LTRP: Field Techniques
Day 7

OVERVIEW

This lesson introduces students to techniques used by scientists to measure and quantify various aspects of the natural environment. It must be done outside where students can practice using the techniques. The teacher must be able to demonstrate the techniques or find someone who can (e.g., county extension person, university graduate student in forestry, botany, biology, or a teacher who has used the curriculum). The techniques described here present basic concepts and methods for quantifying field observations, but many other techniques exist. Students should be encouraged to develop and modify techniques to answer their specific research questions.

Focus Question: *How can different environmental conditions be measured?*

SCIENCE SKILLS

- ✔ Students will be able to perform several techniques that quantify environmental conditions.
- ✔ Students will be able to determine whether a technique produces quantitative or qualitative data.

BACKGROUND INFORMATION

Background information describing the concepts in this lesson is presented in the following sections:

Planning Essentials: Selecting the LTRP Site
Section I: Research Q&H – *Qualitative versus Quantitative Observations*
Section II: Experimental Design – *Repeatable*

MATERIALS

(***Note:*** Not all materials listed are necessary. Materials must be chosen according to the field techniques to be demonstrated.)

- ✔ outdoor metric tape measures
- ✔ string, twine or lightweight rope
- ✔ thermometers
- ✔ trowels
- ✔ white buckets or pans
- ✔ white paper
- ✔ clip boards
- ✔ clear contact paper
- ✔ hanging insect traps

- ✔ ping pong ball
- ✔ large, fine mesh aquatic net
- ✔ insect, plant, bird, mammal track field guides

DEVELOPMENT OF LESSON

Field techniques must be taught and learned outdoors.

Listed below are different standard field techniques that can be easily learned and used by students. You may choose to demonstrate three or four techniques to the entire class or print the instructions and have the students use them as an instruction manual. Other options include contacting a county employee or a University graduate student familiar with these techniques and having them demonstrate techniques to the students. The bottom line is that these techniques are standardized and repeatable in different conditions. If a group wants to compare numbers of mushrooms growing in the forest versus growing in open fields, they must count mushrooms in plots of exactly the same size in both locations for the comparison to be valid.

If you are familiar with the techniques that will be demonstrated, then you may also want to introduce students to the concept of randomizing observations. This concept is discussed in more detail in Section 2: Experimental Design.

Terrestrial Vegetation Techniques:

1. **Vegetation Transects**

   To quantify the number of plants or different species of plants, botanists and foresters often use vegetation transects. Stretch a tape measure out a predetermined distance, for example 10 meters. You have just created a transect. At each 1 meter interval, observe and then quantify the number or types of plants found along the tape. This can be done in a number of different ways:

   A) Decide which is the dominant plant species covering the first meter of the transect. Record the name. This plant covers 10% of the total, 10 meter, transect. An interval may be dominated by a log, stump, tree, stream, bare soil, mushrooms, etc. Record only one dominant plant for every interval. Once you have finished all 10 intervals, add the percentages for any plants that are dominant in more than one interval. For more detail, record the dominant plant in 50cm intervals. This represents 5% of the transect.

   B) Simply count the number of a certain kind of plant found along the transect. For example, in ten meters, there may be 12 sword fern plants.

   C) List or count all the different species or kinds of plants along a transect. This method quantifies the species composition.

2. **Vegetation Quadrats**

   This is another method for quantifying vegetation or ground conditions. Instead of using a transect, a quadrat or fixed area is determined and delineated. For example, a common quadrat size for examining small plants or mushrooms is 1meter square. Students can take a length of twine, string, or light weight rope, measure out 4 meters and tie a knot at each meter. The twine can be laid out on the ground with the knots at each corner. Place a stick or stake to hold each corner in place. (Using pre-measured ropes reduces the number of tape measures that are needed in the field.) Once the quadrat has been laid out, different methods can be used to quantify whatever you are interested in within the quadrat:

   A) Count the number of (e.g., mushrooms, rocks, spiders or other invertebrates, ferns, wood sorrel, seedling trees) in the quadrat. This is the number found per square meter.

   B) Measure the total area covered by (moss, bare soil, logs, rocks, water, etc.) within the quadrat. This is the area per square meter. The area can be expressed either as the area or as a percentage.

   C) Use larger quadrats to quantify larger features such as trees. A 10 meter by 10 meter quadrat can be measured and all the trees identified and counted within the quadrat.

3. **Tree Diameters**

   The size of trees can be measured using a tape measure and some basic geometry. Measure 1.5 meters from the ground on the high side of a tree if it is on a hill. Then measure around the tree at this point. This is a measure of circumference. To convert to diameter, divide the circumference by PI (3.14159).

Terrestrial Invertebrate Techniques

1. **Ground Invertebrates**

   Invertebrates or “bugs” provide a much more reliable source of data than other animals. Students who are interested in studying animals should be encouraged to focus on invertebrates. Students can count the individuals found within a small quadrat (1m x 1m, see vegetation quadrats above). The overall number of invertebrates, the number of different species, the number of one specific species, or the number of one type of invertebrate (spiders, insects, centipedes, millipedes, slugs) can be recorded.

2. **Branch Beating for Invertebrates**

   Entomologists often use a technique called Branch Beating to compare invertebrates in different kinds of trees or in different locations. The investigator selects a reachable branch and shakes it for a predetermined length of time or number of shakes onto a piece of white paper or a piece of contact paper, sticky side up. (It works well to clip a piece of contact paper on a clip board, sticky side up, shake the branch, and then cover the sticky part with the wax paper. Make observations from the clear side of the contact paper.) The number of invertebrates shaken from the branch is counted. Different species or types of invertebrates (caterpillars, aphids, other flying insects) can be identified and recorded. A hand lens is useful for examining very small specimens. Specimens can also be placed in alcohol vials and taken to the classroom for further examination.

3. **Insect Traps**
   Hanging fly traps or sticky traps can be placed in different kinds of trees or in different locations and left overnight. If the sticky surface is exposed, cover the surface with clear contact paper when collecting the traps. The insects are then identified and counted. This can be done back in the classroom or outdoors. Hanging fly traps are available at hardware and grocery stores.

4. **Investigation of Leaf Damage**
   Aphids as well as other insects eat deciduous leaves. The presence of the insects can be detected by examining leaves for damage. Students examine a predetermined number of leaves from a tree and count the number of damaged/eaten leaves versus undamaged leaves. In the fall, students may have to pick the leaves from the ground.

5. **Soil Invertebrates**
   Measure a small area on the surface of the ground. Dig a hole of this size to a predetermined depth. Place the dirt you remove on a piece of white plastic (kitchen garbage bag or white bucket). Sort through the dirt and remove any invertebrates. Record the species or type of invertebrate and the number of invertebrates for each hole.

Vertebrates

1. **Bird Census**
   Using a field guide and a pair of binoculars, identify and count birds found in a predetermined area. Comparisons can be made of the number of different species, the number of one species, or the total number of birds. Ducks and geese lend themselves to this type of census as they are present year round and are relatively easy to identify. Samples can be standardized by recording the number observed during a predetermined amount of time or within a predetermined area. Observers can also record different behaviors (e.g., swimming, diving, resting, feeding, wing spreading, fighting) and how long a bird spends doing each type of behavior. Compare between different environments, different times of day, or different weather conditions. If male and female individuals can be identified, students can compare time spent in different behaviors by individuals of different sexes.

2. **Small Mammal Tracks**
   Mammal tracks can be observed in muddy areas along streams, rivers and lakes. Students can use animal track field guides to identify the tracks and compare the number of species observed at different areas. If you take

plaster of paris along, students can make casts of the tracks. Track plates are another way to survey animal activity in an area. The plates can be made with cookie sheets or other sturdy surface that can be blackened from candle or alcohol burner soot. Place track plates with sooted side up in different areas (field and forest, near water and far from water, under shrubs and in the open), flush with the ground so the animal does not have to climb up over the edge of the plate. Plates must be balanced so they don't jiggles and scare animals that start to walk on them. To protect track plates from rain and falling leaves, cover them with cardboard boxes. Cut two sides off the boxes for animal entrances and cover with plastic so boxes don't get soggy and collapse on the plates.

Aquatic Techniques

1. Water Temperatures

Use an unbreakable thermometer to measure water temperatures at different depths, locations, or different times of day.

2. Sediment Samples

Examine the amount of sediment suspended in the water by collecting equal volumes of water in clean, wide-mouthed jars. Take the samples back to class. To separate the suspended sediment from the water, students can pour water samples through filter paper. Take 2L plastic pop bottles and cut the top off so it makes a funnel. Place filter paper in the funnel and place funnel in the open end of the pop bottle that the funnel was cut from. Slowly pour a set volume of the water sample through the filter paper. Let filter paper with sediment dry. Weigh the filter paper before you start and after drying. Subtract the initial weight from the final weight. This gives you the mass of the suspended sediment for a particular volume of water.

3. Water Quality Measures

Aquatic ecologists measure levels of dissolved oxygen, pH, nitrate, ammonia, phosphorous, calcium, salinity, carbon dioxide, chlorine, and others to determine the amount of water pollution or water quality. Most of these tests are available in kits from the major biological supply houses. Testing the pH of waters is one of the easiest. Extra time may be needed to explain to the students why it is important to know the pH level and what it means. The Seattle Aquarium has an outreach program where they give classroom presentations or meet a class at a stream, measure water quality and talk about the effects on animal and plant life in the stream. County natural resources departments employ field workers who regularly measure water quality in lakes and streams in the county. They can be approached for technical assistance.

4. Water Velocity or Flow

Place a ping pong ball on the surface of the water and measure the amount of time it takes to travel a predetermined distance.

5. **Aquatic Invertebrates**
   Place a large aquarium net with a fine mesh in the water. Scrape the bottom of the stream, pond, or lake by hand within a predetermined area. Use the current and your hands to sweep dislodged sediment and invertebrates inside the net. It may be necessary to move rocks, scraping each one by hand, in the area of interest. Empty the net into clean water in a bucket or pan with a white bottom. Identify and count the invertebrates you found. Students can compare invertebrates in fast-moving and slow-moving areas of the stream, in rocky bottoms (substrates) and in sandy substrates, under aquatic plants and on similar substrates without plants.

Other Ideas

1. Precipitation gauges
   Students can compare the precipitation under a conifer tree, a deciduous tree and out in the open.

2. Air temperatures
   Students can compare air temperatures near bodies of water, in interior forests, and in open fields. There are many more possibilities if students can use thermometers that measure minimum and maximum temperatures over a period of time.

3. Wind velocities
   Students can use some type of pinwheel device to measure wind velocities in a field, at the edge of a forest and at the interior. Comparisons can also be made between wind over a stream and away from the stream.

DISCUSSION QUESTIONS

1. State a research question and describe a sampling technique for answering it that gives quantitative information.

2. Why is it important that each technique to generate quantitative observations?

3. Design a different technique from the ones listed above that would generate quantitative observations.

4. Why must sampling techniques be standardized? In other words, if you compare ducks on rainy days versus sunny days and you count the number of birds that go on a specific dock for an hour on a sunny afternoon, why must you also sit and watch for an hour on a rainy afternoon?

5. How could you standardize a survey for stream invertebrates if you want to compare the number found near the mouth of the stream (downstream) and near the source of the stream (upstream)?