Overview – As Easy as 1-2-3!

Step 1

Discover how trees grow, function, and conserve and produce energy

UNIT A - Learning Objective: Growth & Function

- Students will identify structural components of a tree, be able to explain how these components help a tree grow and function, illustrate the process of photosynthesis, and reflect on the benefits trees provide to the environment. (Pages 2-14)

Basic Activity:

- Role-play the growth process of a tree

Extension Activities:

- Searching for Stoma
- Leaf Transpiration (See UNIT B below for a related Extension Activity)

UNIT B - Learning Objective: Energy Conservation & Production

- Students will be able to describe how tree placement can conserve or produce energy and demonstrate best planting locations for different tree types. (Pages 15-26)

Basic Activity:

- Design an energy wise community using trees

Extension Activities:

- Temperature and Transpiration
- Energy Food Chain

Units A & B Student Handouts (6) & Worksheet

(Pages 27-34)

Conservation Tip:

If you received this book in digital format (PDF) and would like to print it out, why not try printing the pages out double-sided?

You'll use half the paper and reduce waste!

Step 2

Create a poster

Basic Activity:

- Students will create a poster that reflects their understanding of how trees grow, function, benefit the environment, conserve and produce energy, or a related urban tree-based topic, or any combination of these. (Page 35)

Step 3

Celebrate Arbor Day

Basic Activity:

- Students will plan and participate in an Arbor Day celebration. Indiana Arbor Day is celebrated on the last Friday in month of April. (Page 36)

Step 1

UNIT A - Discover how trees grow and function

BASIC ACTIVITY - Role-play the growth process of a tree

GROWTH & FUNCTION

Classroom Activity:

- Students will role-play the growth process of a young tree to become familiar with the structural components of a tree and learn how these components help the tree function

Objectives:

Students will be able to:

- name several environmental benefits and products trees provide
- identify structural components of a tree and explain how these components help a tree function
- describe the process and major components involved in the process of photosynthesis

Time Recommended:

- 60 - 90 minutes

Materials Needed:

- Photocopied Student Handouts #1-3 on pages 27-29
- One or two examples of tree fruits/seeds (i.e. acorn, walnut, apple with seeds)
- Several samples of bark, if available
- Small plant in pot (optional)
- Hand lenses (optional)
- Approximately 6 foot piece of ribbon or yarn
- Pencil and paper
- Tree cross-section or picture of a cross section
- 2 small bottles of water
- 6 small packets of sugar
- Red, blue, green, yellow & brown construction paper
- Tree Labels on pages 12 & 13 photocopied, cut and pasted onto strips of colored construction paper, per instructions
- Ball of string or twine
- Paper clips (one per label)

Indiana Academic Standards - Science (2016) Correlation:

Physical Science
• 5.PS.1, 5.PS.2, 5.PS.3
Life Science
• 5.LS.1, 5.LS.2

Instructional Sequence:

Concept #1 - Trees benefit people and the environment in many ways

Start the classroom discussion by reading Paragraph #1.

Paragraph #1

Recently I read a story in the newspaper about a community that was experiencing environmental problems. The stream in the city was always brown from soil erosion after a heavy rain. The air was hazy because of the smog. The city's buildings and pavements reflected so much heat that the summer temperature was uncomfortably hot. The people in the city were concerned and were looking for some way to improve conditions in their community. A bright young student told the city leaders she had a solution to their problem. She had an invention that could clean the air, produce fresh oxygen, prevent soil erosion, cool the sidewalks, muffle traffic noise, and could last many years with just a little care. And, she added, it could operate on solar power from the sun.

Ask students if they think, with modern technology, such an invention is possible. Could there really be something that would clean and cool the air, make fresh oxygen, prevent soil erosion, and muffle noise – all operated on solar energy? If so, what do they think something like this might cost? Allow students to respond without comment.

After students have had an opportunity for input, continue by reading Paragraph #2.

Paragraph #2

The young student went on to describe other features of the unique invention. She said that along with helping the environment, this invention would provide homes and food for birds and other animals, kids could climb on it, and it would make the community more attractive. If many of these things were available some could eventually be made into things people could use like paper, houses, baseball bats, or even medicine. And when it was no longer useful, this invention was biodegradable or could be used for fuel. She said this thing was not new, but something that had been around for years.

Ask students: *Can you guess what "invention" this young student was referring to?*

By now many students may have guessed that you have been describing a tree. If students are still mystified, continue to give more clues *(i.e. This invention is a living thing, it bears fruits and seeds, it grows, it provides shade, etc.)* If students still do not realize you have been describing a tree, you may need to spend extra time as you introduce and go through each of the following concepts.

With student input, do a quick review of the benefits we get from trees. List the benefits on the board. Encourage students to add additional environmental benefits or tree products to the list.

Write the following questions on the board. Explain they have just discussed the first question, but by the end of the lesson, they should know the answer to all these questions.

1. How do trees benefit the environment?
2. How does a small seed grow into a huge tree?
3. What are the important parts of the tree that work together to help the tree grow and reproduce?
4. How does a tree use sunlight to make its own food?

Concept #2: A tree has many interdependent structural components that are essential for the tree to grow and reproduce.

Starting as a Seed

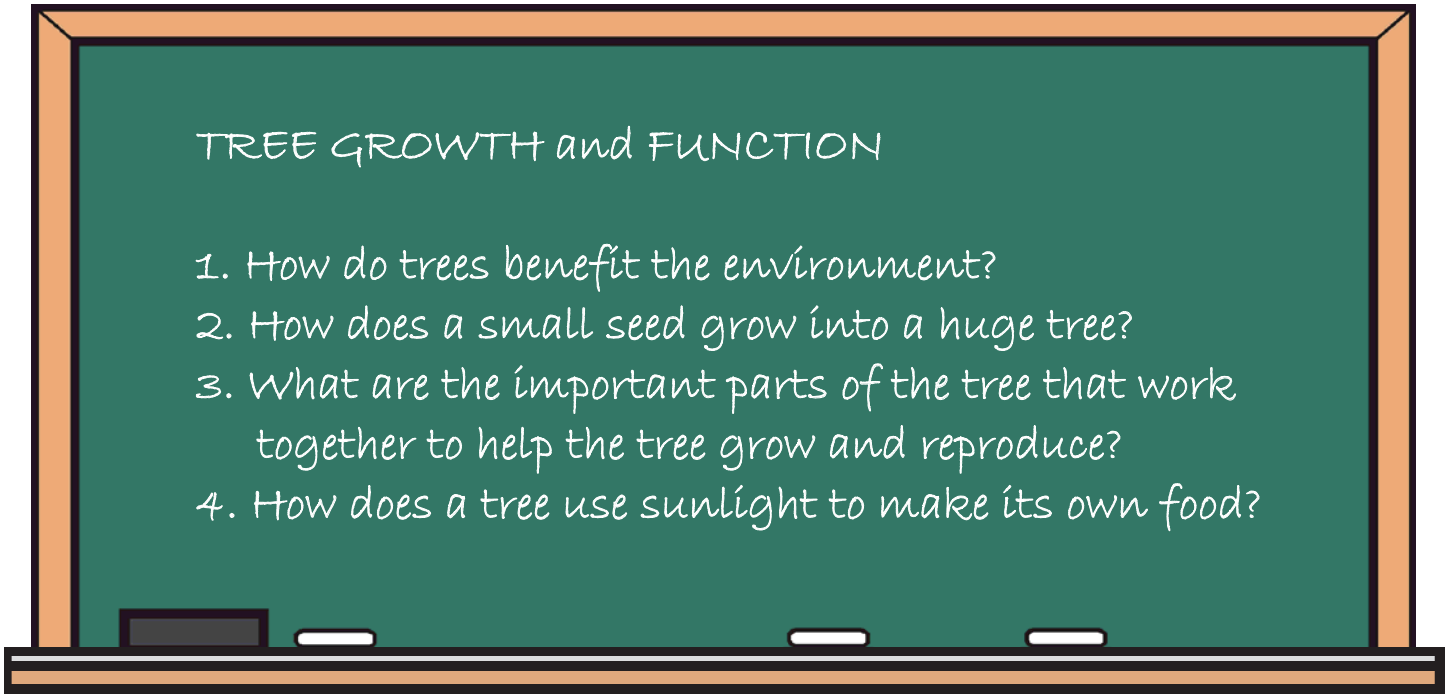
Hold up an acorn, or any available tree seed. Tell students that a tree starts very small...as small as a tiny seed. This seed could someday grow into a tree taller than a house. A tree produces many seeds, but not all seeds fall where conditions will allow them to grow. Only a few seeds actually survive and grow to a tree. But when a seed lands in a good location...and rain comes at the right time...the little seed softens and begins to grow.

Ask students what they think happens first when a seed starts to grow.

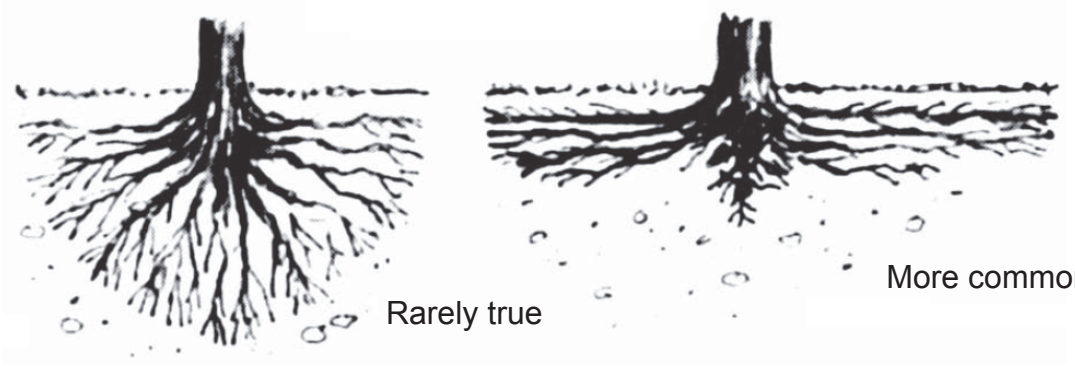
Roots

Tell students that when a seed **germinates** (starts to grow), the first thing the seed sends out is a tiny root to hold its position in the soil and start drawing in water.

As a tree grows larger it develops several kinds of roots. A few trees have long **taproots** that go deep down into



Examples of root growth



the soil, but most trees have shallow, **lateral roots** that lie closer to the surface of the ground. About 85% of a tree's roots are within the top 18" of soil! Most trees are likely to have roots extending out about one and a half to two times the branch spread. (See illustration)

Make a similar quick-sketch picture of a tree and its spreading root system on the board to give students a sense of the lateral, rather than downward, spread of the root system.

Have students work as pairs. One student in each pair should extend their arms like branches, standing on tiptoe with feet together, and pretend to be a tree. *Ask what they think would happen if the wind came up?* The other student in each pair should simulate this by supporting their partner with one hand and giving their partner a very gentle push with the other hand. Repeat the demonstration with the student standing with legs slightly spread and feet flat on the floor. *Ask students what they think this activity showed.* Confirm that one function of the roots is to keep the tree anchored in the soil so it doesn't fall over. In some ways, tree roots are like your feet – when they spread out, the tree is more stable.

The taproot and lateral roots are large, hard and woody; they contain cells for the storage of sugar, just like the trunk and branches. But as these larger roots spread out, they branch into smaller and smaller roots called rootlets, fine fibrous roots covered with tiny **root hairs**. These root hairs suck in water and nutrients from the soil that the tree needs to live. These fibrous roots cling firmly to the soil in order to better absorb water and nutrients. By doing so, the roots also hold the soil in place and protect it from erosion. Tree roots are tenacious in their search for moisture and nutrients. Where soft earth is lacking they will move through clay and gravel, and even into rock.

Root Activity (optional) - A first hand observation of a root is important. Even though a smaller plant won't have the same woody root structure as a tree it is worth the time to study its roots.

Remove a small plant from the pot. Point out to students how the soil remains packed around the bottom of the plant. *Ask them to speculate why that is so.* (The roots are holding the soil in place.) *Ask students to think of ways plants could be used to prevent soil erosion.* Shake the soil off the roots. Break off sections of root and allow children to look at them with a hand lens. *Ask students to make observations about the roots they examine.* Can they see the tiny root hairs? How are the plant roots like the tree roots just discussed; how are they different?

Ask students if they think the plant can survive without its roots. Put the plant and soil back in the pot or set the plant in container of water and observe it over the next several days to see what happens after roots have been damaged.

As an extension activity, if time permits, take students on a walk and notice the above ground tree roots that may be visible, especially in an urban setting. Discuss their similarity to the branches on the same tree. Are the roots causing problems with the cement or ground around them? Observe small trees or plants rooting in cracks in the sidewalks. Have students make observations about the strength of roots.

Trunk Form and Function

Many of these internal tree parts will be new to your students. Background information is included for all the tree parts to share as you look through the Student Handouts #1 & 2 together (pages 27 & 28). Encourage student questions and observations as you examine the Tree Cross-Section illustration on the handout. Student Handout #3 on page 29 contains a vocabulary list of bolded words and a rubric.

Teacher Background Information:

Every tree trunk resembles a cylinder whether long and slender or short and stout. The tall, stately trunk of the eastern white pine and the small, short trunk of the redbud both perform the same function.

A tree trunk is largely composed of a compact mass of tiny tubes made of cells. Great numbers of these hollow tubes serve as pipelines that conduct water and nutrients absorbed by the roots up to the leaves. These are called **xylem cells**, or **sapwood**, and they make up what we commonly refer to as the wood of the tree. Others cells, called **phloem**, or **inner bark**, carry the sugar food made by the leaves back down to the living parts of the tree. Located between these two pipelines is the **cambium**, the growing layer of the tree. Deep in the center of more mature trees are old xylem cells that have become thick and solid, providing strength for the tree. This part of the tree is referred to as the **heartwood**. Surrounding the outside of the trunk and branches are old dead phloem cells commonly called outer **bark** that serve as a protective covering for the tree.

Cambium

In a layer only one cell thick that completely encloses the entire trunk, limbs, and all the branches, rests the tree's ability to grow and create new cells. This layer is called the vascular **cambium**. Some new cells formed in the cambium move outward to become phloem cells, others move inward to become xylem cells. Essentially this layer creates new wood on one side of itself and new bark on the other. As it increases the tree's internal girth the cambium moves outward, pushing the bark before it, leaving the wood behind.

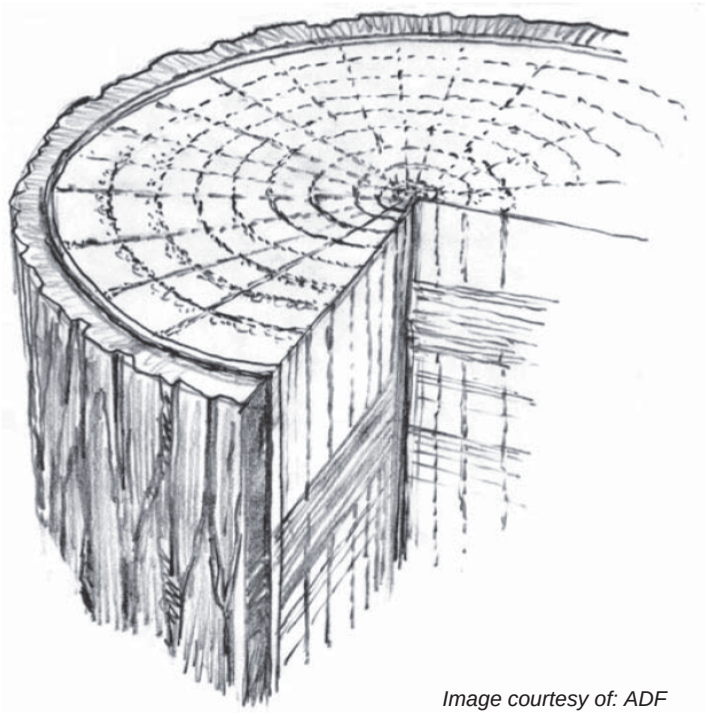


Image courtesy of: ADF

Cambium activity – Ask one student to come to the front of the room and extend his or her arms perpendicular from their body, pretending to be a tree. Tie a ribbon around the child's waist. Ask the class to predict, if this was actually a tree with a ribbon around it, what might happen to the ribbon. *Will it move higher (further up from the ground) as the tree grows?*

After students have had a chance to guess, explain that the answer is no. Trees grow in diameter from the inside out, but tree height comes from new growth at the very tips of the branches...so the ribbon would remain at the same height, no matter how tall the tree might grow. If the scarf were left in place for a long time however, the cambium would keep adding to the width (thickness) of the tree. That would eventually either break the ribbon or force the bark to actually grow around it. Should that happen it might injure the food-transportation system and eventually kill the tree.

Explain that's why people should never tie anything permanently around the trunk of a tree or nail anything to a tree.

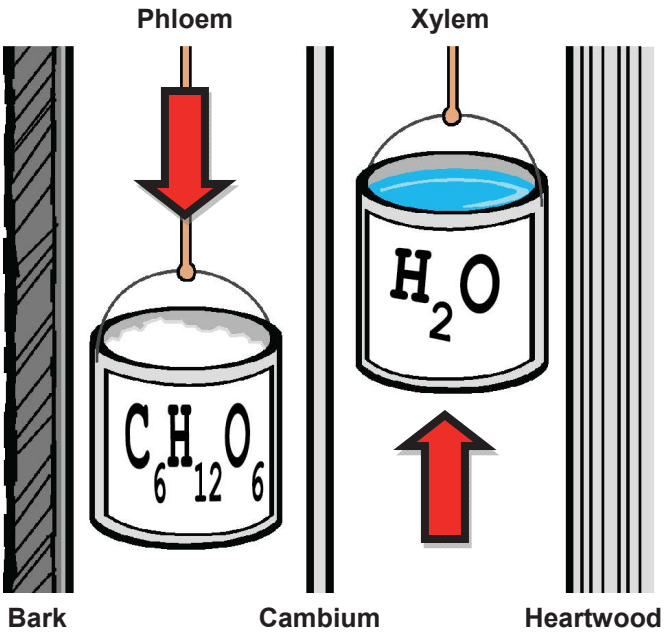
Xylem
The cell layer interior to the cambium is called xylem or sapwood. Each spring and summer the cambium makes new xylem cells, adding new layers of wood around layers laid down in years past, increasing the width of the tree. The wood formed in the spring grows fast and is lighter-colored because it consists of large cells created when there is plenty of moisture. The wood formed in summer grows more slowly and is darker colored because there is less available moisture so the cells are smaller and more compact. When a tree is cut, the layers appear as alternating rings of light and dark wood. Count the dark rings, and you know the tree's age.

Dendrochronology is the study of a tree through its annual growth rings. Scientists not only use these rings to determine the age of the tree, but they can also get information about the climate, the spacing of trees and the presence of fire around the individual tree. A wide ring often indicates that plenty of moisture was available that year. Rings that are very close together often suggest there was a drought.

The xylem is the "up" system in the tree. The cells in the xylem layer fuse to form uninterrupted tubes that conduct the moisture and nutrients from the roots up through the trunk to the leaves. Consider a 200' tall tree. Imagine the challenge of raising water that high without a giant pump, but trees have managed to adapt. Because water molecules have a cohesiveness or a tendency to stick together, there is a constant, continuous "string" of water in each tube of xylem cells. Water continually evaporates or is transpired out of the leaves. This water shortage in the leaves results in a tremendous pull on the water in the xylem tubes causing the water to move up through the xylem into the leaves.

Xylem Activity - Have students examine the tree cross-section and figure the age of the tree when it was cut down. If an actual cross-section is not available, a picture of one can be viewed by 'googling' for an image on the Internet using key search words: "tree rings cross section" and then clicking on image results.

Heartwood
The center, supporting pillar of the tree is called heartwood. Although it is non-living it will remain strong and will not decay as long as the outer layers of the trunk are intact. As a tree grows in diameter the inner, older xylem layers fill with gum and resin and harden providing support to the tree as it grows taller



In the trunk, the phloem transports sugar food downward while the xylem carries water and nutrients upward.

and wider. The vast majority of a living tree (99%) is nonliving cells that provide structural support rather than active fluid conduction.

Phloem
The cell layer exterior to the cambium is called phloem, sometimes referred to as inner bark. It is the "down" transport system in the tree. Only a few cells wide, it carries the jelly-like sugar food produced in the leaves throughout the tree. Phloem cells are stacked one on top of the other. Their connecting cell wall is perforated like a strainer. When one cell is full of the jelly-like food the contents ooze slowly into the next. Eventually the food finds its way down from the leaves to the roots. When phloem cells die they become part of the outer protective layer of bark.

Bark
The outer layer of the trunk is covered with bark. Tree bark can be smooth, rough, or scaly. Although bark may look different from tree to tree it serves the same purpose – to protect the tree from injury and disease, somewhat like your skin. Often bark has bad-tasting chemicals, which discourage hungry insects or gnawing rodents from harming the tree. Some trees have very thick bark, which prevents damage from fire.

Every year the cambium layer produces new phloem

and the cambium. Outer bark is formed as old phloem cells die and are forced outward. When smooth, tight-fitting young bark is unable to expand or stretch because of the addition of new cells the bark may crack, split, or be shed from the tree. Each tree species has a characteristic way of expanding or breaking its bark forming patterns by which many trees can be identified.

Bark Activity – Look at samples of different kinds of tree bark. Notice the thickness of the bark and examine it for evidence of how the bark expanded and grew from the inside out. You may wish to use pencils and paper to do bark rubbings that will reveal the different patterns in tree bark.

Concept #3: Through a process called photosynthesis leaves take in carbon dioxide and water, and using chlorophyll and sunlight, create oxygen and make a sugar food that feeds the tree.

Leaves

Teacher Background Information:

Leaves come in many shapes and sizes and provide the easiest means of identification of an individual tree. Some are needle-shaped, some are flat and thin. Some leaves remain on the tree throughout the year (**evergreen**) and some leaves are shed annually (**deciduous**). But regardless of size or shape, all leaves have the same function: they create the sugar food that feeds the tree and, through the web of life, feeds all other living things. The amazing process that makes this possible is called **photosynthesis**. Refer to the illustration on Student Handout #2 as you discuss this process with students.

Photosynthesis is a combination of "photo" meaning "produced by light" and "synthesis" which means "putting together parts or elements to make a whole." Photosynthesis occurs only in plants that contain a green substance called **chlorophyll**. Chlorophyll is the enabler for the photosynthetic process. During photosynthesis, chlorophyll, carbon dioxide, water and light-energy from the sun are used to make a sugar-like food that becomes the basic source of energy for the plant and other living things. While making this food, the green plant gives off oxygen and water vapor into the air.

Carbon dioxide (CO_2) is exhaled by animals, created by microorganisms through the process of decomposition, and released during the combustion of fossil fuels. In the leaf of a green plant, carbon dioxide comes in contact with water (H_20) and nutrients that have been drawn up from the soil by the roots of the plant. In the presence of sunshine, chlorophyll within the green leaf combines the CO_2 and H_20. This combination results in the creation of a sugar food called glucose ($C_6H_{12}O_6$) that provides energy for the plant and all animals that eat that plant, or eat the animal that ate the plant. Not only are plants the base of food chains upon which all animals depend, plants also produce oxygen a gas that all animals (including humans) need to survive.

Carbon dioxide enters the leaf and oxygen exits the leaf through tiny holes called stoma, usually found on the undersurface of the leaves. At the same time, water is also released in a process called **transpiration**. Most plants in temperate climates transpire about 99% of the water the tree has taken in by their roots. The plant transpiration helps modify the temperature and humidity of the surrounding area. For a leaf transpiration activity, see Extension Activities, page 14.)

Seeds/Fruits

Most trees grow from seed. Many kinds of seeds exist - but the function of seeds is always the same...to produce a new plant. A mature plant produces seeds that have the genetic blueprint for a new plant of the same kind. Fruits or cones serve as outer protection for the seeds inside.

Pass around several examples of seeds for students to observe. Point out to students the hard outer seed coat which protects the tiny plant inside. Explain that a seed is like a baby plant in a box with its lunch. There is enough food stored in the seed to get the baby plant started growing until it can make leaves and start to produce its own food through the process of photosynthesis.

Additional Suggested Reading

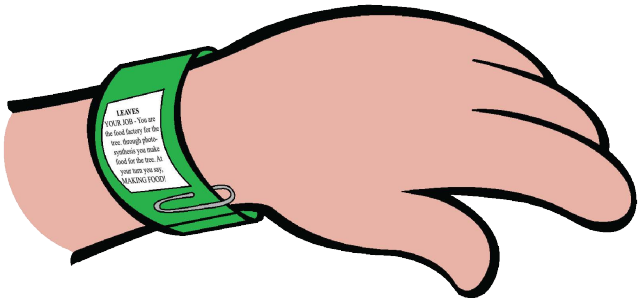
The Giving Tree by Shel Silverstein

The Activity: Role-play the growth process of a tree to understand its form and function

Activity description: The purpose of this activity is to reinforce the understanding of how a tree grows and functions over a number of years. Each student will represent an important part of the tree. The activity starts with a tiny seed as it germinates. It then moves to a young tree in its growth over 5 years.

In Advance: Make sure you select a large space for the activity where the tree will have room to "grow." Gather string, paper clips, 2 small bottles of water and six sugar packets. Photocopy the labels found on pages 12 & 13. Cut and paste the labels onto the suggested colored strips of construction paper and attach a paper clip to each so children can create wristbands. **NOTE: After labels are made, set aside the labels for "Heartwood" and "New Bark" to use later in the activity.** The number of labels in this guide works for a group of 18 students. If you have more students, make more Leaves and Roots labels. With fewer students, use fewer Leaves and Roots labels, keeping at least one of each. A minimum of 14 students is needed to demonstrate the 5 years of growth. (Go to **www.arborday.org/treelabels** to see a label list based on class numbers.) Make a dot on a piece of paper and place it on the ground to indicate the central, starting point for the tree.

Introductory Sequence: Explain to students that they are going to "build" a tree. Pass a container holding the labeled wristbands (with exception of Heartwood and New Bark labels) from which students can draw to determine the tree role they will play. Have them use the paperclips to secure their tree part label around their left wrist. Group students by color of wristbands.



Before you start, encourage students to use their bodies to creatively express the growth process of the tree based on what they hear in the narrative.

Instruct students with the following wrist labels to come to the open area and line up in the order shown in the acorn above. (Just have one leaf and one root student come forward at this time.) Have the student with the "Xylem Year 1 " label sit on the paper with the dot. Have the six students curl up and imagine they are all together inside a seed, Put the string close around the group of six students to represent the outside of the seed, then begin the germination role-play narration. The narration for the role-play is printed in **bold** and should be read aloud by the teacher.

GERMINATION

1. **A small seed falls to the ground. It lands on good soil. Gentle rains come and soften the seed. The little seed germinates. As it starts to grow, it sends out a tiny root to hold its position in the soil and starts drawing in water.** *(Have the "Roots" student move just outside the string circle and act like a tiny root searching for water.)*

2. **A baby tree with tiny leaves pushes its way to the sun. The seed has enough food stored inside to help the little tree grow until the leaves can use sunlight to make food.** *(Have the "Leaves" student move just outside the string circle. Encourage students to act like the little tree, emerging from the soil.)*

Tell students this is now a seedling tree. As the role play continues, they will see how the little tree grows. Remind students to think about the illustration they looked at earlier that showed the cross-section of tree trunk with the small piece shown running from the center of the tree to the outer bark. That is the part most of them will

role play in the activity. That section of trunk contains tubes that run from the roots below the tree to the leaves high above.

Students representing leaves should stand with arms raised, their hands representing the leafy canopy. Students representing roots should sit on the floor with feet out in front of them to represent spreading roots. Students inside the tree trunk should stand. It is important for them to stay in a straight line during the activity to get a true sense of the tree's expanding growth. The "Xylem Year 1 " student needs to always stay on the dot-marked paper representing the center of the tree.

Instruct everyone to look at their tree part information on their wrist so they know what to do and say when the teacher points to them at their turn. Before resuming the activity, hand the "New Bark" labels to the student representing "Bark Year 1 " and tell him/her to hold onto those until it's time to pass them to newly formed bark (one each year). Divide sugar packets among the students with "Leaves" labels. Give a water bottle to the student with "Roots" label.

The starting arrangement for the Tree Growth activity should look like Example 1 below. Continue to expand the string ring each year to reflect the tree's growing circumference.

Example 1

Image courtesy of: ADF

The narration for the role-play is printed in bold and should be read aloud by the teacher.
Actions for the role-play are printed in italics and are also on the role labels the students will draw. **NOTE:** During the first round of the role-play the teacher may need to prompt students when it's their turn. As the role-play progresses, the teacher may be able to simply point to a student(s) when it's their turn to act/speak.

TREE GROWTH - YEAR ONE

1. The little tree adds more roots and leaves.
Have the remaining students with Roots and Leaves labels join the first "Roots" and "Leaves" just outside the string ring – Roots all on one side, Leaves on the other.

2. Roots suck up water and nutrients from the soil and pass them on to the Xylem.
Have the student(s) with "Roots" label make a slurping sound while handing one of the water containers to the student with "Xylem Year 1 " label.

3. Xylem passes water to leaves.
Have the student with "Xylem Year 1 " label make a swish sound while handing the water to the student(s) with "Leaves" label.

4. Leaves release most of water into the air. Through photosynthesis Leaves make sugar food for the tree.
Have the student(s) with "Leaves" label hand the water to teacher. Leaves put their hands up and shake them (saying,) "Making food!"

The Leaves pass food to the Phloem.
Have the student(s) with "Leaves" label pass one sugar packet down to the student with "Phloem Year 1 " label.

5. Phloem passes food through the tree, down to the Roots.
Instruct the student with "Phloem Year 1 " label to say "yum, yum" while passing the sugar packet down to the student(s) with the "Roots" label.

6. With plenty of food and water, the Cambium helps the Xylem and Phloem get fatter.
Instruct students representing "Xylem" and "Phloem" in the tree to puff out their cheeks.

7. The cycle continues.
REPEAT STEPS 2-7 – with actions and narration.

8. When winter comes, the cycle slows down and the tree rests.

TREE GROWTH - YEARS TWO THROUGH FIVE

(TEACHER'S NOTE: REPEAT steps #1-12 four times to represent years two through five. Any adjusted actions to reflect the tree growth are indicated, year by year, in the text. An * asterisk denotes several additional narrative statements that are to be read and applied only at *YEAR FIVE*.)

1. Spring comes and the tree "wakes up."
Everyone in the "tree" stretches.

2. The Cambium makes new Xylem toward the inside of the tree. This makes a new ring in the trunk of the tree.
The student representing the Cambium should call, "New Xylem!"
YEAR TWO - Have the "Xylem Year 2" student come stand between the "Cambium" and "Xylem Year 1".
YEAR THREE - "Xylem Year 3" comes to stand between the "Cambium" and "Xylem Year 2".
YEAR FOUR – "Xylem Year 4" comes to stand between the "Cambium" and "Xylem Year 3".
YEAR FIVE - "Xylem Year 5" comes to stand between the "Cambium" and "Xylem Year 4".

3. The Cambium also makes new Phloem toward the outside of the tree.
The student representing the Cambium should call, "New Phloem!"
YEAR TWO - Have the "Phloem Year 2" student come stand between the "Cambium" and " Phloem Year 1".
YEAR THREE - "Phloem Year 3" comes to stand between the "Cambium" and "Phloem Year 2".
YEAR FOUR – "Phloem Year 4 " comes to stand between the Cambium and "Phloem Year 3".
YEAR FIVE - "Phloem Year 5" comes to stand between the "Cambium" and the "Phloem Year 4".

4. Last year's Phloem hardens and turns into Bark, making the outer bark thicker.
YEAR TWO - Have "Bark Year 1 " student say "Help me protect!" while handing a new bark label to the "Phloem Year 1 " student who should cover his/her Phloem label with the new Bark one.
YEAR THREE – Same as Year Two only with New Bark label passed to "Phloem Year 2".
YEAR FOUR – Same as Year Two only with New Bark label passed to "Phloem Year 3".
YEAR FIVE – Same as Year Two only with New Bark label passed to "Phloem Year 4".

*****(READ ONLY AT YEAR FIVE.) **After many years, the oldest Outer Bark has worn away or fallen off. It decomposes and adds nutrients to the soil.** *Student representing "Bark Year 1 " should kneel or lay on the floor to represent the shed bark.*

At this point the arrangement for the Tree Growth activity should look like Example 2 on page 11.

5. Spring rains soak into the soil.
Teacher hands the water containers to the "Roots".

6. Roots suck up water and nutrients from the soil and pass them on to the Xylem.
YEAR TWO - "Roots" make a slurping sound while handing one of the water containers to the student with "Xylem Year 2" label.
YEAR THREE – Same as Year 2 but "Roots" pass water to "Xylem Year 3".
YEAR FOUR – Same as Year 2 but "Roots" pass water to "Xylem Year 4".
YEAR FIVE – Same as Year 2 but "Roots" pass water to "Xylem Year 5".

7. Xylem passes water to leaves.
"Xylem" students in the tree make a swishing sound while handing the water to the "Leaves".

*****(READ ONLY AT YEAR FIVE.) **After many years, the oldest Xylem no longer transports water. It dies and becomes Heartwood, the strong supporting center of the tree.** *(Teacher hands student representing "Xylem Year 1 " the Heartwood label. Instruct that student to now say, "Standing Strong!")*

8. Leaves release most of water into the air. Through photosynthesis the Leaves make sugar food for the tree. *("Leaves" hand the water to the teacher."Leaves" put their hands up and shake them saying, "Making food!")*

The Leaves pass food to the new Phloem. *("Leaves" pass a sugar packet down to the student currently representing "Phloem".)*

9. Phloem passes food through the tree, down to the Roots. *(The student currently representing Phloem should say, "Yum, yum" while passing the sugar packet down to the "Roots".)*

10. With plenty of food and water, the Cambium helps the Xylem and Phloem get fatter. *(Students representing the new "Xylem" and "Phloem" should puff out their cheeks.)*

11. The cycle continues. *(At end of YEAR FIVE, if time permits, have students repeat their actions and words.)*

12. When winter comes, the cycle slows down and the tree rests.

*****(READ ONLY AT YEAR FIVE for activity conclusion.) **Next year the tree may produce seeds. These seeds may fall to the earth and grow into new trees! After many, many years, the tree may finally die. It will slowly fall to the earth and decompose, making the soil rich so new trees can grow.** *(Have students all carefully fall to the earth.)*

Example 2

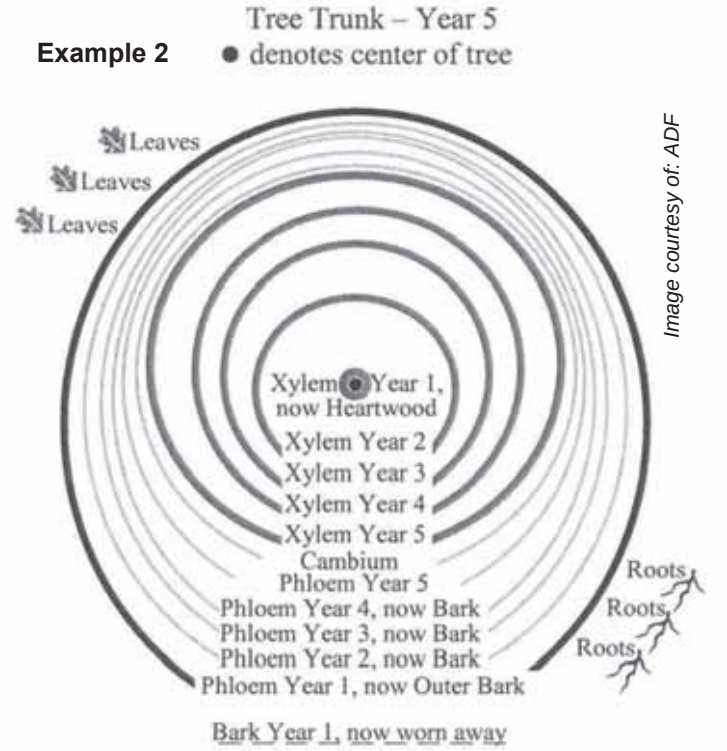
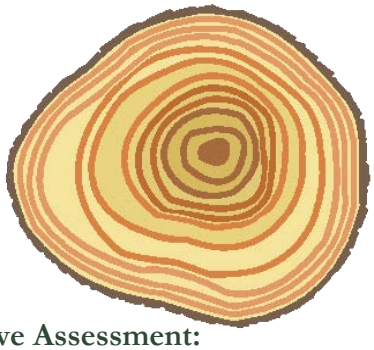


Image courtesy of: ADF

Follow up the role-play with class discussion. Ask: *What parts of the tree got thicker? What parts of the tree ended up where they started?* What other observations about tree growth did you make?

Authentic Assessment:

Refer students back to the questions written on the board at the start of the lesson. Have students record the questions on a piece of paper. Students may answer the questions in a written narrative or create and label a diagram to illustrate the process. See Rubric on page 29.



Alternative Assessment:

Have students draw a cross-section of tree trunk with the number of annual rings that correspond to their age. Starting with year 1, at the inside of the tree "cookie", have students write or illustrate some event that happened in their life during each year in the life of the tree.

Paste each label on an 11" x 3" strip of colored construction paper as indicated.

CUT THESE LABELS OUT AND PASTE ON BLUE PAPER

XYLEM YEAR 1 (sapwood)

YOUR JOB – You transport water from the roots to leaves. You are part of the wood of the tree! At your turn you say, "SWISH, SWISH"

XYLEM YEAR 5 (sapwood)

YOUR JOB – You transport water from the roots to leaves. You are part of the wood of the tree! At your turn you say, "SWISH, SWISH"

XYLEM YEAR 2 (sapwood)

YOUR JOB – You transport water from the roots to leaves. You are part of the wood of the tree! At your turn you say, "SWISH, SWISH"

ROOT/ROOT HAIRS

YOUR JOB – You take in water and some nutrients from the soil which get passed up the tree. You also hold the tree in place. At your turn you say, "SLURP, SLURP"

XYLEM YEAR 3 (sapwood)

YOUR JOB – You transport water from the roots to leaves. You are part of the wood of the tree! At your turn you say, "SWISH, SWISH"

ROOT/ROOT HAIRS

YOUR JOB – You take in water and some nutrients from the soil which get passed up the tree. You also hold the tree in place. At your turn you say, "SLURP, SLURP"

XYLEM YEAR 4 (sapwood)

YOUR JOB – You transport water from the roots to leaves. You are part of the wood of the tree! At your turn you say, "SWISH, SWISH"

ROOT/ROOT HAIRS

YOUR JOB – You take in water and some nutrients from the soil which get passed up the tree. You also hold the tree in place. At your turn you say, "SLURP, SLURP"

- Use these labels to construct simple wristbands for the role-play activity described on pages 8–13.
- Photocopy or print pages 12 & 13 and then carefully cut the labels out.
- Create 11" x 3" strips of colored construction paper and paste each label to the color strip indicated.
- Attach a paper clip to each strip so children can create wristbands.

HAVE FUN with this learning activity!

PASTE ON RED PAPER

HEARTWOOD

YOUR JOB – Your xylem cells have hardened and you no longer transport water. You are now the strong heart of the tree. At your turn you say, "STANDING STRONG!"

PASTE ON YELLOW PAPER

CAMBIUM

YOUR JOB – You are the growing part of the tree. As thin as a piece of paper, you make new xylem (wood) and new phloem (inner bark). At your turn you say, "NEW XYLEM" and "NEW PHLOEM!"

PASTE ON BROWN PAPER

BARK YEAR 1

YOUR JOB – You are rough and tough. You are Outer Bark that protects the tree. At your turn you say, "I PROTECT!" When others become bark, hand them a NEW BARK wristband and welcome them by saying, "HELP PROTECT!"

Paste each label on an 11" x 3" strip of colored construction paper as indicated.

CUT THESE LABELS OUT AND PASTE ON GREEN PAPER

PHLOEM YEAR 1
(inner bark)

YOUR JOB – You transport food from the leaves through the trunk to the roots.
At your turn you say, "YUM, YUM"

PHLOEM YEAR 5
(inner bark)

YOUR JOB – You transport food from the leaves through the trunk to the roots.
At your turn you say, "YUM, YUM"

NEW BARK
(outer bark)

YOUR JOB – You are no longer phloem. You have become Outer Bark that protects the tree. At your turn you NOW say, "I PROTECT!"

PHLOEM YEAR 2
(inner bark)

YOUR JOB – You transport food from the leaves through the trunk to the roots.
At your turn you say, "YUM, YUM"

LEAVES

YOUR JOB – You are the food factory for the tree. Through photosynthesis you make food for the tree.
At your turn you say, "MAKING FOOD!"

NEW BARK
(outer bark)

YOUR JOB – You are no longer phloem. You have become Outer Bark that protects the tree. At your turn you NOW say, "I PROTECT!"

PHLOEM YEAR 3
(inner bark)

YOUR JOB – You transport food from the leaves through the trunk to the roots.
At your turn you say, "YUM, YUM"

LEAVES

YOUR JOB – You are the food factory for the tree. Through photosynthesis you make food for the tree.
At your turn you say, "MAKING FOOD!"

NEW BARK
(outer bark)

YOUR JOB – You are no longer phloem. You have become Outer Bark that protects the tree. At your turn you NOW say, "I PROTECT!"

PHLOEM YEAR 4
(inner bark)

YOUR JOB – You transport food from the leaves through the trunk to the roots.
At your turn you say, "YUM, YUM"

LEAVES

YOUR JOB – You are the food factory for the tree. Through photosynthesis you make food for the tree.
At your turn you say, "MAKING FOOD!"

NEW BARK
(outer bark)

YOUR JOB – You are no longer phloem. You have become Outer Bark that protects the tree. At your turn you NOW say, "I PROTECT!"

CUT THESE LABELS OUT AND PASTE ON BROWN PAPER

Step 1

UNIT A - Discover how trees grow and function

EXTENSION ACTIVITIES

The following are activities that further extend learning about the form and function of trees. These activities have the same objectives and correlation to Indiana Academic Standards for Science (2016) as the Basic Activity (listed on page 2).

SEARCHING FOR STOMA

Time Recommended:

- One class period

Materials Needed:

- Lettuce leaf
- Iodine
- Microscope
- Slides and cover slip

Teacher Background Information:

The exchange of oxygen and carbon dioxide in the process of photosynthesis and the release of water from the leaf into the air in the process of transpiration take place through tiny openings in the leaf called stoma. The stoma are opened and closed by surrounding guard cells, which contain chloroplasts (structures within a cell containing chlorophyll). Providing students the opportunity to see under the microscope some of the cells that play a major part in the process of photosynthesis helps them better grasp the process.

Stoma Activity Description:

Place a drop of iodine on the center of a clean slide. Break a lettuce leaf at a vein on the underside of the leaf and tear off the thinnest layer of leaf epidermis possible. Carefully place the layer in the drop of iodine stain on the slide; making sure it is laid out flat, not folded back. Place another drop of iodine on top of the lettuce leaf layer. Wait about 30 seconds and add a cover slip, then let the students start searching for stomas using the microscope. Guard cells that are open are easier to spot than guard cells that are closed. They will resemble two green jellybeans formed around an oval. Have students draw and label what they see under the microscope.

LEAF TRANSPIRATION

Time Recommended:

- One class period for the activity with follow up observations over the next week

Materials Needed:

- 1 clear plastic bag with a twist tie per student
- 1 or 2 potted plants (5" pot or larger)
- 1 or 2 large, transparent plastic bags with twist ties
- Scale

Leaf Transpiration Activity Description:

To prove that leaves give off moisture try this experiment. Have each student find a leaf on a broadleaf tree that is in a sunny location. Cover the leaf on the tree with a plastic bag, securing the bag with a twist tie around the leaf stalk or the twig. Check the bag in 24 hours. Water vapor will gather on the inside of the bag due to the transpiration of moisture through the leaves. If broadleaf trees are not leafed out, this experiment can be done with a potted plant. Cover a healthy potted plant tightly with a transparent plastic bag. Do not cover the entire pot, just the plant. Leave the covered plant in the sunshine for a day or two. Note the water formation on the inside of the bag. Ask students to speculate what this might be from.

To prove that this moisture is coming into the leaves from the soil, take a second plant and cover the pot and soil tightly with the transparent wrap (this limits the evaporation of moisture directly from the pot). Do not cover the plant. Weigh the potted plant when you begin the experiment and then set the plant in the sun. Ask students to predict what might happen. Weigh the potted plant every day. The pot will get lighter as the moisture in the soil is used by the plant and given off into the surrounding air through transpiration.

Questions that could lead to additional experiments might include:

Does temperature affect the rate of transpiration?
Does the size of the leaf's surface affect transpiration?
Does wind affect the rate of transpiration?
Do broadleaf trees transpire more moisture than conifers?

More Great Activities... Additional activities that support these materials are available on-line at **www.treesaregood.org/other/educationalResources/educationalResources.aspx**.
"Life of the Forest" (**https://www.arborday.org/trees/ringsmain.cfm**) offers students a visual image of how trees grow.

Step 1

UNIT B - Discover how trees conserve and produce energy

BASIC ACTIVITY – Design an energy wise community

ENERGY CONSERVATION & PRODUCTION

Classroom Activity:

- Design an Energy Wise Community Using Trees

Objectives:

Students will be able to:

- describe several ways appropriately placed and planted trees can conserve energy
- demonstrate best planting locations for different types of trees to conserve or produce energy

Time Recommended:

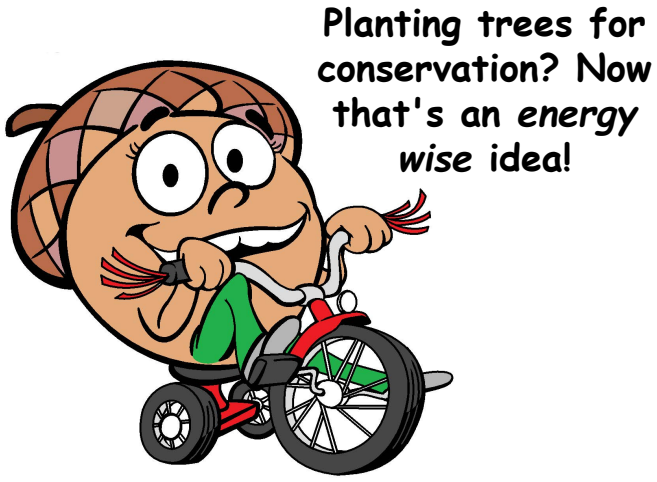
- One 60 minute or two 30 minute class periods

Materials Needed:

- Fan
- Water in mist bottle or bucket
- 2 thermometers (optional)
- 11" x 17" or larger sheet of paper and pencils (one per child or group)
- Photocopies of *Vocabulary and Rubric* (Handout #4 on page 30)
- Photocopies of the *Tree Planting for Energy Conservation Guidelines* (Handout #5 on pages 31 & 32; one per student or group)

Indiana Academic Standards - Science (2016) Correlation:

Physical Science
• 5.PS.1, 5.PS.2, 5.PS.3
Earth and Space Science
• 5.ESS.3
Life Science
• 5.LS.1, 5.LS.2



Teacher Background Information:

Unit B builds upon the basic concepts learned from "Unit A - Discover how trees grow and function" (pages 2-14) by developing a deeper understanding on the functional benefits of trees. *Covering the activities in Unit A is recommended, but Unit B can be used as a stand-alone activity.*

Trees are widely appreciated for the bountiful products they produce and the beauty they contribute to our environment, but they also provide many conservation benefits as well.

Trees' roots grip and hold the topsoil, slowing runoff and reducing erosion and water pollution. Leafy tree canopies conserve moisture, slow the wind, keep the air clean, help quiet loud traffic noises, and provide shade from the hot summer sun. They also create a welcome home for birds and wildlife.

One thing people don't always realize, though, is that trees are vital for converting and producing energy for human use, as well as conserving energy when properly placed in the landscape.

Energy is defined as the ability to do work; it powers everything in nature. Energy warms and cools our homes, fuels our cars, powers our TVs and DVD players, and runs our manufacturing plants. It takes energy for us to walk, talk, digest our food, and even breath.

Many different sources of energy exist. Some sources are **nonrenewable**, such as fossil fuels like coal, oil, and natural gas. Once the supply of a fossil fuel has been depleted, it is gone forever. Some energy sources are **renewable** – like wind, sun, water, trees, and plants. These are energy sources that can be replenished through natural processes or careful management. Energy that comes from plants, like trees, is considered **biomass**. It is renewable as long as new trees or plants are planted.

Some of this information is included in the student handouts, but additional information is provided here for you to include as a part of the classroom discussion as you go through the handouts with students as time allows.

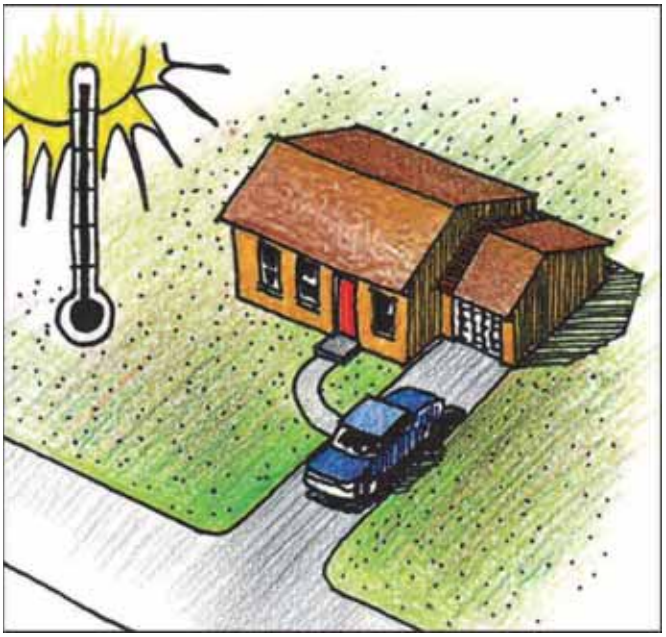
Concept - Trees can help conserve energy

Most people living in cities and towns don't have enough available land to grow their own individual biomass plantations to **produce energy**. Biomass is a homegrown source of energy. Wood, animal waste, crops, and even garbage can be used as a biomass energy source. Agricultural biomass crops like corn and soybeans can be burned directly or turned into other liquid fuels. However, by properly locating and planting a few trees around their home, people can **conserve energy**, lessen the use of nonrenewable fossil fuels, save money, increase property value, and help the environment. Proper landscaping with trees and shrubs is often the best long-term investment for reducing heating and cooling costs while also bringing improvements to the home and the community. Planting trees that incorporate practices from the three Guidelines described below can have a significant impact on conserving energy resources and money.

Images courtesy of: ADF

GUIDELINE #1: Plant Trees to Shade Your Home

Carefully positioned trees can save up to 25% of a household's energy needs for heating and cooling. According to the U.S. Department of Energy, this can save the average household between $100 and $250 in energy costs each year. What could your family do for fun with the money saved from cutting energy costs?

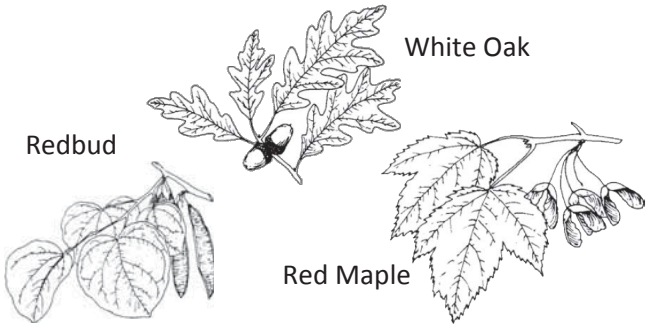


A lack of trees around houses means less comfort and higher energy costs.

Carefully planned trees annually save money and add comfort to a home.

The most energy savings and the best use of shade generally come from **deciduous, broadleaf trees** planted about 10 to 20 feet from the walls to the west, east, or northwest of the house, depending on species. These trees shade the house and air conditioning unit during the summer, reducing the energy needed for air conditioning and increasing the efficiency of the unit by as much as 10%. When they lose their leaves in the winter, trees correctly planted allow the sun to reach and warm the houses, making maximum use of winter solar heat, and thus saving energy for heating.

Because the sun is more directly overhead at midday during the summer months, planting shade trees on the south is discouraged. Trees on the south will not shade the house unless planted very close to it and they will make unwanted shade in the winter when the sun is at a lower angle. Trees planted to the south of a home may also block beneficial summer breezes.



Select broadleaf species trees that are right for your sight considerations: Do they fit the location? At maturity, will they conflict with utility lines? Will the location provide what they need to survive?

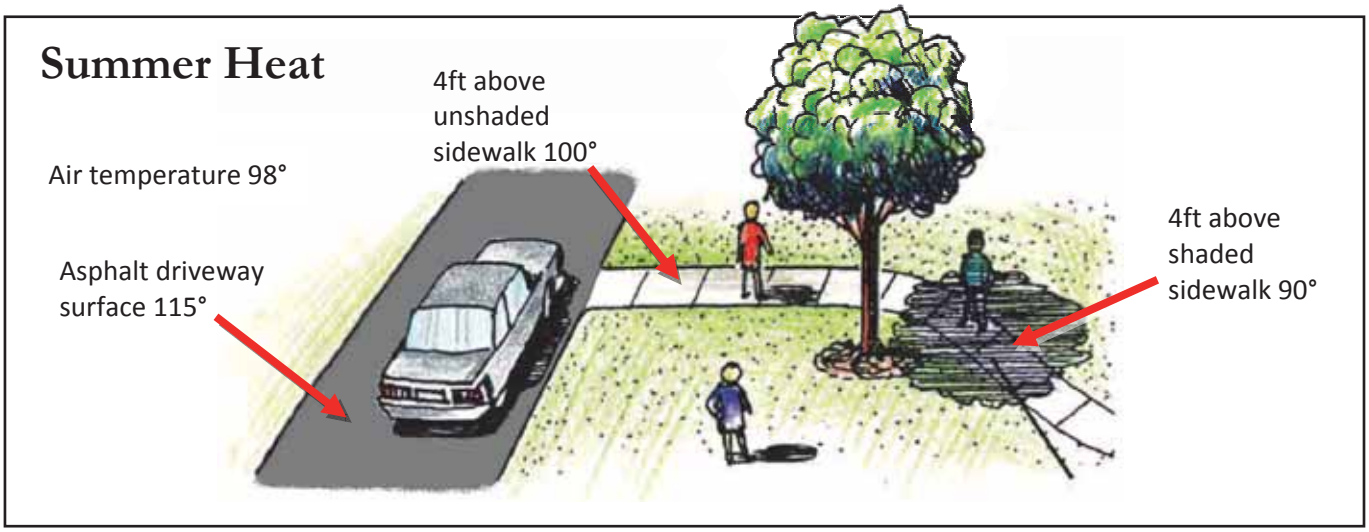
Images courtesy of: ADF

Because the sun is more directly overhead in the summer, trees plant on the south will not provide shade unless planted very close. Trees planted on the south also block beneficial summer breezes. Trees planted on the east, west, and northwest sides of a house provide the best shade during the summer morning s and afternoons.

In the winter, trees planted on the south side of the house may produce unwanted shade. Trees planted on the east, west, and northwest sides minimize unwanted winter shade.

GUIDELINE #2: Plant Trees to Shade Paved Areas

Trees shading paved areas, like driveways and asphalt parking lots, will greatly decrease surface heat. In the summer, a city with trees shading paved areas can be 12 degrees cooler than one without trees.



Cities with unshaded stretches of concrete streets and parking lots are sometimes referred to as "heat islands" that are 5-12 degrees hotter than surrounding areas. Planting trees on rooftop gardens in these areas helps alleviate the heat island effect – which saves both energy and money.

The net cooling effect of a young, healthy tree is equivalent to ten room-sized air conditioners operating 20 hours a day.

In the process of **transpiration**, water escapes from small openings in a tree's leaves. This water evaporates in hot weather. The evaporated moisture cools the air around the tree. Since cool air is heavier than hot air, this cool air moves toward the ground making us feel cooler. (The evaporation activity you may choose to do with your students on page 22, Step 5, illustrates how this works.)

Heat Island Effect

Images courtesy of: ADF

If it seems hotter downtown than in the suburbs, and cooler in the park than in your backyard, it is not simply your imagination. Cities are heat islands - zones of summer air temperatures that can be as much as 12 degrees Fahrenheit higher than surrounding areas.

GUIDELINE #3: Plant Trees as Protection from Hot or Cold Winds

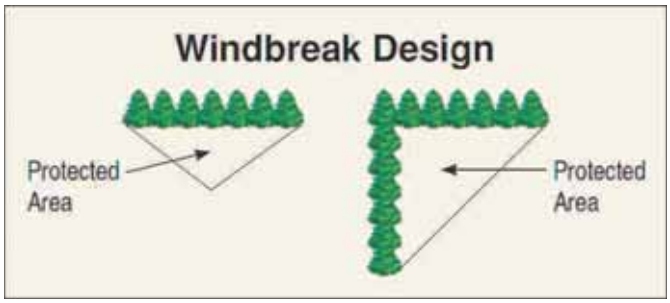
Windbreaks are barriers used to reduce and redirect wind. Planting a windbreak around a home can provide an energy savings of up to 30 percent and reduce blowing snow, noise, and dust. Since most homes in the United States are heated by natural gas or electricity generated from burning coal, this energy savings means a reduction in fossil fuel use as well.

An effective windbreak should be planted at a right angle (perpendicular) to **prevailing winds**. In the southern United States, hot, drying winds can erode soil and increase energy demands for cooling. Hot winds often come from the south or southwest, so an effective windbreak would be planted to the south and/or west of the home or housing development. In the northern United States, bitter cold winds can dramatically increase heating costs. Winter winds are often from the north or northwest, so an effective windbreak would be planted to the north and/or west of the home or housing development.

Since winds vary, multiple legs of windbreaks, or windbreak systems often provide the best protection and greatest energy savings.

Evergreen conifers with branches close to the ground form the best windbreaks. Pine, red cedar, and Douglas fir are species often used in windbreak plantings. Choose trees adapted to your region.

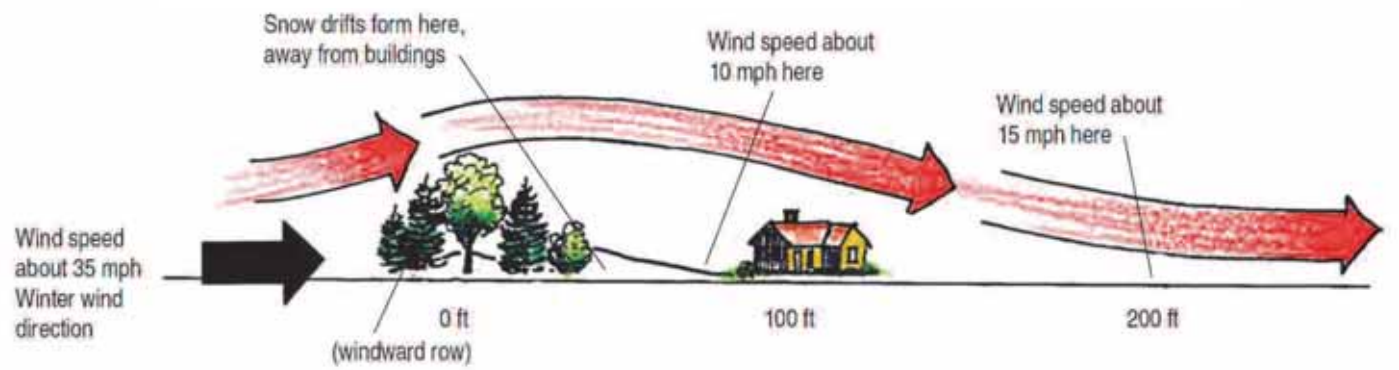
The effectiveness of the windbreak also depends on the density of the windbreak and its height. Three or more continuous rows of trees in staggered formation provide the best wind protection, but even a single row of trees will have an effect. Trees, bushes, and shrubs are often planted together to better block the wind from ground level to the treetops. The tallest row of trees is often planted in the center. Trees should be planted fairly close together. Spacing between rows should be about 12 feet.



Two-sided windbreaks offer protection over a larger area for greater energy conservation.

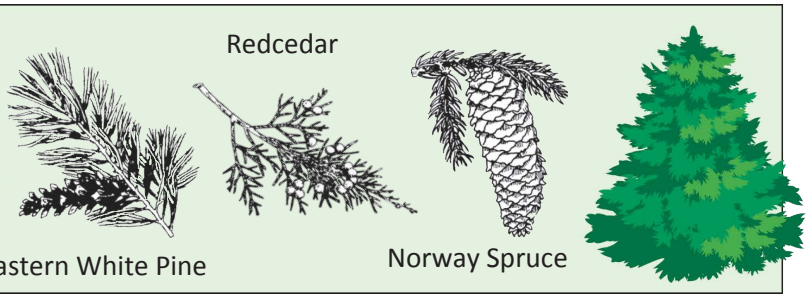
Windbreaks offer protection for a distance of up to 8 to 10 times the height of the mature trees. Snow and stagnant air can collect in the area directly behind a windbreak so, in regions that receive lots of snow, buildings to be protected should be located no closer than 100 feet from the windward row (front row facing the wind). A good rule of thumb is that the area to be protected should be within a downwind distance of 2 to 5 times the expected height of the tallest windbreak row. (For planning purposes, 20 feet is often used as the height of the tallest trees.)

If open wind speed is 35 miles per hour (mph), the windbreak reduces wind speed to:



Images courtesy of: ADF

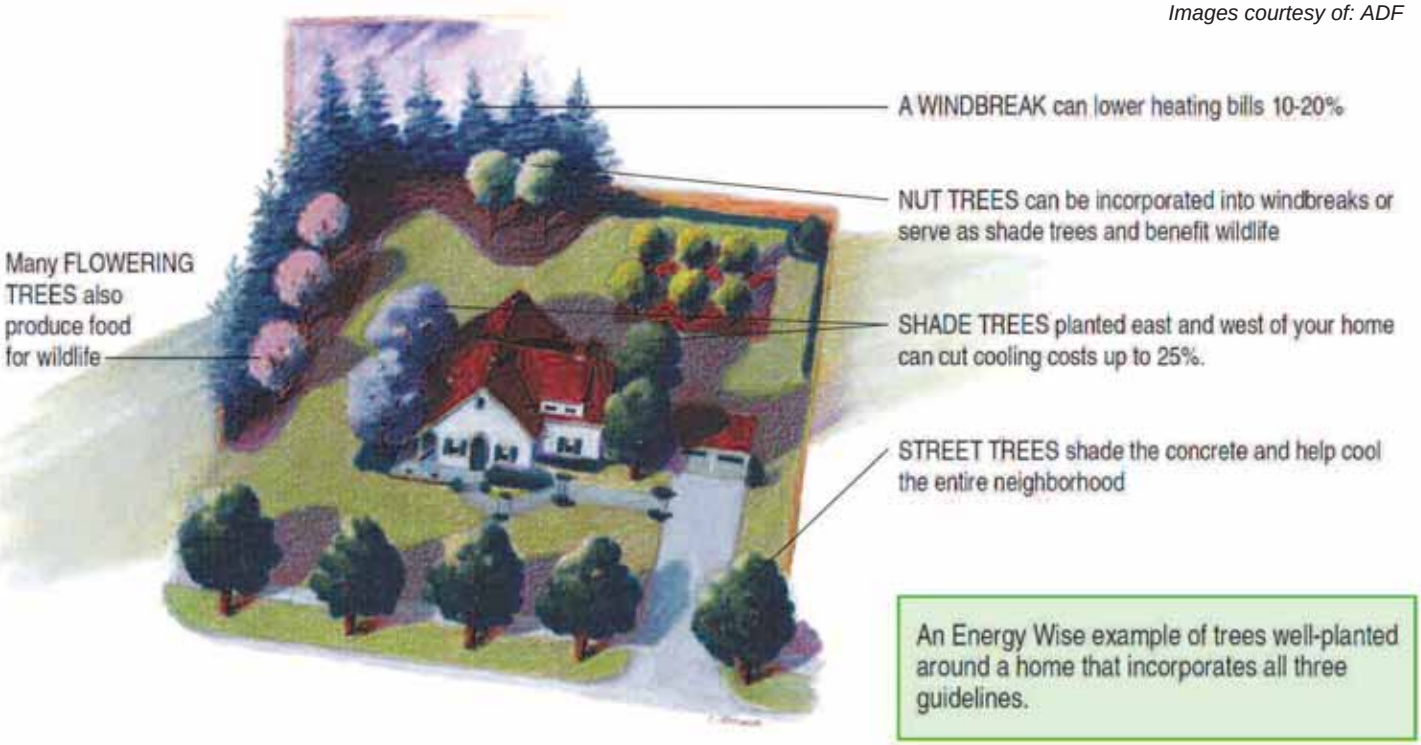
Conifers bear cones and have needle-like or scale-like leaves. Most conifers are evergreens since they do not lose all their leaves at once. Pines, firs, cedars, and spruces are conifers. Conifers generally provide the most effective buffer in windbreaks.



The greater the number of trees in a neighborhood, the more effective the trees are in reducing the wind. New housing developments benefit from windbreak plantings that border the neighborhood.

A well-placed windbreak can protect several homes or an entire development from chilling sinter winds and drifting snow.

Images courtesy of: ADF



An Energy Wise example of trees well-planted around a home that incorporates all three guidelines.

Activity - Instructional Sequence

Step 1. Begin by asking students what comes to mind when they hear the word "tree." Record responses on the board without comment. (Note: If you have not skipped the role-play activity from "Unit A – Discover how trees grow and function" (pages 2-14), your students will likely be prepared to offer good responses from their basic understanding of trees.) Remind students of additional things trees do for the environment, if they are not already listed, then continue discussion by asking if energy should also be included on the list. After student discussion, explain that trees are vital for converting and producing energy for human use, as well as conserving energy when properly placed in the landscape.

Step 2. Write the words "renewable energy" and "non-renewable energy" on the board. Have students think of sources of energy and work together to determine into which of the two categories each energy source falls. Tell them that most of the energy used today in factories, offices, and homes and for transportation comes from fossil fuels. Fossil fuels such as coal, oil, and natural gas take millions of years to form and are nonrenewable. Sun, wind, trees, and water are renewable energy resources because supplies are not limited and with proper management we can always grow trees.

Step 3. Pass out the two-page *Tree Planting for Energy Conservation Guidelines* Handout #5 (pages 31 & 32). Explain that this handout has three important guidelines. Each guideline describes both what they should know and what they can do to conserve energy by planting trees in specific locations. They will need to understand this information to do the activity. As you review each of the energy conservation guidelines, incorporate additional material provided in the Background Information section (page 15) into the discussion.

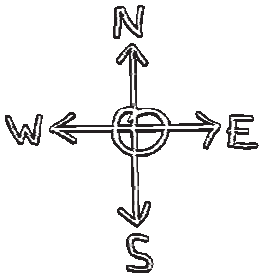
Step 4. Start with Guideline #1: Plant Trees to Shade Your Home.

Ask … *Look at the thermometer on the two top pictures.*
Which home is cooler?
Why do you think that is?
Which home looks more appealing to live in?

Review the "*What you should know*" information in Guideline #1.

Ask …*Now look at the bottom two pictures in this section. If you know that north is marked at the top of each picture, which sides of the house are the trees planted on?*

Draw a compass on the board with the cardinal directions (north, south, east, and west) to help students gain orientation.



Then review the "*What you can do*" information with students, referring to the visual examples as you go through the text.

When you get to the term "deciduous, broadleaf trees" direct student attention to the illustration examples of broadleaves and conifers. *Ask students to comment on the trees' differences. Ask what kinds of trees they see around their school? In their neighborhood?*

Explain that both kinds of trees play important roles in creating an **ENERGY WISE** community, but when selecting trees for planting, the location of existing utility lines must also be considered to avoid future conflicts.

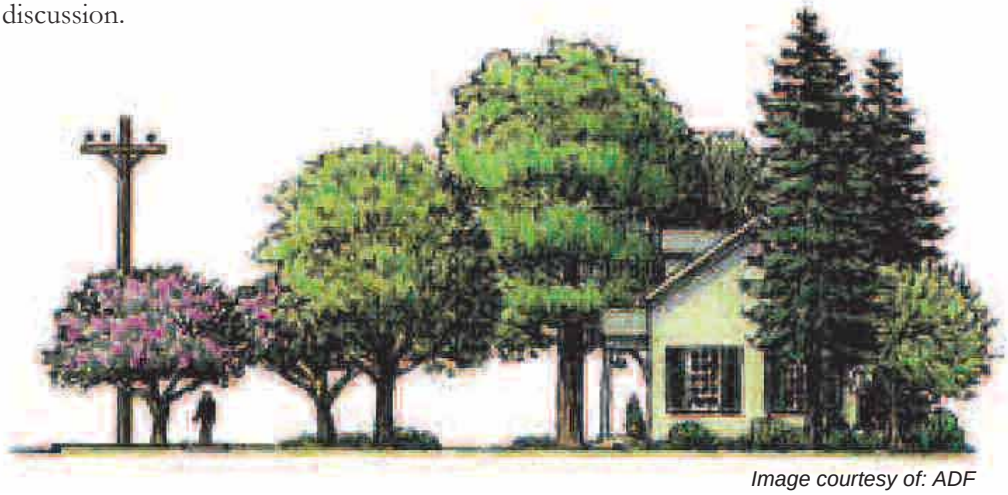


Image courtesy of: ADF

Step 5. Explain that trees not only provide shade from the sun, they also **transpire** (release water vapor) through their leaves. This is an additional cooling benefit. Tell them you'll show them how this works. Have students line up and file by the bucket of water. Ask each student to dip just one hand in the water to wet it, then hold both hands briefly in front of the fan. After all children have tried this, ask which hand felt cooler. Explain that the warmth of your skin and the air from the fan caused the water to evaporate. That process cools your skin. Nature uses evaporative cooling everyday. When we sweat, our perspiration evaporates, cooling us off. When a tree transpires, releasing moisture, that moisture evaporates, cooling the air. Tell students that the net cooling effect of just one young, healthy tree is equivalent to ten room-sized air conditioners operating 20 hours a day. Amazing!

Step 6. Introduce Guideline #2: Plant Trees to Shade Paved Areas

Review the content. *Ask students what temperature differences they notice in the different areas of the illustration.* You might wish to add information about heat islands from the background information.

If the sun is out, have students go outside and measure the temperature difference between the sidewalk areas and the area in the shade. Discuss results.

Step 7. Introduce Guideline # 3: Plant Trees as Protection from Hot or Cold Winds.

To illustrate how a windbreak works, have one student stand about 8 feet from the fan and ask if he or she can feel the air movement. Then have other students come up and stand as a windbreak between the first student and the fan. Ask the first student the difference he or she feels. *Ask students what direction the prevailing winds come from in their area…in the summer and in the winter.*

Step 8: The Activity

Determine if you wish to have students work individually or in small groups. Pass out the *Vocabulary and Rubric* (Handout #4, page 30) and review it with students. Give each student or student group a large sheet of paper or photocopy and distribute the optional *Neighborhood Design Plan* Student Worksheet on page 34.

Tell students they will create a Neighborhood Design Plan and to imagine they are community planners or landscapers. They are going to have an opportunity to design a new neighborhood development.

Their job is to design & draw a landscape plan that shows some important community features (a school, several homes, a small business) and also incorporates tree planting that will help the home owners and the neighborhood conserve energy. Tell students they should refer to the *Tree Planting for Energy Conservation Guidelines* (Handout #5) to determine the best tree planting locations…both around the neighborhood AND around the homes and school, while avoiding planting too close to utility lines.

Remind students it is important to indicate north, south, east, and west on their design so they can know where to properly place trees for best energy conservation and windbreak protection. They should also indicate on the plan which trees are broadleaf trees and which trees are coniferous trees. Remind them of the direction of prevailing winds in their area. Review the assessment details in the rubric with students before they begin.

When the landscaping projects are complete have students explain their plans and their choice of tree locations to the class. Provide the opportunity for peer review and redesign.

Authentic Assessment

Have students use the *Tree Planting for Energy Conservation Guidelines* handout to evaluate real plantings around the school building, area homes, or business sites. Have them determine if efficient use of tree planting was made to conserve energy. They could select areas on the grounds where new trees might be planted on Arbor Day. If available, they can observe and comment on areas where windbreaks have been planted.

Alternative Assessment

Make an enlarged photocopy of the Energy Wise example at the bottom of page 20 and have students point out energy conserving features.

Other Ideas!

1. Take a field trip to a tree farm. A list and map of Indiana tree farms can be viewed at: **http://indianachristmastree.com/pages/locate.php**
2. Invite a landscape architect to speak to the class
3. Build a 3-D model of an energy wise neighborhood
4. For additional outdoor activities, visit **https://natureexplore.org/**.

Step 1

UNIT B - Discover how trees conserve and produce energy

EXTENSION ACTIVITIES

TEMPERATURE & TRANSPIRATION

Classroom Activity #1:

- Conduct temperature and transpiration experiments to show how trees shade and cool their surroundings

Objectives:

Students will:

- Make predictions about how trees affect temperature
- Set up a scientific experiment
- Measure the difference in temperature in tree shaded and unshaded areas
- Demonstrate the process of transpiration

Time Recommended:

- Two 30 minute class periods

Materials Needed:

- Several plastic baggies with twist ties
- 2 or more different kinds of leafy plants if there are no available leafed-out broadleaf trees
- Grow light or sun lamp (if no access to a sunny location)
- Two or more thermometers with same scale (F or C)
- Pencil and Paper
- Several microscopes
- Microscope slides and cover glass
- Lettuce leaf
- Iodine stain
- Eyedropper
- Forceps or tweezers
- Fan and container of water (optional)*

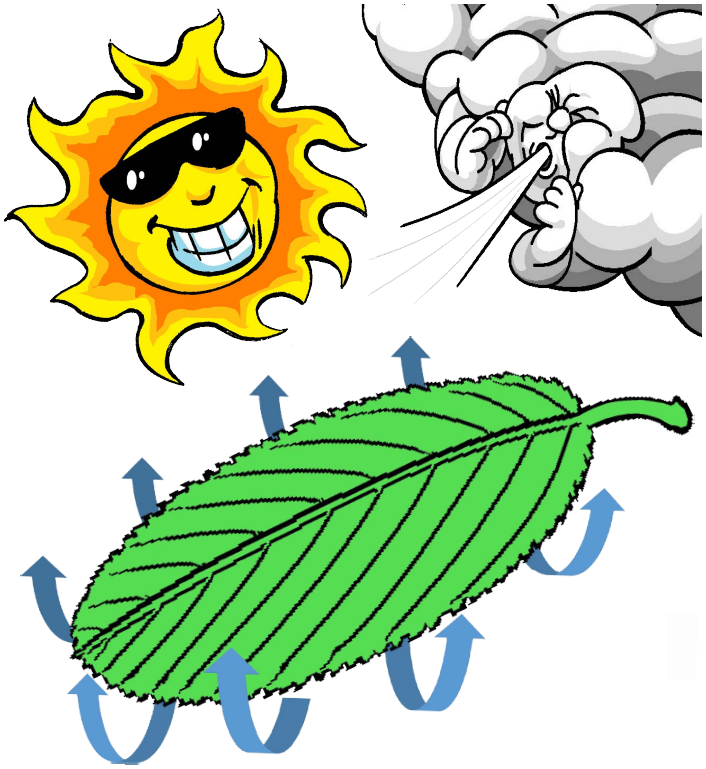
Indiana Academic Standards - Science (2016) Correlation:

Physical Science

- 5.PS.1, 5.PS.2, 5.PS.3

Life Science

- 5.LS.1, 5.LS.2



Building off the knowledge gained in the Unit B Basic Activity, these "extension" experiments are designed to show how trees can cool their surrounding spaces. If you choose to just do these Extension Activities rather than the Basic Activity in this unit, you may wish to consider including the *evaporative cooling demonstration from page 22, Step 5, here.

Teacher Background Information:

Temperature is the degrees of hotness or coldness measured on a numerical scale (Fahrenheit or Celsius).

Transpiration is the process by which water evaporates from plant tissues, primarily leaves. Most plants in temperate climates transpire about 99 percent of the water taken in by the roots. The other one percent is incorporated into the plant's structure. The vast majority of water that is transpired by trees escapes through the stomata. The stomata, as will be discussed in this unit, are pores located on the underside of leaves. Different species of trees and plants transpire at different rates depending on temperature, wind, light, and humidity. Plants in arid climates need to retain the limited moisture they take in, so their transpiration rate is much less than plants in more temperate climates.

Anticipatory Set: The students will be setting up experiments using the scientific method. If students have not done any experiments it will be important to review some of those terms with them. Write the words hypothesis, variable, and constant on the board.

Tell students they are going to do two simple experiments. Explain that scientists have guidelines they follow when they set up experiments. They start with a question, then they make a prediction (educated guess) about what the answer might be. That prediction is called a hypothesis.

Next scientists determine the ONE specific thing they need to test and compare to prove their hypothesis. For example, a scientist may wish to see if corn grows faster using fertilizer. To test that, the scientist will plant corn. Half of the corn planted would not have any fertilizer while the other half of the corn would have fertilizer. The ONE thing that changes, or is different, is called the experiment variable. The one thing in this example that is different is fertilizer. Everything else in the experiment needs to be the same or constant.

Using this same experiment example, ask students what things would need to be constant. List these things on the board. (Same brand of corn seed, same kind of soil, equal amounts of water, equal amounts of sunlight, same temperature, similar location area, same planting date.) Remind students that to prove that fertilizer makes a difference, everything else that affects the corn must be the same.

Temperature Experiment

Tell students they are going to get to conduct experiments to see if trees do make a difference in temperature of an area. Assign them to groups and help each group develop an experiment that has one variable involving temperature. One group might compare the temperature of grass in the sun to the temperature of grass in the shade. Another group might compare the temperature of a sidewalk surface in the sun to the sidewalk surface in the shade. A third group might measure the difference in temperature of asphalt in the sun to asphalt in the shade. (In each location, the variable is sun/shade.) Have each student make a prediction about what they think their own group results might be.

Remind students that everything else in their experiment needs to be constant. Have them brainstorm a list of what those constants need to be. The list might include time of day temperature is taken, amount of time they leave the thermometer before reading the temperature, the location site for each group...group one – grass; group 2 – sidewalk; group 3 – asphalt, etc.

Go outside and find a spot for each group where there is the appropriate mix of sun and shade. Each group must record the temperature after a specified amount of time. (10 minutes is plenty.) When tests are complete, ask the groups to describe the results of their investigations to the whole class.

Transpiration Experiment

Using a transparent bag, have each group wrap a leaf on the potted plant or a small portion of a leafy broadleaf tree branch that is exposed to full sun. Seal the end of the bag as tightly as possible. Do this on several kinds of plants or trees.

Have students check on the leaf periodically making notes on what they see. Ask them to indicate how long it takes for water droplets to form inside the bag and record results. Compare results from the experiment. Do different kinds of leaves transpire at different rates?

As students are waiting to check their leaves, discuss the process of transpiration with them. If you have not done the evaporative cooling demonstration with the fan and water from the Basic Activity (page 22, Step 5), you may wish to do that here. If you have done that, remind students of how the water that transpires from the leaves evaporates like the water on their hand, cooling the air around it.

Explain that plant leaves have tiny openings, called stomata. They consist of two specialized cells, called guard cells, that surround a tiny pore called a stoma. Guard cells are shaped like two tiny green jelly beans on each side of the stoma and open and close the stoma. These little openings are where carbon dioxide enters the leaf and oxygen and water moisture exit the leaf. Tell students they will have a chance to see stomata through a microscope, if available.

If there are enough microscopes in the class for each group to use, you may wish to have each group prepare their own slide. Otherwise prepare the slide using the procedure on following page and allow each group a chance to come look at the slide.

Procedure:

1) Put one drop of iodine stain on the center of the slide.
2) Break the lettuce leaf and pull off the thinnest layer of epidermis possible.
3) Carefully spread out this thin layer in the iodine on the slide and ensure it is flat and not folded over on itself.
4) Carefully place a cover slip over the epidermis, trying to avoid any air bubbles.
5) Carefully and slowly bring the slide into focus. Move the slide around until you find some stomata.
6) Change the lens to high power to observe the stomata in more detail.
7) If time permits, draw a picture of what you see, indicating the guard cells surrounding the stoma.

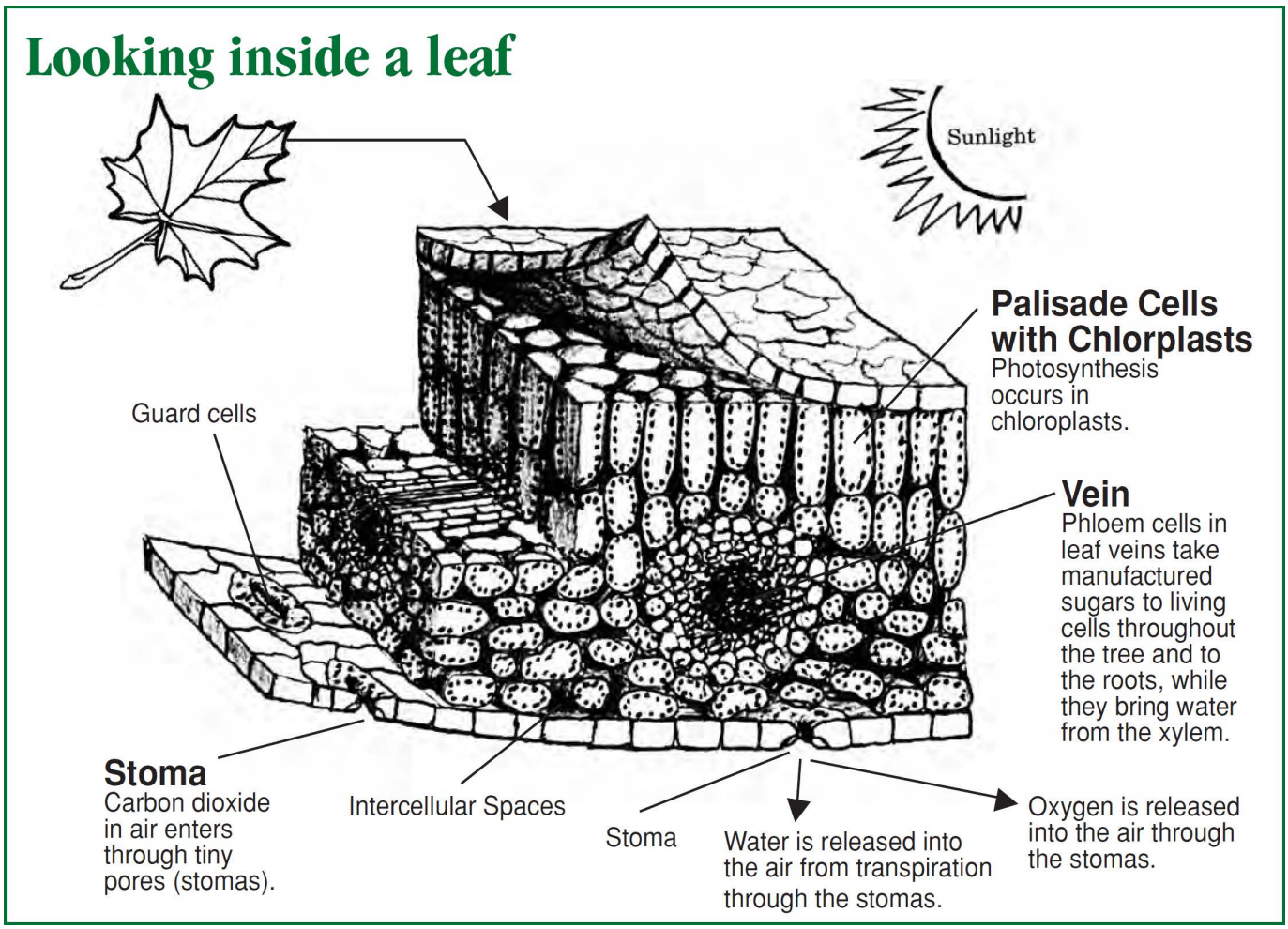


Image courtesy of: ADF

Authentic Assessment:

After students evaluate the two experiment results, they will determine what other experiments they might like to do related to trees. Each student will describe their experiment idea, list a hypothesis, constants, variable, materials needed, and outline the procedure they would use.

Step 1

UNIT B - Discover how trees conserve and produce energy

EXTENSION ACTIVITIES

ENERGY FOOD CHAIN

Classroom Activity #2

Objectives:

Students will be able to:

- trace the flow of energy in various forms, from plants to humans, by creating an energy chain
- describe several ways trees provide energy for human use

Time Recommended:

- One 30 minute class period

Materials Needed:

- Photocopied *Trees Produce Energy* (Handout #6, on page 33), one per student
- Pencil and Paper
- *Neighborhood Design Plan* created in Basic Activity

Indiana Academic Standards - Science (2016) Correlation:

Physical Science

• 5.PS.1, 5.PS.2, 5.PS.3

Life Science

• 5.LS.1, 5.LS.2

Introduction: This activity can be used to enrich and expand on the Basic Activity. It helps students understand that trees can produce, as well as conserve, energy. This activity will use the neighborhood design plans that students create in the Basic Activity.

Instructional Sequence:

Discussion: *Ask students how they would define the word "energy."* Allow student responses. Let them know energy is defined as the ability to do work; it powers everything in nature. Energy warms and cools our homes, fuels our cars, powers our TVs, and runs our manufacturing plants. It takes energy for us to walk, talk, digest our food, and even breathe.

Tell them that in the previous activity they learned how well-planted trees can play a key role in energy conservation. In this activity they will learn how trees and other plants can produce energy in ways that also benefit the environment.

Pass out the *Trees Produce Energy* (Handout #6, page 33) and review the content with students.

As you discuss Concept 1, review the illustration "Energy Food Chain." Ask students to come up with other examples of energy food chains.

As you discuss Concept 2, you may wish to include some of the Additional Information shown below.

Additional Information:

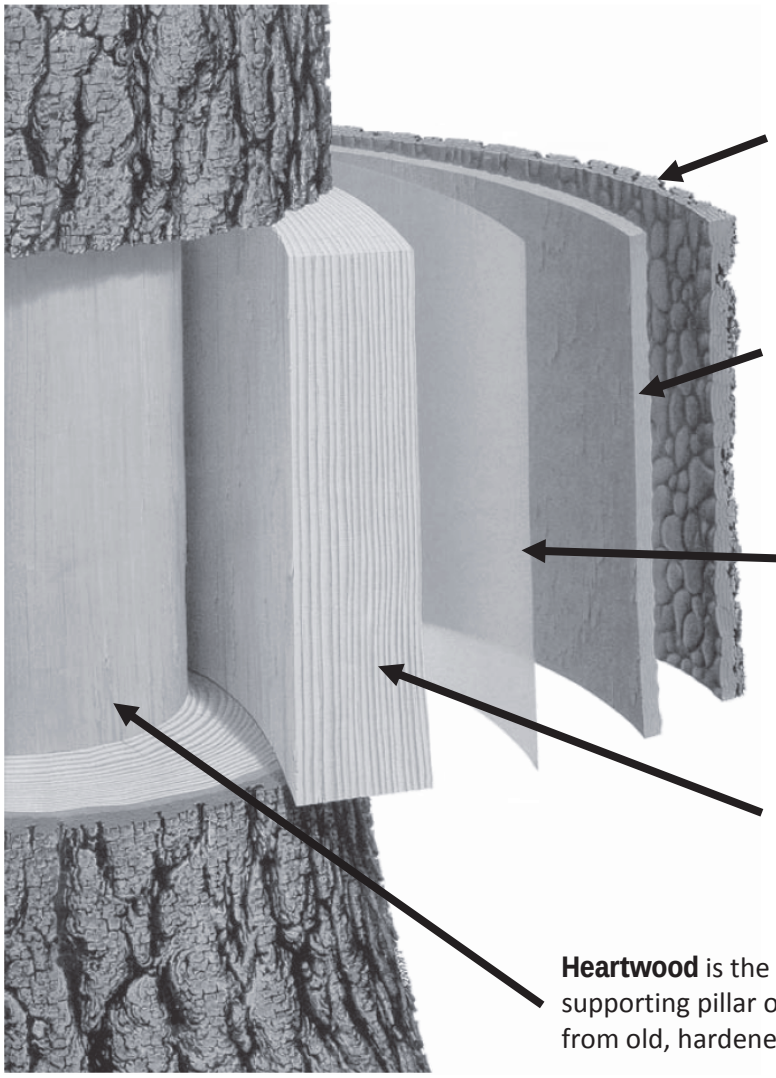
Two hundred years ago wood accounted for over 90% of the world's energy/heating needs. Today some nations still use wood as an important fuel source for cooking and heating, but in the United States wood and other plant-based biomass fuels account for less than 5% of the fuel used for energy production. The United States depends heavily on fossil fuels, which will eventually run out.

Only through wise use and proper forest management can wood and other biomass fuels be considered a renewable resource. Trees must be replanted as they are used. According to the National Renewable Energy Laboratory, more than 36 million acres of land in the United States, considered unfit to grow food, could be used to grow energy crops.

"Each generation takes the Earth as trustees. We ought to bequeath to posterity as many forests and orchards as we have exhausted and consumed."

Arbor Day Founder, J. Sterling Morton

Tree Cross-Section



Outer bark is the tree's protection from the outside world. It insulates against cold and heat and wards off insect enemies.

Phloem, or inner bark, is the pipeline through which food is passed to the rest of the tree. It lives for a short time and then dies and becomes part of the protective outer bark.

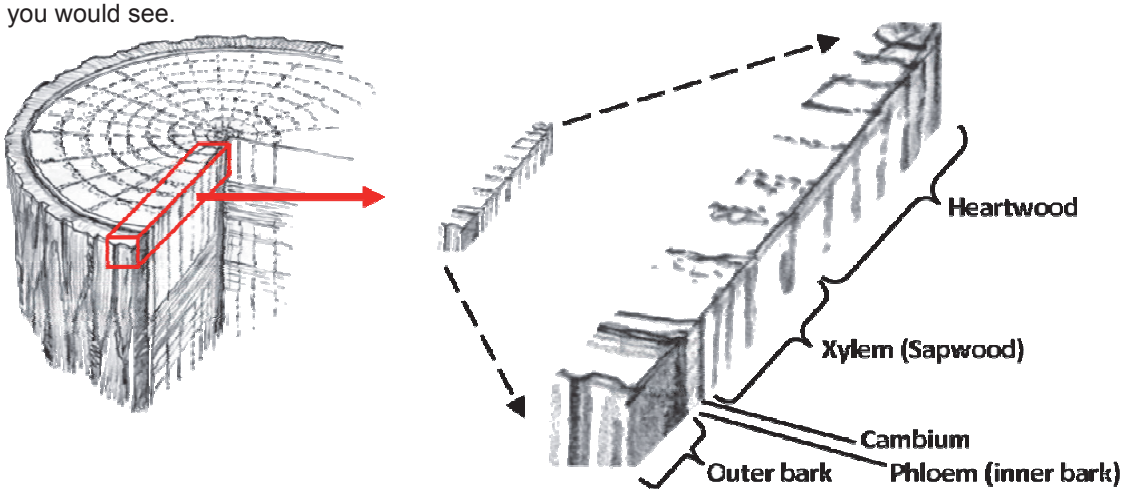
The **cambium** cell layer is the growing part of the trunk. It annually produces new bark (phloem) and new wood (xylem).

Xylem, or sapwood, is the tree's pipeline for moving water from the roots to the leaves. The new xylem laid down each year become the annual rings of the tree. Eventually, xylem hardens and turns to heartwood.

Heartwood is the central, supporting pillar of the tree made from old, hardened xylem layers.

Images courtesy of: ADF

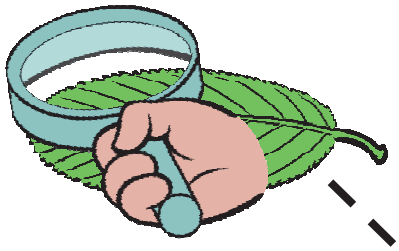
If you could pull a pull a chunk from the trunk of a tree, then cut a radial piece out of that chunk, then magnify it… this is what you would see.



In the activity you will do, you will pretend to become part of a section of trunk, like in the picture above, as you discover how a tree grows and functions!

1. Sunlight energy is captured in **leaves** by **Chlorophyll**, a green pigment found in the Chloroplasts of plant cells.
2. Tree **roots** draw water and minerals from the soil up the **Xylem** and eventually into many leaf veins.
3. **Carbon dioxide** (CO_2), a gas you exhale, enters leaves through leaf pores called, **stomata** (stomas, stomates).

4. ***PHOTOSYNTHESIS***: Chlorophyll uses the sun's energy to combine water and carbon dioxide to make special kinds of sugars ($C_6H_{12}O_6$) which are food for the plant. The sugar food moves through the leaf veins via the **Phloem** to other parts of the plant for use or storage.



Take a closer look inside and out!

Sunlight

1

Chloroplasts

Leaf Veins

4

Light Energy +
H_2O + *CO_2* =
Sugar,
Water Vapor,
and Oxygen

5

$C_6H_{12}O_6$

H_2O

2

CO_2

3

$H_2O(g)$

O_2

Stomata

5. While making food, **Oxygen** (O_2), a gas we inhale to survive, is produced and exits through the stomata. The passage of water vapor ($H_2O(g)$) from leaves is called, **Transpiration**.

Out
In
Oxygen

WE BREATHE IN **OXYGEN**.

In
Out
CO_2

WE BREATHE OUT **CARBON DIOXIDE**.

UNIT A - Vocabulary

Annual rings – The fast then slow growth of xylem each year creates a concentric ring pattern in the trunk. Count the rings and you know the age of the tree, as well as past weather conditions**.**

Bark – Outer bark protects the tree from weather extremes and insect pests.

Cambium – The thin, growing part of the tree that makes new xylem and phloem.

Carbon dioxide – A gas exhaled by animals and released from burning fossil fuels or decomposition. Trees clean the air by taking in carbon dioxide to use in photosynthesis. Often shown as CO2.

Chlorophyll – The green pigment in leaves that makes photosynthesis possible.

Deciduous – Trees that lose their leaves each year.

Evergreen – Trees that lose their leaves gradually over time so they appear green year round.

Germination – The beginning of seed growth.

Heartwood – The central supporting wood of mature trees made up of dead xylem.

Leaves – The food producing part of the tree where photosynthesis takes place.

Oxygen – Trees produce oxygen, a gas needed by animals to survive. Often shown as O.

Phloem – Inner bark of the tree that carries food from the leaves down to the rest of the tree.

Photosynthesis – The process by which plants make food.

Roots – The wide spreading woody roots of a tree that anchor the tree in the soil. Often called lateral roots.

Root hairs – Tiny roots growing off the lateral roots that take in water and nutrients from the soil.

Seeds – The part of a plant containing a tiny plant that may someday grow to be a mature plant of the same kind.

Stomata – Tiny pores where carbon dioxide enter into and where oxygen and water moisture exit out of a leaf.

Taproot – A long, deep root grown by very few tree species.

Transpiration – The passage of water vapors from leaves.

Xylem – (or "sapwood") The tube-like water transportation system in tree trunks that moves water up from the roots to the leaves of the tree. Xylem is the wood of the tree.

RUBRIC – Determine how your tree knowledge has grown. Are you a 10?

#1	Trees are amazing; they help people and the environment in so many ways. You should understand and be able to name some of the environmental benefits and products that trees provide.			
	No growth **0 points** if you can't name any environmental benefits or tree products.	**Germination** **1 point** if you can name 1 environmental benefit trees provide and 1 tree product.	**Vigorous growth** **2 points** if you can name 2 environmental benefits trees provide and at least 1 tree product.	**Fully grown** **3 points** if you can name 3 or more environmental benefits trees provide and at least 2 tree products.
#2	Knowing the essential parts of a tree and understanding the interdependent role those parts play in helping the tree grow and reproduce are important to ultimately understanding how to plant or care for trees in your community. (Main tree parts include roots/root hairs, outer bark, phloem, cambium, xylem, heartwood, leaves, and seeds.)			
	No growth **0 points** if you can name fewer than 4 tree parts and can't describe what the tree parts do for the tree.	**Germination** **1 point** if you can name 5 tree parts and describe what these parts do for the tree.	**Vigorous growth** **2 points** if you can name 6 or 7 tree parts and describe what these parts do for the tree.	**Fully grown** **3 points** if you can name all 8 major tree parts and clearly describe what these parts do for the tree.
#3	Photosynthesis, the process by which plants make their own food, is one of the most important cycles of nature. All life on earth (through food chains) depends on a plant's ability to make food using energy from the sun. (Main photosynthesis components include sun, water, chlorophyll in the leaf, carbon dioxide, oxygen, and sugar.)			
	No growth **0 points** if you can name fewer than 3 components of photosynthesis and can't describe how this cycle works	**Germination** **1 point** if you can name at least 4 components of photosynthesis and generally describe how this cycle works.	**Vigorous growth** **2 points** if you can name at least 5 components of photosynthesis and clearly describe how this cycle works.	**Fully grown** **3 points** if you can name all 6 main components of photosynthesis and clearly describe how this cycle works, including the process of transpiration.
Get 1 EXTRA BONUS POINT for actively and cooperatively participating in the Tree Growth Activity				

UNIT B - Vocabulary

Biomass Energy – Energy that comes from plants. Biomass gets its energy from the sun. It is renewable as long as new trees or plants are planted.

Broadleaf – Trees with leaves that are thin, flat, and usually shed annually. Broadleaf trees are often good for shade.

Conifer – Trees that bear cones and have needle or scale like leaves that usually remain on the tree into the next growing season. Conifers are often good for windbreaks.

Deciduous – Trees that shed their leaves each year.

Diversity – Variety of many different kinds.

Energy – The ability to do work.

Energy Conservation – Efforts that reduce energy use...especially use of non-renewable energy sources..

Evergreen – Trees that keep their leaves into the next year.

Fossil Fuels – Fossil fuels come from organisms that lived long ago and have been buried underground for thousands of years. These are nonrenewable energy sources that include coal, oil, and gas which people use to create energy that powers our cars, homes, and factories. Fossil fuels can produce pollution when burned to create energy.

Heat Island Effect – City areas with lots of concrete and few shade trees that are hotter during the summer than nearby areas that have shade trees.

Nonrenewable Energy – Energy sources like coal, oil and gas that have limited supply.

Prevailing Wind – The most common direction of the wind.

Renewable Energy – Energy that is continuous or can be replaced naturally. Examples include energy created by the sun, wind, or biomass.

Windbreak – Rows of trees planted to slow the force of the wind.

Windward Row – The front row of trees facing the wind in a windbreak.

Images courtesy of: ADF

Examples of **broadleaf** and **conifer** trees (left to right): White Oak, Redbud, Red Maple, Eastern White Pine, Redcedar, and Norway Spruce

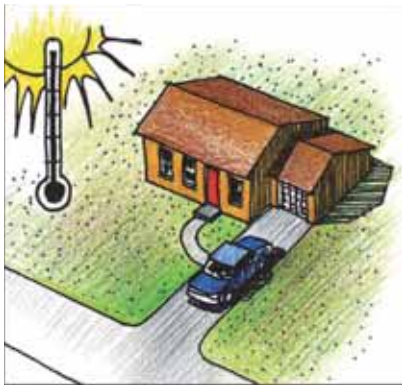
RUBRIC: RATE YOUR ENERGY CONSERVATION LANDSCAPE PLAN

1- 2 Points POOR PLAN	3-5 points AVERAGE PLAN	6-8 Points GOOD PLAN	9-10 points EXCELLENT PLAN
• Only one or no *Trees for Energy Conservation Guidelines* are included with trees correctly located in the community design.	• Two of the *Trees for Energy Conservation Guidelines* are included with trees correctly located in the community design.	• Three of the *Trees for Energy Conservation Guidelines* are included with trees correctly placed in the community design.	• All three of the *Trees for Energy Conservation Guidelines* are included with trees correctly placed in the community design.
• Student cannot describe how trees in the landscape design conserve energy.	• Some of the ways trees in the landscape design conserve energy and can be correctly described.	• Most of the ways that the trees in the landscape design conserve energy and can be correctly described.	• All of the ways that the trees in the landscape design conserve energy and can be very well described.
• Only a few broadleaf and conifers are identified in the plan.	• Broadleaf and conifers are included in the design with most trees correctly placed for good energy conservation.	• Broadleaf and conifers are included in the design with all trees correctly placed for good energy conservation.	• Many broadleaf and conifers are included in the design with all trees correctly placed for good energy conservation.
• Only one aspect of a community is included.	• Several aspects of a community are included.	• Work is neat with several aspects of a community included.	• Work is very neat with many aspects of a community included.

Guideline #1: Plant Trees to Shade Your Home

What you should know – Trees shading a home can reduce the need for air conditioning. Carefully placed trees can save up to 25 percent of an average household's energy needs for cooling - up to 65 percent in the case of mobile homes. According to the U.S. Department of Energy, proper placement of only three trees can save the average household up to $250 in energy costs each year. Think about what fun things your family could do with that extra money!

What you can do – The most energy savings and the best use of shade generally comes from deciduous, broadleaf trees planted about 10 to 20 feet from the walls to the west, east or south of the house, depending on the species. These trees shade the house during the summer, reducing the energy needed for air conditioning. When they lose their leaves in the winter, trees correctly planted allow the sun to reach and warm the house, saving energy for heating as well.



2 Main Types of Trees

Different kinds of trees can be part of an energy wise plan, but watch for utility lines.

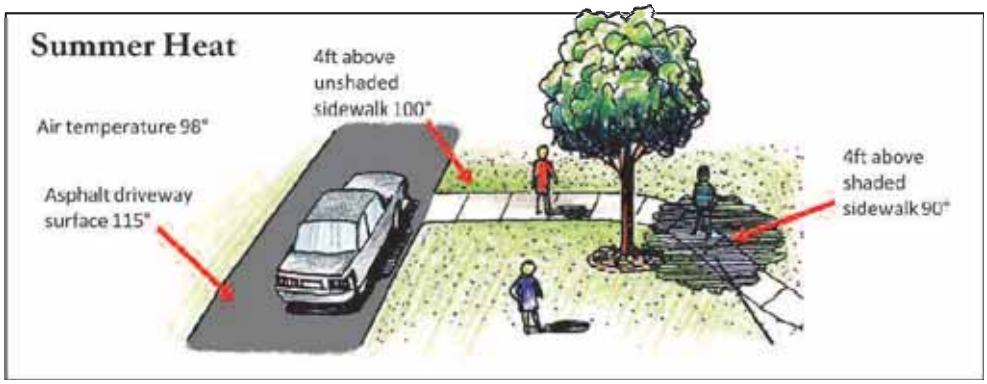
Broadleaf trees have leaves that are flat and thin. They are usually deciduous, shedding their leaves annually. Oak, ash, and maple are several examples of broadleaf trees. Broadleaf trees generally provide the best summer shade.

Conifers bear cones and have needle-like leaves. Most conifers are evergreen since they do not lose all their leaves at once. Pines, fir, cedars, and spruces are conifers. Conifers generally provide the most effective buffer in windbreaks.

Images courtesy of: ADF

Guideline #2: Plant Trees to Shade Paved Areas

What you should know – Trees shading concrete or asphalt driveways and parking lots will greatly decrease surface heat. In the summer, a city area with trees shading paved areas can be 12 degrees cooler than one without trees.



What you can do – Plant broadleaf trees near, but not right against, sidewalks or driveways. Be mindful of nearby utility lines because some tree species at maturity may interfere with them. Try planting trees for shade in large parking lots or along city streets, but ensure you have proper permits beforehand. Another idea is to plant rooftop gardens.

Guideline #3: Plant Trees as Protection from Hot or Cold Winds

What you should know - Windbreaks are rows of trees used to reduce the force and direction of the wind. Planting a windbreak around a home or housing development can provide an energy savings of up to 30 percent and reduce blowing snow, noise, and dust.

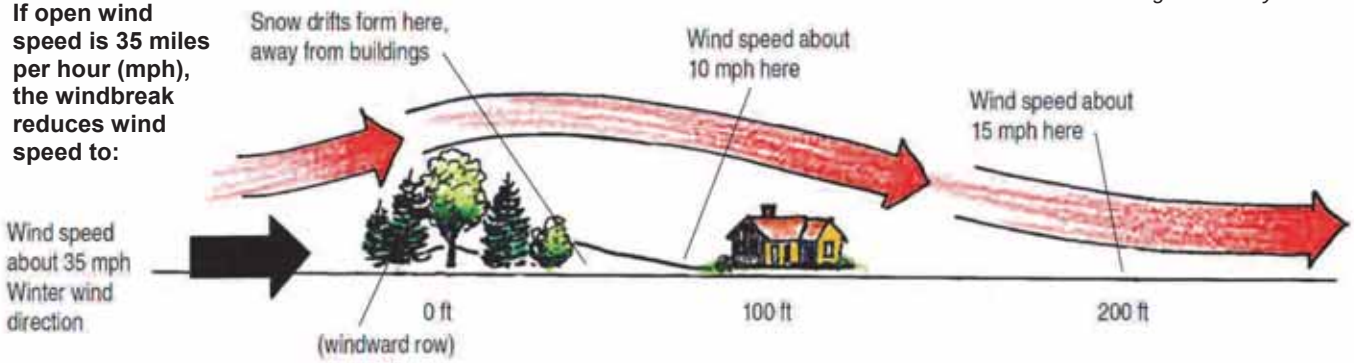
Windbreaks should be planted in an L-shape (right angle) toward the common wind direction. For best protection, windbreaks may be planted on more than one side of the property. Effectiveness of the windbreak also depends on the density (thickness) of the windbreak and its height. Three or more rows of trees in staggered formation provide the best wind protection. Conifers generally form the best windbreaks but some windbreaks include a few broadleaf trees as well. Windbreaks are effective for a distance of up to 8 to 10 times the height of the mature fully grown trees.

A well-placed windbreak can protect several homes or an entire development from chilling winter winds and drifting snow.

What you can do – Plant conifers several rows deep in a continuous line facing **prevailing winds**. Since snow and stale air can collect in the area directly behind a windbreak, buildings to be protected should be located no closer than 100 feet from the **windward row** (front row facing the wind). The area to be protected should be within a downwind distance of 2 to 5 times the expected height of the tallest windbreak row. (For planning purposes, 20 feet is often used as the height of the tallest trees.)

Images courtesy of: ADF

If open wind speed is 35 miles per hour (mph), the windbreak reduces wind speed to:



Worksheet Directions: Create a Neighborhood Design Plan. Imagine you are a city planner or landscaper. Use the "*Tree Planting for Energy Conservation Guidelines*" to aid in determining the best locations to plant trees. Draw them into the design plan of this new, energy-saving, neighborhood development to shade homes, paved areas, and to serve as windbreaks. Consider carefully where to plant deciduous, broadleaf trees and where to plant conifers. Think about what sides of the homes to plant trees on for the best energy savings. Then, in the box below, describe what makes your Neighborhood Design Plan energy wise. [The energy company plans to install their utility lines for this neighborhood underground so that these will not conflict with your neighborhood design plans.]

Trees Produce Energy

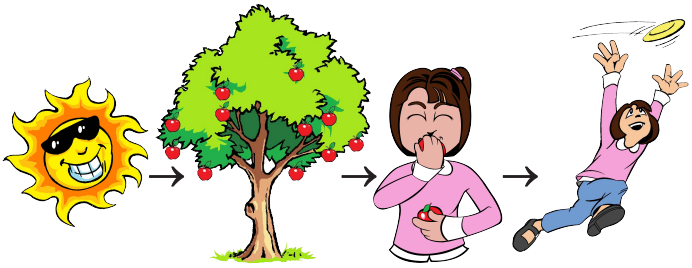
Energy is defined as the ability to do work; it powers everything in nature. Energy warms and cools our homes, fuels our cars, powers our TVs and DVD players, and runs our manufacturing plants. It takes energy for us to walk, talk, digest our food, and even breathe. The following two concepts will help you understand how you can plant trees to produce energy.

Concept 1: Plant Trees to Produce Food Energy for People and Wildlife

What you should know – Trees and other green plants are the source of energy for all animal life to live and grow. Through the process of photosynthesis, plants change light energy from the sun into chemical energy that is stored in the plant as carbohydrates (sugars) as it grows. All animal life, including human life, depends on that stored energy. When you eat an apple, the chemical energy stored in the fruit becomes the energy "fuel" that allows you to work, play, run, and grow. Every living animal either gets its energy directly from plants or depends on other animals that depend on plants for food.

What you can do – Plant many different kinds of trees that have high food value. This will increase healthy food energy for people as well as provide food and habitat for many kinds of wildlife. Plant fruit and nut trees that will grow in the climate where you live. Trees or shrubs with high-energy food value for people or wildlife can include: apple, orange, cherry, peach, oak, hazelnut, plum, etc.

Energy Food Chain



Concept 2: Grow Trees as an Energy Crop

What you should know – While the fruits, seeds, and nuts of trees provide fuel (either directly or indirectly) to run our bodies, the wood from trees can be burned to release energy for heat to keep us warm or power to make things run. This homegrown source of energy is referred to as **biomass energy**...it is energy you can grow. Wood, animal waste, crops, and even garbage can be used as a biomass energy source. Agricultural biomass crops like corn and soybeans can be burned directly or turned into other liquid fuels (ethanol, methanol, and biodiesel) that can be used to power vehicles or machinery. When not burned efficiently, wood and other biomass products can cause air pollution. However, modern heating/cooling systems, and even efficient wood burning stoves, burn the biomass at such a high temperature and so completely that there is often less pollution with it than with conventional fuels like oil and coal.

Wood manufacturing waste and wood from street tree trimmings can also be burned for fuel, which saves fossil fuels and landfill space. Biomass not only produces energy, but it is good for the environment too.

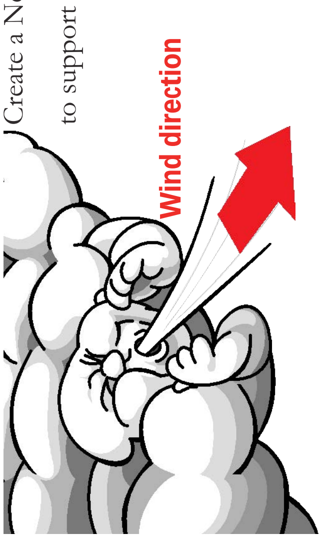
Types of Biomass

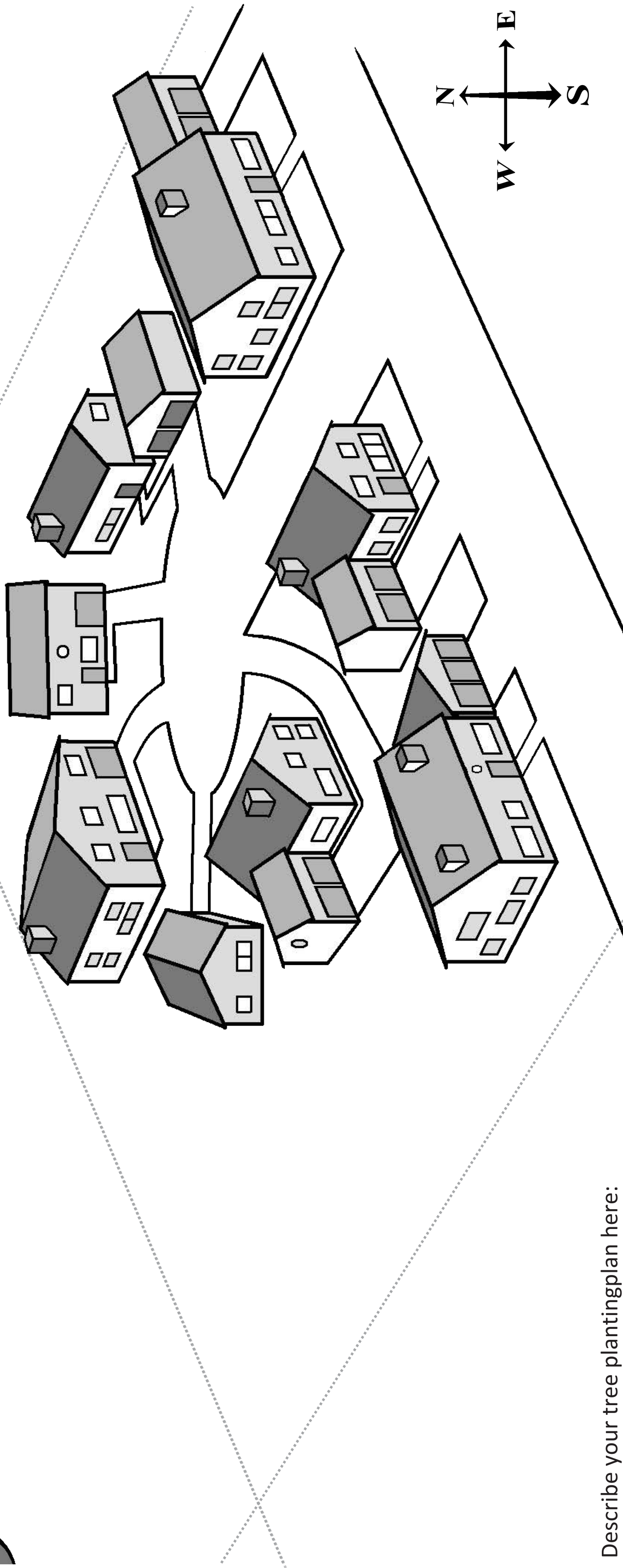
What you can do – Plant trees or other biomass energy crops on land that is considered unfit to grow food crops. Plant new trees when trees are cut down. Take care of the soil in which our crops grow. With careful management, wood and other biomass fuels will always be a renewable resource.

Activity Directions: Research what tree species will grow in your community. Look at the *Neighborhood Design Plan* worksheet you created in the last activity. Add trees to your plan that will produce either food or biomass energy. Label your tree species. Discuss how these changes benefit the neighborhood.

Neighborhood Design Plan

Create a Neighborhood Design Plan using **broadleaf** and **conifer** trees to form **windbreaks** and shade to support **energy conservation**. Refer to the *"Tree Planting for Energy Conservation Guidelines"* (Handout #5).





Describe your tree plantingplan here:

Student Name: ____________________

Step 2 Create a Poster

Trees are Terrific and Energy Wise!

Objective:

- Students create original posters reflecting their understanding of tree growth & function, the benefits in diversity of native species, and/or how trees benefit communities & are energy wise.

Deadline:

- See Contest Entry Form for details.

Time recommended:

- A minimum of one class period is recommended.

Materials needed:

- paper no smaller than 81/1/2" x 11" and no larger than 11" x 17"
- markers, crayons, colored pencils, paint pens, watercolor, ink, acrylic, and/or tempera paint

Indiana Academic Standards - Fine Arts: Visual Arts (2010) Correlation:

Standards 6 & 7 - Creating Art: Studio Production

- 5.6.1 Demonstrate refined perceptual skills through convincing representation of objects and subject matter from life.
- 5.6.2 Utilize new interests, current events, or personal experiences as subject matter in artwork
- 5.7.4 Identify, control, and use a balance of two-dimensional and three-dimensional media, techniques, and processes to effectively communicate ideas, themes, experiences, and stories.

Standard 8 - Integrated Studies

- 5.8.1 Compare the ways big ideas and concepts are communicated through the perspectives of visual arts and other disciplines.
- 5.8.2 Create artwork incorporating concepts, subject matter, technology, or the sign systems of other disciplines that communicates in-depth knowledge gained through integrated study.

For additional Indiana Arbor Day Poster Contest information, including participant eligibilty, registration, poster contest theme, entry deadline, prizes and Arbor Day event learning resource links, etc. please visit:

https://www.arborrangers.com

and review the Poster Contest Checklist and Contest Entry forms and links. Thank you!

Create a Poster

Ask each student to create a poster that reflects his or her understanding of the important parts of a tree and the functions they serve to help the tree live and grow which make them so terrific. Also, encourage them to think about the different benefits trees provide to people, animals, and the environment by conserving and producing energy, food, shelter, etc.

Students should make sure their posters follow the contest rules by using the Indiana Arbor Day Poster Contest Checklist. You may select the winners or have a judging panel for the classroom or a school contest, if applicable. Judges could include other students, garden club members, nursery personnel, arborists, the city forester, teachers, PTA members, or other local individuals with an interest in trees who are willing to volunteer their time.

Criteria for judging should consider the students ability to clearly convey their understanding of the subject matter using critical-thinking, creativity and originality. Artistic ability alone should not be the sole determining factor for selecting a classroom winner, so please stress this to all your 5th graders and encourage them to fully participate and have fun with this meaningful activity.

Note: Schools with multiple participating classrooms entering the contest may mail those entries together.

Home schooled 5th graders and students attending a non-participating school or classroom are eligible to participate but must be sponsored by a parent, guardian, or teacher, 18 years of age or older.

Step 3

Celebrate Indiana Arbor Day

Get your students outside and celebrate Arbor Day!

Since 1872, Arbor Day has been celebrated throughout the United States and Arbor Day celebrations in schools have always played an important role. We are proud to contribute to enhancing Hoosier appreciation for this tradition by promoting Indiana Arbor Day and raising awareness through our annual poster contest.

An Indiana Arbor Day celebration can be…

1. **Simple** – Plant a tree in honor of your school poster contest winner, their teacher, and/or for recognition of an outstanding volunteer.
2. **Inspiring** – Have your graduating class plant a tree with the younger students. This is a tradition that honors the students leaving and gives new students something to enjoy throughout their years!
3. **Entertaining** – Students could compose poems about trees or perform an Arbor Day play. A sample play may be found at **https://www.arborday.org/celebrate/play.cfm**. This could be performed for fellow students, families, or senior citizens.

Batesville, IN - A tree planting celebration at St Lawrence Catholic School.

Whatever you choose to do for your Arbor Day celebration, go outside and enjoy the trees and environment that surround you!

- IN Dept. of Natural Resources/CUF

DNR
Indiana Department of Natural Resources

INDIANA
ARBORIST ASSOCIATION

THANK YOU to our hardworking Indiana Teachers taking the lead, their talented participating Students, and to our wonderful contest Sponsors and Volunteers! It is by your support this poster contest was made possible!