is the current; and R is the resistance of the conductor.

Oogenesis. The formation, development, and maturation of an ovum.

Orbit. The path of a celestial body or an artificial satellite as it revolves around another body.

Organelle. Membrane-bound structure within a eukaryotic cell.

Osmosis. Diffusion of fluid through a semipermeable membrane from a solution with a low solute concentration to a solution with a higher solute concentration until there is an equal concentration of fluid on both sides of the membrane; the tendency of fluids to diffuse in such a manner; a gradual, often unconscious process of assimilation or absorption.

Patella. A flat triangular bone located at the front of the knee joint; also called kneecap.

Parallel circuit. The voltage is the same across any of those components that are in parallel with each other.

Pedigree analysis. A diagram of the inheritance of a trait through a family.

Pelagic zone. The part of the open sea or ocean comprising the water column; all of the sea other than that near the coast or the sea floor.

Pelvis. A basin-shaped structure of the vertebrate skeleton, composed of the innominate bones on the sides, the pubis in front, and the sacrum and coccyx behind, that rests on the lower limbs and supports the spinal column.

Period. Horizontal row of elements in the periodic table.

Periodic table. A tabular arrangement of the elements according to their atomic numbers so that elements with similar properties are in the same column.

Permafrost. Permanently frozen subsoil, occurring throughout the Polar Regions and locally in perennially frigid areas.

Photosynthesis. The process in green plants and certain other organisms by which carbohydrates are synthesized from carbon dioxide and water using light as an energy source. Most forms of photosynthesis release oxygen as a byproduct.

Phenotype. The appearance of a trait in an organism.

Pioneer species. Plant species that colonizes previously uncolonized land, usually leading to ecological succession. Since uncolonized land usually has thin, poor quality soils with few nutrients, pioneer species are typically very hardy plants, with adaptions such as long roots, root nodes containing nitrogen-fixing bacteria, and leaves that reduce transpiration.

Pitch. Any of various thick, dark, sticky substances obtained from the distillation residue of coal tar, wood tar, or petroleum and used for waterproofing, roofing, caulking, and paving; any of various natural bitumens such as mineral pitch or asphalt; a resin derived from the sap of various coniferous trees, as the pines.

Planet. A nonluminous celestial body larger than an asteroid or comet, illuminated by light from a star, such as the sun, around which it revolves. In the solar system there are nine known planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.

Plate tectonics. The dynamics of movement of Earth's plates.

Plate tectonic theory. Theory that Earth's crust and upper mantle are broken into plates that float and move around on a plastic-like layer of the mantle.

Plateau. An elevated, comparatively level expanse of land; a tableland.

Ploidy. A multiple of the basic number of chromosomes in a cell.

Polar. Ionizing when dissolved or fused.

Polygene.. Any of a group of nonallelic genes, each having a small quantitative effect, that together produce a wide range of phenotypic variation; also called multiple factor, quantitative gene.

Pollution. The act or process of polluting or the state of being polluted, especially the contamination of soil, water, or the atmosphere by the discharge of harmful substances.

Potable. Fit to drink.

Potential energy. The energy of a particle or system of particles derived from position, or condition, rather than motion. A raised weight, coiled spring, or charged battery has potential energy.

Power. Strength or force exerted or capable of being exerted.

Prehistoric. Of, relating to, or belonging to the era before recorded history.

Population. The organisms that constitute a specific group or occur in a specified habitat.

Precipitation. Any form of water, such as rain, snow, sleet, or hail, that falls to Earth's surface; the quantity of such water falling in a specific area within a specific period; the process of separating a substance from a solution as a solid.

Prokaryotic cell.. An organism of the Monera kingdom or Prokaryotae, comprising the bacteria and cyanobacteria, characterized by the absence of a distinct, membrane-bound nucleus or membrane-bound organelles, and by DNA that is not organized into chromosomes.

Projectile motion. The motion of a projectile or other moving body through space.

Proton. Subatomic particle with a positive charge.

Proximal. Nearer to a point of reference such as an origin, a point of attachment, or the midline of the body.

Pulsar.. Any of several celestial radio sources emitting short, intense bursts of radio waves, X rays, or visible electromagnetic radiation at regular intervals, generally believed to be rotating neutron stars.

Punnett square. Chart that shows possible gene combinations. The possible gene combinations in the offspring of two organisms can be predicted using a Punnett square.

Quasar.. An extremely distant, and thus old, celestial object whose power output is several thousand times that of our entire galaxy.

Radial symmetry. Symmetrical arrangement of constituents, especially of radiating parts, about a central point.

Radius. The bone of the forearm that extends from the inside of the elbow to the thumb side of the wrist.

Reaction force.. A force is a push or a pull upon an object that results from its interaction with another object. Forces result from interactions and are called action and reaction forces. These two forces are the subject of Newton's third law of motion. Newton's third law states that "For every action, there is an equal and opposite reaction."

Recessive gene. A type of gene that is not expressed as a trait unless inherited by both parents.

Recycle. To use again, especially to reprocess as in the recycling of aluminum cans.

Reflection. Something, such as light, radiant heat, sound, or an image, that is reflected.

Refraction. The turning or bending of any wave, such as a light or sound wave, when it passes from one medium into another of different optical density.

Replication of DNA. The process of making a copy of DNA.

Respiratory system. The integrated system of organs involved in the intake and exchange of oxygen and carbon dioxide between an organism and the environment.

Reproductive system. The bodily system of gonads, associated ducts, and external genitals concerned with sexual reproduction.

Revolve. To orbit round a central point.

Ribonucleic acid (RNA). A chemical that acts as a messenger for DNA.

Ribosome. An organelle that makes proteins for the cell.

Rotate. To turn around on an axis or center.

Rib.. One of a series of long curved bones occurring in 12 pairs in humans and extending from the spine to or toward the sternum.

Sand dune. A hill or ridge of wind-blown sand.

Sagittal. Of or relating to the suture uniting the two parietal bones of the skull.

Saturated solutions. Those that are at the solubility limits.

Scapula. Either of two large, flat, triangular bones forming the back part of the shoulder; also called shoulder blade.

Scientific classification system. Scientific classification or biological classification is how biologists group and categorize extinct and living species of organisms.. Modern classification has its roots in the work of Carolus Linnaeus, who grouped species according to shared physical characteristics. These groupings have been revised since Linnaeus to improve consistency with the Darwinian principle of common descent. Molecular systematics, which uses DNA sequences as data, has driven many recent revisions and is likely to continue to do so. Scientific classification belongs to the science of taxonomy or biological systematics.

Scientific law. Scientific theory that has been tested many times and is generally accepted as true.

Scientific method/process. The principles and empirical processes of discovery and demonstration considered characteristic of or necessary for scientific investigation, generally involving the observation of phenomena, the formulation of a hypothesis concerning the phenomena, experimentation to demonstrate the truth or falseness of the hypothesis, and a conclusion that validates or modifies the hypothesis.

Seafloor spreading. Process that forms new sea floor.

Seismic wave. Shock waves in solid rock generated by earthquakes or underground explosions.

Series circuit. An electric circuit connected so that current passes through each circuit element in turn without branching.

Sex linkage. Linked by genes on the X or Y chromosome.

Sexual reproduction. The production of a new living thing by two parent organisms, with each parent contributing half the material in the DNA of the offspring.

Shadow. To throw or bend back (light, for example) from a surface.

Simple machine. A simple device, such as a lever, pulley, or incline plane; a machine without moving parts.

Single replacement. When one element replaces another element in a compound.

Soil profile. The layers, or horizons, of the soil at any given point.

Soil sample. Several trowels of soil, mixed together, to represent the soil typical throughout a garden, plot, or field.

Solar energy. Any form of energy radiated by the sun, including light, radio waves, and X rays, although the term usually refers to the visible light of the sun.

Solar system. The sun together with the nine planets and all other celestial bodies that orbit the sun.

Solar eclipse. Occurs when the moon passes between Earth and the sun.

Soluble. Can be dissolved, especially easily dissolved.

Solution. Homogeneous mixture in which one substance is dissolved in another.

Solute. Substance that is dissolved in a solution.

Solubility. The quality or condition of being soluble; the amount of a substance that can be dissolved in a given amount of solvent.

Solvent. Substance that does the dissolving in a solution.

Speciation or species variation. Process of evolution of new species that occurs when members of similar populations no longer interbreed to produce fertile offspring.

Spermatogenesis. Formation and development of spermatozoa by meiosis and spermiogenesis.

Squamous. Resembling a scale or scales; thin and flat like a scale as in the squamous cells of the cervix.

States of matter. The three traditional states of matter are solids (fixed shape and volume), liquids (fixed volume and shaped by the container), and gases (filling the container).

Stratified. Arranged in the form of layers or strata.

Sternum. A long, flat bone in most vertebrates that is situated along the ventral midline of the thorax and articulates with the ribs. The manubrium of the sternum articulates with the clavicles in humans and certain other vertebrates; also called breastbone.

Subduction zone. Place where old oceanic crust is forced back down into an ocean trench.

Subscript.. A subscript is a number, figure or indicator, that appears below the normal line of type, when used in a formula, mathematical expression, or description of a chemical compound. Probably the most famous example of a subscript is the number 2 in the formula for the molecule of water; H_2O.

Substance. That which has mass and occupies space; matter.

Supernova. A rare celestial phenomenon involving the explosion of most of the material in a star, resulting in an extremely bright, short-lived object that emits vast amounts of energy.

Supersaturated solutions. To cause (a chemical solution) to be more highly concentrated than is normally possible under given conditions of temperature and pressure; to cause (a vapor) to exceed the normal saturation vapor pressure at a given temperature.

Temperature. The degree of hotness or coldness of a body or environment; a measure of the average kinetic energy of the particles in a sample of matter, expressed in terms of units or degrees designated on a standard scale.

Theory of plate tectonics. The theory that Earth's curst is broken into plates that float on the upper part of the mantle.

Transcription of DNA. The process of forming a nucleic acid by using another molecule as a template; particularly the process of synthesizing RNA by using one strand of a DNA molecule as a template.

Translation of DNA. The portion of protein synthesis that takes place at ribosomes and uses the codons in mRNA molecules to specify the sequence of amino acids in polypeptide chains.

Transposons. DNA elements that can move from one position in a DNA molecule to another.

Transverse. Situated or lying across; crosswise.

Tropic level. A group of organisms that occupy the same position in a food chain.

Tundra.. A treeless area between the icecap and the tree line of Arctic regions, having a permanently frozen subsoil and supporting low-growing vegetation such as lichens, mosses, and stunted shrubs.

Ulna. The bone extending from the elbow to the wrist on the side opposite to the thumb in humans.

Uniform circular motion. Motion in which an object moves with constant speed along a circular path.

Unsaturated solutions. Those that are below the solubility limits of the solute in that solvent. This means that if you were to add more solute to the liquid, it would keep dissolving.

Vacuole. A small cavity in the cytoplasm of a cell, bound by a single membrane and containing water, food, or metabolic waste.

Valence electron.. An electron in an outer shell of an atom that can participate in forming chemical bonds with other atoms.

Van Allen Radiation Belts. Two belts (sometimes considered as a single belt of varying intensity) of radiation outside Earth's atmosphere, extending from c.400 to c.40,000 miles (c.650–c.65,000 kilometers) above Earth.

Vascular plant. Any of various plants, such as the ferns and seed-bearing plants, in which the phloem transports sugar and the xylem transports water and salts.

Velocity.. A vector quantity whose magnitude is a body's speed and whose direction is the body's direction of motion.

Vector. Quantity having both magnitude and direction; it may be represented by a directed line segment. Many physical quantities are vectors, such as force, velocity, and momentum. Thus, in specifying a force, one must state not only how large it is but also in what direction it acts.

Ventral. Relating to or situated on or close to the anterior aspect of the human body or the lower surface of the body of an animal.

Vertebrate.. Having a backbone or spinal column.

Vibration. A rapid linear motion of a particle or of an elastic solid about an equilibrium position.

Volume. The amount of space occupied by a three-dimensional object or region of space, expressed in cubic units.

Water cycle. The cycle of evaporation and condensation that controls the distribution of Earth's water as it evaporates from bodies of water, condenses, precipitates, and returns to those bodies of water.

Wave. A disturbance that transfers energy through matter or space.

Wave characteristics. Attributes of a wave, including frequency, period, amplitude, length, crest, and trough.

Weathering. Any of the chemical or mechanical processes by which rocks exposed to the weather undergo changes in character and decompose.

Work. Physical or mental effort or activity directed toward the production or accomplishment of something.

Zygote. The cell formed by the union of two gametes; a fertilized ovum before cleavage.