Tree Ring Inquiry
4th Grade Life Sciences
Julia Barton
NSF STEM Graduate Fellow in K-12 Education in the Sugar Creek
Ohio State University
Ohio Agricultural Research & Development Center
Background and Rationale for the Activity

Students taking part in fourth grade life sciences have varying experience with plants. Many students in my class are the children of builders, woodworkers, or carpenters, and see this as their family’s future livelihood, so understanding trees and forest ecosystems generates a great deal of interest and discussion. It seems that students have heard discussions of stand management and woodlot harvesting strategies at the dinner table. Most families in the region also seem to take part in hunting, so the impact of deer on forest ecosystems might also be an interesting bridge between experience and classroom learning.

The fourth grade science curriculum at Mt. Eaton Elementary is based on 4 nine-week sessions. The first session focuses on weather, the second on plants, the third on physical sciences, and the fourth session allows opportunities for linking of the other three topics together and to watershed science through hands-on projects and the analysis of long-term weather data collected over the 27 weeks. In addition to science curriculum, the 4th grade social studies curriculum hinges on the study of Ohio and its natural resources. Students recognize forests as a renewable resource and are aware of its many industrial uses. Students may be less aware, however, of the ecosystem functions Ohio’s forests. In addition to social studies curriculum, the 4th grade language arts curriculum links easily to pieces of science and social studies curriculum, bringing in important state and local resources such as state parks, local history, and even plant science through stories. It is also important to note that this unit includes a visit from a naturalist and a forester from the Wilderness Center for a program focusing on trees as renewable resources, tree ID by twigs, use of tree keys, and tree parts and functions. At this point in the course, students are able to identify the basic plant parts and their related functions and explain that plants make their own food through photosynthesis. Students have familiarity with the scientific method and have designed and conducted simple seed germination experiments.

The current unit focuses on learning some basic research and analysis methods associated with forest ecosystems including using standardized principles for forest analysis and measurement (using keys for tree ID; diameter at breast height; creation of transects and test plots), calculating tree height using geometry, as well as dendrochronology (using tree rings to analyze temporal and spatial patterns of biological, physical, and cultural processes). Today’s discussion and activity focuses on the basic concepts of dendrochronology and what can be learned from trees as “ecological historians.” The instructor will begin by asking students what they think they can find out from tree rings. She will then go into more specifics of tree ring formation and its relationship to the environment, for example, explaining that during the early part of a growing season, trees tend to produce large, thin-walled cells, whereas during the later period of the growing season, they produce smaller, thicker-walled cells, in other words, early and latewood which is clearly visible in the form of tree rings in tree rounds (or a cross section of a tree). The instructor could also explain various measurement techniques, for example, measuring the distance from the earlywood boundary of one ring to the earlywood boundary of another ring shows the amount of wood produced in a given year. The instructor can tie this information to environmental factors with which students have experience, such as weather patterns, floods, access to light, droughts, and temperature. After the instructor has presented the basics through examples and the use of visual aids with the overhead projector, document camera, or computer, the lecture activity may begin.
Course Learning Goals Based on Ohio’s 4th Grade Academic Content Standards
1) Students will observe and explore that tree rounds provide evidence about plants that lived long ago (or not so long ago) and the nature of the environment at that time.

2) Students will apply facts and concepts related to the following themes to analyze tree rounds:
   Science
   - Relate plant structures (leaves, flowers, roots, stems) to their specific functions (e.g. growth, survival, death)
   - Compare changes in an organism’s ecosystem that affect its survival
   - Analyze a series of events and/or simple seasonal cycles, describe patterns and infer the next likely occurrence
   - Record the results and data from an investigation and make a reasonable explanation
   Social Studies
   - Identify ways that people have affected the physical environment of Ohio including use of forests
   - Identify the productive resources needed to produce a good or service and suggest opportunity costs for the resources involved

3) Students will increase their scientific literacy as they demonstrate critical thinking and scientific logic in the inquiry into and analysis of tree rounds (i.e.: forest ecosystems and related social systems).

Outcomes for this recitation activity:
Students will:

1) Observe and discuss tree rounds (“cookies”) in small groups.
2) Participate readily in group discussion, debate, and observation of the tree round characteristics and their implied meanings.
3) Describe and analyze the appearance of the tree rounds explaining possible growth stories for the appearance of the tree rings.
   A) Verbally, first individually, then in groups of 4 during the session using the tree rounds and making observation notes in individual notebooks. Groups will present and explain their assessment to the entire class (in classes of 40 or less). In larger classes, two groups will meet and explain their growth stories to each other.
   B) In writing, by individually choosing a plausible growth scenario for the tree and describing it in greater detail. Students must use the tree round and their biological understanding of tree growth as the basis for their explanation, but could also make connections to possible changes in weather, natural history, or forest management practices. This written
assignment will be approximately 1-2 paragraphs, single spaced, and will be
due one week from this class session.
4) Present one story and defend it verbally in front of the class and/or groups.

Assessment for this recitation activity (which carries over into the following recitation
session):
Students will be provided with directions for the activity and a rubric for their assessment at the
start of the recitation activity so that expectations are clear. After briefly going over directions
as a group, students will have an opportunity to pose questions regarding the directions or
assessment. Students will receive a copy of the rubric with his or her score and constructive
comments by the instructor. If the student is absent (unexcused) or does not complete the
assignment, he or she will have the opportunity “check out” a tree round during free study time
in order to complete the assignment.

Students will be assessed according to:
1) Participation or lack of participation in group discussion and debate, as perceived by
roaming instructor (on a scale of 1-5 points).
2) Participation in presentation of tree round story to the larger group and ensuing
discussion, as perceived by instructor (on a scale of 1-5 points).
3) Instructor’s assessment of written document explaining arguments and justification
of support for the students “tree round story” (1-10 points).
4) This assessment will be returned to the students 1-2 weeks after the initial activity.
   There will be time allotted in that session for questions or comments regarding
   grading.

Theoretical Background of Lecture Activity
This activity ties to both place-based and constructivist teaching philosophies. Place-based
principles are included in the activity by using regional tree rounds (“cookies” from species or
trees found in the region). When the instructor ties the activity back into lecture, an
opportunity exists to integrate society/forest ecosystem relationship using local examples. This
activity also draws from constructivist ideas in that learning by way of tree round examination
and scenario explanation is an active process whereby the learner uses the sensory input from
the tree round (how it feels, looks, etc.) to construct meaning (the story). The group-work
component activity also draws from constructivist principles of learning as a social activity.

Activity and Schedule: Tree Ring Inquiry, Analysis, and Explanation
This activity is designed to help students think critically about facts learned regarding tree parts,
their functions, and plant life cycles, as well as social impacts of forest and ecosystem
management. Students will be given the opportunity to apply their knowledge using real tree
rings from their region. The activity is also designed to foster written and verbal
communication skills through group interaction, debate, discussion, and presentation, as well
as individual, written explanation and substantiation of their tree round story. Visual learners
also benefit through the use of tangible tree rounds and optional visual note-taking skills.
Although students are aware of the principles of dendrochronology in theory, this will be the first time for most students to apply their cognitive knowledge to the analysis and interpretation of real tree ring “data.”

Materials:
- Tree rounds (“cookies”). Enough to accommodate as many groups of 4 as the class requires, with a few extras. One tree round will be provided to each group of 4.
- Overhead projector or document camera to project tree rounds
- Paper, crayons, and other writing utensils to create a rubbing, or “illustrate” tree rounds through a tree-round rubbing or visual note-taking.
- Computer
- Document camera

Tree rounds can be obtained from the U.S. Forestry Department, Ohio Department of Natural Resources, and some Soil and Water Conservation Districts. If these groups are not easily contacted, or do not have tree rings available, local nature centers or tree-trimming businesses may also have rings for classroom use. The School of Natural Resources (Dr. Charles Goebel) or a related school might also have tree rounds or cores available to instructors.

Students will:

1) Divide into groups of 4 people. Each student will be provided a tree round from the instructor (2 mins)

2) Review directions and assessment rubric and pose questions in conjunction with instructor. (3 mins)

Directions are as follows:
- Inspect the tree round from our region. (5 mins)
- Make detailed observations and notes regarding your tree round. (You will need this information later to do the written portion of this activity.) (5 mins)
- Instructor will remove all but one of the tree rounds per group. (2 mins)
- Discuss and debate with your group, creating possible stories that explain the visual appearance of your group’s tree round. (10 mins)
- Create a plausible story and present it to the class. (3/group= 12 mins)
- Prepare your first draft of a 1-2 paragraph, written explanation of what you know about trees, their parts, your tree round, and the story that it tells you. Your first draft is due by the end of the class today for peer review. The final draft will be due one week from today. (10-15 mins)

4) Conduct tree round analysis activity. (40-45 mins)
(When each group is presenting their chosen tree round, the tree round may be projected on the smart board or overhead so that all students may see it.)
5) Next science class will be spent as follows: turning in written explanation (2 min), 1st peer-review (5 min), 1st self-editing of written explanation of trees and tree round story (10 minutes), 2nd peer-review (5 mins), 2nd self-editing of explanation and story (10 minutes). After written work has been turned in a discussion will serve to summarize key points and observations that students identified in their group and written scenarios (20 min). If the Wilderness Center visitors have not already come to class, this would be a great day to have a regional environmental historian visit the class and shed additional light on regional forest ecosystem history!

Activity Back-up Plan:

Should materials go missing or tree rings be unavailable, this activity may be adjusted accordingly. There are multiple options:

1) Instead of creating 4 small groups, this activity can be conducted as a whole group using an overhead projector or document camera with students making notes to help fuel their individual, written explanations. The instructor could “illustrate” tree rings, on the overhead or document camera, labeling several different options A, B, C, and D for groups to discuss and analyze
2) Alternately, groups could be maintained and the instructor could provide each group with “mock” or “illustrated” tree rounds.
3) If tree rounds are not available, but tree cores are, similar observations and assignments can take place to the original activity using cores in place of the rounds.

Transition:

Following the activity, students may return to desks or tables, and the instructor may engage students in a larger group discussion regarding the pros and cons of this type of forest analysis. The instructor can ask students why tree rings should or should not be used for this sort of analysis. She could present tree cores as a similar data source that is less invasive (ie-does not require trees to be cut down). The instructor can review the assignment and due date with students before class is dismissed. If time permits, the instructor can introduce students to issues of societal impacts on forest ecosystems using a few local examples.