



Curricular Planning Resource (CPR)

Science 4

PLANTS

SOL 4.4

SOL 4.8 b,d

SOL 5.5 c

STRAND/UNIT/TOPIC: Life Processes / Resources

PACING: Refer to Pacing Guide

STANDARD(S) AND COMPETENCIES:

4.4 The student will investigate and understand basic plant anatomy and life processes. Key concepts include

- a) the structures of typical plants (leaves, stems, roots, and flowers);
- b) processes and structures involved with reproduction (pollination, stamen, pistil, sepal, embryo, spore, and seed);
- c) photosynthesis (sunlight, chlorophyll, water, carbon dioxide, oxygen, and sugar); and
- d) dormancy.

4.8b,d The student will investigate and understand important Virginia natural resources. Key concepts include

- b) animals and **plants**
- d) forests, soil, and land

5.5c The student will investigate and understand basic plant anatomy and life processes. Key concepts include

- c) vascular and nonvascular plants

RELATED STANDARDS/COMPETENCIES: K.6, 1.4, 1.5, 2.2, 3.4, 4.1, 6.8

K.10, 1.8, 2.8, 3.10, 3.11

2.5, 3.5, 3.6, 4.5, 6.7

UNDERSTANDING THE STANDARD/OVERVIEW:

4.4 This standard focuses on the basic life processes and anatomy of plants. It represents a more in-depth treatment of the structures and processes associated with reproduction. Photosynthesis is introduced in this standard. Closely related standards from previous grades include K.6, 1.4, and 2.4. This standard also is closely connected with concepts presented in science standard 4.5. It is intended that students will actively develop scientific investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

4.8b,d Virginia has a rich variety of resources. These provide the raw materials for our daily lives and sustain our economy. Natural resources are finite and must be used wisely to insure their continued availability. This concept of natural resources is introduced in 1.8 and extended in 6.9. It is intended that students will actively develop scientific investigation, reasoning, and logic skills (4.1) in the context of the key concepts presented in this standard.

5.5c This standard emphasizes the major categories of living things and builds on science standards 2.4 and 4.4. The use of a microscope may be applied to the study of plants, animals, and cells. It is intended that students will actively develop scientific investigation, reasoning, and logic skills (5.1) in the context of the key concepts presented in this standard.

OVERVIEW (TESTED MATERIAL)

4.4 The concepts developed in this standard include the following:

- For many typical green plants there are anatomical structures that perform certain basic functions. For example, roots anchor the plants and take water and nutrients from the soil. Plant stems provide support and allow movement of water and nutrients.
- The plant kingdom can be divided into two general groups, those that produce seeds and those that produce spores.
- Many seed producing plants have roots, stems, leaves, and flowers. The stamen and pistil are reproductive parts of the flower. The sepals are the small leaves that form the housing of the developing flower.
- Pollination is part of the reproductive process for flowering plants. Pollination is the process by which pollen is transferred from the stamens to the stigma.
- Some plants reproduce with spores. These include ferns and mosses.
- Green plants produce their own food through the process of photosynthesis. Green plants use chlorophyll to produce food (sugar) using carbon dioxide, water, nutrients, and sunlight. Leaves are the primary food producing part of these plants.
- Oxygen is produced during photosynthesis.
- Dormancy is a period of suspended life processes brought on by changes in the environment

4.8b,d The concepts developed in this standard include the following:

- **Virginia is rich in a wide variety of natural resources including forests, arable (farmable) land, coal, sand and aggregates (rocks), wildlife and aquatic organisms, clean water and air, and beautiful scenery.**
- Virginia has a great variety of plant and animal resources.
- Natural and cultivated forests are a widespread resource in Virginia.
- Virginia's soil and land support a great variety of life, provide space for many economic activities, and offer a variety of recreational opportunities.

5.5c The concepts developed in this standard include the following:

- Plants can be categorized as vascular (which have special tissues to transport food and water such as trees and flowering plants) and nonvascular (which do not have tissues to transport food and water such as moss). Most plants are vascular.

ESSENTIAL KNOWLEDGE, SKILLS, OR PROCESSES: (TESTED MATERIAL)

4.4 In order to meet this standard, it is expected that students should be able to:

- create a model/diagram illustrating the parts of a flower (stamen, pistil, sepal, ovary, ovule, seed) and explain the functions of those parts.
- analyze a common plant: identify the roots, stems, leaves, and flowers; and explain the function of each.
- create a model/diagram illustrating the reproductive processes in typical flowering plants and explain the processes.
- compare and contrast different ways plants are pollinated.
- explain that ferns and mosses reproduce with spores rather than seeds.
- explain the process of photosynthesis using the following terminology: sunlight, chlorophyll, water, carbon dioxide, oxygen, and sugar.
- design an investigation to determine the relationship between the presence of sunlight and plant growth.
- explain the role of dormancy for common plants.

4.8b,d In order to meet this standard, it is expected that students should be able to:

- compare and contrast natural and man-made resources.
- appraise the importance of natural and cultivated forests in Virginia.

5.5c In order to meet this standard, it is expected that students should be able to:

- **group organisms into categories using their characteristics:** living things (kingdoms), **plants (vascular and nonvascular plants)**, and animals (vertebrates or invertebrates). Name and describe two common examples of each group.

SAMPLE STRATEGIES:

- Generate a class discussion to talk about what students know and what they want to know about plant parts.
- Select three different plants. Examine each plant with a hand lens and draw its parts. When finished, compare drawings. Create a chart to group the three plants examined according to their similarities and differences.
- Observe plants in your neighborhood, in your home, or in books or magazines. Draw the plants and label their parts.
- Ask students to list some foods they eat that are made of leaves.
- Collect several deciduous leaves or find pictures of several deciduous leaves.
 1. Ask students to describe the different shapes of the leaves.
 2. Ask students what features the leaves have in common.
 3. Ask students to describe the blade, veins, and petiole of each leaf.
- Compare the needles of coniferous trees to the leaves of deciduous trees.
- Make a chart that shows the differences in monocot and dicot sprouts, flowers, and leaves.
- Hold up a piece of wood and ask from what part of a plant it came.
- Compare the leaf stem of a flower to the trunk of a tree.
- Tell how the rings of a tree's trunk are like the terminal bud scars of a soft stem.

- Grow radish seeds in soil ½ inch deep in rows 1 foot apart. Place in full sunlight. Thin to 1 inch apart when tops are up. Use a hand lens to observe the root and root hairs of the sprouting radish seedlings of the plants. Examine them with hand lens
- Why do roots grow down and stems grow up? What happens if you plant a seed upside down? “Plant” six beans along the outside edge of a glass jar with moist, crumpled paper towels. Keep the towels damp and observe the sprouting seeds for five days. When roots and shoots are about an inch long, try to “fool” the seed by turning the jar upside down. Observe changes over the next few days. A change in direction should be apparent. Shoots bend so that they are again growing upward, and roots reverse to continue growing downward.
- Bring several different plants to class including plants with fibrous roots, such as lima beans and peas, and ones with taproot systems, such as carrots and turnips. Expose the root systems and examine with a hand lens.
- Visit an arboretum or botanical garden to learn more about the many ways plants make, transport, and store food.
- Form small groups of students and have each prepare a simple lesson on photosynthesis and its importance to plants, animals, and humans. Each group could present its lesson to a first or second grade class.
- Cut a diagram of a plant, or the process of photosynthesis, apart and have students put the puzzle pieces back together.
- Collect two identical plants. Draw each plant. Wrap all the leaves of plant 1 in aluminum foil. Do not cover the leaves of plant 2. Place both plants near a sunny window. Predict what will happen and record predictions. Check plants daily and water when the soil feels dry. After 5 days, remove the foil and sketch each plant. Describe and explain what happened to each of the plants.
- Cut off the bottom of a piece of celery and examine the inside with a hand lens. Draw what you see. Mark what you think is the xylem. Put the celery in colored water and let it stand overnight. Observe the stalk of celery in the morning. Record what happened and located the xylem.
- To show how plants reproduce without seeds use a sweet potato. Insert four toothpicks around the center of the sweet potato. Place the sweet potato in a jar of water pointed side down. Make sure the tip is in the water. Predict what will happen.
- Bring in three or four different kinds of flowers and cones. Use a hand lens to examine the parts. Make a drawing of the parts of each flower or cone and a drawing of each whole flower or cone. Label the drawings.
- Experiment to find out how weather affects cones. Place a cone in water for several hours to watch it close. Heating a cone in a low oven should make it open, as warm weather signals that conditions are right for germination.
- Research types of plants that cause hay fever. Prepare a poster showing the flowers of a few of these plants and the time of year they produce pollen in their area.
- Compose an expository essay explaining the events that occur during the pollination of a lily by a butterfly.
- Design a model of a seed that will travel by wind, by water, or by hitching a ride, using scissors, paper, and a paper clip. Test your design and record your results.
- Peel the seed coat off a lima bean and split the bean in half. Examine the inside with a hand lens. Draw the seed and label the parts.
- Provide these fruits: grapes, lemons, pears, bananas, tomatoes, and cucumbers. Cut open each of the fruits and examine the insides. Note whether the fruit and/or its seeds are edible. Create a chart that has this data: fruit, color, number of seeds, edible fruit (yes or no), edible seeds (yes or no).
- Provide one mushroom and two sheets of unlined paper to each student. Draw and label a mushroom. Remove the stalk from the cap. Place the cap, gills down, on a sheet of unlined paper. Place a second piece of unlined paper on top of the mushroom cap and leave it undisturbed over night. The next day, carefully

take the piece of paper off the cap. Carefully remove the cap from the unlined paper. Draw the pattern of spores remaining on the bottom sheet of unlined paper.

- Bring some fern fronds to school. Using a hand lens, examine the small, brownish cases on the backs and sides of the leaves that contain spores.
- To preserve biodiversity and help the environment, plant grasses, shrubs, and ornamental flowers that are native to the region. These plants help water because they are adapted to local conditions.
- To cut or not to cut? Help students examine the issue as they look at two opposing views about rain forests. Divide students into groups of three or four. Have half of the groups take the role of government officials who wish to cut down large areas of the rain forest in their countries. Assign the other groups to represent the opinions of a worldwide citizens' group that is opposed to cutting down any more trees from any rain forest. Ask each to prepare arguments for a class debate.
- Costa Rica's lush environment supports more bird species than in all of North America. These species are threatened by one of the highest deforestation rates in the world. Research what Costa Rica is doing to combat this problem.

SAMPLE RESOURCES:

- Destinations in Science: Vacant Lot, Pages B6 – B62
- Plants, Chesterfield County Guide, Hands-on Plant Kit, Lessons 1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 13, 14, 15, 16, 19, 20, 21, 22, 23, 24, 25, 26, and 27
- "Take a Hike! Nature Walk Ideas for Big Kids," The Mailbox (Intermediate), August/September 2000, pages 44-45
- "Plant Power!" The Mailbox (Intermediate), April/May 2000, pages 32-37
- Rockwood Nature Center 745-7020
- Lewis Ginter Botanical Garden (Garden Explorers) 262-9887
- Pocahontas State Park Nature and Discovery Programs 796-4472
- Virginian Department of Forestry 796-4360
- Dutch Gap Conservation Area (Tremendous Trees) 796-4360 *Excellent tree program
- Books

Budding Botanist, AIMS Education Foundation, 1993

Why Do Leaves Change Color, Betsy Maestro

Tops and Bottoms, Janet Stevens

Planting a Rainbow, Lois Ehlert, Harcourt Brace & Company, 1988 ISBN 0-15-262610-7 A mother and child plant a rainbow of flowers in the family garden.

Leaf, Yellow Leaf, Lois Ehlert, Harcourt Brace & Company, 1991

The Reason for a Flower, Ruth Heller, Putnam Publishing Group, 1983

What's Inside? Plants, DK Direct Limited, Dorling Kindersley Limited, 1992

Flowers (Eyewitness Explorers series), David Burnie, Dorling Kindersley Publishing, Inc., 1993

Janice VanCleave's Plants: Mind-Boggling Experiments You Can Turn Into Science Fair Projects (spectacular Science Projects series), Janice VanCleave, John Wiley & sons, Inc., 1997

My Indoor Garden, Carol Lerner, Morrow Junior Books, 1999

The Nature and Science of Leaves, Jane Burton, Gareth Stevens Publishing, 1997

Children's Atlas of the Environment, Rand McNally & Company, 1992

A Drop of Water: A Book of Science and Wonder, Walter Wick, Scholastic, Inc., 1997

Earthwatch: Earthcycles and Ecosystems, Beth Savan, Perseus Press, 1992

A Handful of Dirt, Raymond Bial, Walker Publishing Company, Inc., 2000
How a Plant Grows, Bobbie Kalman, Crabtree Publishing Company, 1997
The Dandelion Seed, Joseph Anthony, DAWN Publications, 1997
Dandelion Adventures, L. Patricia Kite, Millbrook Press, Inc., 1998
A Dandelion's Life (Nature Upclose series), John Himmelman, Children's Press, Inc., 1999
Dandelion by Hilda Conkling
From Seed to Sunflower (Lifecycles series), Gerald Legg, Franklin Watts, Inc., 1998
From Seed to Plant, Gail Gibbons, Holiday House, Inc., 1991
The Magic School Bus Plants Seeds: A Book About How Living Things Grow, Joanna Cole, Scholastic Inc., 1995
Seeds and Seedlings (Nature Close-Up series), Elaine Pascoe, Blackbirch Press, 1997
A Weed is a Flower: The Life of George Washington Carver, Alike, Econo-Clad Books, 1999
What Is a Life Cycle? (Science of Living Things series), Bobbie Kalman, Crabtree Publishing Company, 1998
A Tree is Growing, Arthur Dorros, Scholastic Inc., 1997
What Rot! Nature's Mighty Recycler, Elizabeth Ring, The Millbrook Press, Inc., 1996
Rainforests, A Kids Discover Publication
Welcome to the Greenhouse by Jane Yolen
Where the Forest Meets the Sea by Jeannie Baker
Rain Forest Secrets by Arthur Dorros
Rain Forest by Helen Cowcher
Trees and Forests, Scholastic Voyages of Discovery
Look What I Did With a Leaf! by Morteza E. Sohi
Trees and Shrubs of Virginia by Oscar W. Gupton
Tree by David Burnie, Eyewitness Book
Trees by Joyce Kilmer
The Lesson of the Oak by C. A. Lufburrow
The Ferns by Gene Baro
Life Cycles-How Living Things Change, 1993 ISBN 0590261169 Great photos of changes in plants and animals released by the North Carolina Museum.

TECHNOLOGY CONNECTIONS:

- www.pen.k12.va.us The state offers strategies for every content area at all grade levels.
- Sunburst "Real World Science Series" video tapes: Seeds and Plants (13 minutes). Tapes are located at the Fulghum Center and should be requested through your school's librarian.
- Lewis Ginter Botanical Garden www.lewisginter.org
- Virginia Department of Forestry www.vdof.org
- Greenways Incorporated www.greenways.com
- Windows on Science, "Sorting It All Out," Life Science, Volume I, Chapter 21, Pages 10 and 11, Videodisc Frames 6875 – 6883, (about fungi)
 - “Kingdom Fungi,” Pages 26 – 31, Videodisc Frames 8550 – 8561
 - “Kingdom Plantae, Pages 31 – 42, Videodisc Frames 8562 – 8979
 - Activity 1 – The Fungus Among Us

- Activity 4 – Make Way for the Mushroom
- Windows on Science, “Rooting for Plants,” Life Science, Volume I, Chapter 46, Pages 1 – 41, Videodisc Frames 29554 – 33887
 - Activity 1 – Botany Bottle
 - Activity 2 – Roots
 - Activity 3 – Celery Stalks
 - Activity 4 – Polishing Stomata and Guard Cells
 - Activity 5 – Fast Flowers
 - Activity 6 – A Fruity Problem
- Photosynthesis Websites
 - <http://photoscience.la.asu.edu/photosyn/education/colorchange.html>
 - <http://www.worldandi.com>
 - <http://www.iit.edu/~smile/bi9201.html>
- Trees, Eyewitness video, 35 minutes
- Plants, Eyewitness video, 35 minutes
- In Celebration of Trees, Discovery Channel Video Library, 50 minutes
- Tropical Rainforest, IMAX video, 40 minutes
- Photosynthesis, Teacher Video Company, 35 minutes
- The Magic School Bus Goes to Seed, Scholastic video, 30 minutes
- The Magic School Bus in the Rainforest, Scholastic video, 60 minutes
- Totally Tropical Rainforest, National Geographic, 40 minutes
- Rain Forest, National Geographic, 60 minutes
- Rainforest Researchers, Mac/Windows, CD-ROM, Tom Snyder Productions
- American Forests <http://www.amfor.org/>
- Tree List <http://www.fs.fed.us/database/feis/plants/tree/>
- The Wonderful World of Trees <http://www.domtar.com/arbre/english/start.htm>
- Trees in North America http://www.domtar.com/arbre/english/p_07.htm
- Why Do Leaves Change Color in the Fall?
 - <http://photoscience.la.asu.edu/photosyn/education/colorchange.html>
- Photosynthesis: Don't “Leaf” Out Fall's Most Valuable Lesson
 - http://www.education-world.com/a_lesson/leseson024.shtml

ASSESSMENTS:

- Teacher made tests
- Teacher observation
- Teacher questioning
- CCPS SOL Assessments
- Destinations in Science: Vacant Lot, Chapter 1, Assessment Booklet, Pages 31 and 32
- Destinations in Science: Vacant Lot, Concept Map, Blackline Master, Page 17
- Destinations in Science: Vacant Lot, Mind Bender, Blackline Master, Page 18
- Destinations in Science: Vacant Lot, Chapter 2, Assessment Booklet, Pages 33 and 34

- Destinations in Science: Vacant Lot, Concept Map, Blackline Master, Page 20
- Destinations in Science: Vacant Lot, Mind Bender, Blackline Master, Page 21
- Destinations in Science: Vacant Lot, Unit Assessment, Assessment Booklet, Pages 37 through 40
- *Windows on Science*, “Rooting for Plants,” (True or False, Matching, and Multiple Choice Test)
- Plants, Chesterfield County Guide, Assessments, Lessons 11, 18, 29, and 30
- Released tests with DOE website
- Specific Flanagan tests (Tests For Higher Standards)
- Alternative methods such as good project ideas (learning by doing)
- Virginia SOL Blueprint (ex: Force, Motion, Energy and Matter 25%)

CROSS-CURRICULAR CONNECTIONS:

Art

1. Create an original diagram to capture the life cycle of a plant.
2. Make leaf pictures by pressing leaves between two sheets of wax paper. Place the wax paper between sheets of newspaper and press the picture with an iron on “medium” setting.
3. Save trees with creative designs. Obtain a paper package for a fast food, toy, CD, or computer game. Redesign the package to use less material. Write a persuasive essay that tries to convince the manufacturer to purchase the new design.
4. Turn a picture of a leaf into something entirely different.
5. Create leaf animals from dried leaves.
6. Create a stunning bulletin board that doubles as a visual map of the rain forest ecosystem.
7. Ikebana, the art of flower arranging, is a tradition that the Japanese brought with them to the United States. Ikebana encourages the use of all parts of the plant, including stems, leaves, branches, fruits, and flowers. Make such an arrangement or draw one.
8. Make a leaf print for a science display. Place a sponge in an aluminum tray. Pour a thin paint solution over the sponge. Place the leaf, vein side down on the sponge. Press gently. Carefully pick up the leaf and place it paint side up on a piece of newspaper. Place a piece of white printing paper on the leaf and rub gently. Remove the white paper. Turn it over to dry.

Language Arts

1. Create a slogan for plants and put it to work in an ad campaign.
2. Create an essay about the destruction of the rain forests.
3. Read The Big Tree by Bruce Hiscock. This biography of a sugar maple that sprouted in 1775 in New York State combines United States history with botany.
4. Read Top Secret by John Reynolds Gardiner, which is about a boy who decides to discover the secret of human photosynthesis.
5. Create an alphabet poem about a Virginia forest.
6. Read The Giving Tree by Shel Silverstein. Compose an essay describing who or what in your life is most like the giving tree.
7. Pretend you are a deciduous leaf and describe your life from the time you emerge from the leaf bud until you change color in the fall.
8. Have students interview the older people in their families or neighborhood about the changes that have occurred. Help them create questions about what caused the changes, whether they were caused by people or nature, and what the effect of the changes has been on the people, animals, and plant life in the area.

Math

1. Measure the heights of several examples of four kinds of plants growing nearby. Find the average height for each type of plant and make a bar graph.
2. Grand Trees of America by Lisa Jorgenson describes state trees and explains the efforts of the National Register of Big Trees to preserve ancient trees. Instructions for measuring and nominating a tree as a Champion Tree—the largest tree of its species—are included. Suggest that students locate examples of their state tree and measure them using the method described in the book and compare their sizes to the Champion tree.
3. Keep a record of every time you eat or use something made from a plant part. Make a bar graph of the number of times you recorded uses of leaves, roots, and stems.
4. In a science experiment related to plant growth, students will collect, organize, graph, and interpret data. Two potted seedlings, centimeter graph paper, and rulers are needed. Place one of the seedlings 3 inches from a window and the other 24 inches away. Keep all other care of both seedlings the same. Have students:
 - a) Formulate questions to be answered by the experiment.
 - b) Measure and record each height daily for two weeks.
 - c) Represent data on a line graph.
 - d) Write a description of the experiment and their conclusion.
5. Examine the data to determine if a numerical generalization can be made between the height of the plant and the number of days of growth.
6. Almost 17,000 animal species are becoming extinct each year because of rain forest destruction. About how many species are becoming extinct each month? (Round to the nearest whole number.)
7. Scientists estimate that a thimble full of rich rain forest soil contains 1,004,225,000 organisms. What digit is in the ten thousands place?
8. Using pipe cleaners, construct the skeletons of several dinosaurs and place them in a museum box for display.

Social Studies

1. Research Henry Blair, an African-American who worked on plantations and invented devices that made the work of slaves easier. He applied for patents for both a seed planter for corn and a seed planter for cotton.
2. Research the Dutch horticulturists who developed many new types of tulips in the early 17th century.

FYI (FOR YOUR IDEAS):