

# **Yuba River Charter School**

## **SCIENCE STANDARDS**

**Grades 1–8**

**2000**

# GRADE ONE

The science curriculum in Grade One is taught through story, drama, music, art and first-hand experience. These multisensory approaches enliven the subject and are used to promote the connection young children already have with the natural world, so that it may be strengthened and deepened.

The goal of the curriculum is to enhance a child's wonder, curiosity and enthusiasm for the world and to provide opportunities for a child to feel s/he is part of a whole living cosmos.

Understanding factual information is secondary to developing these faculties of awe, respect and inquisitiveness, as well as developing the child's sensory abilities to observe. All investigatory work is left to impressions from sensory observations.

Material is presented in a pictorial and imaginative way, with the understanding that it is in the way that a child thinks and sees the world. Additionally, the science curriculum in Grade One consists primarily of the life sciences to support the alive, animated view that a 6- 7-year-old has of the world.

Assessment is based on teachers' observations. The primary questions that should be asked are, "Does the child have a joyful, inquisitive and wonder-filled connection to the natural world?" "Does the child ask questions and want to know more?" "How is the child responding through activity and artistic work to the nature stories, projects and walks."

# Grade One Standards

## Curriculum Standards

## Curriculum Activities

### LIFE SCIENCES

1. The earth is inhabited by living plants, animals and people.
  - a. Plants, animals and people are interconnected and dependent on each other.
  - b. Everything works together as a whole. All parts are needed.
2. There are always large seasonal patterns of growth and change.
  - a. In fall, plants wither, leaves change, harvest occurs, birds migrate.
  - b. In winter, animals and seeds sleep.
  - c. In spring, new growth appears.
  - d. In summer, the sun brings growth.
3. Animals have special ways to:
  - a. Eat.
  - b. Move.
  - c. Protect themselves.
4. Plants have different parts—roots, stems, leaves, flowers, seeds—and grow in different forms—shrubs and trees.

- Nature stories.
  - > Listening to and recalling stories.
  - > Dramatizing stories through plays, puppets or finger games.
- Nature songs, poems, verses, augmented by movements and memorization to reinforce learning.
- Nature walks and field trips.
  - > Observing and exploring with the senses.
  - > Sharing observations and objects from nature and making nature collections.
  - > Visiting a barn, collecting eggs, petting and feeding animals.
- Beeswax modeling, painting, drawing or multi-media responses to nature stories or experiences from nature.
- Nature crafts and collages.
- Nature games.

# Grade One Standards

---

## Curriculum Standards

## Curriculum Activities

---

### EARTH SCIENCES

1. Seasonal changes can be observed with our senses.
  - a. Weather changes through the seasons.
  - b. Weather changes day to day.
  - c. Trends in temperature, quality of light, rain, snow, etc. tend to be predictable during a season.
  - d. The sun warms the land, air and water.
2. Riches of the earth nourish life on top.

- Weather observations.
- Seasonal songs, verses, stories and plays.
- Walks looking for “seasonal signs.”
- Festival activities.
- Seasonal crafts.

### INVESTIGATION AND EXPERIMENTATION

1. Observation is the means through which we learn. Students will:
  - a. Observe using the senses.
  - b. Communicate observations artistically, dramatically, orally.
  - c. Describe positional objects using reference (above, below).
  - d. Compare and sort common objects based on one physical attribute (including color, shape, size).

# GRADE TWO

The Second Grade students continue and deepen the work begun in First Grade. Where the curriculum in First Grade provided a foundation into which “seeds were planted,” the Second Grade science curriculum strengthens these ideas and adds to them.

All curriculum material remains in the realms of life and earth sciences and continues to support a child’s sense that s/he is connected to the wholeness of a life-filled world. The development of a child’s faculties to imagine, to see whole relationships and connections, to perceive sensorially and to be curious are still the primary objectives of the curriculum.

Fables, Native American stories and stories of people who have dedicated themselves to the preservation of nature are told in addition to the types of nature stories told in Grade One.

Assessment continues to be done primarily by teacher observation of the children and oral and artistic responses to the stories, walks and nature activities.

# Grade Two Standards

## Curriculum Standards

---

### LIFE SCIENCES

1. The earth is inhabited by living plants, animals and people.
  - a. Plants, animals and people are interconnected and dependent on each other.
  - b. Everything works together as a whole. All parts are needed.
2. There are always seasonal patterns of growth and change.
3. Plants and animals meet their needs in different ways.
  - a. Plants and animals both need water and food.
  - b. Most plants and animals need light.
  - c. Roots are associated with the intake of water and soil nutrients; green leaves are making food from sunlight.
  - d. Animals have different diets and ways to get food.
  - e. Animals have different ways to move.
  - f. Animals and plants can protect themselves.
  - g. Most animals make homes and use plants or even others animals for shelter and nesting.
4. Plants and animals have predictable life cycles.
  - a. Organisms reproduce offspring of their own kind. The offspring resemble their parents and each other.
  - b. The sequential stages of life cycles are different for different animals, for example, mice, frogs, butterflies.

## Curriculum Activities

- Nature stories.
  - > Listening to and recalling stories.
  - > Short written and artistic responses to nature stories.
- Listening to fables, Native American stories and stories of “nature heroes” (i.e., Johnny Appleseed, Albert Schweitzer, George Washington Carver).
- Nature songs, poems, verses.
- Seasonal festival activities, songs, verses, plays.
  - Nature walks and field trips.
    - > Observing and exploring with all the senses.
    - > Sharing observations and objects from nature and making nature collections.
    - > Watching farm and other animals move and eat.
    - > Distinguishing different parts and types of the plant.
  - Beeswax modeling, painting, drawing or multi-media responses to experiences from nature or to illustrate earth features.
  - Raising pollywogs to frogs; caterpillars to butterflies.
  - Nature crafts, collages, “crazy animals.”
  - Nature games.
  - Simple dramatizations, charades or improvisations. Creation of children’s own play.
  - Observing and caring for classroom plants and animals.

# Grade Two Standards

---

## Curriculum Standards

## Curriculum Activities

---

### EARTH SCIENCES

1. The earth has different features.
  - a. There are mountains, meadows, valleys.
2. The earth is composed of land, water and air.
3. The moon's appearance changes.
  - Draw murals or model these features.
  - Watching the sun and moon.
4. The position of the sun in the sky changes during the course of the day.

### INVESTIGATION AND EXPERIMENTATION

1. Observation is the means through which we learn. Students will:
  - a. Observe using the five senses.
  - b. Describe their observations orally, pictorially and dramatically.
  - c. Compare and sort common objects based on two or more physical attributes (including color, shape, size, etc.).
  - d. Draw descriptions of sequence of events or observations.

# GRADE THREE

In Third Grade, a transition is made in the science curriculum from the imaginative treatment of the kingdom of nature to one where the child is shown the natural world as a place in which the needs of human beings can be met.

More emphasis is placed on the physical and earth sciences as the curriculum includes gardening, farming, clothing, house-building, measuring, cooking and local geography.

The children progress from their teacher's stories of how our world fulfills our needs to hands-on involvement—making clothes, building structures, gardening. In this way, the children cross the bridge from imagination and story to visible activities, and confidence is built by the performing of these practical activities.

The earth is presented as a wonderful, interesting place to be, and the children are given a picture of humans as “caretakers of the earth.” The curriculum should help the children gain confidence in growing food, making shelter and clothing. They should learn that the latter is possible and useful.

Studies of diverse landforms, changes in the environment or the water cycle remain as much as possible within the limits of what is observable.

It is the teacher's prerogative to assess each child's understanding of the material presented by evaluation of oral work and by observation of written and artistic work.

# Grade Three Standards

---

## Curriculum Standards

## Curriculum Activities

---

### LIFE SCIENCES

1. Plants and animals meet their needs with different physical structures and behaviors and increase their chance for survival.
  - a. Plants have structures that serve different functions in growth, reproduction, protection.
  - b. Different plants and animals inhabit different environments such as oceans, deserts, forests and grasslands, and have features that help them survive in these places.
  - c. Decomposers, including fungi, worms and insects, recycle matter from dead plants and animals.

### EARTH SCIENCES

1. Objects in the sky move in regular and predictable patterns.
  - a. The moon's appearance changes during the four-week lunar cycle.
  - b. The position of the sun in the sky changes during the course of the day and from season to season.
2. Water on earth moves between the oceans, land and sky through the process of evaporation and condensation.
  - a. The origin of water used by the local community.
  - b. The origin of water used by the students.

(In addition to the activities in Grades One and Two)

- Gardening.
  - > Planting, watering, tilling, harvesting vegetables and the seven grains.
  - > Composting.
  - > Gathering fruit.
  - > Observing the position of the sun on the crops.
- Farm visits.
  - > Feeding and observing the animals.
  - > Drawing, painting, modeling animals.
- House building.
  - > Building with different materials.
  - > Observing house construction.
  - > Visiting homes made with different materials.
  - > Building a house model and writing a report.
- Cooking.
  - > Bread making with yeast.
  - > Canning and dehydrating.
  - > Jam making.
  - > Comparing, measuring, classifying.
  - > Grinding wheat or other grains.
  - > Boiling, condensing or freezing water or other liquids.
  - > Evaporating liquid.

# Grade Three Standards

## Curriculum Standards

---

## Curriculum Activities

3. The earth is full of resources.
  - a. Resources from the earth are used for food, shelter, clothes and health.
  - b. Resources can be preserved and cared for.

### PHYSICAL SCIENCES

1. Energy and matter have multiple forms and can be changed from one form to another.
  - a. Energy comes from the sun to the earth in the form of light and heat.
  - b. Water can be a liquid, solid or gas and can change back and forth from one form to another. Solids, liquids, gases have different properties.
  - c. Evaporation and melting are changes that occur when objects are heated. Condensation occurs when water is cooled.
  - d. Water in an open container can evaporate, and water in a closed container cannot.
  - e. When two or more substances are combined, a new substance may be formed that can have original properties.

- Clothes-making.
  - > Using materials from a variety of animals and plants.
  - > Carding, spinning, weaving, knitting or sewing with wool, silk, alpaca, flax or cotton.
- Time-telling methods.
  - > Making water clocks, sun dials, simple clocks.
  - > Making calendars with seasonal pictures and cycles.
- Drama
  - > Charades and improvisations.
  - > Children's own play.
- Stories — of different living environments; of gardeners, farmers, cloth makers; of the water cycle and where local water begins.
- Riddles, songs, poems, verses on farming, gardening, geographical features, time, clothes, etc.
- Paintings, drawings, dramatizations and other artistic presentation of the water cycle and celestial motion.
- Fieldtrips and nature walks.
  - > Observing plant structures.
  - > Comparing plant and animal habitats.
  - > Scouting for "signs of seasonal change."
  - > Observing sources of water.

# Grade Three Standards

---

## Curriculum Standards

2. Light has a source and travels in one direction (unless reflected).
  - a. Sunlight can be blocked to create shadows.

## Curriculum Activities

- Observation of the sun and the moon.
- Shadow play.
- Sun prints.

## INVESTIGATION AND EXPERIMENTATION

1. Observation and activity are the means through which we learn. Students will:
  - a. Observe using their five senses.
  - b. Describe their observations orally, in writing and artistically.
  - c. Develop their questions learning to use what, when, and where.
  - d. Measure length, weight and liquid volumes with non-standard and standard measurement.
  - e. Compare objects.

- Self-measurement.
  - > Experimenting with “the king’s foot.”
  - > Measuring classroom objects in standard and non-standard measurement.
  - > Measuring harvested produce and shorn wool.
- Comparing physically the seven grains.

# GRADE FOUR

In the Fourth Grade children study animals—their morphology, adaptations, homes, and their relationship to plants and human beings. Animals are presented through observations, the teacher's stories, and artistic presentations, such as drawings, paintings and poems. A morphological or behavioral aspect is often emphasized to show how an animal differs from other animals in their own environment (e.g., the hare's long hind legs for fast sprinting, the cow's cud-chewing and multiple stomachs). As in other curricular areas, an effort is made to present a wholistic picture—thus the animal is presented in relationship to the plants, weather conditions and other environmental features. After receiving many examples of animals described by the teacher, children experience the process of writing their first reports which are on an animal of their choice.

A Fourth Grader also experiences the transition from the imaginative treatment of the natural world to one where s/he stands opposite it in a more objective and understanding way when studying local and California geography. The forces that shape and change the geographical features are presented artistically, dramatically and through observations where possible. Children make both topographical and two-dimensional maps.

The teacher will assess each child's understanding of the material presented by evaluation of oral work and by observation of written and artistic products.

# Grade Four Standards

---

## Curriculum Standards

## Curriculum Activities

---

### LIFE SCIENCES

1. All organisms need energy and matter to live and grow.
    - a. Plants are the primary source of matter and energy entering most food chains.
    - b. Producers and consumers (herbivores, carnivores, omnivores and decomposers) are related in food chains and food webs, and they may compete with each other for resources in an ecosystem.
  2. Adaptations in physical structure or behavior may improve an organism's chances for survival.
    - a. Animals have structures that serve different functions in growth, survival, reproduction, eating, moving and protection.
    - b. Animals have structures for respiration, digestion and transport of material.
    - c. Animals have teeth shaped to eat different materials.
    - d. There are diverse life forms in different environments, such as oceans, deserts, tundra, forests, grasslands and wetlands.
    - e. Living things cause changes in the environment where they live; some of these changes are detrimental to the organism, whereas others are beneficial.
    - f. When an environment changes, some animals survive, others die or move to new locations.
- Stories about:
    - > Different animals, describing their physiology, morphology and habitat.
    - > People with a special relationship with an animal.
    - > Animals and other living things that cause beneficial or detrimental change to an environment (i.e., beaver).
  - Observation of wild and classroom animals.
  - Animal reports, including writing, drawings and paintings.
  - Animal verses and songs.
  - Animal charades, improvisation, role-playing.
  - Animal modeling.
  - Collages, murals, models and displays of food webs and cycles and of different environments and ecosystems.
  - Dramatizations and games depicting food webs, chains and cycles, and various animal movement.

# Grade Four Standards

---

## Curriculum Standards

---

### **EARTH SCIENCES**

1. The earth's surface is always changing due to wind, water, and ice.
  - a. Some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides and earthquakes.
  - b. Moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt and mud in other places.
2. The earth's feature include mountains, valley, meadows, river beds, beaches and deltas.
3. A watershed includes all the streams flowing into one river.
4. California has many geographical features.

## Curriculum Activities

---

- Map-making (draw 2-dimensional and construct 3-d topo):
  - > Map of student's bedroom.
  - > Student's route to school from home.
  - > Map of California.
- Make basic geographical land forms out of clay or paper maché.
- Field trips locally and throughout California to different habitats.
- Role-play, dramatize earth changes.
- Create small examples and models of earth changes.

### **INVESTIGATION AND EXPERIMENTATION**

1. Observation and activity is the means through which we learn. Students will:
  - a. Observe using their five senses.
  - b. Describe their observations orally, in writing and artistically.
  - c. Develop their questions using what, when and where.
  - d. Reproduce land forms on a small scale, 3-dimensionally.

# GRADE FIVE

Botany is the primary focus of the Fifth Grade science curriculum. When possible, plants are observed and studied in their environments. For example, why does a certain plant in a special environment, under certain climatic conditions, develop its particular form? By this grade a child's ability to understand causality makes these questions live.

The curriculum includes looking at the individual plant parts and their roles—basic conditions of plant life, different types of soil and plant communities and plant adaptations. It covers the evolution of lower plants to the higher plants, classification of plants, plant growth, and the relationship of plants and insects. Plants from different environments (desert, tundra, rain forest, etc.) are looked at as well as plants growing from the poles to the equator. Individual plants may be compared and contrasted (a monocot, dicot (lily or rose) or a coch—mushroom.)

Wherever possible, the curriculum strives to bring forth relationships, comparisons and contrasts—and to bring the material in an artistic way so that the feeling life of a child will be touched.

# Grade Five Standards

## Curriculum Standards

## Curriculum Activities

### LIFE SCIENCES

1. Plants are in continual states of growth.
    - a. As a part of a plant grows, another part dies (i.e., the cotyledons give rise to the leaves).
    - b. Plants need earth, water, sun and air to grow.
    - c. Different soil conditions affect different plants.
    - d. Growth occurs differently throughout the seasons (the cycle of the seasons).
    - e. Sun affects patterns of growth.
  2. Plants have various physiologies. The physiology of plants illustrate the complementary nature of structure and function. These structures play parts in respiration, digestion and transport of material.
    - a. Roots take different shapes (bulbs, tap, fibrous).
    - b. Different types of roots have different functions. Mostly roots help bring water and nutrients to the plant.
    - c. The delicate part of the root does most of the work.
    - d. Stems may be underground (rhizomes, etc.) or above. They help transport materials.
    - e. As stalks of a plant grow higher, often the leaves attached grow finer, sometimes changing their shape.
    - f. The number of shapes of leaves is infinite with different venation, edges, shapes, coverings.
- Growing plants.
    - > Sprout seeds.
    - > Take cuttings.
    - > Watch flowers bloom and turn to seed.
    - > Garden.
  - Observations of:
    - > Whole ecosystems.
    - > Plant communities.
    - > Individual plants.
    - > Different species of plants.
    - > Plant parts.
    - > Environmental factors – soil, sun, water, etc.
  - Artistic renderings:
    - > Drawing, observational sketching, painting, modeling, plant form drawings.
  - Stories about:
    - > Plants.
    - > People involved with plants.
    - > Native American stories.
    - > Other cultures involving plants.
    - > Biographies (Luther Burbank, George Washington Carver, etc.).

# Grade Five Standards

## Curriculum Standards

- g. Leaves may grow on opposite sides of a stalk or in a spiral form, or a bunch of leaves may come from a root. Emphasis is on the variations in nature.
  - h. The leave and stem of a plant use  $\text{CO}_2$  and sunlight to make sugar and release  $\text{O}_2$ .
  - i. A flower (with a corolla and calyx) comes from the bud.
  - j. Flowers have a multitude of forms (fused petals, number of petals, shape, etc.)
  - k. Structures and processes of flowers (stamen, sepals, etc.) generate pollen and ovules, seeds and fruits.
  - l. Flowers turn to seeds.
  - m. Seeds have many ways to be distributed.
  - n. There are various types of fruit (pods, pomes, berries, nuts, etc.)
3. Flowers and insects have symbiotic relationships.
    - a. Flowers attract insects for pollination by various means.
    - b. Some insects can only survive in the presence of the particular aspects of a specific plant (e.g., their nectar, leaves or reproductive parts).
    - c. Insects are specially adapted for these relationships (e.g., their probosces or ther tongues).
  4. Plants are at various stages of “completeness” (root, leaf, stem, flower)
    - a. Fungus – have no leaves or flowers.
    - b. Lichen – have leaf and partial fruit.

## Curriculum Activities

- Songs, verses, poems with plant and earth themes.
- Field trips and nature walks.
- Collections of flowers, seed pods, fruits, etc.
- Demonstrations of various seed dispersal methods (coconut, filaree, maple seed, etc.) and fruits.
- Collection of flowers with various attraction mechanisms.
- Collection of Monarch butterfly larvae on milkweed pods or silkworm larvae on mulberry leaves.
- Drawings and observations of insects.
- Observations of plant types: fungus, lichen, algae, moss, fern, horsetail, trees, flowering plants with comparing and contrasting in mind.
- Artistic renderings of different plant types.

# Grade Five Standards

## Curriculum Standards

---

- c. Algae – have only leaf, no form.
- d. Mosses – No real root and incomplete flower, not visited by insects.
- e. Ferns – mostly leaf, incomplete flower.
- f. Horsetails – no proper leaves or flowers, mostly stem.
- g. Trees – Conifers (gymnosperms have no seed covering), Deciduous (with tree flowers).
- h. Flowering plants.

5. Plants grow in different vegetational regions of the earth. Their growth form and adaptations reflect the climatic conditions of these ecosystems. Ecosystems can be characterized in terms of living and non-living components.

- a. Arctic – Tundra  
(Plants close to the ground, few species, vegetation mostly root-like in appearance, little water and sunlight.)
- b. Equator – Jungle  
(Abundance of species; branching, abundant green growth and huge leaves; plenty of sun and water.)
- c. Temperate zones  
(Climate conditions and growth in the middle of the poles and equator.)
- d. Deserts  
(Dry, plants mostly leaf and stem.)
- e. For any particular ecosystem, some plants survive well, some survive less well, and some cannot survive at all.

## Curriculum Activities

- Crafts.
  - > Mushroom spore prints.
  - > Stem, leaf and bark rubbings.
- Handmade book of plant groups.
- Poems and verses about various plant types.
- Murals of the earth's vegetational regions.
- Songs, verses, skits and stories about regions of the earth and the plants connected to them.

# Grade Five Standards

---

## Curriculum Standards

6. Plants are classified for various reasons.
  - a. Monocots send out one leaf when the plant grows, have parallel veins and flower parts are in three. Dicotls send out two leaves, have branching veins and flower parts are not in three.
  - b. Plants return annually, biennially or perennially.
  - c. Flowers are arranged by families. (The rose and lily families are good examples.)
  - d. Trees are arranged by families. (Note a tree's general shape, trunk, spread of branches, buds and leaves.)
7. People have found great uses for plants.
  - a. For shelter.
  - b. Medicine.
  - c. Clothing.
  - d. Food.
8. Plants and animals are related.
  - a. Many plants depend on animals for pollination.
  - b. Animals depend on plants for shelter and food.
  - c. There is a breathing cycle shared by the plant and animal kingdoms in the exchange of  $O_2$  and  $CO_2$ .

## Curriculum Activities

- Gardening.
  - > Growing monocots (lilies, onions) and dicots (beans, peas).
- Flower and tree walks.
- Flower and tree drawings, paintings and verses.
- Make a simple flower or tree guide for local species.
- Cooking.
  - > Herb soups.
  - > Drying herbs, dehydrating fruit.
  - > Flower salads.
- Using plants medicinally.
  - > Chamomille, mint tea.
  - > Comfrey wraps.
- Stories and pictures of animals “helping” plants and plants serving animals.
- Earthworm farm.
- Diagrams of oxygen and carbon dioxide cycles.

# Grade Five Standards

## Curriculum Standards

## Curriculum Activities

### EARTH SCIENCES

1. Water on earth moves between the oceans and land through the processes of evaporation and condensation.
  - a. Most of the earth's water is present as salt water in the oceans, which cover most of the earth's surface.
  - b. When liquid water evaporates, it turns into clouds and can reappear as a liquid (rain) when cooled, or as a solid (snow) if cooled below the freezing point of water.
  - c. Water moves in the air from one place to another in the form of clouds or fog, which are tiny droplets of water or ice, and falls to the earth as rain, hail, sleet, or snow.
  - d. The amount of fresh water located in rivers, lakes, underground sources, and glaciers is limited, and its availability can be extended through recycling and decreased use.

- Diagrams, drawings, stories and dramatization of the water cycle.
- Observations and illustrations of clouds.
- Experiments:
  - > Water evaporating from a jar.
  - > Water condensing on a glass jar.
- Discussions and practicing water conservation. Rain water collections.

### INVESTIGATION AND EXPERIMENTATION

1. Observation and activity is the means through which we learn. Students will:
  - a. Observe using their five senses.
  - b. Describe their observations orally, in writing and artistically.
  - c. Develop their questions using when, what and where.

# GRADE SIX

Earth Science in Sixth Grade includes Geology and Astronomy. Through the presentation of lively pictures, students consider how the earth was created years ago and how various forces have caused the formation of mountains, oceans, lakes and other geographical features. Emphasis is placed on how the earth is changing constantly and what is causing this change. Comparisons are made between granite and limestone and between various types of rocks—metamorphic, sedimentary and igneous.

The study of geology is connected to geography (actual earth forms), and particularly local geography, whenever possible. The study moves from the “whole” to the “part.” For example, only when a lively image of a granite mountain range as contrasted to a limestone landscape has been given are actual samples of the respective rocks presented.

Astronomy includes the study of the movements of the sun, moon, planets and constellations, and emphasis is placed on observations with the naked eye. The picture-generating nature of imagination is fully engaged and precedes the material, informational experience of the subject.

In the Physical Sciences, the Sixth graders are given a picture of what we can experience when observing the inanimate world and the opportunity to observe this phenomena with all their senses. Sound, light, heat, magnetism and static electricity are introduced. Similarities in the latter are elucidated. (For example, the ways that sound, light and heat travel are compared. These forces can also be obstructed, deflected, reflected or absorbed.)

The teaching is based mostly on observation so that true and sound conclusions can be drawn. Students are engaged in exploring the “mysteries” of nature rather than being given instant conclusions. In this process they experience and realize that the path to knowledge is at times difficult and different from the stores of information with which we are inundated. Experiments start with what is familiar and known. Students carefully write up their observations and artistically illustrate their notebook pages.

# Grade Six Standards

## Curriculum Standards

## Curriculum Activities

### EARTH SCIENCES

#### GEOLOGY

1. The earth seems firm and solid, but change is taking place all the time. Geological events as well as waves, wind, water and ice shape and reshape the earth's land surface.
    - a. Some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes such as landslide, volcanoes and earthquakes.
    - b. Natural processes, including freezing/thawing and growth of roots, cause rock to break down.
    - c. Rivers and streams are dynamic systems that erode and transport sediment, change course and flood their banks in natural and recurring patterns.
    - d. Landslides, erosion and water running downhill are the dominant processes in shaping the landscape.
    - e. Beaches are dynamic systems in which sand is supplied by rivers and moved along the coast by wave action.
    - f. Shellfish in the ocean die and form strata of rocks.
    - g. Earthquakes are sudden motions along breaks in the crust called faults.
    - h. Volcano fissures are locations where magma reaches the surface. There are four types of volcanoes.
    - i. Earthquakes, volcanic eruptions, landslides and floods change human and wildlife habitats.
- Take fieldtrips to observe:
    - > Weathering.
    - > Erosion.
    - > Landslides.
    - > Rivers and streams.
    - > Beaches.
    - > Evidences of earthquakes and fault zones.
    - > Volcanoes
    - > Different rock formations
  - Make models of landforms, volcanoes, faults and other geologic features.
  - Make a "Flow model." Observe erosion, silt deposits, etc.
  - Draw, illustrate, paint, dramatize volcanoes.
  - Stories about Pompeii, Mount St. Helens or stories from current events about flooding and earthquakes.

# Grade Six Standards

---

## Curriculum Standards

## Curriculum Activities

---

2. Plate tectonics explain important features of the earth's surface and major geologic events such as earthquakes and volcanic eruptions.
  - a. The fit of continents, location of earthquakes, volcanoes, midocean ridges and the distribution of fossils and rock provide evidence of plate tectonics.
  - b. The solid earth is layered with the cold, brittle lithosphere; the hot, convecting mantle; and the dense, metallic core.
  - c. Plate tectonics have caused buckling of the earth's crust so that the strata of rocks, which were once flat, become bent and twisted, causing mountains and valleys.
  - d. These plates move at rates of centimeters per year in response to movements of the mantle.
  - e. These great movements of the earth's crust create pockets below in which gas and oil form.
  - Draw the continents indicating how they conce fit together and the various "plates."
  - Draw, illustrate, model the layers of the earth.
  - Draw, paint, dramatize mountain building and faults.
3. The earth is made of materials that have distinct properties. Rocks have different physical properties and different combinations of minerals. These reflect the processes that formed them.
  - a. Sedimentary rocks are made from deposits of material.
  - b. Sand becomes sandstone and remains of sea creatures become limestone. (Other examples are coal and chalk.)
  - c. Igneous rocks form deep in the earth in a molten state. The movement of the earth's crust forces them out. (Examples are granite, basalt and lava.)
  - Illustrate coal, gas and oil pockets in the earth. Discuss fossil fuels.
  - Collect rocks. Compare and contrast:
    - > Granite/limestone.
    - > Igneous, sedimentary, metamorphic.
    - > Different types of granite.
    - > Mineral components and sizes.

# Grade Six Standards

---

## Curriculum Standards

- d. Metamorphic rock undergoes transformation with heat and pressure.
- e. Marble is transformed limestone; slate, transformed clay.
- f. Common rock-forming minerals are quartz, mica, feldspar, calcite, and hornblende. Each has special properties.
- g. Soil is made from weathered rock and organic materials. Soils differ in color, texture, capacity to retain water and ability to support the growth of plants.
- h. Rock, water and soil provide many resources including food, fuel and building materials that humans use.
4. Evidence from rocks allows us to understand the evolution of life on earth.
  - a. Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
  - b. The history of life on earth has been disrupted by major catastrophic events, such as volcanic eruptions.
  - c. The rock cycle includes the formation of new sediment and rocks. Rocks are often found in layers with the oldest generally on the bottom.
  - d. Fossils provide evidence of how life and environmental conditions have changed.

## Curriculum Activities

- Draw and illustrate various rock types and cycles.
- Observe examples of different rocks and fossils.
- Use a table of diagnostic properties to categorize minerals.
- Collect, observe and test soil samples.
- List and illustrate these resources.
- Listen to the story of the creation of the California landscape.
  - > Retell it orally and in writing. Illustrate it.
- Write geological songs, verses, poems.
- Dramatize and illustrate the rock cycle.
- Recite geological songs, verses, poems.
- Observe fossils.

# Grade Six Standards

## Curriculum Standards

---

## Curriculum Activities

---

### ASTRONOMY

1. Objects in the sky move in regular and predictable patterns.
    - a. The patterns of stars stay the same although they appear to move across the sky nightly.
    - b. The moon's appearance changes during the lunar cycle.
    - c. The position of the sun in the sky changes during the course of the day and from season to season.
  2. The solar system consists of planets and other bodies that orbit the sun in predictable paths.
    - a. The solar system includes the earth, moon, sun, eight other planets and their satellites, and smaller objects such as asteroids and comets.
    - b. Objects in the solar system have their unique appearances, compositions, relative position and size.
    - c. The sun, an average star, is the central and largest body in the solar system.
    - d. Galaxies are clusters of billions of stars (ex., Milky Way).
    - f. Stars may differ in size, color and temperature.
    - g. Stars are the source of light for all bright objects in space. The moon and planets shine by reflected sunlight, not by their own light.
    - h. The path of a planet around the sun is due to the gravitational attraction between the sun and the planet.
    - i. The tilt of the earth's axis and the position of its orbit causes the seasons and day and night.
- Keep a journal. Daily:
    - > Record the rising and setting time of the sun and moon.
    - > Illustrate the position of a constellation at the same time each night.
    - > Illustrate the shape, size and position of the moon.
    - > Indicate where on the horizon the sun set.
  - Observe constellations and signs of the zodiac.
    - > Big Dipper, Little Dipper, Orion, North Star, etc.
    - > Scorpio, Cancer, the Bull, etc.
    - > Illustrate how these move in the southern hemisphere.
  - Make a 3-D model of the solar system or a 2-D illustration.
  - Dramatize the orbits of the moon and earth. "Create" day and night and the seasons.
  - Red and write constellation stories.
  - Visit a planetarium.
  - Make the starry sky with pinholes through black paper.
  - Write and recite verses, poems, and songs about the stars, moon and sun.

# Grade Six Standards

---

## Curriculum Standards

## Curriculum Activities

---

### PHYSICAL SCIENCE

#### PHYSICS

1. *Sounds* have observable properties.
  - a. Sound occurs constantly and can be categorized.
    - Listen to sounds in nature and the classroom.
    - Classify sounds by how they are made or who made them.
    - Create “hidden” sounds for others to guess what created them.
    - Listen to music made by various instruments.
    - Play different musical instruments
    - Make a bullroarer, a jugboard or a slide whistle.
    - Make a wine glass harmonica ensemble.
    - Put lycopeidium powder on a Chladni plate and draw a violin bow.
  - b. Sound produces vibrations with distinct visible patterns.
  - c. Sound travels through different media.
    1. Air.
      - Listen to a clock upwind and down wind. Measure distances.
      - Hold an open end of a container near a lit candle and tap the other end.
      - Play a trumpet with its end in water.
    2. Water.
      - Hold ear to fish tank filled with water, then air, as two spoons are tapped above.
      - Put ear to wooden desk and listen to tapping on it.
      - Tap a spoon suspended on a string held to the ear.
    3. Through wood and string.
      - Experience an entirely dark room. Light one candle at a time.
      - Observe light from the sun, a candle and a glowing wire.
      - Hit two chalk erasers together in a beam of light.
      - Place paper in a circle one yard from a candle in center. Notice if all papers are lit the same.
2. *Light* has observable properties.
  - a. The absence of light is darkness.
  - b. Light can be created by different means.
  - c. Light itself cannot be seen.
  - d. Unless obstructed, light travels in all directions from a source.

# Grade Six Standards

## Curriculum Standards

---

- e. The intensity of light decreases with distance.
  - f. Light travels in a straight narrow path.
  - g. Light passes through some materials, but not others.
  - h. Primary color is generated from the interplay of light and dark.
  - i. Shadows are created by the obstruction of light.
  - j. White light is a mixture of many wave lengths (colors).
3. **Heat** has observable properties.
- a. Warmth or cold are more than physical qualities.
  - b. Various materials have different temperatures.
  - c. There are many sources of heat—combustion, light, friction, stress, chemical reactions.
  - d. Warmth is an “unshaper” and cold a “form-giver.”
  - e. Heating causes expansion in most solids, liquids and gases.
  - f. Heat travels through solids and liquids by conduction (which involves no flow of matter) and by convection (which involves flow of matter).
  - g. Heat energy is also transferred between objects by radiation. Radiation can travel through space.
  - h. Hot air rises.

## Curriculum Activities

- Observe a candle from various distances.
  - Clap chalk erasers along a flashlight’s beam of light.
  - Place tissue paper, construction paper and cardboard in front of a light source and observe the transmission of light.
  - Vary the paper thickness in front of a light to observe yellow and red.
  - Observe a candle through milk in water in a dark room to see blue.
  - Create color with a prism.
  - Create afterimages and color shadows.
  - Make shadows. Observe shadows cast by sunlight.
  - Make a Bentham top or chromotrope.
- 
- Experience warm and cold colors, sounds and feelings.
  - Press hard on various materials to experience their warmth.
  - Demonstrate different sources of heat.
  - Melt paraffin and reshape in cold water.
  - Boil water and other liquids.
  - Feel heat traveling through a metal rod.
  - Boil water in paper cup, observe convection currents in the air and the water.
  - Put hands around a candle flame and feel the hottest part.
  - Put a pinwheel above a candle flame.

# Grade Six Standards

---

## Curriculum Standards

4. *Magnets* have observable properties.
  - a. Magnets have the ability to attract iron and steel.
  - b. Magnets have a north and south seeking pole.
  - c. Like magnetic poles repel each other, unlike poles attract each other.
  - d. Magnetism can be propagated through various materials.
  - e. Magnetism can be induced in steel by contact, by nearness and by rhythmic striking. Magnetized steel can be demagnetized.
  - f. A field of force penetrates and surrounds a magnet.
5. *Static electricity* has observable properties.
  - a. Static electricity is produced by rubbing certain substances together.
  - b. Static electricity can be observed by sound, sight, touch.
  - c. An electrostatic charge can attract or repel.

## Curriculum Activities

- Tell story of the discovery of magnetism.
- Experiment with a magnet and its attraction.
- Play with magnetite. Find north.
- Make a hanging magnet. Observe the orientation of its ends.
- Make a floating compass with a magnet. Observe ends.
- Experiment with the ends of two magnets.
- Experiment moving one magnet with another magnet through wood, water, air.
- Touch a magnet to a nail and then the nail to a paper clip.
- Stroke a piece of steel with a magnet.
- Strike a magnet to demagnetize it.
- Pour iron filings on paper lying on top of a magnet.
- Compare the strength of the magnetic force in various objects.
- Tell the story of Thales who discovered static electricity.
- Rub amber on a woolen cloth.
- Rub vinyl or rubber with wool or fur, or plexiglass with silk Put charged rod near styrofoam, hair or a balloon.
- See, hear, feel an electrostatic spark from an electrophorus.
- Attract and repel balloons and ping pong balls with a charged rod.

# Grade Six Standards

---

## Curriculum Standards

## Curriculum Activities

---

### INVESTIGATION AND EXPERIMENTATION

1. Observation and activity is the means through which we learn. Students will:
  - a. Observe with their five senses.
  - b. Follow instructions for a scientific investigation.
  - c. Record data on charts, diagrams and graphs.
  - d. Distinguish between what is known and what is seen.
  - e. Develop questions using when, where, who and what.
  - f. Communicate the procedure, observations and conclusions of an experiment in written reports, artistic diagrams and verbal presentations.

# GRADE SEVEN

In the Seventh Grade, the physical science curriculum continues with the study of light, sound, heat, magnetism and electricity. The Seventh grader, in addition to experiencing phenomena and then reflecting on the experience, also asks “how.” “How has the phenomena arisen and how does it work?” The demonstrations, activities and investigations now refine the student’s capacities for observation, for drawing conclusions and forming judgments. They call upon the student to compare what they are experiencing with what they know.

Through the process of quantifying and measuring, students begin to objectify their experience. They begin to delineate specific forces and explore their interactions. For instance, students experienced the pitches of different sounds in Sixth Grade; now they discover how the relationships between pitches correspond to mathematical formulas.

Students study mechanics and again the children observe, experiment and discover the laws themselves.

Work with inorganic chemistry begins at this grade. Moving out from the familiar process of combustion, students learn elementary ideas and concepts of chemistry. Acids are introduced as another form of fire and how, together with bases, salts are formed. Water and various gases (hydrogen, oxygen, carbon dioxide) can be studied along with the principal metals. Students are approached with the scientific, cultural, artistic and practical sides of chemistry and how it relates to industrial and economic life. They are asked to respond through observations, reports and illustrations.

The life science curriculum includes Physiology. The main systems of the body are studied: respiratory, circulatory, digestive, and perhaps reproductive. These are presented to the students in an artistic and beautiful way. Health, nutrition and hygiene are brought so that these systems have meaning and relevance to the students.

Throughout the science blocks accurately written descriptions and drawings are integral. Reports on the applied aspects of these subjects are done as well.

# Grade Seven Standards

---

## Curriculum Standards

## Curriculum Activities

---

### LIFE SCIENCES

#### PHYSIOLOGY

1. Physiology illustrates the complementary nature of structure and function.
  - a. Humans have levels of organization for structure and function including organ systems, organs, tissues and cells.
  - b. Organ systems function because of the contributions of individual organs and tissues.
    - Observe and study artistically drawn charts and the various systems.
    - Draw artistic illustrations of the systems and their organs.
2. The *digestive* system helps us assimilate food.
  - a. The teeth, mouth, esophagus, stomach, small and large intestines and colon function in the system.
  - b. The kidney removes cellular wastes from the blood and converts them into urine.
  - c. The gallbladder.
  - d. The liver.
3. The *circulatory* system circulates blood through the heart chambers, lungs and body.
  - a. Contractions of the heart generate blood pressure.
  - b. Heart valves prevent backflow of blood.

# Grade Seven Standards

---

## Curriculum Standards

## Curriculum Activities

---

4. The *respiratory* system circulates oxygen and carbon dioxide.
  - a. The arterial system takes oxygen throughout the body.  
It includes:
  - b. The system of veins carries carbon dioxide to the heart.  
It includes:
  
5. The *reproductive* organs of the human female and male generate eggs and sperm. Sexual activity may lead to fertilization and pregnancy.
  - a. The umbilicus and placenta function during pregnancy.

# Grade Seven Standards

---

## Curriculum Standards

## Curriculum Activities

---

### EARTH SCIENCES

#### CHEMISTRY

1. Physical processes do not create permanent change.
  2. Chemical reactions completely transform a substance.
    - a. When fuel is consumed, energy (heat, light and smoke) are released. Most of the energy is heat energy.
    - b. Ash remains.
    - c. Oxygen is used and carbon is released  $\text{CO}_2$ .
    - d. Fire is extinguished with sand, cloth, water and foam.
    - e. Fire is structured and orderly.
    - f. Human history changed with the invention of fire.
- Freeze and boil substances. Show physical changes.
  - Discuss fire in nature.
  - Tell the story of Prometheus.
  - Read history of lighting and heating.
  - Burn common substances with attention to light, form of the flame, color, odor, ash and smoke.
    - > Wood, wool, hair, coal, charcoal, plant parts, various plants, sulfur, magnesium, paraffin, plastic, oil.
  - Put a bell jar and then a large bowl over a lit candle.
    - > Measure the amount of oxygen used with water at the bottom of the pan.
    - > Place a jar under which a candle has gone out, over another candle.
  - Extinguish a flame with various materials.
  - Study the flame of a candle.
    - > Illustrate its parts.
    - > Study how and where heat is given off. What is burning?
  - Read about and repeat some of Faraday's experiments.
  - Watch a flame on a Bunsen burner.
  - Discuss man's historical relationship to fire.

# Grade Seven Standards

---

## Curriculum Standards

- g. Fire is essential in so many processes today.
- h. Some inorganic substances have particular combustible characteristics.
3. **Salts** are compounds made up of acids and bases.
- a. Salts may be broken down into acids and bases.
- b. Acids have certain characteristics: vapory matter, sour taste, turns litmus paper red.
- c. Bases have certain characteristics: solid matter, insipid, turn litmus paper blue.
- d. Acids and bases may combine to form a salt. The salt process is a formation (or contraction) process.
- e. A “catalyst” speeds along a chemical reaction.
- Discuss heat as the source of power in steam engines and motors and in almost everything we use today.
- Write poetry, paint, artistically render “fire.”
- Construct a simple oven, paraffin stove, or lamp.
- Burn powdered sulphur, charcoal and yellow phosphorus. Compare the light and heat given off.
- Discuss where phosphorus and sulfur are found in nature and the human being. Where are they used? Study samples.
- Discuss the history of matches and how carbon, sulfur and phosphorus are found in them.
- Discuss and observe various salts.
- Use lime as an example of a salt.
- > Discuss its forms in nature (shells, bones, stones).
- > Discuss its circulation in nature (stone to stalactite).
- > Discuss larger circulation of lime in nature (streambeds, waterfalls, ocean organisms, limestone mountains).
- > Burn lime: Make quick lime or put lime into hydrochloric acid. Demonstrate the release of a gas by putting a burning match to the gas released.
- > Test quicklime and gas released with litmus paper.
- > Contrast and compare an acid and a base.
- > Add water to acids and bases.
- > Add water to quick lime to make slaked lime.
- > Mix carbonic acid with slaked lime to make limestone.
- > Discuss cement, building houses.

## Curriculum Activities

# Grade Seven Standards

## Curriculum Standards

---

f. An “indicator” is a substance that shows whether a substance is acidic or basic.

## Curriculum Activities

---

- Discuss how another “salt,” cooking salt, is made up of sodium hydroxide and hydrochloric acid. Collect hydrochloric acid by putting sulfuric acid on the salt and collect the released gas in water. Notice the caustic soda that remains.
- Connect acids and bases to human digestion and muscles.
- Test foods and household substances for their acid and base qualities with a red cabbage indicator.
- Discuss acid rain.

3. *Water* has many properties.

- a. Water is a unifying element, essential to all life.
- b. It is composed of hydrogen and oxygen.

- Boil/freeze water. Note surface tension.
- Discuss types of water, where found and importance.

4. *Metals* have many properties.

- a. Properties such as electrical and thermal conductivity are common in metals. Most have a luster.
- b. Some metals are pure elements; others are combinations of elements.

- Observe samples of different metals.
- Experiment with metals to discover their properties.
- Discuss where different metals are found, their importance and uses.
- Experiment with acids and fire on metals. Which ones react?

5. *Gases* have different properties.

- Heat potassium chlorate with a quarter of its own weight of manganese dioxide to make  $O_2$  or combine the latter with  $H_2O_2$ .
- Burn charcoal in oxygen to make carbon dioxide or pour hydrochloric acid on marble chips.
- Observe properties of gases for color, odor, taste. Which support combustion?
- Discuss the proportion of gases in the air.
- Discuss and illustrate the carbon, oxygen, hydrogen and nitrogen cycles.

# Grade Seven Standards

---

## Curriculum Standards

## Curriculum Activities

---

### PHYSICAL SCIENCE

#### PHYSICS

1. Musical intervals and resonance are part of *sound*.
    - a. Musical intervals are created when notes sound together.
    - b. The relative consonance of musical intervals can be expressed by mathematical ratios.
    - c. The length of a column of air determines the pitch of blown sound.
    - d. A sounding object can cause another object to sound.
    - e. Overtones follow a predictable sequence.
  2. *Light* has observable properties.
    - a. Light can be reflected.
    - b. The angle of incidence equals the angle of reflection.
    - c. Light can be focused to create images by a small aperture, lenses or curved mirrors.
  3. *Heat* can be measured.
    - a. Every substance has a specific boiling and freezing point which can be raised or lowered.
- Read the biography of Pythagoras.
  - Play any instruments that allow two notes to be played and sound together. Listen.
  - Use any stringed instruments or columns of air in bottles and measure ratios.
  - Hold a hollow container to the ear and listen to sound being made by another person. Listen to a hollow shell.
  - Put a sounding tuning fork on a table.
  - Experiment with sympathetic vibrations using a violin, a cello or a sonometer.
  - Reflect light off various surfaces.
  - Study these angles using mirrors, a light source and a protractor.
  - Look at light through various convex and concave lenses and in curved mirrors.
  - Heat an ice cube until it steams.
  - Fill a glass with ice water and watch for condensation.
  - Create “rain” in a jar.
  - Watch dry ice go from a solid to a gas.

# Grade Seven Standards

## Curriculum Standards

---

- b. The density of a substance is affected by heating and cooling.
4. *Static electricity and electricity* have certain properties.
  - a. Electrostatic charges can be stored.
  - b. Current electricity can be generated by chemical reactions.
5. *Electricity and magnetism* are related.
  - a. Magnetism can be created by electricity.
  - b. Electric currents produce magnetic fields.
  - c. Electromagnetism can be used to create motion, light or heat.
6. There are six simple *machines* that increase mechanical advantage.
  - a. There are three classes of levers.
  - b. The law of the lever says that equal weight at equal distances balance each other, but different weights can balance each other at different distances.

## Curriculum Activities

- Find the boiling, freezing and melting point of water. Lower and raise these points with salt.
- Experiment with boiling/freezing points of different liquids.
- Measure what weighs more—hot or cold water.
- Make and experiment with an electrophorus. Measure current with an electroscope.
- Make and experiment with a Leyden jar.
- Create electrical currents using zinc and copper strips, your tongue or a lemon.
- Make a voltaic pile or cell. Use many cells to make a battery.
- Repeat and tell Oersted's discovery.
- Make a Galvanoscope.
- Make electromagnets, door bells or earphones.
- Make a solenoid.
- Make a simple electric motor.
- Make all three classes of levers, placing the load and fulcrum in different positions.
- Find examples of these levers in the home and in the body.
- Experiment with a see-saw and a balance beam. Measuring weights and distances. Discover the law of equilibrium.

# Grade Seven Standards

## Curriculum Standards

- c. The pulley is a flexible lever going over a curved surface.
- d. Mechanical Advantage = Load x Effort.
- e. The Velocity Ratio = Distance of effort moves/Distance of load moves.
- f. The axle and wheel increase mechanical advantage.
- g. The mechanical advantage here is load/effect.
- h. Inclined planes give mechanical advantage.
- i. The wedge and screw also are simple machines.

7. Unbalanced **force** can cause change in velocity.
  - a. Forces have direction and magnitude.
  - b. When an object is subject to two or more forces at once, the effect is cumulative.
  - c. When the forces of an object are balanced, the motion of an object does not change.
  - d. The greater the mass of an object, the more force is needed to achieve the same change in motion.
  - e. Friction reduces mechanical advantage of all machines.

## Curriculum Activities

- Experiment using a number of pulleys and calculate various mechanical advantages and velocity ratios.
- Experiment with different size wheels and different length axles. Calculate mechanical advantage and velocity ratios.
- Make a “broomstick crank.” Observe a bicycle.
- Experiment with different lengths of inclined planes and the differences of weights being pulled.
- Experiment with these tools.
- Drop ball bearings from different heights. Measure fall time with a stop watch.
- Calculate distance (distance = speed x time).
- Feel friction.
- Reduce friction with lubrication or ball bearings.

# Grade Seven Standards

---

## Curriculum Standards

## Curriculum Activities

---

### INVESTIGATION – EXPERIMENTATION

1. Observation and activity is the means through which we learn. Students will:
  - a. Observe with their five senses.
  - b. Follow instructions for scientific investigation.
  - c. Demonstrate the ability to use lab apparatus and choose appropriate equipment and methods in experiments.
  - d. Conduct multiple trials and draw conclusions.
  - e. Develop questions using how, what, when, where and who.
  - f. Record data on charts, diagrams, graphs from measurements and develop quantitative statements about the relationships between variables.
  - g. Apply simple mathematical relationships to determine one quantity given the other two (density = mass x volume; force = pressure x area; volume = area x height).
  - h. Measure and estimate weight, length, volume, area, density, pressure, force, speed, distance, time.
  - i. Interpret events by sequence and time from natural phenomena.
  - j. Differentiate observation from inference.
  - k. Communicate the procedures, observations and conclusions of an experiment in written reports, artistic diagrams and verbal presentations.

# GRADE EIGHT

With the awakening of the capacity for logical thinking and free, independent judgment, the Eighth grader now wants to be in the world more than ever before. They are wanting to do, to discover, to know and to find relevance in their studies by extrapolating from the classroom to the outside world. The science curriculum strives to meet these needs.

If the key question in Seventh Grade was “How,” the questions in Eighth are “Why” “Where” and “Who.” Why does this process occur? Where in the world does it happen? Who found a way to apply it?

In physics, acoustics, optics, heat and electromagnetism are pursued further and are taken up through their practical application as founded in the industrial/ technological revolutions. Studies in hydraulics, hydrostatics, meteorology and aeromechanics are introduced.

Work in the life sciences, or physiology, continues with a study of the skeletal and muscular systems, as well as the inner working of the eye and ear. The nervous (and perhaps reproductive) systems are also taught.

Finally, using simple chemical concepts extended from the Seventh Grade curriculum, a link is developed with substances which build up the human organism, such as starch, sugar, protein and fat. This block deepens the understanding of health and nutrition studied in Seventh Grade.

# Grade Eight Standards

## Curriculum Standards

### LIFE SCIENCE

#### CHEMISTRY

1. Sugars, starches and indigestible roughage in our food are called *carbohydrates*.
  - a. Carbohydrates may be divided into monosaccharides (simple sugars), disaccharides and polysaccharides.
  - b. Monosaccharides are glucose, fructose and galactose.
  - c. Glucose, fructose and sucrose are found in fruits and honey.
  - d. Glucose is the sugar present in human blood.
  - e. Fructose is the sweetest of all sugars.
  - f. Galactose does not occur freely; it is combined with glucose in milk sugar (lactose).
  - g. Disaccharides are combinations of monosaccharides.
  - h. Sucrose (table sugar) is glucose and fructose combined.
  - i. Polysaccharides are denser compounds formed from monosaccharides. Starch and cellulose are examples.
  - j. Starch is the means by which plants store energy and a staple in a human's diet.
  - k. Glycogen is animal starch.
  - l. Humans store energy mostly in fat. 80% of our glucose is found in muscle tissue.
  - m. Cellulose is the most organic compound. It is the principal structural material in plants and used for housing, clothing, paper, fabric and explosives.

## Curriculum Activities

- Dissolve salt (a mineral) and sugar (an organic substance) in water and compare. Discuss results. Why are large quantities of sugar transported by living organisms?
- Melt and burn sugar. Discuss from what sugars are composed.
  - > Make lollipops and candy.
- Burn sugar using cigarette ashes as a catalyst.
- Combine sugar with sulfuric acid. Note the by-products.
- Taste different kinds of sugars: (Fructose, lactose, sucrose, maltose) and artificial sweeteners.
- Study the history of the production and consumption of sugar.
- Test for the presence of sugar using Fehling's and Benedict's solutions.
- Break down a disaccharide (sucrose) to two monosaccharides with hydrochloric acid.
- Test for starch in various foods with iodine.
- Prepare starch by grating or grinding a potato.
- Compare the solubility of starch and sugar.
- Burn starch. Add starch to boiling water.
- Break down starch with hydrochloric acid and with saliva.
- Discuss/compare sugar and starch in a plant.
- Cook and discuss chemical reactions:
  - > Pop corn; sprout barley; make tapioca; bake bread.
- Dissolve and burn cellulose. Use cotton balls.

# Grade Eight Standards

## Curriculum Standards

---

## Curriculum Activities

- n. Carbohydrates are made up of carbon, hydrogen and oxygen.
2. **Proteins** are complex compounds made principally from carbon, hydrogen, oxygen and nitrogen.
- They are essential building materials for all living cells.
  - Animal products (meat, dairy, eggs) and vegetables (legumes) and grains can provide complete proteins.
  - In a living organism, proteins are mobile in solution.
  - Heat destroys the structure of proteins and causes them to coagulate and precipitate out of solution. When proteins fall out of a living state they become hard and fixed (hams, hooves).
3. **Fats and oils** are necessary compounds in our diets and bodies and have particular characteristics.
- Fats and oils have different melting points.
    - All fats contain glycerol.
    - Oil and water do not combine.
  - An emulsifying agent has the properties of water and oil so it can overcome some of the antagonism between the two substances. When mixed in water, oil becomes suspended.
  - Grease fires may not be extinguished by water.
- Munch celery. Discuss roughage in our diet.
  - Make paper from recycled paper.
  - Germinate seeds. Discuss starch turning into sugar in a plant.
  - Burn proteins. Show they are a different class of compounds from carbohydrates.
  - Observe egg whites. Put them in water.
  - Cook egg whites. Then dissolve egg whites with sodium hydroxide. Burn them. Notice the smell.
  - Coagulate casein (milk protein) with vinegar.
  - Make casein glue.
  - Make cheese.
  - Test for fat by dropping it on brown paper (bacon, nuts, white and yolk of a boiled egg, oils, bread, vegetables, etc.).
  - Extract fat from chocolate with methylene dichloride.
  - Place cocoa butter in a jar of hot water. Observe “form” of fats.
  - Extract oil from lemon peel with ethyl alcohol.
  - Test for glycerol by adding sodium bisulfate to vegetable oil.
  - Shake water and oil together in a jar.
  - Shake oil, water and detergent together.
  - Burn oil and water.
  - Put water on grease flames. Put baking soda on grease flames.

# Grade Eight Standards

---

## Curriculum Standards

- f. The role of oil in cooking is to conduct heat.
  - g. Fats may be broken down into fatty acids and glycerol.
  - h. An emulsion is a suspension of one liquid in another.
  - i. Unsaturated fats are more metabolically active and desirable than saturated fats.
4. Many people discovered the properties of carbohydrates, proteins and fats.

## Curriculum Activities

- Make French fries.
- Make soap. Discuss process of saponification.
- Make mayonnaise, an emulsion of oil suspended in water.
- Combine iodine with different fats to see which fats are more reactive. Compare saturated and unsaturated fats.
- Study emulsion of water and oil by making cosmetics: cold cream and lipstick.
- Study the biographies of

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

### ANATOMY - PHYSIOLOGY

1. The muscular-skeletal system gives support to the body.
  - a. It is made up of round, curved and straight **bones**.
  - b. Some bones are connected and move; others are stationary.
  - c. There are different kinds of bones based on their shapes: long, short, irregular, flat, wormian.
  - d. Bones grow by the process of creating and breaking down cells. Babies have a softer substance for bone called cartilage. Cartilage cells break down to form bone cells.
  - e. A bone is covered with periosteum. Red and white blood cells are created in the marrow.
  - Place hands on a body and feel different shaped bones.
  - Discover where in the body “hinged bones” are found.
  - Look at a skeleton and identify different types of bones.
  - Sketch and draw bones. Model bones in clay.
  - Compare skeletons of animals and birds.
  - Observe and feel bones of babies and adults.
2. The skull begins as a curved jigsaw of nearly 30 pieces of cartilage, bone and membrane and becomes solid.
  - a. Fontanelles are “soft spots” on a baby’s head.
  - b. Cranial structures are joints holding the skull together.
  - c. The skull has stationary and moveable parts.
  - Diagram and illustrate the structure of a bone.
  - Draw, sketch, model a skull.
3. The backbone is composed of three types of vertebrae: cervical, dorsal and lumbar which protect the spinal cord.
  - Observe a skull for its stationary, moveable parts as well as the bones which are curved and round.
  - Observe a skeleton. Draw, illustrate and model the vertebrae.
4. The pelvis is made up of six bones, fused together in an adult: ilium, pubic, ischium, sacrum, acetabulum, coccyx. A man’s and woman’s pelvis differ.
  - Observe a skeleton. Draw, illustrate and model the bones.

# Grade Eight Standards

---

## Curriculum Standards

5. The bones in the arm are the humerus, radius and ulna.
  - a. The two forearm bones can cross.
  - b. The wrist (or carpus) consists of eight bones.
  - c. Hand bones are metacarpals; finger bones are phalanges.
  - d. There is great mobility in the first metacarpal or thumb.
  - e. The bones and joints of the arm work as levers.
6. There are many bones in the leg, knee and foot.
  - a. The leg bones are: the femur, the patella, the tibia and fibula.
  - b. Three parts of the foot are called the tarsus, metatarsus and phalanges.
  - c. Ligaments, tendons and cartilage add stability to the knee.
7. There are three basic types of **muscles**.
  - a. Smooth muscles coat our digestive organs.
  - b. Cardiac muscles pump our blood.
  - c. Skeletal or striated muscles primarily move limbs.
  - d. Muscles must have glucose and oxygen and produce carbonic dioxide and lactic acid.
  - e. Muscles often work in pairs—one contracts/the other relaxes.
  - f. The biceps and triceps are in the upper arm.
  - g. The quadriceps and hamstring muscles are in the thigh.
  - h. The muscles over the knee act similarly to pulleys.

## Curriculum Activities

- Observe a skeleton. Draw, illustrate and model the bones.
- Compare the thumb of a human and of an animal.
- Compare bones/joints to familiar levers.
- Observe a skeleton. Draw, illustrate and model the bones.
- Work and experiment moving one's own muscles.
- Draw, diagram, and sketch systems of muscles.

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

8. *Joints* in the body (wrist, ankle, shoulder, thigh, etc.) are like structures used in simple devices (hinge, ball-and-socket and sliding joints).
  - Demonstrate types of joints—ball and socket, hinged, saddle, pivot, and show where each of these is located in the body. Draw them.
9. There are two basic *nervous systems*: central and peripheral.
  - a. The central consists of the brain and the spinal cord.
  - b. The peripheral, or autonomic, nerves work on their own accord.
  - Diagram a nerve with its parts.
  - Research how, when, where nerve cells form.
10. An *eye* is composed of the iris, lens, cornea, pupil, sclerae, aqueous and vitreous humor, retina and optic nerve. Each has a role and adjusts to light, distance, etc.
  - a. For an object to be seen, light emitted by or scattered from it must enter the eye.
  - Observe eyes.
  - Experiment with changing the size of the iris by being in light and darkness.
  - b. The image our eye makes is upside down.
  - Diagram an eye with its parts.
  - c. The lens in our eye changes so we can focus.
  - Make a camera obscura
  - d. Retinal cells (rods and cones) react differently with different wave lengths of light.
11. The *ear* is a complex system. The outer ear includes the canal and drum; the middle ear includes the hammer, anvil and stirrup; and the inner ear includes the semicircular canals.
  - Diagram an ear.
  - a. Our normal hearing occurs in a decibel range of 60–70.
  - Test hearing for different decibel levels.

# Grade Eight Standards

## Curriculum Standards

## Curriculum Activities

### EARTH SCIENCE

#### METEOROLOGY

1. *Weather* is caused by: the earth, sun, water and air.
  - a. The earth's shape, rotation and orbit cause different weather patterns.
  - b. The atmosphere above the earth is layered: troposphere, stratosphere and the mesosphere. Weather occurs in the troposphere—up to 8 miles above the earth.
  - c. The weight of the atmosphere and pull of gravity create air pressure. Warm air is less dense and cold air is denser.
  - d. The earth is warmed by solar radiation.
  - e. The heat of the sun moves from the equator to the poles.
  - f. The turning of the earth imparts a twist to the motion of air, causing winds. This is known as the Coriolis Effect.
  - g. Warm air rises carrying water.
  - h. Clouds form from condensation of moisture in air.
  - i. The water cycle redistributes water.
  - j. Cold and warm air, holding water and moving, create high and low pressure areas. Low pressure areas bring stormy weather. High pressure areas bring clear, fair weather.
  - k. Two air masses meeting cause fronts. Cold and warm air fronts can bring storms.
- Illustrate the layers of atmosphere above the earth.
- Map the different winds (prevailing, westerlies, trade, easterlies, doldrums) on the globe.
- Illustrate different cloud types. Make cloud types with cotton.
- Diagram the water cycle in a meadow or near the ocean.

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

- l. Lightning bolts are electrical. Thunder is a burst of intense heat.
  - m. Humans can be affected by tornadoes and hurricanes.
2. Weather can be measured.
    - a. Thermometer measures temperature.
    - b. Wind vanes, indicate direction of the wind.
    - c. Barometer measures air pressure.
    - d. Hygrometer measures humidity.
    - e. Rain gauge measures precipitation.
    - f. Anemometer measures wind speed.
  3. Weather can be forecasted by:
    - a. Observing clouds and fronts.
    - b. Watching weather maps.
    - c. Weather changes from day to day but trends in temperature and rain tend to be predictable during a season.
- Experiment with these instruments.
  - Make a wind vane.
  - Make a simple barometer by stretching a balloon over a jar.
  - Keep a daily weather journal. Note: speed and direction of wind; types and heights of clouds; temperature; precipitation. Observe sky daily at same time.
  - Predict the weather from observation.
  - Observe weather maps in the newspaper and on T.V.

# Grade Eight Standards

## Curriculum Standards

---

## Curriculum Activities

---

### PHYSICAL SCIENCE

#### PHYSICS

1. *Sound* arises from vibrations of the sounding object and of the surrounding medium.
  - a. Pitch corresponds to the frequency of vibration.
    - Strike a tuning fork and hold against paper, a hanging ball, in water, or against teeth.
    - Fill a wine glass  $3/4$  full—rub top with vinegar, watch ripples.
    - Experiment with the Chladni plate.
    - Clamp different length rulers to the end of the table and note the relationship of pitch to length of ruler.
    - Place pieces of cardboard behind a ticking clock and observe differences in the volume of the ticking.
    - Experiment with echoes, moving closer and closer to walls.
    - Make a broad funnel shape and place next to ear. Listen.
    - Absorb sound from a ticking clock with various materials and listen.
  - b. Sounds can be reflected, directed, focused or absorbed.
    - Produce a clear sound from a wall at various distances. Measure the pattern of sound, echo, etc. with a metronome. Record how many beats the metronome is making per minute and compare to distance from wall.
    - Experiment with sound in a vacuum by putting a radio in a jar. Evacuate the bell jar with a vacuum pump.
    - Fasten a clothesline to a post. Pull taut and give it a vertical impulse. Observe how the impulse travels along the line.
    - Fasten a spring to a post. Extend spring and give spring a push. Observe how the compression passing along the spring is reflected from the fastened end.
  - c. The transmission and speed of sound depend on the medium.
    - Experiment with sound in a vacuum by putting a radio in a jar. Evacuate the bell jar with a vacuum pump.
    - Fasten a clothesline to a post. Pull taut and give it a vertical impulse. Observe how the impulse travels along the line.
    - Fasten a spring to a post. Extend spring and give spring a push. Observe how the compression passing along the spring is reflected from the fastened end.
  - d. Sound travels in longitudinal waves.
    - Produce a clear sound from a wall at various distances. Measure the pattern of sound, echo, etc. with a metronome. Record how many beats the metronome is making per minute and compare to distance from wall.
    - Experiment with sound in a vacuum by putting a radio in a jar. Evacuate the bell jar with a vacuum pump.
    - Fasten a clothesline to a post. Pull taut and give it a vertical impulse. Observe how the impulse travels along the line.
    - Fasten a spring to a post. Extend spring and give spring a push. Observe how the compression passing along the spring is reflected from the fastened end.

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

2. *Light* has certain properties.
  - a. The propagation of light is affected by the medium through which it passes.
    - Project a beam of light in a darkened room. Hold a convex and a concave lens close to the projection of light.
    - Establish the focal length of a lens by moving a lens between a candle and an index card until an image is focused.
    - Hold a plane, convex and concave mirror in the path of a light beam in a darkened room.
    - Apply laws of lenses and mirrors to cameras, microscopes, telescopes, glasses, projectors, etc.
  - b. Light can be refracted.
    - Place a rod in a tank of water. Observe from different angles.
    - Place a corner of a pane of glass over a paper with lines drawn on it. Look down at the lines through the glass.
    - Put a coin in a bowl of water and stand so one can barely see it. Move back slightly so coin can't be seen. Now pour water into bowl so coin can be seen.
    - Shine light at a steep angle into a tank of water and determine. Observe refraction. Measure the angle of refraction.
  - c. Color can be created through refraction and diffraction.
    - Experiment with prisms. Identify color spectrum and which colors are bent the most. Observe patterns of colors where light and darkness meet. Observe patterns of color at edge where white and black paper meet.
    - Create colors from diffraction by looking at a candle through the fine fringes of a feather or a fine slit in a file card.
  - d. Light travels in transverse waves.
    - Demonstrate how light waves are like water waves.

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

### 3. *Heat* has certain properties.

- a. It can be affected by pressure.
  - Measure the temperature of water as it boils in an open pot and as it boils under pressure.
  - Melt ice by pressure.
- b. It can be reflected, focused and absorbed.
  - Reflect heat from a mirror.
- c. It moves in a predictable flow from warmer to cooler objects until all objects are at the same temperature.
  - Focus radiant heat with a curved or parabolic mirror.
- d. Energy can be carried from one place to another by heat flow (or by waves—water, light, sound or by moving objects)
  - Test the absorptive properties of black and white paper.
- e. Heat from the sun is the major source of energy on the earth’s surface, powering winds, ocean currents and the water cycle.
  - With two cans, one black and one white, filled with water, see in which one the water heats the fastest. Then pour boiling water into each can and note in which can the water temperature drops the fastest.
- f. Solar energy (light and heat) reach earth through radiation.
  - Heat strips of various metals in boiling water. Place on paraffin and observe which strips have sunk into the paraffin the most due to heat content.
- g. Heat from the earth’s interior reaches the surface primarily through convection.
- h. Uneven heating of the earth causes air movements (convection currents).
- i. Convection currents distribute heat in the atmosphere and ocean.
- j. Differences in pressure, heat, air movement and humidity result in changes of weather.

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

4. *Electromagnetism* has many practical applications.
- Electromagnetism can be used to create motion.
  - Electric currents can be controlled by switches, fuses and circuits.
  - Electricity can flow in a simple, a series or a parallel circuit.
  - Some materials can conduct an electrical current while others can't.
  - A magnet moving within a coil or a coil moving within a magnet can generate an electric current.

- Make a simple electric motor.
- Make an electric switch with a battery, wire, small light bulb, two metal tacks and a paper clip.
- Make a two-way switch with the above as well as two more tacks and another clip.
- Make a simple fuse using steel wool or a piece of tinsel.
- Connect small light bulbs to a battery to demonstrate three types of circuits.
- Using electromagnets, make a telegraph key or a telegraph system.
- Test various objects to see if they can conduct electricity: a key, paper, clip, eraser, plastic spoon, rock, pen cap, wood.
- Test water and salt water for conductivity.
- Test baking soda, borax, lye, vinegar, lemon juice, oil, milk.
- Make an electric dynamo. Attach the ends of a coiled wire to a galvanometer. Insert the end of a magnet into the center of the coil. Read galvanometer. Now insert other end of the magnet. Hold magnet still and wave the wire.

# Grade Eight Standards

## Curriculum Standards

---

## Curriculum Activities

5. *Liquids* have certain properties.
- Liquids have no shape of their own.
  - Liquids seek a constant level.
  - Liquids exert pressure.
  - The pressure liquid exerts increases with depth.
- Pressure exerted on one part of a liquid is distributed to all parts of the liquid.
  - Liquids may support substances giving them buoyancy. The density and shape of an object affects its buoyancy.
  - The buoyant force on an object in a fluid is an upward force equal to the weight of the fluid it has displaced.
  - Liquids have different densities. Density is mass per volume.
  - Liquids have surface tension.
- Fill different size and shape containers with colored water.
  - Clamp funnels to the two ends of a rubber hose. Fill with water. Move funnels up and down. Observe water level.
  - On different sides of a can cut holes 1", 4" and 7" above the bottom. Fill with water. Observe the water streams to determine which shoots the farthest.
  - Drill a hole 1" from the bottom in a wide and in a narrow can. Fill water to the same heights in the can. Which water stream shoots the furthest?
  - Make a manometer (a device to measure the pressure of the liquid) with a funnel, rubber tubing and a piece of U-shaped glass pipe. Use it to test the depth/pressure relationship.
  - Demonstrate Pascal's flask (or make one with holes drilled into a rubber ball). Notice how water will squirt out regardless of where the pressure is applied.
  - Make a Cartesian Diver.
  - Float different objects on water. Predict if an object will float.
  - Float equal size blocks of different woods to see if density affects buoyancy.
  - Show Archimedes Principle with an overflow container.
  - Tell the story of Archimedes and the King of Syracuse's crown.
  - Pour molasses, water, oil and alcohol into a glass.
  - Calculate the density of substances from mass and volume.
  - Measure equal amounts of liquids and compare weights.
  - Float a razor blade on the surface of a glass of water.
  - Drill five horizontal holes 1/4" apart, 2" from the bottom of a can. Fill with water. "Pinch" streams of water together.

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

6. *Air* has certain properties.

a. Air has volume and weight.

b. Air offers resistance to moving objects.

c. Air exerts pressure.

d. Moving air creates an area of lower pressure.

e. The absence of air creates a vacuum.

- Make an “air cushion.” Rest a book on a bag filled with air.
- See something rush out of a bottle when it fills with water inside a tank of water,
- Make a balance with two balloons filled with air. Deflate one balloon. Is the scale still balanced?
- Hold cardboard in front of oneself and run.
- Drop two equal sized pieces of paper horizontally. Then drop one horizontally and the other vertically.
- Fill a cup with water and cover with stiff paper. Turn upside down. Repeat, filling the cup half full.
- Invert a straw in water and observe the water level. Cover the top of the straw and lift water out.
- Cover the hole on top a bottle cap and watch water stop flowing from a hole in the bottom of the bottle.
- Build a siphon.
- Demonstrate lift and force pumps.
- Make and fly paper airplanes. Demonstrate lift.
- Blow air between two ping pong balls. Observe them move.
- Make a simple atomizer.
- Try to pull a bathroom plunger off the wall.
- Model Magdeburg hemispheres.
- Put an inflated balloon in a bell jar and evacuate air with a vacuum pump.
- Boil 1/2 cup water in a metal canister. Put lid on after steam has come out. Surrounding air pressure will crush the can when water vapor cools.

# Grade Eight Standards

---

## Curriculum Standards

## Curriculum Activities

---

### INVESTIGATION – EXPERIMENTATION

1. Observation and activity is the means through which we learn. Students will:
  - a. Observe with their five senses.
  - b. Communicate the steps, observations and conclusions of an experiment in written reports, artistic diagrams and verbal presentations.
  - c. Develop questions using how, what, when, where, who and why.
  - d. Follow instructions for scientific investigation.
  - e. Record data on charts, diagrams, graphs from measurements and develop quantitative statements about the relationships between variables.
  - f. Apply simple mathematical relationships to determine one quantity given the other two (density = mass x volume; force = pressure x area; volume = area x height).
  - g. Interpret events by sequence and time from natural phenomena.
  - h. Conduct multiple trials from which to draw conclusions.
  - i. Measure and estimate weight, length, volume, area, density, pressure, force, speed, distance, time.
  - j. Differentiate observation from inference.
  - k. Justify predictions based on cause and effect relationships.