FOREST ACTIVITIES

Section 1
ELEMENTS THAT CREATE FORESTS

Section 2
FOREST ECOSYSTEMS

Section 3
FOREST LEARNING TRAIL

Section 4
SUCCESSION

Section 5
HUMAN USES AND IMPACTS

Breath of Life

Section 1
FOREST ACTIVITIES

Grade Level: K - 12

State Standards: S A-14, S B-1, Geo E-5
NGSS: K-LS1-1, 5-LS1-1, MS-LS1-6., -LS2-5
Subjects: Science, language arts

Skills: Observing, notetaking, applying, analyzing, writing

Duration: 60 minutes and periodic observation

Group Size: 2-4

Setting: Indoors

Vocabulary: Carbon dioxide, oxygen, photosynthesis, recycle

Objectives:
Students will observe the role of plants in releasing oxygen.

Teaching Strategy:
Students conduct experiments to determine the rolel plants play in the web of life.

Complementary Activities:
OUTDOOR: "Forests and Air" *in this section;* "Forests and Sunlight" *and* "Forests and Soils," *both in Section 4, Succession, compare forested and non-forested sites. INDOOR:* "Rain-Making Partners" *in this section.* "Watershed Guardians" *in Section 5, Human Uses and Impacts.*

Materials:
2 medium-sized jars with tight lids, fruit flies or other insects, 1 plant small enough to fit into the jars, 2 pieces of fruit.

Background:
See INSIGHTS, *Section 1, Elements that Create Forests: "The Giving Forests."*

Natural History Tips:
In 1772, scientist Joseph Priestly conducted experiments on air quality. He found that a mouse died if placed in a covered jar by itself, but could live if placed in a jar with a plant. Priestly's discovery eventually led to an understanding that plants remove **carbon dioxide** from the air and return **oxygen**.

Procedure:
1. Students keep a daily log of the experiment. Each page should include the date, the subject, a drawing of it, and two or three sentences describing changes.

2. Students place a piece of fruit in each of two jars. Place the small live plant in one jar. Then, release several fruit flies in each jar and close the lids tightly.

3. Ask the students to predict what they believe will happen over the next several days. Students should record their observations in their journals.

The number of flies in each jar will initially increase if they reproduce. Then, the number of flies in the jar with no plant will decrease as they run out of oxygen. (Fruit flies are short-

lived, so some of those in the jar with the plant will die. As long as they have food, however, they will continue to reproduce, so live ones should remain.)

4. Students compare their experiments to the world around them. (a) Why did the fruit flies in the jar with no plant die even though they had plenty of food? (b) Compare the earth's atmosphere to the air in the jar. (c) Why do astronauts have to wear space suits? (d)What would happen to us if all the forests and plants ceased to exist?

Evaluation:

1. Pairs or groups of students write an analysis of the experiment and the question discussions.

2. Students compare their experiment to real forest issues such as reforestation of beetle-killed or logged forest land. Students present their experiment and their comparisons to another class.

3. Students design other experiments to demonstrate the possible complications of deforestation.

Credits:

Adapted from American Forest Foundation, "Nature's Air Conditioners," *Project Learning Tree Supplementary Activity Guide for Grades 7-12*. 1987.

Curriculum Connections:

(See appendix for full citations)

Books:

Be a Friend to a Tree (Lauber) K-3

Focus on Trees (Ganeri)

How Leaves Change (Johnson)

Photosynthesis (Silverstein)

Science Project Ideas About Trees (Gardner)

Shrinking Forests (Tesar) 7-12

A Tree is Growing (Dorros)

Media:

Trees (Eyewitness Video)

Website:

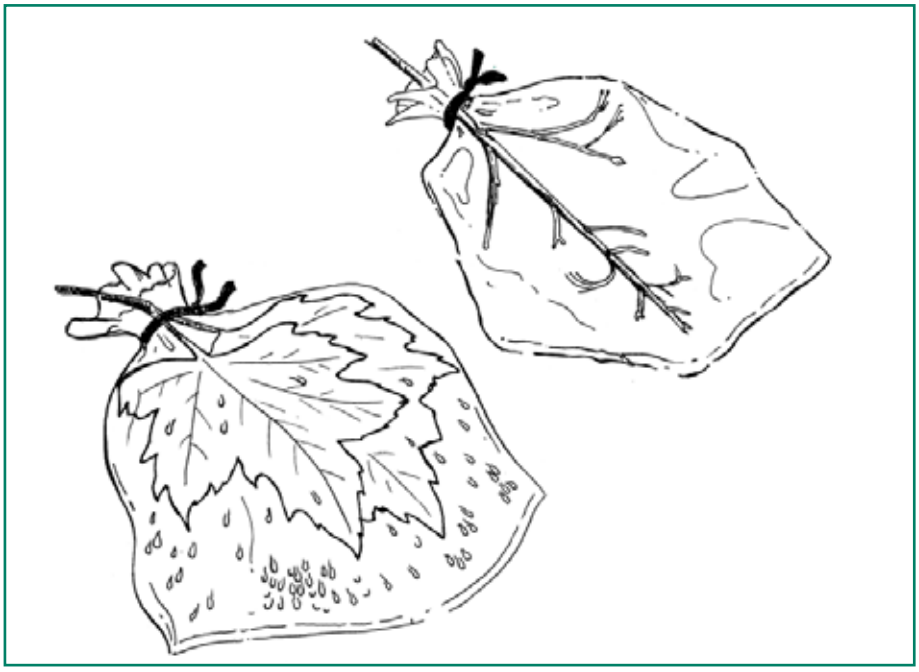
Alaska Science Forum
<www.gi.alaska.edu/ScienceForum>

Teacher Resources:

(See appendix)

Forests help to maintain the balance of oxygen and carbon dioxide in our atmosphere, keeping the air breathable for all living things.

Rain-Making Partners



Section 1
FOREST ACTIVITIES

Grade Level: K - 12

State Standards: S A-14, S B-1, Geo E-5
NGSS: 2-ESS2-3.,5-LS1-1,5-LS2-1 5-ESS2-1, MS-LS1-6, MS-ESS2-4 HS-LS2-5

Subjects: Science, language arts

Skills: Observing, note-taking, applying, analyzing, writing

Duration: 60 minutes and periodic observation

Group Size: 2-3

Setting: Indoors

Vocabulary: Recycle, transpiration, water cycle

Objectives:
Students will learn the role plants play in the water cycle.

Teaching Strategy:
Students will conduct an experiment to demonstrate the process of transpiration.

Complementary Activities:
Any water cycle discussion. *OUTDOOR:* "Forests and Air" *in this section;* "Forests and Sunlight" *and* "Forests and Soils," *both in Section 4, Succession, comparing forested and non-forested sites. INDOOR:* "Breath of Life" *in this section.* "Watershed Guardians" *in Section 5, Human Uses and Impacts.*

Materials:
For every 2-3 students: 2 plastic bags, a live plant with leaves and branches, a branch from a dead plant, rubber bands or twist-ties.

Background:
See INSIGHTS, *Section 1, Elements that Create Forests: "The Giving Forests."*

Procedure:
1. Students keep a daily log of the experiment. Each page should include the date, the subject, a drawing of it, and/or 2 to 3 sentences describing changes.

2. Each group puts a plastic bag around one branch of a live plant (recently watered), and another bag over the dead branch. Seal the bags around the branches using rubber bands or twist-ties. Place both the live plant and the dead branch in the sun.

3. Ask students to predict what they believe will happen over the next several days. As students record their observations, *they should note that water will appear inside the bag on the branch of the living plant, but none will appear inside the bag on the dead branch.*

4. Students compare their experiments to the world around them. If the single branch of the live plant put water droplets into the air, imagine the 80 gallons per day that a tree **transpires** into the air! How much water might a large forest **recycle** into the air? What happens to the water that forests recycle into the air? What would happen if all the forests were lost? How would that affect the **water cycle**?

Evaluation:

1. Depending on grade, pairs or groups of students write an analysis of the experiment and the question discussions.

2. Students compare their experiment to real forest issues such as reforestation of beetle-killed or logged forest land. Students present their experiment and their comparisons to another class.

3. Students design other experiments to demonstrate the possible complications of deforestation.

Credits:

Adapted from American Forest Foundation, "Snow Use," and "Nature's Air Conditioners," *Project Learning Tree Supplementary Activity Guide for Grades 7-12*. 1987.

Curriculum Connections:

(See appendix for full citations)

Books:

Be a Friend to a Tree (Lauber) K-3

How Leaves Change (Johnson)

A Tree is Growing (Dorros)

Water Up, Water Down (Walker)

Water, Water Everywhere: A Book About the Water Cycle (Berger) K-3

Website:

Https://www.gi.alaska.edu/AlaskaScienceForum/administration

Teacher Resources:

(See appendix)

Forests & Air

Section 1
FOREST ACTIVITIES

Grade: K-12
State Standards:
S B-1, S B-5, S C-2
NGSS: 5-LS1-1,5-LS2-1, 5-ESS3-1,-ESS2-1.,MS-LS1-6, MS-ESS2-4, HS-LS2-5

Subjects: Science, social studies

Skills: Observing, measuring, predicting, comparing, contrasting, inferring
Duration: 2 days, 30 minutes classroom, 60 minutes outdoors each day
Group Size: 2
Setting: Outdoors/indoors
Vocabulary: Broadleaf, carbon dioxide, conifer, ground cover, hypothesize, oxygen, shrub, transpiration

Objectives:
Students will conduct an identical set of air quality and moisture experiments and compare the results to learn how forests effect air quality.

Teaching Strategy:
Students conduct identical experiments in two different ecosystems, compare results and draw conclusions.

Complementary Activities:
OUTDOOR: "Forests and Sunlight" *and* "Forests and Soils," *both in Section 4,* Succession, *compare forested and non-forested sites. INDOOR:* "Breath of Life" *and* "Rain-Making Partners," *both in this section.*

Materials:
Small plastic bags, rubber bands, petroleum jelly, index cards, string, pinwheels or wind gauges, and hand lenses for each site. Clipboards and writing paper or field note books, pencils or pens for each student. "Science Cards" for both forested and non-forested sites *(following pages).*

Background:
See INSIGHTS *Section 1, Elements that Create Forests.*

Procedure:
IN ADVANCE, locate two sites for taking measurements, one forested and one non-forested.

DAY ONE

1. Brainstorm potential differences between forested and non-forested sites. Lead the discussion to the differences in wind, dust, and water vapor.

2. Introduce the experiment by asking for ideas on how to measure the differences.

3. Introduce the tools that will be used: wind gauge, petroleum-jelly-smeared cards, and plastic bags. Explain that the students will use these to conduct identical experiments at forested and non-forested sites.

4. Introduce the Science Cards.

5. Have students prepare their observation notebooks by writing the heading "Forests and the Air" across the top of a page. Tell them to draw a line down the center of the page, and put the heading "Forested Site" at the top of the left side and "Non-Forested Site" at the top of the right side.

6. Go OUTDOORS. Each team will set up their experiments at the sites and take initial wind measurements.

7. ***At the forested site***, each team places plastic bags around leafy branches of a **conifer**, a **broadleaf**, and a dead stick. Tightly seal each bag around each branch with a rubber band. *This experiment will work well only if the ground is thawed.*

8. Each team ties an index card to a branch of a tree or shrub, and then spread petroleum jelly over it. This will trap dust in the air.

9. Using the pinwheels or a wind gauge, measure the wind at the site. Students record in their notebooks *(under the appropriate column)* whether they observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

10. ***At the non-forested site***, each team places plastic bags around a leafy branch of a **shrub**, **ground cover** such as grasses, and a dead stick. Tightly seal each bag around each branch with a rubber band. *This experiment will work well only if the ground is thawed.*

11. Each team ties an index card to a branch of a shrub, and then spread petroleum jelly over it. This will trap dust in the air.

12. Using the pinwheels or a wind gauge, measure the wind at the site. Ask students to record in their notebooks *(under the appropriate column)* whether they observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

DAY TWO

Go OUTDOORS. Using the Science Cards as format, students observe, collect, and record data from both sites.

Classroom Follow-Up:

Compare the two sites. Discussion questions include:
(a) Did one site have stronger wind? Which one? Why do students think there was a difference? If students did not observe a difference, do they think they would have found a difference on a windy day? Which do students **hypothesize** would be more windy? Why do they hypothesize this?

(b) Which site had the least dust? Why do students think this difference occurred? Did the leaves of conifers or broadleafs trap dust? How might this affect the air quality?

(c) Based on the bags sealed on branches, did students conclude that the plants were putting moisture into the air (**transpiration**)? *If they did, their answer is correct. A tree may pump 80 gallons of water into the air in a single day.* Which of the two sites do they think is most likely to have moist air?

Students should find less wind and less dust in the forested site, and predict the forested site would have the most moisture in the air. Students should conclude that forests break the wind, remove dust from the air, and add moisture. They should remember that trees and other plants, and therefore forests, add ***oxygen*** *and remove* ***carbon dioxide*** *from the air.*

Evaluation:

Based on their observations, students name three ways that forests affect the air. *(Hint: remember* ***photosynthesis****)*

Curriculum Connections:

(See appendix for full citations)

Books:

America's Forests (Staub)

Biomes of the World (v.1) (Allaby) 7-12

Forests and Woodlands (Pipes) K-6

Taiga (Kaplan)

Taiga (Sayre)

U-X-L Encyclopedia of Biomes (v.3) (Wigel) 7-12

Website:

Alaska Science Forum
<www.gi.alaska.edu/AlaskaScienceForum>

Teacher Resources:

(See appendix)

SCIENCE CARD

Forests & Air: Forested Site

1. Record the data under the column "Forested Site" on the page "Forests and the Air."

2. Measure the wind on this day also. Hold the pinwheel or wind gauge over your head and slowly turn around. If there is any wind, the gauge or wheel will turn. Record whether you observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

3. The card tied on the tree is a trap for dust in the air. Use a hand lens to look at it closely. Record the amount of dust it has collected: (1) none, (2) a few specks, (3) 10-20 specks, (4) 20- 50 specks, (5) over 50 specks.

4. Look at a branch of a conifer tree using a hand lens. Record the number of dust specks on it using the same scale as above.

5. Look at the leaf of a broadleaf tree for dust specks. Record the number of dust specks on the leaf using the same scale.

6. The plastic bags that are tied around the branches of a conifer, a broadleaf, and a dead branch were all dry when tied to these trees. Record which, if any, bags now contain water. How do you think this water got into the bag?

SCIENCE CARD

Forests & Air: Non-Forested Site

1. Record the data under the column "Non-Forested Site" on the page "Forests and the Air."

2. Measure the wind on this day also. Hold the pinwheel or wind gauge over your head and slowly turn around. If there is any wind, the gauge or wheel will turn. Record whether you observe any wind at this site and whether the wind caused the gauge or pinwheel to turn: (1) not at all, (2) very slowly, (3) slowly, (4) fairly quickly, or (5) very quickly.

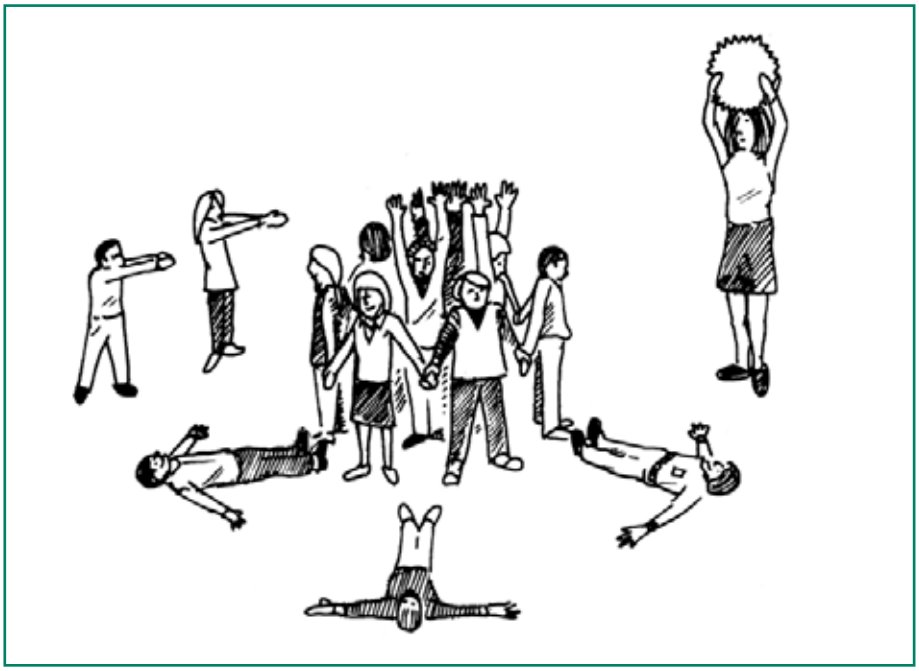
3. The card tied on the tree is a trap for dust in the air. Use a hand lens to look at it closely. Record the amount of dust it has collected: (1) none, (2) a few specks, (3) 10-20 specks, (4) 20- 50 specks, (5) over 50 specks.

4. Look at a branch of a shrub using a hand lens. Record the number of dust specks on it using the same scale as above.

5. Look at the leaf of a shrub or grass blades for dust specks. Record the number of dust specks using the same scale.

6. The plastic bags that are tied around a shrub branch, ground cover plant, and a dead stick were all dry when tied. Record which, if any, bags now contain water. How do you think this water got into the bag?

Role-Play a Tree



Section 1
FOREST ACTIVITIES

Grade Level: K - 4

Subject: Science

NGSS: 4-LS1-1.

Skills: Role-playing, modeling, applying

Duration: 30-90 minutes

Group Size: 17 or more

Setting: Outdoors or indoors

Vocabulary: Bark, beetles, branches, cambium, heartwood, leaves, phloem, photosynthesis, roots, sapwood, tree, trunk, xylem

Objectives:
Students will identify and describe the parts of a tree.

Teaching Strategy:
Students role-play parts of a tree and pantomime the functions of the various parts.

Complementary Activity:
OUTDOOR or INDOOR: "Trees to Imagine" *in this section.*

Materials:
OPTIONAL: large ball or circle of paper painted yellow to represent the sun; twigs and elastic headbands to represent beetle antennae.

Background:
See INSIGHTS *Section 1, Elements that Create Forests,* "Tree Basics" *and* "Inner Workings –Tree Trunks" *Fact Sheets.*

Procedure:
1. Introduce the background of the activity. Draw a diagram of the **tree** on the board and name the parts.

2. Depending on group size, pick 1-3 strong, tall students to be the **heartwood**. These students stand at the center of the space allotted with their backs to each other. *Explain to the class that these students make the tree tall and strong, and that it is their job to hold up the **branches** and **trunk** so the leaves get lots of sunshine. Although the heartwood used to carry water and food, its tubes are now dead.*

3. Choose at least four students to be the **roots**. Some should have long hair to represent the millions of hairs at the end of each root. These students lie down with their feet next to the heartwood, their bodies pointing away from the center, and their hair spread out from their heads.

Explain to the class that Alaska trees have strong roots not very far underground which stretch out from the trunk sideways and help the tree drink water quickly, even in areas that are dry in summer. Roots also help the tree absorb oxygen; too much soil on top of the roots suffocates the tree. Roots serve as an anchor, keeping the tree solidly on the ground even in windy places.

Tell the roots to imagine themselves holding the tree to the ground and taking in water and oxygen. Then have all the roots perform their job: taking in water and oxygen.

When you give the signal, "Let's slurp," all the roots suck in "water."

4. Pick several students to be the **sapwood**, or **xylem**. Select enough children to make a circle all the way around the heartwood. These students stand facing the heartwood and hold hands *(and do not step on any of the roots!)*. Their job is to take water from the roots all the way up to the tips of the branches. *Acting as an efficient pump, the xylem carries many gallons of water every day from the roots to the leaves.* When the leader gives the signal, "Carry the water up," the sapwood takes the water from the roots by raising their hands high in the air and saying "Wheeeeee!"

5. Choose several more students to be the **cambium/ phloem** layer, forming a circle outside the xylem. They stand facing in, or alternating in and out, not holding hands. *Tell the students that the functions of the cambium/ phloem are the growing layer of the tree and taking food made by* ***photosynthesis*** *in the* ***leaves*** *down to all parts of the tree.*

These students pretend their hands are leaves, stretch their hands toward the sun, and make food by wiggling their fingers and hands. Tell the group that their *first* signal is "Let's make food" – students raise their hands and move their "leaves" to take in light energy from the sun and make food. After the leaves make food, the leader gives a *second* signal to "Bring the food down" – students drop the top of their bodies toward the ground and say "Whoooo."

6. After all the students know their signals and their roles, they practice living like a tree. Give the signals: "Let's slurp!" "Let's make food!" "Carry the water up!" "Bring the food down!"

7. Designate 1 or 2 students to wait on the side. Whisper to them that they will become the attacking **beetles** in the next step, and they should go "behind a shrub" and wait.

8. All remaining students should then take the role of the **bark**. These students form a circle around the other parts of the tree and face out. Ask the students to protect the tree. Show the bark a football-blocking stance to use for protecting the tree. Ask students if they hear a distant *whine*, and tell them it is a spruce bark beetle about to attack the tree.

9. Students waiting "behind a shrub" form their fingers into a "drill." They return to the tree as *spruce bark beetles, which drill through the bark to lay eggs in the cambium layer. There the eggs hatch, and the larvae eat tunnels for a year before emerging as adults.*

10. Student beetles circle the tree, attempting to break through the bark's defenses. The bark should try to protect the inner part of the tree.

11. While the beetles circle the tree, the teacher calls out the commands so that the tree people act the parts of the tree. Review the parts of the tree the first time by calling the name of the part and the action signal. Eventually, just give the signals.

VARIATIONS:
A. Have a golden "sun" signal food making instead of the commands. Use a paper cutout or a big ball spray-painted yellow. Walk around the tree raising or lowering the sun over your head. When raised, the sun triggers photosynthesis, and the "tree" wiggles its leaves. When the sun is lowered, the tree doesn't make food.

B. Use twigs to represent antennae on the spruce bark beetle. Hold twigs in place with an elastic headband.

Evaluation:

Students build a tree using these materials: straws, sponges, tiles, sticks, small pieces of green paper, glue, tape, scissors and clay (for a stand).

Credit:

Adapted from Joseph Cornell, "Build a Tree," *Sharing the Joy of Nature: Nature Activities for All Age*s, 1989.

Curriculum Connections:
(See appendix for full citations)

Books:
Bark (Chambers)

Big Tree (Hiscock)

Outside and Inside Trees (Markle)

The Tree (Jeunesse)

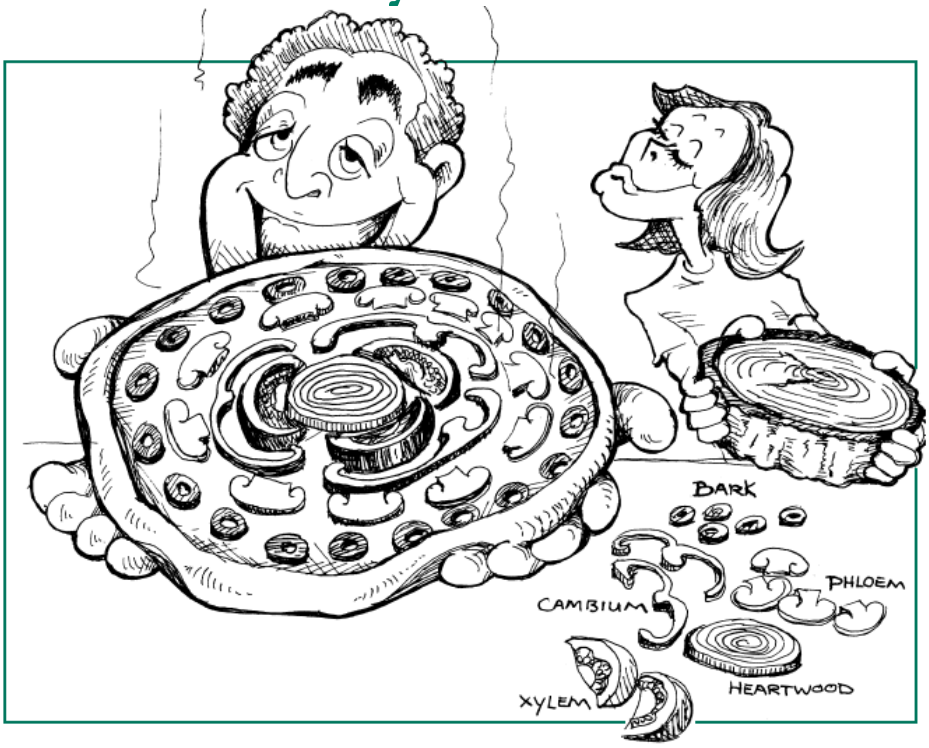
A Tree is Growing (Dorros)

Trees (Eyewitness Explorer) (Gamlin)

Media:
Dirt Made My Lunch (Audio Tape or CD) (Banana Slug String Band)

Teacher Resources:
(See appendix)

Build a Tasty Tree Trunk



Section 1
FOREST ACTIVITIES

Grade Level: 5 - 12

Subject: Science

NGSS: 4-LS1-1.,HS-LS1-1

Skills: Analyzing, comparing

Duration: 2 class periods

Group Size: Groups of 8

Setting: Indoors

Vocabulary: Bark, cambium, consumers, cross-section, crown, heartwood, meristematic tissue, parenchyma cells, phloem, producers, roots, trunk, xylem

Objectives:
Students will identify and describe the parts and functions of a tree trunk.

Teaching Strategy:
Students create edible tree trunk cross-sections and compare them to real tree trunks.

Complementary Activities:
OUTDOOR: "Tree Trunks;" *INDOOR:* "Make a Tasty Leaf," *both in this section.*

Materials:
Copies of "Trees" worksheet *(following pages)*. For every eight students: pizza pan, pizza dough or ready-made crust, tomato sauce, mozzarella cheese, paring knives, oven, pizza cutter, plates. Vegetables such as onions, zucchini, broccoli or asparagus stems, corn kernels, peas, carrots, cooked potatoes.

Background:
See INSIGHTS *Section 1, Elements that Create Forests,* "Inner Workings – Tree Trunks" *Fact Sheet.*

Procedure:
DAY ONE:

1. Draw a diagram of the tree trunk on the board. Review its main parts with the class. Complete the "Trees" worksheet.

2. Describe the activity. Explain that each group of eight students will assemble an edible tree trunk cross- section. List the tree trunk parts once again – bark, phloem, cambium, xylem, heartwood – and ask each group to brainstorm a vegetable that might represent that part on a pizza. Remind them to consider the role each part plays in the function of the tree.

3. If the students are stumped (pun intended), you might suggest: **bark** – mushrooms, onions, artichoke leaves; **phloem** – zucchini, celery; cambium: corn kernels, peas; **xylem** – broccoli stems, asparagus stems; **heartwood** – carrot slices, cooked potato slices.

4. Each group will bring in vegetables ready to put on a pizza, or have a shopping committee purchase the ingredients. Ask for pizza pan, dough, cheese, and sauce contributions.

DAY TWO:
1. Prepare the pizza base with dough (the **"soil**") on the bottom, tomato sauce **(water**) next, and then a layer of grated cheese **(minerals**). These are all needed for the tree to exist. Assemble the cross-sections with the vegetables.

2. Bake each pizza 10-12 minutes at 450ºF or as recommended for that particular dough.

3. Eat and enjoy.

4. During or immediately after the feast, discuss the concept that plants are the **producers** of food not only for themselves, but for most of the animal world. We are **consumers**. What other creatures are consumers?

VARIATION
Instead of a tree pizza, make tree trunk cross-sections with non-edible objects, Each student can work individually to create a cross-section suitable for display using found or recycled materials.

Evaluation:
Students sketch and label cross-sections of a tree trunk.

Credit:
Adapted with permission of National Wildlife Federation, *Trees are Terrific!* (Ranger Rick's NatureScope), 1992.

Curriculum Connections:
(See appendix for full citations)

Books:
Bark (Chambers)

Focus on Trees (Ganeri)

Outside and Inside Trees (Markle)

Science Project Ideas About Trees (Gardner)

Tree (Eyewitness Book) (Burnie)

Media:
Dirt Made My Lunch (Audio Tape or CD) (Banana Slug String Band)

Think about the Planet (Audio Tape) (Rodden)

Teacher Resources:
(See appendix)

Trees Worksheet

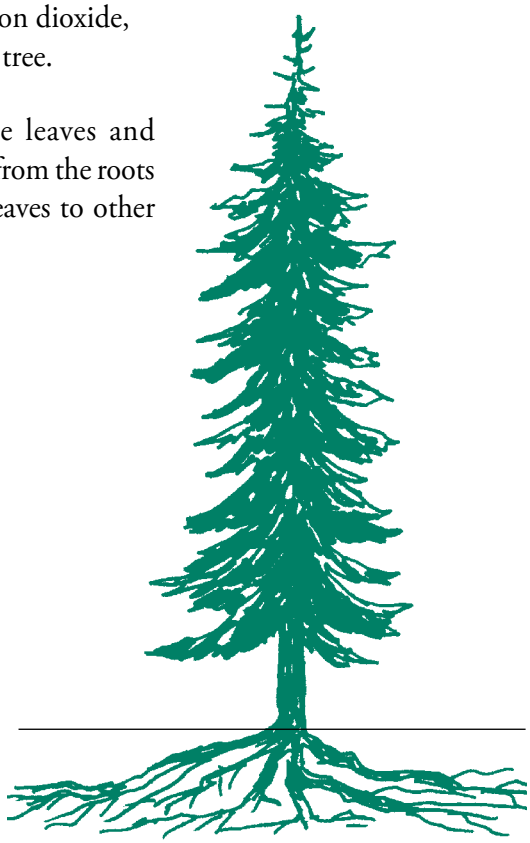
Name _____

Use the following words to fill in the blanks below: **bark, cambium, cross-section, crown, heartwood, leaves, meristematic tissue, phloem, roots, trunk, xylem**

1. The _____ of a tree is made of the leaves and branches.

2. _____ use sunlight, carbon dioxide, and water to make sugar (food) for the tree.

3. The _____ holds the leaves and branches up, carries water and minerals from the roots to the leaves and sugars made in the leaves to other parts of the tree.

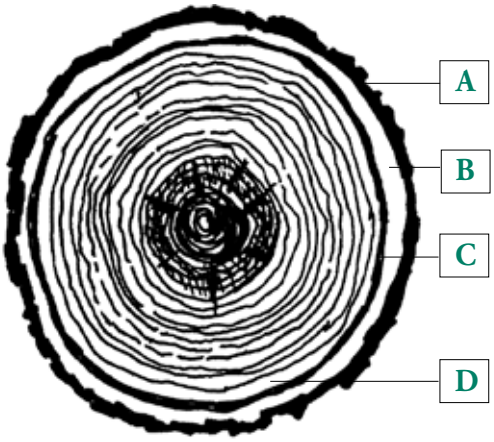


4. When trees are cut for timber, the logger wants the _____ which makes up most of the trunk.

5. The tips of the branches and roots have actively growing and dividing cells called _____.

6. _____ anchor the tree to the ground and get water and minerals from the soil.

7. This drawing shows a _____ of a tree trunk.



Fill in the blank spaces. Then write the letter identifying the correct part of the tree in the box at the end of the statement.

8. The _____ protects the tree from insects, diseases and weather. ☐

9. The _____ is the living and growing part of the tree. ☐

10. The sapwood or _____ carries water and minerals from the roots to the leaves. ☐

11. The _____ carries sugars made in the leaves to other parts of the tree. ☐

Make a Tasty Leaf

Section 1
FOREST ACTIVITIES

Grade Level: 5 - 12

Subject: Science

NGSS: 4-LS1-1., HS-LS1-1

Skills: Analyzing, comparing

Duration: 2 class periods

Group Size: Groups of 8

Setting: Indoors

Vocabulary: Chlorophyll, chloroplasts, consumers, cross-section, cuticle, epidermis, leaves, mesophyll, palisade layer, phloem, photosynthesis, producers, spongy layer, stomata, veins, xylem

Objectives:
Students will identify and describe the parts and functions of a tree leaf.

Teaching Strategy:
Students create edible leaves and compare them to real leaves.

Complementary Activities:
OUTDOOR OR INDOOR: "Tree Leaf Relay;" *INDOOR:* "Build a Tasty Tree," *both in this section.*

Materials:
Copies of "Leaves" worksheet and "Leaf Mold" directions *(see following pages).* For every eight students: one shallow square or rectangular glass pan. For each pan: one (6 oz) package of green gelatin, two envelopes of clear gelatin. Apples, bananas, green grapes, melons (preferably two kinds that can be cut into long strips and then split lengthwise), water, paring knives, spoons, mixing bowl, stove, refrigerator or freezer.
OPTIONAL: green food coloring, whipped cream.

Background:
See INSIGHTS *Section 1, Elements that Create Forests,* "Inner Workings – Tree Leaves" *Fact Sheet.*

Procedure:
Allow for four 30-60-minute intervals while gelatin sets.

Collect the food ingredients and utensils. Ask for food contributions. Locate a refrigerator or freezer for fast setting of the gelatin.

DAY ONE:
1. Draw a diagram of a leaf on the board. Review its parts with the class. Complete the "Leaves" worksheet.

2. Divide students into groups of eight. Give each group a copy of the leaf mold directions.

3. Each group should slice apples **(stomata**) through the core and layer them on the bottom of the glass pan in pairs. Each pair of apple slices should form a pattern like an "O."

4. Prepare the green gelatin according to the package directions. Add a few drops of green food-color (optional). Pour a layer **(epidermis**) just to cover the apples. Keep the remaining gelatin covered at room temperature. Chill the apple/gelatin layer until the gelatin is firm (one hour – or less in a freezer – to overnight).

5. Prepare the clear gelatin. Hold at room temperature.

6. Cut two kinds of melons into strips. Cut strips in half lengthwise and stack one from each melon on top of the other **(xylem** and **phloem**). The combined strips should be no higher than 1/2 inch. Lay them in a row **(vein**) on the middle of the green gelatin.

7. Cut the bananas **(spongy layer**) into pieces about 1/2 -inch thick and loosely cover the rest of the gelatin, leaving spaces.

8. Pour half of the clear gelatin **(mesophyll**) over the banana and melon. Cool until the clear layer is firm.

DAY TWO:
1. Arrange the green grapes (palisade layer) in tight rows on the firmed clear layer. Pour the last half of the clear gelatin **(mesophyll**) over the grapes.

2. When the clear/grape layer is firm, pour the last green gelatin layer **(epidermis**) on and cool until firm.

3. Optional: Spread whip cream **(cuticle**) over the top.

4. Before cutting into the leaf mold, ask students if they can figure out what each layer represents. Discuss the layers and their functions.

5. Discuss the concept that plants are the **producers** of food, not only for themselves, but for most of the animal world. We are **consumers**. What other creatures are consumers?

VARIATIONS:
A. Substitute vegetables for the fruits.

B. Combine the tree pizza *(previous activity)* and leaf mold for a single plant feast.

Evaluation:
Students sketch and label cross-sections of a tree leaf.

Credit:
Adapted with permission of National Wildlife Federation, *Trees are Terrific!* (Ranger Rick's NatureScope), 1992.

Curriculum Connections:
(See appendix for full citations)

Books:
Focus on Trees (Ganeri)

How Leaves Change (Johnson)

Outside and Inside Trees (Markle)

Science Project Ideas About Trees (Gardner)

Tree (Eyewitness Book) (Burnie)

Teacher Resources:
(See appendix)

Leaf Mold Directions

1. Slice apples through the core and layer them on the bottom of the glass pan in pairs. Each pair of apple slices should form a pattern that looks like an "O."

2. Prepare the green gelatin according to the package directions. Add a few drops of green food color (optional). Pour a layer just to cover the apples. Keep the remaining gelatin covered at room temperature. Chill the apple/ gelatin layer until the gelatin is firm (oone hour – or less in a freezer – to overnight).

3. Prepare the clear gelatin. Hold at room temperature.

4. Cut two kinds of melons into strips. Cut strips in half lengthwise and stack one from each melon on top of the other. The combined strips should be no higher than 1 /2 inch. Lay them in a row on the middle of the green gelatin.

5. Cut the bananas into pieces about 1 /2-inch thick, and loosely cover the rest of the gelatin leaving spaces.

6. Pour 1 /2 of the clear gelatin over the banana and melon. Cool until the clear layer is firm.

7. Arrange the green grapes in tight rows on the firmed clear layer. Pour the remaining clear gelatin over the grapes.

8 When the clear/grape layer is firm, pour on the last green gelatin layer, and cool until firm.

9. Optional: Spread whipped cream over the top

Leaves Worksheet

Name _____

Write the following words on the appropriate lines: **chlorophyll, chloroplasts, cuticle, epidermis, mesophyll, palisade, phloem, photosynthesis, spongy, stomata, vein, xylem**. Then write the letter identifying the correct part of the leaf in the box at the beginning of each statement.

1. _____ is the process of making food from light, carbon dioxide, and water.

2. The pigments that absorb light energy and produce the green color of plants are called _____.

☐ 3. The outer waxy layer of the leaf is the_____.

☐ 4. The _____carries the "food" manufactured in the leaf to other parts of the tree.

☐ 5. The "skin" of the leaf is also known as the _____.

☐ 6. The _____ of the leaf contains the xylem and phloem tubes.

☐ 7. The middle area of the leaf where light, water, and gas exchanges happen is called the _____.

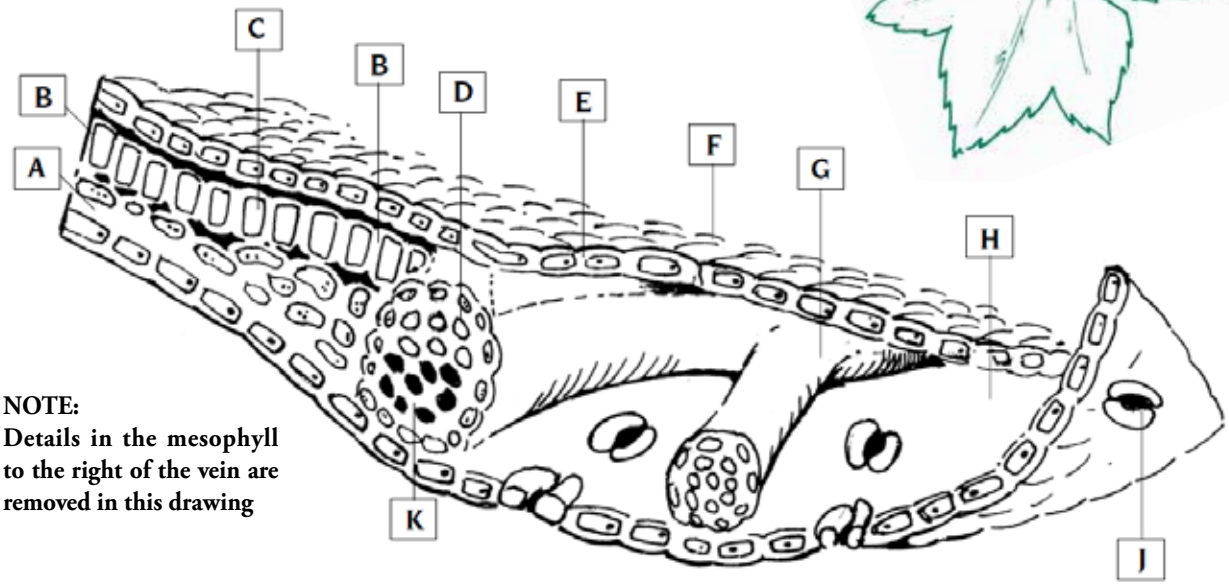
☐ 8. The _____ layer is where light is absorbed in photosynthesis.

☐ 9. _____ are the thin-walled cylindrical cells in the palisade layer that contain chlorophyll.

☐ 10. _____cells carry water and dissolved minerals in the leaves.

☐ 11. _____ are the small pores on the underside of the tree's leaves that open to absorb carbon dioxide.

☐ 12. The _____ layer is where most gas exchanges occur in the leaf.



NOTE:
Details in the mesophyll to the right of the vein are removed in this drawing

Trees to Imagine
3 EXTENSIONS

Section 1
FOREST ACTIVITIES

Grade Level: K - 5

Subjects: Science, language arts, dramatic arts
NGSS: 4-LS1-1., 5-LS1-1

Skills: Listening, visualizing, identifying, describing

Duration: 20-30 minutes

Group Size: Individual

Setting: Indoors or outdoors

Vocabulary: Broadleaf, cone, conifer, crown, deciduous, evergreen, roots, sap, seeds, trunk

Objectives:
1. Students will name the parts of a tree and describe the function of each.

2. Students will describe the seasonal cycle in the life of a tree.

Teaching Strategy:
Students imagine themselves to be trees in the forest.

Complementary Activity:
OUTDOOR/INDOOR: "Role-Play a Tree" *in this section.*

Materials:
Copy of a guided imagery *(following page or story of your own)*

Background:
See INSIGHTS *Section 1, Elements that Create Forests.*

Procedure:
1. Outdoors: Students stand against the trunk of a tree, close their eyes, and imagine that they are the tree. Indoors: Students draw each part of the tree as it is discussed in the guided imagery.

2. Guide the students through a year of a tree as you review the roles of the various parts of a tree by reading the story.

3. If you want to change this guided imagery or repeat it with a **deciduous broadleaf** tree, change the shape of the crown and add details about leaves changing, falling in autumn, and growing again in the spring.

4. In summary, ask students to name the parts of a tree and their jobs. Ask students to name changes that take place in the annual cycle of tree life.

Evaluation:
1. Students name the parts of a tree and describe their functions.

2. Students describe changes in the life of a tree over a year.

EXTENSIONS:
A. **Adopt a tree.** For an ongoing extension, each student adopts a tree in the area. Students can keep daily or weekly observation logs on their trees throughout the year. Encourage students to draw conclusions from their observations.

GUIDED IMAGERY:

You are a **conifer** tree. Your **crown** is shaped like a cone and stretches far up into the sky. Your **trunk** is straight and strong, so strong that winds don't blow you over. Your trunk holds up all your branches and needle-like leaves.

Your **roots** are planted solidly in the cool soil. They grow only a few inches below the ground and stretch outward from your trunk as far as your trunk reaches skyward. They mingle with the roots of other trees of your forest. Your roots are soaking up water and minerals from the soil Those nutrients (called **sap**) are slowly drawn upward through the inner layers of your trunk. You feel the cool moisture traveling upward, then out to your branches and into your leaves.

Your **leaves** look pretty just hanging there, but they are really busy working. Leaves are the kitchens of trees. They are soaking up warm sunshine and the cool air. They mix sunshine and carbon dioxide from the air and add water sent up from your roots. This makes a feast of sugars.

These sugars move from your leaves and slowly seep through the outer layers of your branches and trunk to reach all parts of you. These sugars are food for your trunk so it can grow taller and stronger. These sugars are food for your cones and the seeds that are forming inside. And these sugars are food for your roots so they can grow longer and find more water and minerals.

Day in and day out, your **sap** flows through your trunk. Your leaves are busy capturing the energy of sunlight. You grow taller. You grow new leaves at the tips of your branches. And you form new **seeds** and **cones** to protect the seeds..

Soon summer is ending. The cool air dries your leaves and the wind shakes some needles from your branches. Just as the thick bark on your trunk and branches protected you from the insects and sun of summer, now that bark protects you from cold, dry winds. Some mornings there is frost creeping over your roots, making your sap flow more slowly.

By the time the winter snows fall, you have stopped growing for a while. You keep your needles so you are called **evergreen**. Your roots hold you solidly to the ground as the winter winds howl and toss your branches. When the wind stops, your branches fill with heavy snow, bending them to the ground. You sleep and wait for warmer weather, more sunshine, and another season to grow.

You have lived through 100 winters. Months of cold and darkness move slowly before you feel spring arriving. Then, one day, cold meltwater begins to seep through the soil; your roots wake to the icy cold water. You begin growing again as the sunlight shines on you for longer hours.

A bird perches in your branches and sings a song. It's spring and time to get busy. You begin adding another ring of cells to your trunk, more branches and leaves to your crown, and you begin making more seed cones. Life continues.

Measure each tree's girth and height during the year. *To measure height by triangulation, see "Champion Tree" in Section 5.* In multi-grade classes, students can measure their tree from year-to-year.

B. **Build a classroom tree with "found" parts.** Build a classroom tree using real, "found" tree parts. Draw the shape of a tree on a large piece of butcher paper. Glue on small branches, bark, leaves, cones, and others that the children bring to class. Caution them about not tearing off living plants.

C. **Build a classroom tree with paper.** Build a model of a tree in the classroom. If you use long cardboard tubes from

wrapping paper, you have a way to make "winter trees" or tree silhouettes.

(1) Collect as many wrapping paper tubes, paper towel tubes, toilet tissue tubes, and drinking straws as you can, to represent trunks and long branches, shorter branches, and twigs.

(2) Stand the long tubes in a 5-gallon bucket filled with sand.

(3) Cut slits along the long tubes and attach long and shorter tubes for branches and twigs. Try to make a pattern resulting in silhouettes of various Alaska tree species.

Credits:

Adapted from Susan. Quinlan, "Alaska's Forests: More Than Just Trees." *Alaska Wildlife Wee*k, Alaska Department of Fish & Game, 1987.

Extensions contributed by Jean Ward, Chugach Optional School, and Patrick Ryan, Northwood Elementary, Anchorage, Alaska.

Curriculum Connections:

(See appendix for full citations)

Books:

Ancient Ones, The World of the Old-Growth Douglas Fir (Bash)

Just a Dream (Van Allsburg)

Old Elm Speaks (O'Connell) (Poetry)

Owl Moon (Yolen)

Tree of Life, The World of the African Baobab (Bash)

Media:

Billy B Sings About Trees (Billy B)

Teacher Resources:

(See appendix)

Tree-Leaf Relay

3 EXTENSIONS ***ALERT: ALASKA ECOLOGY CARDS OPTIONAL***

Section 1
FOREST ACTIVITIES

Grade Level: 3 - 12

State Standard: SA-12, SA-15
NGSS: 3-LS4-3. 4-LS1-1. MS-LS1-4

Subjects: Science, physical education, math

Skills: Observing, comparing

Duration: 30 minutes or more

Group Size: 1-4

Setting: Indoors /outdoors

Vocabulary: Broadleaf, conifer, deciduous, evergreen

Objectives:

1. Given a set of pictures, students will identify the major Alaska tree species (or trees in your area).

2. Given a set of pictures, students will distinguish conifers from broadleaf species.

Teaching Strategy:

Students use leaves or pictures of them in a relay race to identify or classify common Alaska trees.

Complementary Activities:

OUTDOOR: "Tree Identification;" *INDOOR:* "Make a Tasty Leaf," *both in this section. OUTDOOR:* "Champion Tree" *in Section 4, Succession.*

Materials:

A set of tree pictures *(all available in the* Alaska Ecology Cards *series)* or leaf specimens from a variety of the following trees: balsam poplar, black cottonwood, willow, paper birch, alder, aspen, mountain ash, mountain hemlock, Alaska cedar, tamarack, lodgepole pine, white spruce, black spruce, Sitka spruce, western hemlock. Copies of "Broadleafs and Conifers" worksheet *(following pages),* pencils, paper.

OPTIONAL: construction paper leaves (enough leaves for two teams), a collection of live branches from Alaska trees, copies of "Alaska's Trees" worksheet *(following pages).*

Background:

See INSIGHTS *Section 1, Elements that Create Forests:* "Tree Basics," "Alaska's Broadleaf Trees," "Alaska's Conifer Trees," and "Profiles of Alaska's Forests" *Fact Sheets.*

Procedure:

1. *BEFORE CLASS,* place tree cards from the *Alaska Ecology Cards* or other pictures of trees at different stations around the room. If leaves and live branches are available, put them next to the cards. Whenever possible, take students outside to look at the species of trees nearby.

2. Students visit each station, noting traits that will later help them identify the tree and its leaves.

3. After students have observed the cards and/or specimens, review the differences they see between broadleafs and conifers. Each student labels a paper with two columns, BROADLEAFS and CONIFERS, and places each trait in the appropriate column. Distribute the "Broadleafs and Conifers Worksheet."

4. Take students outside. Divide the class into several teams. Each team makes a collection of dead leaves from the trees nearby, noting the species. Students collect enough dead leaves from each type of tree to share with each team. *Treat the trees gently; do not strip live leaves from the trees.* If necessary, the teacher can use clippers to cut small samples from live trees.

5. On one side of the relay area, make a pile of leaves for each team. Include at least one leaf from each kind of tree in both piles. Make a third pile with sample leaves of all the species for the teacher. Teams line up on the opposite side of the area.

6. When the teacher holds up a sample leaf and/or calls out the name of the tree, the first student in each team runs to that team's pile, finds a matching leaf, and holds it up for the teacher to check. After positive identification, the player returns the leaf to the pile and goes to the end of the line. A team receives a point for each correct leaf identification.

7. Play until everyone has had a turn, or as long as time and interest permit.

8. Back in the classroom, students list the names of the trees observed in the game. They describe the differences between broadleafs and conifers.

Evaluation:

1. Students list three differences between broadleaf trees and conifers.
2. Students identify 2-10 Alaska tree species from pictures or live samples.
3. Given the worksheet, "Alaska's Trees," students match the names of trees with the pictures.

EXTENSIONS:

A. **Illustrate a guide to Alaska trees.** Students make their own illustrated "Alaska Tree Log." The class can decide on evaluation criteria and format.

B. **Create a video on community trees.** Students work in teams of 2-4 to create a nature-guide video for Alaska trees, describing each tree's characteristics and name.

C. **Bark and leaf rubbings.** Students make bark and leaf rubbings of different tree species using drawing paper and the flat edge of a crayon. Label and identify.

Credit:

Adapted from the American Forest Foundation, "Leaf Hunt Relay," *Project Learning Tree Supplementary Activity Guide for Grades K-8,* 1987.

Curriculum Connections:

(See appendix for full citations)

Books:

Alaska Trees and Shrubs (Viereck)

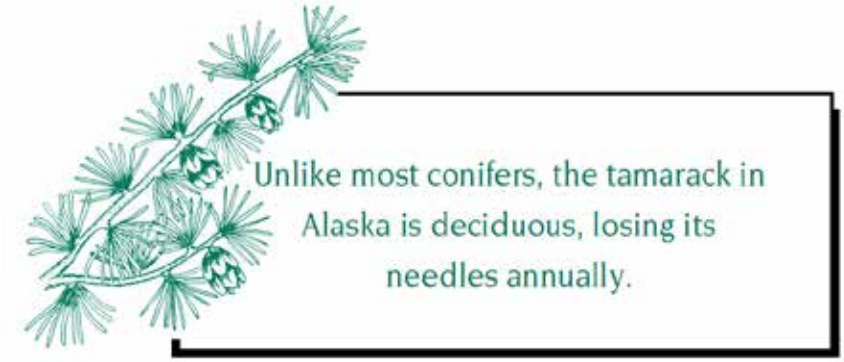
Crinkleroot's Guide to Knowing the Trees (Arnosky) 3-5

National Audubon Society First Field Guide: Trees (Cassie)

Tree (Eyewitness Book) (Burnie)

Teacher Resources:

(See appendix)

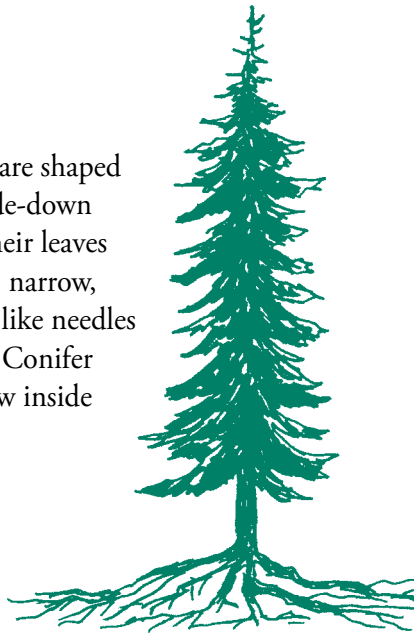


Broadleafs and Conifers Worksheet

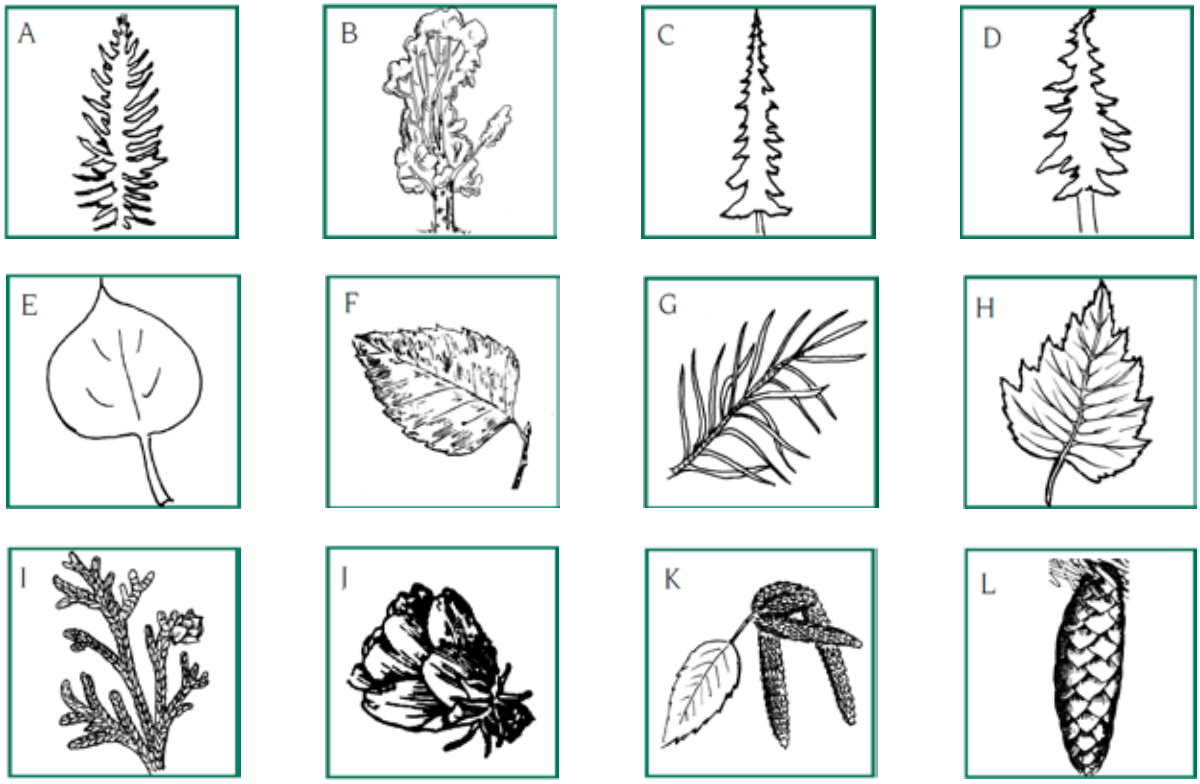
NAME_____

Broadleaf trees have broad, flat leaves. Their seeds grow in flowers.

Conifers are shaped like upside-down cones. Their leaves are small, narrow, and look like needles or scales. Conifer seeds grow inside cones.



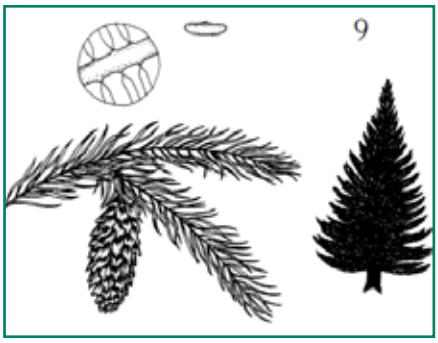
Some of the pictures shown below are of conifers and some are of broadleafs. **Circle** the letter of each **broadleaf** drawing. Put a **square** around the letter of each **conifer** drawing.

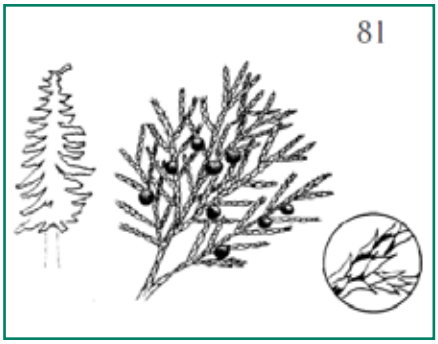


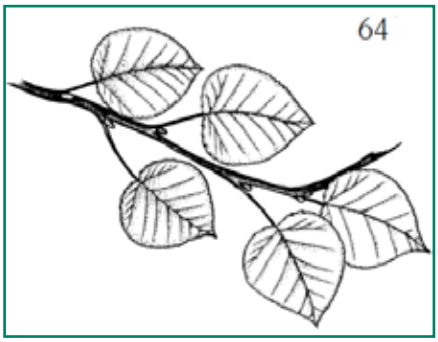
Alaska's Trees Worksheet

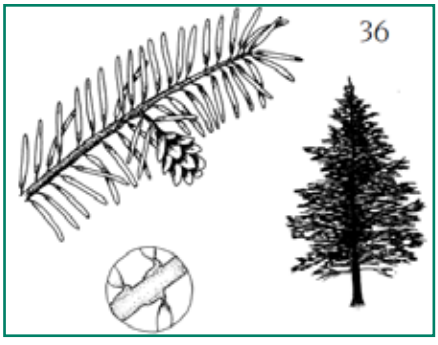
NAME_____

Match each drawing to the correct tree name. Write the name in the box of the appropriate picture. You can check your answers by finding the square root of the number in the corner of each square. The answer will match the number of the correct name.









1. White spruce
2. Black spruce
3. Sitka spruce
4. Tamarack
5. Lodgepole pine
6. Western hemlock
7. Birch
8. Aspen
9. Alaska cedar
10. Alder
11. Willow
12. Mountain ash

List the numbers of the trees that are conifers.

List the names of the trees that grow in your area. (You may need to consult a reference book.)

Tree Identification

1 EXTENSION ***ALERT: ALASKA ECOLOGY CARDS OPTIONAL***

Section 1
FOREST ACTIVITIES

Grade Level: 4 - 12

State Standards: S A-14
NGSS: 4-LS1-1.

Subjects: Science, math, art

Skills: Observing, measuring, identifying, drawing

Duration: 1 class period

Group Size: Individuals

Setting: Outdoors & indoors

Vocabulary: Alternate branching, broadleaf, compound leaves, conifer, opposite branching, simple leaves, twigs, whorled branching

Objectives:

Students will identify and illustrate characteristics of various Alaska trees.

Complementary Activity:

OUTDOORS or INDOORS: "Tree Leaf Relay" *in this section. OUTDOOR:* "Champion Trees" *in Section 4, Succession.*

Materials:

Clipboards and writing paper or field note books, pencils or pens. Tree Identification Science Cards *(following)*. Small ruler; hand lens; crayons (brown, black, and green); *Alaska Ecology Cards* or a field guide to tree identification such as *A Golden Field Guide: Trees of North Americ*a, or *The Audubon Society Field Guide to North American Trees.*

Background:

See *INSIGHTS Section 1, Elements that Create Forests: "Alaska's Broadleaf Trees," "Alaska's Conifer Trees"* and *"Profiles of Alaska's Forests" Fact Sheets.*

Procedure:

IN ADVANCE, find an outdoor site where there are examples of the different trees in the area.

1. *IN CLASS,* discuss the activity. Depending on grade level, lead the children through the steps on the "Science Card" or ask them to complete the activity independently.

Classroom Follow-Up:

1. Students use their field notes and the *Alaska Ecology Cards* or a field guide to trees to identify the trees they saw. They write the name in the column "Species."

2. Below the tree's name, students write one trait that will help them separate it from similar trees.

EXTENSION:

Compile a mural of bark and leaf rubbings. Students take rubbings from the variety of local trees and leaves and create an artistic mural for the classroom or hall. Label each rubbing with the name of the tree, but conceal the name under another flap of paper. Fellow students try to guess the tree's name and lift the flap to see if they guessed correctly.

Curriculum Connections:

(See appendix for full citations)

Books:

Alaska Trees and Shrubs (Viereck)

Field Guide to Western Trees (Petrides)

Golden Field Guide to North American Trees (Brockman)

National Audubon Society Field Guide to North American Trees: Western Region (Little)

National Audubon Society First Field Guide. Trees (Cassie)

Tree (Coombs)

Websites:

Audubon On Line Field Guides <www.enature.com>

Teacher Resources:

(See appendix)

Tree Identification Task Card

1. Look at the "Tree Identification Chart." It shows some of the different shapes and characteristics of Alaska trees and their parts. Notice the different types of tree shapes, branching arrangements, and leaf shapes.

2. Turn your notebook so that the long side of the page is facing you. Write the heading "Alaska Trees" along the new top edge of the page. Write these headings across the page to form columns as shown :

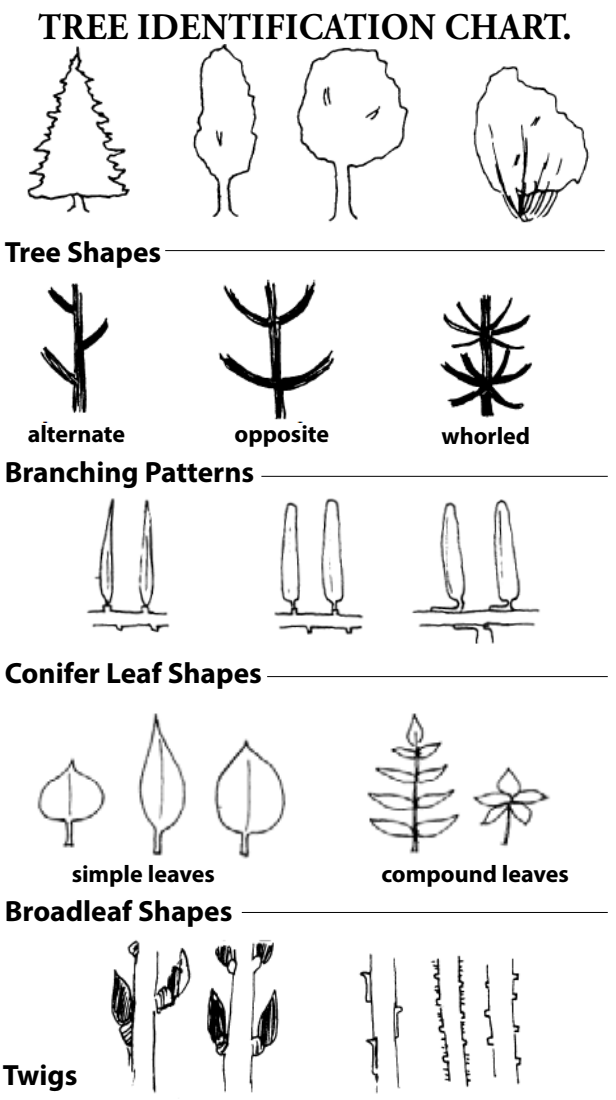
TREE SHAPE BRANCHING LEAVES TWIG BARK SPECIES

3. Look at the nearest tree and fill in your Alaska Trees chart with drawings of the shape and branching of this tree. Make a crayon rubbing of the bark by holding your paper against the bark and rubbing a crayon over the top of the paper. Make a rubbing of the leaf by placing the leaf under the paper, then rubbing the crayon over it.

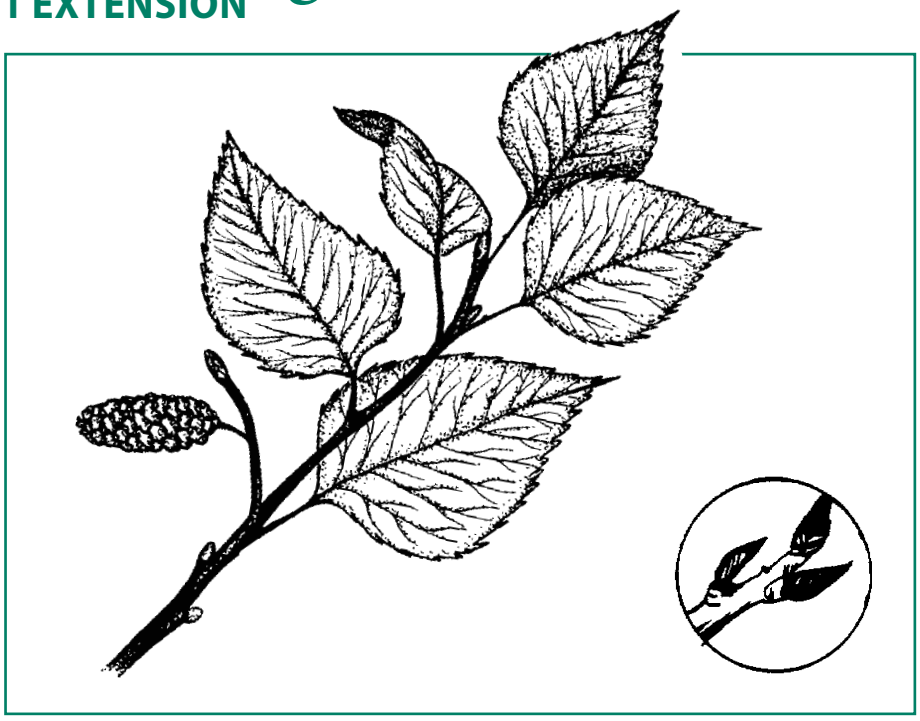
4. Measure the length of a leaf using a ruler and write this measurement below your crayon rubbing.

5. Look at a twig at the end of a tree branch. Draw the twig. Examine it with the hand lens. Is it covered by small hairs, or is it smooth? Write hairy or smooth under your drawing of the twig.

6. Draw a line under these drawings, then find a different kind of tree and repeat Steps 3-5. Complete your chart so it includes information on all the kinds of trees in this area. Use a second page if you need it.



Tree Twig Growth Rate
1 EXTENSION



Section 1
FOREST ACTIVITIES

Grade Level: 7 - 12

State Standards: S A-15, SB-1, SB-5
NGSS: MS-LS1-5 MS-LS2-1.

Subjects: Science, math

Skills: Observing, comparing, analyzing, mapping, graphing

Duration: 30-60 minutes

Group Size: Whole class

Setting: Indoors or outdoors

Vocabulary: Dormant, terminal bud

Objectives:
1. Students will determine the growth rate of a tree based on the number of terminal bud scars.

2. Students will infer environmental conditions based on varying lengths of annual growth as depicted by terminal bud scars.

Teaching Strategy:
Students will identify terminal bud scars on a deciduous tree or bush by locating closely spaced, fine lines encircling twigwood.

Complementary Activities:
OUTDOOR: "Tree Identification " *and* "Tree Trucks" *in this section, and* "Forests and Sunlight" *in Section 4, Succession. INDOOR:* "Build a Tasty Tree" *and* "Tree History – Your History" *in this section.*

Materials:
If the activity is conducted outside, students can use live specimens. If in the classroom, samples of twigwood must be collected. Magnifying lenses, measurement devices, and record sheets.

Background:
See INSIGHTS, *Section 1, Elements that Create Forests.*

Procedure:
1. Explain to students that many trees produce buds at the end of the summer growing season. These buds remain **dormant** during the winter until warmer weather causes the buds to open in the spring.

The location of a **terminal bud** on the twig creates a discoloration on the tree bark and leaves a scar of several closely-spaced, fine lines that encircle the twig. Each terminal bud scar marks the end of a year's growth.

2. Students will examine twigwood, beginning at the end of the branch and moving back toward the trunk, noting each bud scar to determine the growth rate of that twig. *As the twigwood becomes a branch, the thicker bark obscures the end of a year's growth.*

3. Students will use measurement devices to determine growth patterns as indicated by the spacing of the bud scars. *These growth patterns reflect varying environmental conditions that influenced the growth of the tree through time.*

For example, a growth spurt would be indicative of favorable environmental conditions.

4. If students are conducting this experiment on live specimens, they can compare growth pattern on twigs at different locations on the same tree to determine if environmental conditions, such as greater amount of sun on one side of a tree, affect the twig growth on a single tree.

Evaluation:

Beginning with the most recent terminal bud scar, students will date a twigwood specimen.

EXTENSION:

Map trees studied and graph results. If the activity is conducted outside on live specimens, students will map the location of the trees studied. Working backward from the most recent terminal bud scar, students will graph the rate of growth for each of the twigwoods examined. Students will then examine their data to determine if, within their sample area, environmental fluctuations occurred that affected the annual growth of the trees.

Credits:

Adapted by Jeanne L. Williams, teacher at Kingikmiut School, Wales, Alaska, from *Botany for All Ages – Discovering Nature Through Activities Using Plants,* Jorie Hunken and the New England Wild Flower Society, The Globe Pequot Press, Chester, CT, 1989.

Curriculum Connections:

(See appendix for full citations)

Books:

Science Project Ideas About Trees (Gardner)

Focus on Trees (Ganeri)

Tree (Eyewitness Book) (Burnie)

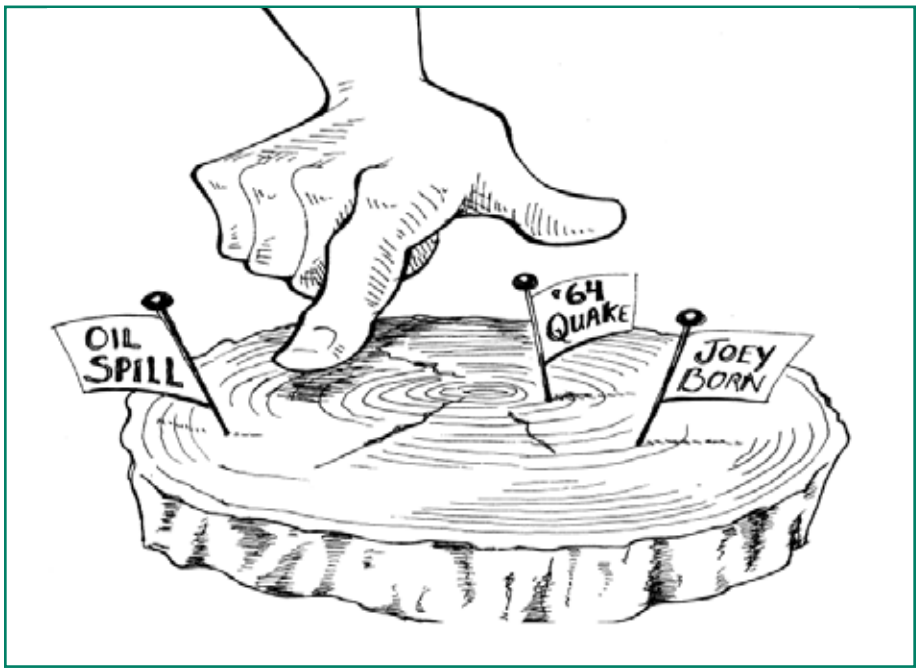
Trees (Eyewitness Explorer) (Gamlin)

Teacher Resources:

(See appendix)

Tree History – Your History

2 ACTIVITIES, 1 EXTENSION



Section 1
FOREST ACTIVITIES

Grade Level: K - 12

State Standards: S A-15, S B-1, S B-5, AC A-2, AC E-2

NGSS: K-LS1-1.K-ESS3-1,K-ESS3-3 2-LS2-1, 2-LS4-1, 2-ESS1-1. 3-LS3-2.,3-ESS2-2,4-LS1-1,5-PS3-1.,5-LS1-1. ,5-ESS3-1. MS-LS1-5.,MS-LS1-6.,MS-LS2-1. , MS-ESS3-2,MS-ESS3-3, MS-ESS3-5, HS-LS1-5,HS-LS2-1. ,HS-ESS3-5.

Subjects: Science, social studies, art, math

Skills: Reasoning, comparing, observing, describing

Duration: 60 minutes

Setting: Indoors

Vocabulary: Annual rings, cambium, core sample, cross dating, cross-section, dendrochronology, drought, earlywood, increment bore

Objectives:

1. Given a cross-section of a tree, students will describe how the annual life cycle of a tree affects the appearance of its annual rings.

2. Given a cross-section of a tree, students will determine the age of the tree.

Teaching Strategy:

Students determine the age of a tree and describe events which may have influenced its appearance. Students could use this method to learn about this history of their community.

Complementary Activities:

OUTDOOR: "Tree Trunks" *in this section; and* "Champion Trees" *in Section 4, Succession. INDOOR:* "Build a Tasty Tree Trunk" *in this section.*

Materials:

Cross-sections of tree trunks from several different trees (can be obtained from students, Division of Forestry, Christmas tree sales lot, firewood, driftwood), T- or large ball-head pins, yarn, scissors, pencils, paper, chalkboard or flip chart, and writing materials. Copies of worksheets "Reading the Rings, Part One," and "Reading the Rings, Part Two" *(following page*s).

Background:

See *INSIGHTS Section 1, Elements that Create Forests: "Reading Tree Rings" Fact Sheets.*

Procedure:

Reading the Rings, Part One

1. *IN ADVANCE,* obtain enough recently-cut tree cross-sections for groups of 2-4 students. If using Christmas tree butts, a short time span will be represented, since most Christmas trees are harvested between 6 and 25 years of age. If saw-marks blur the tree rings, students should sand the butts or re-cut them with a bow saw.

2. *IN CLASS,* explain how tree rings are made and what constitutes one annual ring. Each group of students decides how old its tree was when it was cut. Students calculate what year the tree started to grow.

3. Each group finds the rings that correspond to the years

their classmates were born. Use pins to mark the ring(s), and the yarn to connect the ring to a label outside the cross-section. The label could be glued to poster board or pinned to a bulletin board. Another way to do this is to make a small "flag" with the date and event written on a label attached to a pin. Stick the pin "flag" into the annual ring which corresponds with the date of the event.

4. Use pins to mark other significant dates. For example, how large was the tree when:

(a) students were in first grade?
(b) the school was built?
(c) the community was settled?
(d) Alaska became a state?
(e) other dates corresponding to events students are studying in history.

Attach a label to these or your own important dates with additional yarn (or make more flags).

5. Examine the cross-sections for differences in growing conditions during the years the tree lived. *Christmas tree butts will have fewer variations in ring size, as they are a controlled crop and conditions are optimal for their life span.* Discuss with students the possible reasons for the variations in the patterns of rings.

6. Give each group the cross-sections of four different trees to compare using the information in "Reading the Rings." Review events which might influence tree growth. Ask students to match the cross-sections with possible growing conditions. Review conditions influencing ring width and ring irregularities. The following descriptions refer to the illustrations in worksheet "Reading the Rings, Part One".

• A fallen tree leaning against the growing tree might cause wider rings on one side and tighter rings on the other side of the cross-section. Growing on a slope may have the same result. (Illustrated cross-section A)

• A forest fire causes scars. (Illustrated cross-section B)

• A branch broke off, or was cut off, and the tree grew over the break. (Illustrated cross-section C)

• Drought, damage from insect attack, or construction may cause narrow rings. Loss of leaves results in little food production. Root damage results in reduction of water and mineral supplies. (Illustrated cross-section D)

7. Students apply their understanding and come up with three other events which might limit the growth of a tree.

Procedure:

Reading the Rings, Part Two

Note: In the following part of the activity, we have adapted cross-dating techniques. Dendrochronologists look at the pattern of rings to cross-date trees. To make it easier for students, we've instructed them to lay the core samples on top of the cross section to match the over-lapping sections. With real trees the distances between the rings would never match perfectly. Dendrochronologists also core many trees in one area to get an accurate representative sample of the growth rings in similar trees.

1. Distribute copies of *"Reading the Rings, Part 2"* worksheet to each person.

2. Explain that the large cross section at the top of the page is from a tree that was used to build a cabin along the Iditarod trail. They must find out when the cabin was built by finding out when the tree started growing and when it was cut down. *(The students can assume that the cabin was built the same year the tree was cut.)* They can also discover when some events happened during the life of the tree. To find out, they must study the core samples at the bottom of the page.

3. Explain what a core sample is and how a core sample is taken. Have the students cut out each core sample, making sure they leave the lettered tabs attached.

4. Describe how dendrochronologists cross-date trees by matching similar ring patterns in a core sample with those in an unknown-age cross-section. Explain that only one of the three cores is from a tree that grows in the same area where the log (cross-section) once grew. It has an interval of rings that over-laps with a section of the tree trunk at the top of the page. The students must first decide which core matches the trunk cross-section.

5. To do this, they should take one of the core samples and try to match its pattern of lines with a section of the rings on the round cross-section. *(See the "Cross-dating technique" illustration for how to do this. Remind them that core samples go no farther than the center of the tree, so they should not extend the core sample across the center of the cross-section.)*

6. When they've discovered which core sample overlaps the cross-section *(core sample B)*, they should count backward on the core sample to find the dates when the core sample matches the cross-section. Remind them that the line closest to the letter on their tab is the annual ring from 1985.

7. Once they determine the dates, they can figure out when the tree was cut and when it first started growing. *(It was cut in 1930 and started growing in 1896.)* Tell them that historical records kept during that time indicate that the cabin was abandoned in 1933 only three years after it was built. What was happening along the Iditarod trail during this time that might have caused people to abandon their cabin? *(The Iditarod gold mining was a bust and newcomers probably learned quickly that they couldn't get rich.)*

8. Then have the students assign dates to some of the events in the tree's life. What year did fire scar the tree? *(1915)* How many years did it take for the tree to grow around the remains of a dead branch? *(10 years)* How long did the drought that began in 1912 last? *(2 years)*

9. Wrap up the activity by asking the students for ideas on other things that cross-dating can reveal.

Evaluation:

1. Students name the parts and functions of the rings in a cross-section of a tree.

2. Students observe a cross-section of a tree and list events which might cause differences in the width of tree rings. They describe how each event might influence the size of the ring.

EXTENSION:

Use tree rings as a basis for local history research. If available, use rings taken from recently cut, local trees. Repeat the above activity and then have students gather information about the history of their community corresponding with the life of their tree. Historic photographs and oral histories are an excellent source of information for this extension.

Credits:

Adapted with permission from the American Forest Foundation, "Tree Cookies," *Project Learning Tree Activity Guide for Grades K-6*, 1994. Reprinted with permission of National Wildlife Federation, *Trees are Terrific!* (Ranger Rick's NatureScope), 1992.

Curriculum Connections:

(See appendix for full citations)

Books:

Be a Friend to a Tree (Lauber) K-3

Crinkleroot's Guide to Knowing the Trees (Arnosky) K-5

Focus on Trees (Ganeri)

Once There was a Tree (Romanova) K-3

Outside and Inside Trees (Markle)

Science Project Ideas About Trees (Gardner)

Shrinking Forests (Tesar) 7-12

Tree (Eyewitness Book) (Burnie)

A Tree is Growing (Dorros)

Media:

Once There was a Tree (Video) (Reading Rainbow)

Teacher Resources:

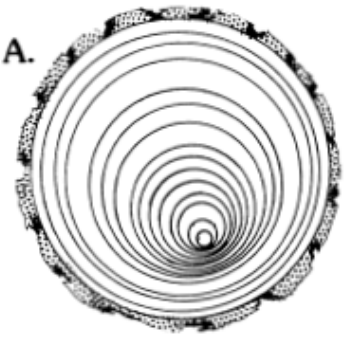
(See appendix)

Reading the Rings, Part One

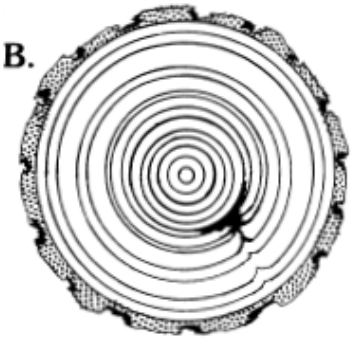
NAME _____

What events have influenced the growth of these trees? Draw a line from each cross-section to a matching event. (*More than one event can explain the growth pattern!)*

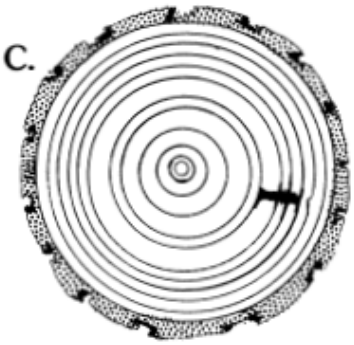
A.



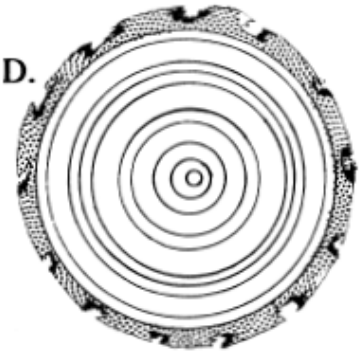
B.



C.



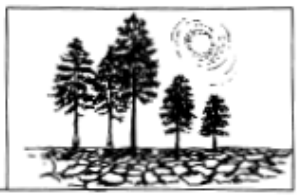
D.



1. *Fallen tree* _____

2. *Fire* _____

3. *Drought* _____



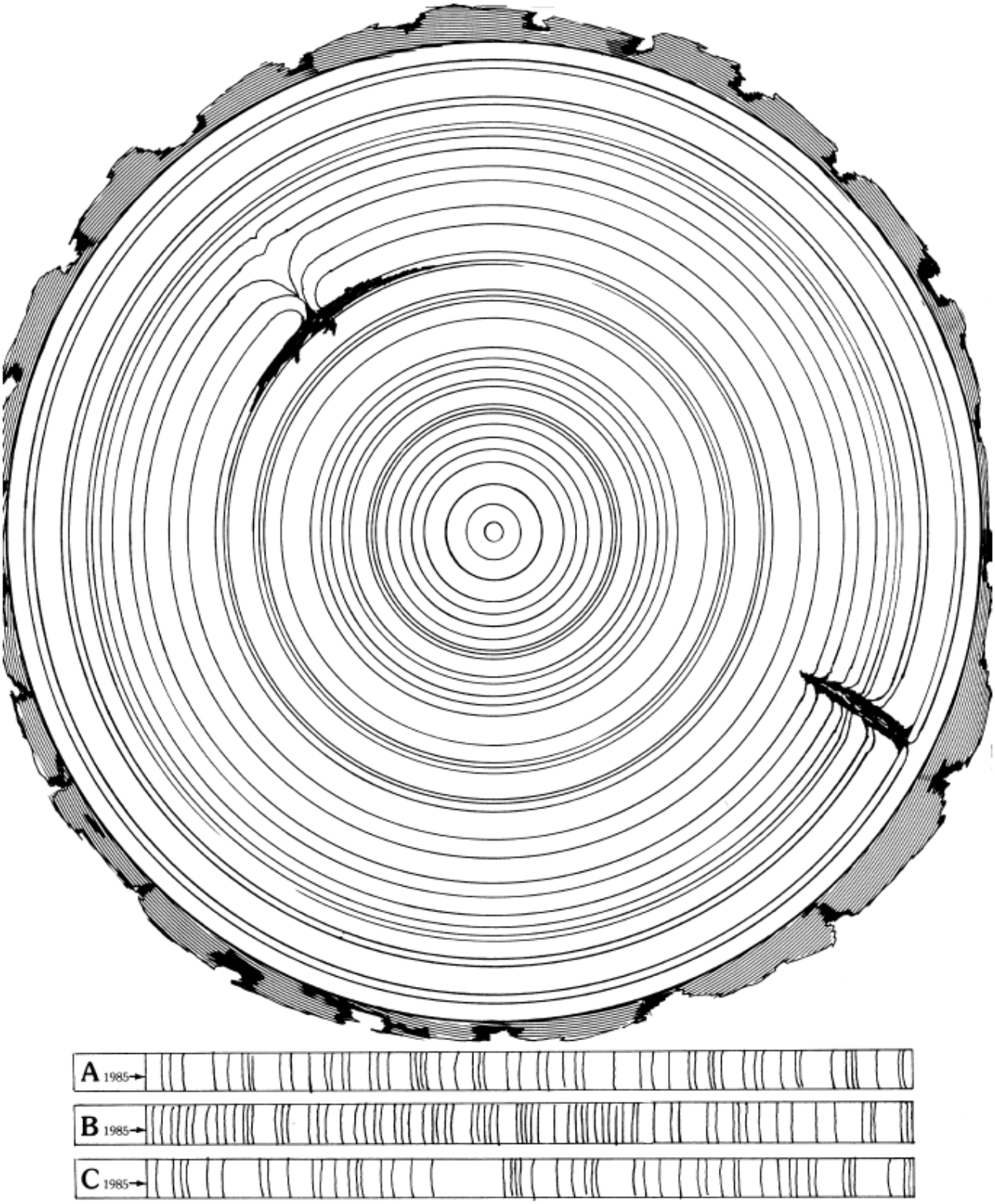
4. *Insect attack* _____

5. *Construction* _____

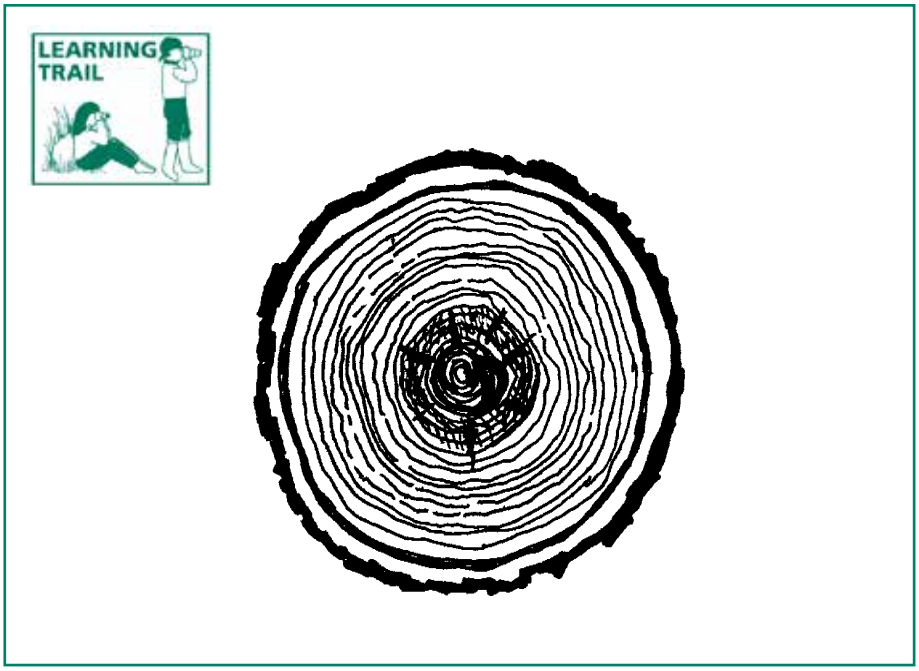
6. *Growing on slope* _____

7. *Dead branch* _____

Reading the Rings, Part Two



Tree Trunks



Section 1
FOREST ACTIVITIES

Grade Level: 4-12

State Standards: S B-1, S B-5, S B-6
NGSS: 4-LS1-1., 5-PS3-1.,5-LS1-1. 5-ESS3-1.MS-LS1-5.,MS-LS1-6. MS-LS2-1.,MS-ESS3-3.,HS-LS1-5. HS-LS2-1.,HS-ESS3-5.
Subjects: Science, math

Skills: Observing, measuring, counting, estimating

Duration: 1 class period

Group Size: Individuals

Setting: Outdoors & indoors

Vocabulary: Annual rings, bark, cambium, circumference, heartwood, phloem, sapwood, xylem

Objectives:
Students will use a cross-section of a tree trunk to identify the function of the tree rings and infer environmental conditions that affected the growth rate of the specimen.

Complementary Activities:
OUTDOORS: "Champion Trees" *in Section 4, Succession. INDOORS:* "Tree History – Your History" *and* "Build a Tasty Tree," *both in this section.*

Materials:
Clipboards and writing paper or field note books, pencils or pens. Yard or meter stick; length of string.
OPTIONAL: Increment borer *(contact local foresters with the USDA Forest Service or State Division of Forestry if you want to use one of these tools*).

Background:
See *INSIGHTS Section 1, Elements that Create Forest: "Inner Workings - Tree Trunks" and "Reading Tree Rings" Fact Sheets.*

Procedure:
IN ADVANCE, locate an outdoor site where trees have been cut recently so that the annual rings are still visible. Or place a cross-section of a tree trunk cut elsewhere at a convenient site with a variety of other age trees.

If you have access to an increment borer, you could take a core from a living tree. Ask a forester for specific instructions on boring trees safely.

IN CLASS, discuss the activity. Depending on grade level, lead the children through the steps on the "Science Card" or ask them to complete the activity independently.

Classroom Follow-Up:
1. Students estimate the age of each unknown tree at the Tree Trunk site by using the following formula:

$$\text{Age of Unknown Tree} = \frac{\text{Age of Known Tree X Circumference of Unknown Tree}}{\text{Circumference of Known Tree}}$$

2. Did the ages of the trees vary at the site? By how many years? What factors might cause this method of estimating tree ages to give incorrect estimates?

Inaccurate estimates may result because different trees may have grown at different rates. Other trees may have lived through more bad or good years than the sample tree, and thus have a relatively smaller or larger trunk. Comparisons of different tree species would also cause errors; different species grow at different rates.

Curriculum Connections:

(See appendix for full citations)

Books:

Outside and Inside Trees (Markle)

Science Project Ideas About Trees (Gardner)

Tree (Eyewitness Book) (Burnie)

Teacher Resources:

(See appendix)

SCIENCE CARD

Tree Trunks

1. Write the heading "Tree Trunks" across the top of a page in your notebook. Record your answers to the questions below, and make any calculations on this page.

2. Look at the cross-section of tree trunk and try to identify the various layers: the **heartwood** (center), the **sapwood** or **xylem**, the **cambium**, the **phloem**, and the **bark**. Measure each part and record its thickness (inner to outer edge).

3. Can you see the **annual rings**? Count the very center as one, then count the number of dark rings to find out how old the tree was when it was cut. Record your answer as: Tree Age = _____.

4. Did you notice that the rings are various distances apart? Find the 2 that seem closest together. These indicate a year when the tree did not grow very much. It may have been a very dry year, or a year when the tree lost many of its leaves to insects or fire. How many years ago did this occur?

5. Find 2 rings that are spaced furthest apart. These indicate a year that the tree grew well. This was probably a year with plenty of moisture, few insects, and warm temperatures. How many years ago did this occur?

6. As you know, even if this tree were alive and standing, only the cambium layer would be growing. The heartwood, sapwood, phloem, and bark do not grow. If the bark is dead and doesn't grow, how does the tree trunk manage to get larger as the tree gets older?

7. You will later be able to estimate the ages of other trees in this area by comparing their trunk measurements to the measurement of this tree whose age you know. *First* measure the **circumference** of this tree by measuring the length of string that is needed to go all around the trunk at the height of a person's shoulders. *Record* this measurement next to the tree's age. *Then* measure and record the circumferences of 10 other trees in this area. You'll want to select both large and small trees.