2- SCHOOL FOREST RESEARCH PLOTS

Nutshell
In this lesson, students work together to plan and establish research plots in their school forest. Students learn about statistical sampling by using a sampling procedure to estimate the numbers of colored poker chips from a large population. They then use a school forest map and a sampling procedure to locate research plot centers in their school forest. In small groups, students work in the field to establish the plots in their school forest. Students will use the plots for a variety of research activities.

Big Ideas
Science and technology contribute to the understanding of forests, the impacts of human actions on these systems, and how forests can be sustained. As knowledge is gained, forest management is adapted. (subconcept 50)

Objectives
Upon completion of this lesson, students will be able to:
- Explain why sampling is used in research
- Describe different sampling methods
- Demonstrate how random sampling is used to establish research plots

Subject Areas
Science, Math

Lesson/Activity Time
Total Lesson Time: 150 minutes
Time Breakdown:
Introduction – Statistical Sampling: 20 minutes
Activity 1 – Locating School Forest Research Plots: 30 minutes
Activity 2 – Planning for the Field: 50 minutes
Activity 3 – Establishing the Plots: 40 minutes
Conclusion – Field Work Summary: 10 minutes

Teaching Site
Classroom and forested site

Vocabulary
Bias – systematic inaccuracy of research results caused by flaws in research design and methods.
Phenomena – an observable event
Plot (research) – a small, well-defined area in which field research is conducted
Plot Center – a point from which a research plot is established
Sample Population – a sub-group of a target population that is actually studied.

Sampling – a statistically valid process used to identify a group of people or objects that accurately represents a target population being studied.
Scientific Method – The process used by scientists, collectively and over time, to construct an accurate representation of the world.
Target Population – The group of interest in a research project.

Materials List

For each student

- School forest map (with scale) showing aerial photograph and school forest boundary

For each student team

- Computer with internet access, fGIS software, and school forest map layers (optional)
- Transparency of Student Page ✎1, Map Grid (optional)
- Map compass
- Field compass
- 100 foot measuring tape

For the teacher

- Opaque receptacle with 3 different colored poker chips

Teacher Preparation

Fill an opaque receptacle with three different color poker chips. Make sure that there are a different number of chips for each color (e.g. 100 white chips, 150 blue chips, 200 red chips) and that there are at least 200 chips total. Write down the exact number of each color chip.

Background Information

See the Master Woodland Stewards binder "Tree Identification and Forest Measurements"

Procedure

Introduction – Statistical Sampling (20 minutes)

1. Place the poker chips in front of the class. Be sure that the three colors are mixed together well. Tell the students the total number of chips in the pale. Tell them that there are 3 different color poker chips and they need to determine how many of each color there are.

   Tell students that they don't have time to count all of the chips, so they will need to figure out a way to estimate the number of chips in each color.

   Lead a discussion on the best way to accomplish this. Help the class arrive at the idea of taking a small sample of chips from the bucket, and using the results to make a guess. Have the class determine different ways to take the sample and the pros and cons of each. Have them discuss how big the sample should be to have an accurate result.

   Have a few volunteers take a sample and use the sample to estimate how many of each color there are. Tell them the real totals, and discuss how accurate their predictions were. Have the class discuss the methods that they could use to get the most accurate results

2. Tell the class that they just completed an exercise in statistical sampling. The purpose of sampling is to identify a sample group that accurately represents the population that you are studying. It is often impractical if not impossible to survey an entire population that you want to study. And, the population itself is an unknown. That is why in the previous exercise the bucket of chips was opaque.

   Sampling allows researchers to survey a smaller group within the population and make accurate conclusions. This saves time and resources.

   Put the following terms on the board and have students use their experience to define them. Help the class come to a similar definition as follows:

   - Target Population - The target population is the group of individuals, organisms, or objects that you are studying. The group can be as large as the Forests of North America or as small as the red pine trees in my school forest.
   - Sample Population - The sample population is the part of the target population that is actually studied. The sample population should be selected using a sampling procedure that minimizes the influence of bias.
   - Bias - Bias is the inaccuracy of research results caused by flaws in research methods and design. Bias can result from poor research methods (e.g., sampling techniques) and researcher influence (e.g., personal values).

Activity 1 – Locating School Forest Research Plots (30 minutes)

1. Tell the class that they will be conducting research in their school forest. Hand each student an aerial map of the school forest (if you finished the fGIS lesson with your students, they should have a map already). Have them identify major features and calculate the area that the school forest covers by using the map scale.

   As the students are looking at the map, tell them that they will be researching the plant and animal habitat in the forest, forest history, and the volume of standing timber.

   Ask the class if they will have time to identify every plant, tree, and animal in the forest. (*No, it would take too long*). Lead a discussion on the best way to "sample" the forest to make accurate research estimates.

   Guide the class to a discussion about using smaller areas of the school forest to conduct research. Tell the class that researchers often study small areas (samples) to develop conclusions about larger forest areas (target population). These small areas are called research plots.

   What is a research plot?
   A research plot is a sample area used for research. The area can be square, circular, or a point from which you use an instrument. They can also vary in size depending on the research that you are doing, most often though, they are only a few feet in diameter. Research plots are often established by locating a plot center. The plot center can then serve as the center of any type and size of research plot.

2. Tell the class that they will need to establish 10 research plots for their school forest. Ideally, their should be no less than 1 plot for every 5 acres, but for large school forests, establishing a large number of plots may be impractical. The plots will be used by them and by future classes of students.

   The placement of the plots is very important. The research done in the plots will be used to describe the entire school forest and the way it changes over time.

   Ask the class to determine how they can make sure that the plots are representative of the entire school forest (i.e. how they can minimize bias). Ask them to use their map as a resource.

   Lead the discussion to include the following two criteria for establishing plots:
   - Representative distribution – All of the distinct land cover types of your school forest should be represented with at least one plot. The number of plots in each land cover type should be proportional to the area covered (i.e. if most the school forest area is pine plantation then most of the plots should be in pine plantation).
   - Practical location – the plots should be located in places that provide easy access and use for students.

3. Have students use the criteria that they came up with to develop a strategy for locating the research plots. At minimum, students will need to determine how to distinguish the land cover types, how many plots to locate in each land cover type, and the exact location of the plots.

   To minimize bias when finding the exact location of plots, researchers often use a random number generator. If you have completed the teacher preparation in Lesson 1 – Geographic Information Systems, then you have already used a computer program, fGIS, to generate random numbers to locate the research plots

   Random plots can also be located by hand. First, a transparent grid with numbered centers is placed over the school forest map. A sample set of numbers is chosen using a random number generator. The selected grid centers correspond to the map locations of the plot centers.

   If your students choose to select their plots randomly, they can use fGIS as outlined in the teacher preparation, or follow the manual format below.

   > Place a transparency of Student Page 1, *Map Grid* over the school forest map. The map grid is a 10x10 grid with 100 numbered centers (The map can be resized on a copy machine to best fit the school forest map). Have students use the random sequence generator at www.randomizer.org to generate 10 numbers between 1 and 100 (the website also has a good overview of the use of random numbers for research). The numbers chosen are the locations of the research plots. Have them mark the plots on the map.

Activity 2 – Planning for the Field (50 minutes)

1. Once students have the plot centers located on their map they will need to make a plan for establishing them in the field. Ask the class to come up with a plan to find the plots and mark them permanently. Everyone in the class must participate.

   Remind the class that they have a number of tools at their disposal. They have a scaled map (and an fGIS program) that they can use to accurately measure distance. They have a map compass that they can use to measure direction on the map. They have a field compass that they can use to direct them in the field. And, they have a 100 ft. measuring tape (and even their pace) to determine linear distance.

   The students plan should include the following:
   - A strategy for forming teams
   - A method for marking the plot centers permanently
   - A strategy for locating the plot centers on the ground
   - A strategy for verifying the plot centers are accurate

2. Once the students have agreed upon a plan, have them collect the necessary equipment and familiarize themselves with their use. This could include such things as measuring their pace, taking practice measurement with a map compass, and taking practice measurements with a field compass.

3. Once students are familiar with the equipment, have them work in their teams and plan exactly how they will find the plot center assigned to them. You may want to have each team present you with their plan so that you know exactly where each team should be in the field.

Activity 3 – Establishing the Plots (40 minutes)

1. Gather your class as a large group in the field and have them divide themselves into teams. You may wish to use the following procedure to manage your students in the field
   - Review as a large group the process for the day.
   - Have each team do an equipment check.
   - Set up a base camp in the school forest that is easily found and tell students that if they have questions or concerns, they should go there.
   - Set a time that all the students should return to the base camp.
   - Tell students exactly where you plan to be throughout the activity.

2. Walk from group to group and make sure that they are working well together, following their plan, and using the equipment correctly.

Conclusion – Field Work Summary (10 minutes)

1. Once the teams have established the plots and verified the locations, regroup at the base camp. Lead a discussion with the teams on how the field work went. Have students discuss how their team worked together, how accurate the plot centers are correlated with the map, how easy the plot centers are to find, and how long the plot centers will persist considering weather, vandalism, etc.

If the class concludes that something about the plot center needs to be improved, help them come up with a plan to do so.

2. In conclusion, review with the class that they will use the school forest plots to conduct the following research activities:
   - **Disturbance History** – Read the forest landscape to determine how the forest has changed trough time.
   - **Timber cruise** – Determine the volume of timber in the forest.
   - **Habitat typing** – Describe forest habitat characteristics to determine suitability for wildlife.

Summative Assessment

Have students use the plots to identify trees in the school forest. Students can use the tree ID key in Field Enhancement 1 of the LEAF 7-8 Lesson Guide. Students can also use the LEAF on-line tree key and tree ID cards at www.uwsp.edu/cnr/leaf/treeid.htm.

Students can also identify plants in the research plots. The following online resources can be used to ID common Wisconsin plants:

- UWSP Common Plants of Wisconsin database: http://biology.uwsp.edu/courses/plantid/cp-hires-main.htm
- Bob Freckman Plants of Wisconsin Homepage: http://wisplants.uwsp.edu/WisPlants.html
- Natural Communities of Wisconsin plant database: http://wisplants.uwsp.edu/NatCom.html
- UW Vascular Plant Database – Wisconsin County Search: http://www.botany.wisc.edu/wisflora/index.asp
- UW Vascular Plant Database – What's Blooming: http://www.botany.wisc.edu/wisflora/blooming/
- Wisconsin Biomapper: http://maps.botany.wisc.edu/
- Invasive Plants of Wisconsin: http://dnr.wi.gov/invasives/plants.htm

Extension

Have a subject matter expert (SME) talk to the class about field research. The SME could also help the students plan, establish, and/or evaluate the research plots. Potential SMEs include, but are not limited to:

- A forester, wildlife manager, or field researcher from the Wisconsin Department of Natural Resources, US Forest Service, or US Fish and Wildlife Service.
- A university professor or graduate student conducting field research

Web Resources

http://en.wikipedia.org/wiki/Sampling_(statistics)
Wikepedia's overview of statistical sampling has a lot of good information and links.

www.randomizer.org
A convenient random number generator that produces a table of numbers that you can use to guide your plot selection.

Model Academic Standards

AGRICULTURE EDUCATION C.12.2

Leadership

Practice skills relating to communication, problem-solving, and decision-making through individual, group, and team processes (see LA B.12.1, C.12.1, C.12.2, C.12.3, D.12.2; SS E.12.15)

- demonstrate the goal-setting process
- demonstrate the relationship between communication and leadership
- identify ways to adapt individual communication style to various situations

Students work together to determine a strategy for locating and establishing research plots in their school forest. Their form teams, assign duties, and establish the plots. They discuss their experience as a group and determine a strategy for verifying the plot locations.

SCIENCE C.12.1

Science Inquiry

When studying science content, ask questions suggested by current social issues, scientific literature, and observations* of phenomena; build hypotheses that might answer some of these questions; design possible investigations*; and describe results that might emerge from such investigations

Students learn about statistical sampling by determining the distribution of poker chips in a random sampling activity. They then use their understanding of random sampling to design a research strategy to investigate their school forest.

SCIENCE C.12.4

Science Inquiry

During investigations*, choose the best data-collection procedures and materials available, use them competently, and calculate the degree of precision of the resulting data

Students work together to determine a system for establishing research plots in their school forest. In small groups, students use field equipment to locate research plots in their school forest. As a large group, the class determines how to verify the accuracy of the plot center locations.

Multiple Intelligences

Verbal-Linguistic
Logical-Mathematical
Visual-Spatial
Interpersonal
Naturalistic

Student Page 1, *Map Grid*

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100