Lesson Title: Tree Identification

Grade Level(s): High School

Time Frame: Two to three week unit (depends on student abilities)

State of Ohio Benchmarks:

- Life Science Benchmarks for Grades 9-10
  - Explain how evolutionary relationships contribute to an understanding of the unity and diversity of life.
  - Explain the structure and function of ecosystems and relate how ecosystems change over time.
  - Describe how human activities can impact the status of natural systems
- Science and Technology Benchmarks for Grades 11-12
  - Predict how human choices today will determine the quality and quantity of life on Earth.
- Science as Inquiry Benchmarks for Grades 9-10
  - Participate in and apply the processes of scientific investigation to create models and to design, conduct, evaluate and communicate the results of these investigations.
- Science as Inquiry Benchmarks for Grades 11-12
  - Make appropriate choices when designing and participating in scientific investigations by using cognitive and manipulative skills when collecting data and formulating conclusions from the data.
- Scientific Ways of Knowing Benchmarks for Grades 9-10
  - Explain how scientific inquiry is guided by knowledge, observations, ideas and questions.
- Scientific Ways of Knowing Benchmarks for Grades 11-12
  - Explain how ethical considerations shape scientific endeavors.

Concept statements:

- Populations of organisms exhibit variations in size and structure as a result of their adaptation to their habitats.

- Biological diversity results from the interaction of living and nonliving environmental components such as air, water, climate, and geologic features.

Specific Concept statements:

- Tree species exhibit variation in morphology as a result of their adaptation to specific habitats.

- Biological diversity is often the result of selection pressures generated by environmental components such as light, water, and nutrients

Objectives:
Teacher made

- Students will describe how leaf shapes, sizes, and other characteristics vary from tree to tree and explain how their leaves can identify particular types of trees.
- Students will become aware of how the bark of different trees varies in texture and describe a variety of shapes found in leaves and other tree parts.
- Students will identify several trees using various structural characteristics.

State of Ohio Indicators:
Life Science for Grade 10:
12. Describe that biological classification represents how organisms are related with species being the most fundamental unit of the classification system. Relate how organisms are arranged into a hierarchy of groups and subgroups based on similarities and differences that reflect their evolutionary relationships.

14. Relate diversity and adaptation to structures and their functions in living organisms (e.g., adaptive radiation).

Science and Technology for Grade 11
3. Explore and explain any given technology that may have a different value for different groups of people and at different points in time (e.g., new varieties of farm plants and animals have been engineered by manipulating their genetic instructions to reproduce new characteristics).

4. Explain why basic concepts and principles of science and technology should be a part of active debate about the economics, policies, politics and ethics of various science-related and technology-related challenges.

5. Investigate that all fuels (e.g., fossil, solar, nuclear) have advantages and disadvantages; therefore society must consider the trade-offs among them (e.g., economic costs and environmental impact).

6. Research sources of energy beyond traditional fuels and the advantages, disadvantages and trade-offs society must consider when using alternative sources (e.g., biomass, solar, hybrid engines, wind, fuel cells).

Science as Inquiry for Grade 9
2. Research and apply appropriate safety precautions when designing and conducting scientific investigations (e.g., OSHA, Material Safety Data Sheets [MSDS], eyewash, goggles, ventilation).

3. Construct, interpret and apply physical and conceptual models that represent or explain systems, objects, events or concepts.

5. Develop oral and written presentations using clear language, accurate data, appropriate graphs, tables, maps and available technology.

6. Draw logical conclusion based on scientific knowledge and evidence from investigations.

Science as Inquiry for Grade 10
4. Draw conclusions from inquiries based on scientific knowledge and principles, the use of logic and evidence (data) from investigations.

5. Explain how new scientific data can cause any existing scientific explanation to be supported, revised, or rejected.

Science as Inquiry for Grade 11
3. Design and carry out scientific inquiry (investigation) communicate and critique results through peer review.

4. Explain why the methods of an investigation are based on the questions being asked.

5. Summarize data and construct a reasonable argument based on those data and other known information.

Scientific Ways of Knowing for Grade 9
1. Comprehend that many scientific investigations require the contributions of women and men from different disciplines in and out of science. These people study different topics, use different techniques and have different standards of evidence but share a common purpose - to better understand a portion of our universe.

2. Illustrate that the methods and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigations.

3. Demonstrate that reliable scientific evidence improves the ability of scientists to offer accurate predictions.

Scientific Ways of Knowing for Grade 10
3. Recognize that scientific knowledge is limited to natural explanations for natural phenomena based on evidence from our senses or technological extensions.

7. Investigate how the knowledge, skills and interests learned in science classes apply to the careers students plan to pursue.

Scientific Ways of Knowing for Grade 11
5. Recognize that bias affects outcomes. People tend to ignore evidence that challenges their beliefs but accept evidence that supports their beliefs. Scientist attempt to avoid bias in their work.

Materials:
Engagement Phase
- One blindfold for every team of two students each
- Field Study Area

Exploration Phase
- One bag for each student team to collect leaf samples from field study area
- 1 Personal Digital Assistant (PDA) e.g. PALM m130's per student team
- 1 Digital Camera per student team
- Computers to download data from PDA's and digital images

Explanation Phase
- Computer and Projector for classroom

Expansion Phase
- 1 Dichotomous Key per student team and digital images of tree leaves in study area
- 1 PDA per team
- Computer access with presentation software for each student team

Safety: All students should have a signed permission slip before taking them off of school property. All pertinent medical history and phone numbers should be on the form. Teacher should carry this with at all times. Carry a cell phone when possible. A complete first aid kit should be taken into the study area. It should also be equipped with an antihistamine for those students with known bee or insect sting allergies, and some topical ointment for skin rashes that may come from poisonous plants. A cleanser such as brown soap or the newer waterless cleaners should also be available in case students touch plants that sting or cause itching to their skin. Require students to wear long sleeved shirts, long pants, and closed toe shoes while doing their field study.

Engagement Phase: *This student-centered phase is designed to help the students focus on their observational skills when identifying trees and to remind them an effective observation uses as many of the senses as possible.* **Why is this activity important to the student? Why should they want to learn this?**

1. Identify the field study area – make sure all safety hazards are removed or that you mark off the area to be studied free of safety hazards.
2. Ask your students to think about trees and what they currently know about a tree. Ask them to imagine and describe what the different parts of a tree might feel like. Ask each student to write down his or her description.
3. Take the students to the field study area and divide them into groups of three. Explain to all the boundaries and what potential safety hazards they should avoid. Give each group of students a blindfold.
4. Explain that each member of the group will take a turn wearing the blindfold. The blindfolded person will be led to two or more trees where they will examine the tree using their sense of touch.
5. The "sighted" members of the group should carefully lead the blindfolded student to the tree. The blindfolded student should examine the tree's bark and, if possible, its leaves and other features. Remind the sighted students to steer clear of irritating plants such as poison ivy, oak, or sumac. It would be best to mark these types of plants as off limits if they are within your study area.
6. Have the students repeat the activity with each member of the group. If possible have the students choose new trees for each blindfolded person.
7. Once everyone is finished, bring the students together and have them describe the different trees they examined. Ask them to write a description of their experiences and to use similes, metaphors, and analogies in their descriptions.
8. Using their written descriptions see if the students can find their trees. Once they have found their tree ask them to add any other words to their description of the tree now that they are "sighted." Ask them to use their descriptions, in particular of the bark, to see if they can find more of the same trees in the area.
9. Ask the students to think about this question as they move into the Exploration Phase of the lesson: Is the bark alone enough to identify the tree?

Exploration Phase: *This student-centered phase is designed to improve on the student's observational skills and to get them ready for using a dichotomous key in identifying trees.*

1. Take the students to the field study area. Again be sure all safety procedures are addressed and any potential hazards are eliminated or blocked from student access.
2. Have the students work in teams of three and ask them to collect two or three different kinds of tree leaves. Encourage them to pick leaves that have already fallen to the ground. Remind them to be sure to collect needles in the clusters in which they grow (not an individual needle).
3. When back in the classroom, have the student teams examine their leaves. Ask the students to create a data table that will address the following questions (have them label this Data Table 1 – Team Data):
    a. What are the differences between the leaves?
    b. What do the leaves have in common?
    c. Do any leaves have teeth?
    d. Do any leaves have hairs?
    e. What do the leaves feel like?
    f. Are any leaves bigger than others? Narrower than others? Smaller than others?
    g. Have any leaves been eaten by insects? How can you tell?
    h. Can you trace the veins on the leaves with your finger?
    i. How do the needles you collected compare to the other leaves?
4. Once the students have completed their data table create a data table that compiles the entire class's data. Label this Data Table 2 – Class Data. Discuss the differences and similarities between the leaves, the presence or absence of teeth and hairs, the differences in how they feel, and the venation. Have prepared a slide presentation of real examples of the different types of leaves highlighting teeth, hairs, shapes and venation. Share these examples as the students share their responses. At this point do not provide the actual names of the trees the various leaf examples came from.
5. Before taking the students back out to the field study area, create a word document containing the following questions:
    a. Where on the branch do leaves grow?
    b. How are they attached?
    c. Do the leaves grow far apart from each other, close together, or in clumps?
    d. If the leaves are needle-like, how many needles are in each cluster?
    e. Are all the clusters the same? Are all the needles in the cluster the same length?
    f. Do all leaves on the tree match exactly?
    g. What color are the leaves?
    h. What color is the bark?
    i. Are flowers, nuts, or fruit on the tree? If so, what do they look like?

    Once this data sheet is developed beam it to one member of each group on their personal digital assistant (PDA – handheld device). Have that group member beam the document to the other students in their group. Inform the students that they will need this document once they return to the field site.
6. Have the students take the leaves they collected previously and return to the study area, back to the trees where they collected the leaves. Ask them to record in their PDA their answers to the questions on the beamed document using the trees whose leaves they collected. They should record answers for each different tree leaf they have collected. Have them take a digital picture of the tree and a picture of a close up of the leaf and the bark of that tree. Be sure to record the image number on the data sheet so as to not confuse the responses to the questions with different pictures of trees.

7. Once indoors the students should download their data and create a comparison chart of the data they collected answering the following questions as a team. The students should label this data "Data Table 3 – Comparison Chart":
    a. Are this tree's leaves larger or smaller than the last tree's leaves?
    b. If the leaves grow in a clump are there any other trees that have leaves that grow that way?
    c. What is similar and/or different about the various trees our team looked at?

Explanation Phase: *Once the students have participated in the Engagement and Exploration activities it is the teacher's responsibility, during this teacher-centered phase, to get the students to reflect on those activities and to use his or her questioning skills to help the students construct an understanding of the concept developed through their experiences. The teacher should strive to make the concept as visual as possible during this phase.*

The key concept behind the Engagement and Exploration phase of this lesson is:

- Populations of organisms exhibit variations in size and structure as a result of their adaptation to their habitats.

More specifically the objectives behind these initial activities were that the:

- Students will describe how leaf shapes, sizes, and other characteristics vary from tree to tree and explain how their leaves can identify particular types of trees.
- Students will become aware of how the bark of different trees varies in texture and describe a variety of textures found in leaves and other tree parts.

Some key questions the teacher should use to make the concept and objectives concrete are:

1. What similarities did you observe in the tree leaves and barks?
2. What differences did you observe in the tree leaves and barks?
3. When you look at your data do you see any patterns developing in your descriptions of the tree leaves, for example ways to describe the edges of the leaves, sizes of leaves, texture, vein patterns on leafs, whether they grow in clumps or not? Look at the data you collected in all of the activities up to this point to help you respond to this question.
4. Go back to the slides you prepared for Step 4 in the Exploration Activity. Ask the students if the patterns they identified from looking at their Data Table 1 and 2 are evident in your prepared slides. As a class, go through the slides again, this time adding labels to the various characteristics that will help identify one tree leaf from another. By including the characteristics listed below as you go through your slides, you are preparing your students for using a dichotomous key in identifying trees during future field studies.
    - *Needles or Broad Leaves* – you want to develop the idea of coniferous and deciduous trees when you compare needles to broad leaves. The background information you could provide at this time includes, "Conifers have seeds that develop inside cones. Pines, spruces, hemlocks, and firs are all examples of conifers. For the most part, conifers also have needle-shaped leaves and they're evergreens. That means they don't lose all their leaves each year but instead stay green year-round. Deciduous trees such as oaks, maples, beeches, and aspens have broad, flat leaves. They

lose all of their leaves each year. Some trees, however, aren't typical conifers or deciduous trees. For example, larches have cones and needles but lost their leaves every year, yew trees have needle-shaped leaves and are evergreen but have berries and not cones, and a holly is a broad-leaf tree that's evergreen" (PLT, p.244).

- *Leaf Shape* – discuss the importance of observing leaf shape and how they give us clues to the tree's identity. Background information could include information such as, "willows have long, slender leaves; cherry trees and swamp magnolias have oval-shaped leaves; and cottonwoods have triangular-shaped leaves. Similarly, fir needles tend to be flat, pine needles are rounded, and spruce needles are square like. The shapes of the leaves differ in many ways. For example, the tips of leaves may be notched, pointed, rounded, tapered, and so on. And the bases of the leaves may be squared, rounded, heart-shaped, and so on" (PLT, p. 244). Whenever possible be sure to include a slide of each leaf shape taken from the local area. When going through these examples also ask the students to look at the digital images they created of the leaves in their study area. Ask them to match the leaves from their collection to the various leaf shapes you're identifying in your slides. You'll want to include leaves that have heart shaped or rounded bases and tapered or rounded tips.
- *Margins* – ask the students to focus on the edges of the leaves. Encourage them to again look at Data Table 1 & 2 for evidence of margin differences. Tell them that this is another clue that will help to identify the tree. "Some leaves have teeth (serrated) along the margins, some leaves are lobed, and some leaf margins are smooth (entire)" (PLT, p.244). Again share your slides with the students where you have focused on leaf margins. Ask the students to hold up any leaves they collected that had a serrated margin, a lobed margin, or a smooth margin. You should be checking for understanding each time the students share their collection. Remember you're working toward having them use a key to identify trees in the future so it is important that they can demonstrate that they know the differences between margin types at this point.
- *Textures* – ask the students to recall their descriptions of their tree and leaves from when they were blindfolded. Ask them to share again the kinds of textures they felt when they observed their tree using their sense of touch. Remind them to look at the data they collected in Data Tables 1-3. If they have not done so already encourage them to use terms such as completely hairy, hairy on one side, completely smooth, feel thick or thin, rough or waxy. Share with them actual slides of leaves that demonstrate each of those leaf textures. Ask them to share either their actual leaf or the digital image they took of their leaves and identify the texture for them. Encourage them to record the texture type.
- *Simple vs. Compound* – Ask the students to recall if they found their leaves far apart, close together, or in clumps? Chances are most of them will think of their leaves as simple, having only one piece to them like a maple, oak, aspen or sycamore. Encourage them to look again at their

leaf samples or their digital images. Ask them – were all of your leaves found as only one piece? Ask them to look for samples of leaves that may be found as leaflets. Be sure to have a sample slide of an actual tree that contains leaflets, e.g. ash, walnut, locust, sumac. Explain to them that these are considered compound leaves.

- *Leaf Arrangements* – The students may need to refer to the digital images they took of their trees to think about this characteristic of leaves. Ask them to recall if they noticed how the leaves were arranged on the twigs. Solicit answers. Share with them slides that demonstrate the various ways leaves may be arranged on a twig, such as alternate, opposite, or whorled for deciduous trees. Share with them slides of needle leafed trees such as pines, spruces, and firs to show that patterns of their growth, e.g. pines growing in clusters of two, three or more.
- *Twig clues* – While the students are focused on leaf arrangements share with them the fact that if no leaves were present, by simply looking at the scars (places where old leaves used to be) or the arrangement of leaf buds (places where future leaves will grow from) they could get a clue as to the leaf arrangement. So even in the absence of leaves they could at least classify the tree down to the leaf arrangement by looking for evidence of past or future leaves. Again, showing a slide of leave scars or leaf buds help make this concept more concrete. Ask the students to look through their digital images. Did they capture any leaf scars or leaf buds in their photos?
- *Fruit and Flowers* – Depending upon the season your students may also have observed the fruits or seeds of the various trees they studied. These can be useful in narrowing down tree identification. You should have slides prepared if the fruits of the trees in the field study area are visible during your lesson. Your background information for this characteristic should include, "Different trees produce different kinds of fruit, such as berries, winged seeds, nuts, pods, or some other type of fruit. Different conifers produce different kinds of cones. Different trees also have different flowers. The shape, color, texture, size, and other characteristics of both the fruit, cones, and flowers can be used to identify the trees" (PLT, p.245).
- *Bark* – Ask the students to recall how the bark of their trees felt when they were blindfolded. Ask them to recall how easy or difficult it was to use the bark texture to go out and identify their tree once they were sighted. Allow them to share their observations. Explain to them that bark can be used to identify trees and that knowing the differences in bark is especially useful during the winter months when the deciduous trees have lost their leaves. Again share slides of various bark types, identifying the tree the slide came from. Point out that bark "may be shaggy, smooth, or rough; it may have deep furrows or markings. Paper birch is an example of a tree easily identified by its white, paper-like bark. However, when using bark to identify a tree, it's best to look at bark growing on the trunk rather than on branches and twigs (because the bark on a branch is thinner and newer, it

may look quite different from the trunk). Bark also looks different as a tree gets older" (PLT, p.245).

- *Overall tree shape* – While this was not a specific focus of the Engagement and Exploration Phases or this lesson ask the students if they did take note of the overall shape of the tree. If they did not encourage them to make note of this characteristic and to use it the next time they go back to the field study area. Many trees have a characteristic shape. Share with them slides of various local trees especially those with characteristic shapes that make them easily recognizable especially from a distance, e.g. Sycamores and Oaks

5. Summarize the information shared with the students during this teacher-centered Explanation Phase by explaining that each of these characteristics independently, while useful, may not be enough to identify some trees. Collectively they can be put together into a Dichotomous Key, which provides a series of statements that use the various characteristics. When they use the key they move through the statements answering Yes or No, following the Yes responses until it takes them down to the name of the tree in question. Share with the students' examples of teacher made and professionally made keys. Send them to the websites listed to look at the various keys that exist in helping to identify the trees. Explain also that they will be using a key in a future activity to identify various trees. Once the trees are identified they will also begin to look at other factors that determine why populations of organisms exhibit variations in size and structure as a result of their adaptation to their habitats. There are many species of Oak Tree. They all produce acorns but all have very different leaves. Many other structures are needed to identify what species of Oak Tree it is.

Expansion Phase: *During this student-centered phase the teacher designs activities that expect the students to apply the concepts learned through the Engagement, Exploration, and Explanation Phase.*

1. Divide the students into teams of two to three and provide them with one of the dichotomous keys they examined during the Explanation Phase. Take the students back to the field study area. Explain to them that they are to use the keys to identify at least four different trees within the study area.
2. Tell the students that once they have identified the tree via the key they are to take a digital image of the leaves, the bark, the overall shape, and the area within a 4-meter diameter around the base of the tree. Tell them to be sure to record in their PDA's the name of the keyed tree and which digital images go with that tree. These data will be used later in the classroom.
3. To check on student progress while in the field you may want to move from student group to student group checking on their ability to accurately use the key in identifying their trees.
4. Return to the classroom and ask each student team to create their own field guides to the trees using the digital images they created and the Yes responses when they used the dichotomous key. They should use a presentation software package to put this together. They may included a brief history of the tree type, other visual images of the tree, for instance the largest of that type of tree ever found, typical habitats for that

tree, and songs or poems written about their tree type also. Set aside time for the students to share their presentations with the rest of the school and/or invite their parents. The students may want to post these presentations to the school website to showcase the trees found within their field study area near their school.

Evaluation Phase: *Evaluation is not something that must be saved for the end of the lesson. Throughout the various phases of the lesson the teacher can be checking for understanding and/or looking for evidence that the students understand the concepts embedded within the various activities. The activities suggested here expect the students to apply their understanding of the concepts studied in a new context.*

Upon completing the various activities above the students will be able to:

- When given 25 different kinds of leaves classify them according to leaf shape, margin, texture, and whether or not they are simple or compound.
- When given a dichotomous key and a particular tree to identify do so with 100% accuracy.
- When given the name of a tree and a pile of different kinds of leaves accurately pick out the leaf that matches the tree name 100% of the time.
- When taken to a field study site that is different than that used during the above activities, use a dichotomous key to accurately identify eight out of ten trees.

References:

Engagement Phase – "Get in Touch with Trees" from Project Learning Tree – Environmental Education Activity Guide. American Forest Foundation. 1993.

Exploration Phase – "Looking at Leaves" from Project Learning Tree – Environmental Education Activity Guide. American Forest Foundation. 1993.

Explanation and Expansion Phase – "Name that Tree" from Project Learning Tree – Environmental Education Activity Guide. American Forest Foundation. 1993.