ECOS
Ecologists Educators and Schools: Partners in GK-12 Education

ECOS Inquiry

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2. NAME OF INQUIRY:
The trees in our schoolyard: a growing library of information!

3. GOALS AND OBJECTIVES:

a. Inquiry Questions:

- What species of trees do we have in our schoolyard?
- What is the average height and circumference of each species?
- What is the average age of each species (# of tree rings)?
- Are the taller and wider species always older than the shorter and narrower species?
- What do the tree's rings tell us about its past environmental conditions?
- What do the tree's rings tell us about its requirements for growth?

b. Ecological Theme(s):

- Different tree species grow at different rates, and have different requirements for growth (ie. different moisture and light requirements).
- Tree rings can tell us not only how old a tree is, but also what the environmental conditions were like during each year of its growth.
- A forest of trees is like a growing library of information about past environmental conditions!

c. General Goal: Students will identify and measure the height, diameter, and age of different tree species in their schoolyard using real forestry tools. They will understand what these parameters can tell us about a species' growth requirements, and what its past environmental conditions were like.

d. Specific Objectives:

Day 1 of Inquiry

- Students will collect leaves (and flowers/seed pods/etc. depending on time of year) from different tree species in the schoolyard, or in a defined area of the schoolyard.
- Students will use the online "ECOS Guide to the Ecology of the Northern Rockies" (www.bioed.org/nhguideweb/) to identify the trees, using the collected specimens. They may also research the different environmental requirements/habitat descriptions for the different tree species.
- Students may preserve the identified tree specimens using plant presses (See ECOS inquiry "Under Pressure!- Why do ecologists press plants?")

Day 2 of Inquiry

- Students will collect and record data on the height and circumference of each tree.
- Students will practice averaging data for each tree species.
- Students will formulate hypotheses as to relative ages of the trees. (ie. Are the larger species older than the smaller species?)

Day 3 of Inquiry

- Students will participate in an activity to help them understand the significance of tree rings.
- Students will help a teacher to remove a tree core from each tree, or from a small sample of trees.
- Students will make and record careful observations of the tree cores, including the number of tree rings, width of rings, etc.
- Students will participate in a discussion about how different tree species have different growth rates and different requirements for growth. (ie. Are the larger trees always older than the shorter ones?) Students will also discuss what we can determine about past environmental conditions based on the banding patterns of the tree cores.

e. Grade Level: 4-6

f. Duration/Time Required:

→ Prep time: There is no necessary set-up time. However, you will want to have made photocopies of the data sheets and tree core activity.

→ Implementing Exercise During Class: The inquiry may be divided into three 90-minute sessions (see Specific Objectives above). Alternately, each session may stand alone as its own inquiry, with some refinement.

→ Students will be assessed for their understanding of the material by their participation in class discussions, and the content of their journal entries.

4. ECOLOGICAL AND SCIENCE CONTEXT:

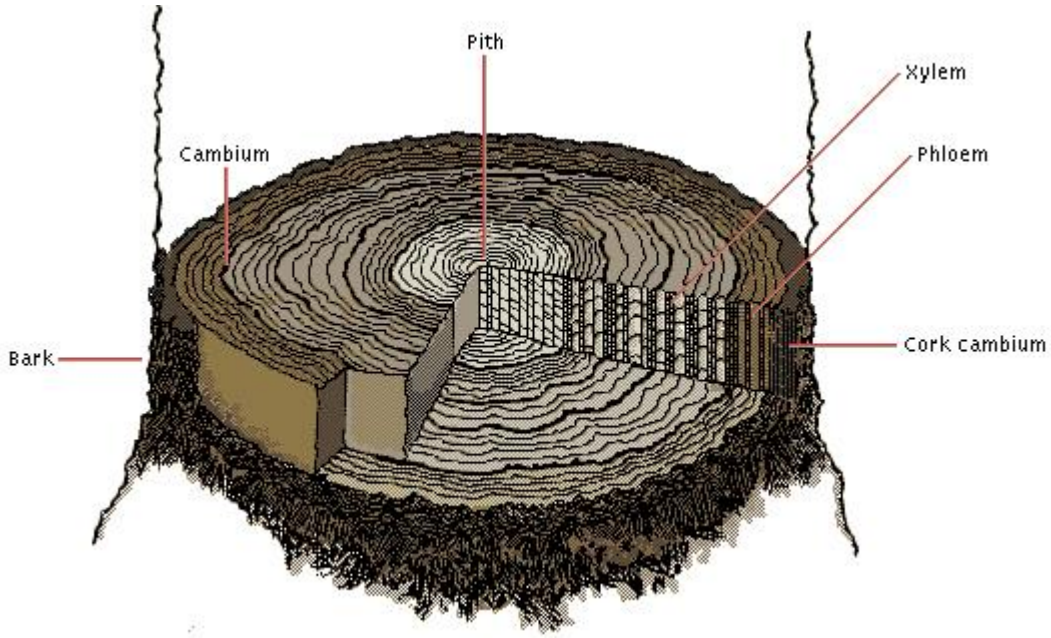
a. Background (for Teachers): A tree is a tall plant with woody tissue. It grows tall to push its crown of leaves above other plants, to compete for light. Most of the tree trunk is just dead woody tissue that supports the tree. The only parts of a tree trunk that are alive are the very outside layers of tissue beneath the bark. Just beneath the bark is a band of reproductive tissue called the **cambium**, which produces new bark to the outside of the tree, and new wood (xylem and phloem) to the inside. Just inside the cambium is a band of tissue called the **phloem**, which transports sugars from the crown down to the roots (think maple syrup!). Then, just inside the band of phloem, there is another band of tissue called the **xylem**, which transports water from the roots up to the crown. Xylem cells are actually dead when they carry water—they're like hollow tubes or straws inside the tree. In the very center of the tree is the **heartwood** or **pith**, which supports the tree but doesn't do anything else.

Each year, the cambium produces an **annual ring**, which is made up of a wide light-colored band, and a narrow dark-colored band. The light-colored band is called the **early wood**, and is produced early in the summer when water is plentiful and temperatures are warm. The dark-colored band is called **late wood**, and is produced late in the summer when water becomes scarce and temperatures get cooler.

Scientists can count the number of dark bands on a tree stump or **tree core** to determine how old the tree is! A **tree core** is like a thin pencil of wood that can be removed from a tree using a **tree borer**. Scientists can study the bands on the core to determine the age of the tree, and the environmental conditions during each year of growth. (Remember, wide, light-colored bands represent years of favorable precipitation and temperature!).

There are many environmental factors that influence the growth of trees; especially precipitation and light. Each tree species has a different set of environmental requirements, and grows at a different rate. Therefore, in the same year, one tree may produce a very wide band of new wood, while another species will produce only a modest band. So, a big tree isn't necessarily older than a small tree. For example, the short, stubby conifer trees on the hillside may actually be much older than the tall, wide cottonwood trees along the creek!

b. Background (to present to Students): This same information may be presented to students, accompanied by a drawing on the whiteboard or chalkboard illustrating the parts of a tree trunk and how it grows outwards. (This can be drawn as simple, concentric circles.)



http://encarta.msn.com/media_461516466_761577657_-1_1/Tree_Trunk_in_Cross_Section.html

5. MOTIVATION AND INCENTIVE FOR LEARNING: Students will get to use the internet and real forestry tools, including clinometers, tree corers, and measuring tapes, to learn about the trees in their own schoolyard.

6. VOCABULARY: Vocabulary words are in **bold**, and are defined above in the "Background" section.

7. SAFETY INFORMATION: Students should not be allowed to handle the tree borers themselves. The ends are very pointy and sharp. Teachers should spray a little WD-40 lubricant on the borer, and then twist the end into the tree. (If you don't lubricate the borer first, the tree core might get stuck inside!) Students make take turns twisting the borer once the sharp end has been inserted, while under teacher supervision.

8. MATERIALS LIST (including any handouts or transparency masters):

- clinometers (See http://www.msgem.net/Hicks%20Plan.pdf for instructions on use).
- measuring tapes
- tree borers (See http://www.plantbio.ohiou.edu/epb/instruct/ecology/field_methods.htm for instructions.)
- student journals, pencils, pens, scissors, and paste
- data sheet and tree core activity (attached)

9. METHODS/PROCEDURE FOR STUDENTS:

a. Pre-investigation work: Prior to the tree-coring investigation on Day 3, students can participate in a fun activity which involves lining up different tree core cut-outs along a time scale (attached).

b. Investigation work:

1) What evidence (data, samples) do students collect?

On Day 1, students collect samples of leaves, flowers, and/or seed pods from different tree species in their schoolyard, or in a defined area of the schoolyard. On Day 2, students record the height and circumference measurements of the trees on data sheets. On Day 3, students assist teachers in taking core samples from the trees.

2) How do students present the evidence (data)?

Height and circumference data may be averaged for each species and presented as a bar graph. Age data may also be averaged for each species (if you're lucky!). It can be difficult to accurately determine the number of annual rings; if so, students may participate in a more general discussion of how cores from different species vary in their banding patterns, moisture of wood, and width between bands.

3) What conclusions are drawn from the evidence students collect?

Students will be able to state which tree species are present in their schoolyard, and the average height and diameter of each. They will be able to conclude whether bigger trees are always older than smaller trees. They will conclude that different species have different growth rates, and thus different banding patterns.

4) Include examples of data sheets (attached).

10. ASSESSMENT: Student understanding of the inquiry material will be assessed by their participation in the tree core cut-out activity (eg. Did they assemble the cores in correct order?), follow-up discussions (eg. How do the tree cores of various species differ from one another? What does that tell us about how they grow?), and their presentation of the data in bar graph form.

11. EXTENSION IDEAS: (SEE REFERENCE SECTION)

12. SCALABILITY: This inquiry could be scaled-up to higher grade levels by having the students perform all of the clinometer calculations on their own, which involves simple trigonometry (See http://www.msgem.net/Hicks%20Plan.pdf).

13. REFERENCES:

- **Tree Physiology**. http://www.dsisd.k12.mi.us/mff/Environment/TreePhys.htm . This is an excellent resource that gives clear and concise explanations of many interesting concepts, including the parts of a tree, photosynthesis and respiration, fall color change, and winter adaptations.
- http://www.tenafly.k12.nj.us/~pnelson/task.htm . This site provides a great extension activity relating tree cores to global warming, which would be more appropriate for grades 10-12. However, it also provides links to many educational sites related to climate, tree identification, tree coring, and forestry equipment (how to order and instructions for use).
- **Learning from Tree Rings**. http://www.earth2class.org/k12/w5_s2005/Learning%20from%20Tree%20Rings%202005.pdf . This is an entire powerpoint lecture (20 slides) that explains the formation of tree rings and the science of dendrochronology, or the interpretation of tree rings. It includes links to many student activities and on-going research projects.

- **Tree Rings: A Study of Climate Change**.

http://www.k12.wa.us/edtech/athena/curric/land/global/treestel.html. This site provides additional explanation of tree ring formation and the interpretation of tree cores. It includes links to activities "Tree Ring Growth and Weather" and "Tree Core Reconstruction".

14. LIST OF EXPERTS AND CONSULTANTS. An excellent resource on all aspects of forest ecology is Dr. Paul Alaback, ECOS Co-Director.

15. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT: Students enjoyed using the "real equipment": clinometers, measuring tapes, and tree borers. The students were especially impressed by the neat little "pencil" of wood that is removed by a tree borer, and made careful observations of the tree cores. During the tree coring, it worked really well to have the students line up behind the teacher in front of the tree. The teacher inserted the borer into the tree. Then, the students got to twist the borer 3-4 times each until it was to the center of the tree. The students each got to twist the borer in the opposite direction until it was removed from the tree, as well. This was much more fun than just watching the teacher do it!