

Observing Ecosystem Response to Human Activity: An Exploration of the School Yard

Alignment to NC Essential Standards

Science 4.L.1, 5.P.2.1, 5.P.3.1, 5.E.1, 5.L.2

Social Studies 4.G.1, 5.G.1.2

Language Arts CCSS.ELA-Literacy.RI.5.7, RI.5.9, W.5.2, W.5.7, W.5.8, SL5.1, SL5.4

Math 5.G.1, 5.G.2

Learning Objectives

- Students will demonstrate an ability to collect and use quantitative and observational data to describe their school yard.
- Students will explain the positive and negative impacts of the school on the physical environment.
- Students will describe the local ecosystem and changes that have occurred.

Time Required

Activity 1: 60 minutes plus time to write essay, preparation 60 minutes

Activity 2: 90 minutes

Activity 3: Two 60 minute sessions

Materials

Tar-Pamlico Basin map

Topographic maps of school

Aerial photos from before school was built

1 copy per student or group of:

- *Maps Can Tell You Where the Water Is*
- *Natural Environments of the Tar-Pamlico River Basin*

For each group:

- *Common Forest Trees of North Carolina*
- *Schoolyard Observational Data Worksheet*
- one or more compasses
- one or more infrared thermometers
- one meter measuring tape
- small paper cups
- one notebook for data collection

Vocabulary

Ecosystem, conduction, convection, temperature, evaporation, topography, habitat, ecoregion

Overview

We come and go from our school every day without thinking much about the building locations and how the building and parking lots affect the land, water and ecosystem around us. Yet the school yard, parking lots, fields and school buildings provide ample opportunities for students to study ecosystems, the water cycle, weather, geography and environmental literacy.

Background

Have you ever wondered what the land was like around your school before it was built? During construction of schools or other buildings, the landscape is commonly manipulated. Trees are removed, low and wet areas are filled in, hills are levelled, and streams are piped; but there are always clues as to what the land looked like before the building existed.

Depending on where you are located, the local town or county planning office may have maps and aerial photos for you to use. Topographic maps are helpful and often you can find maps that were drawn before the school was built. These maps are a primary, accurate source of historical information for your landscape. Aerial photos are also informative. Further directions on how to obtain this information are included in the preparation section.

In addition to modifications to the physical environment during school construction, once the building is there, it can affect temperature and movement of water and microclimates, creating new habitat conditions.

Preparation

For the first activity, obtain aerial photographs and topographic maps using one of the methods described below. If you are computer savvy, one of the first two methods may be easiest. However, contacting your local planning office (described in 3 and 4) will enable you to talk to a professional who should be able to provide you with what you need.

Observing Ecosystem Response to Human Activity: An Exploration of the School Yard

1. If your school was built after 1993, [Google Earth](#) may have the historic aerial photos that you need.
2. For recent aerials and historic topographic maps, go to store.usgs.gov
 - Go to Map locator and Downloader.
 - Follow directions to download topo map/aerials.
 - Put name of your school in the search box, include town and state.
 - An orange bubble should appear on the map over your school.
 - Click on the orange bubble to see what maps are available.
 - Download the newest files, which will contain both aerials and a topographic map of what the area looks like now.
 - Download the older file option to see topographic maps from years past.
 - Choose the download options and save to your computer.
 - Open topographic map and zoom into your school.
 - Go to Edit, take a snapshot and select the area of the map that contains the land area of your school.
 - Paste the snapshot into a word document.
3. You can also contact the town or county GIS office. Tell them you are looking for historical aerial photographs of the area where your school now sits in order to see what was there before the school was built. It is helpful to know when your school was built so the GIS professional can find aerials before that time. You can locate links to your county or town GIS website here:
<https://www.lib.ncsu.edu/gis/counties.html>
4. If your school is in a rural setting, you may also contact your [county Soil and Water Conservation District office](#). They typically have aerial photos of all agricultural lands in a county.

Procedure

ACTIVITY 1

Understanding the Natural Landscape of Your School Grounds

Time: 60 minutes plus time to write essay

1. Review the concept of ecosystem with students. An **ecosystem** is the interaction between a **community** of living (biotic) things and the nonliving (abiotic) environment. Ecosystems can be small or very large.
2. Using the *Tar-Pamlico River Map*, ask your students to determine the ecoregion in which your school is located. An **ecoregion** is a region that contains similar soils and landforms where similar types of ecosystems can be found. Ecoregion boundaries follow the original extent of ecosystems prior to major changes of the land. For another basin, find your ecoregion and other key information on this map developed by the NC Office of Environmental Education and Public Affairs:
<http://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=6b03c62763074346957e6c5096814bee>.
3. Next, tell the students they will learn about the native trees that existed on your school property prior to the school being built. *Natural Environments of the Tar-Pamlico River Basin* will provide sufficient description for the students to determine which native trees existed on your school property. Ask students to name those trees and use the tree identification book or online sources to see what they look like. A good guide is *Common Forest Trees of North Carolina: How to Know Them*, <http://ncforestservice.gov/publications/IE0112.pdf>. Look at the extension section for more ideas on integrating trees on school grounds into your activities.

Observing Ecosystem Response to Human Activity: An Exploration of the School Yard

4. Use the handout, *Maps Can Tell You Where The Water Is*, with your students to gain a basic understanding of topographic maps so they can use one to look for streams, buildings, ponds and hills. Ask your students to determine if the natural landscape of the school was hilly or flat. The class can observe a natural area nearby to make this determination, use topographic maps to see if the contour lines are close together (hilly) or far apart (flat) or read the description in *Natural Environments of the Tar-Pamlico River Basin*.
5. Have your students examine old aerial photo or topographic maps to find out what was on the land before the school was built. Can they see any streams or wetlands? Was it forested or farmland?
6. Essay: Using the information they have gathered (depending on where you live and what studies have been done in your area, more information will be available in some areas than others), ask the students to write an essay describing what they imagine the footprint of the school building and parking lot looked like before anything was built. They should describe the trees, the topography (whether it was hilly or flat), and the animals. (Students do not have to know specific species names.) Ask them to also include water sources (river, streams, wetlands) and describe them.
7. Now ask a few students to read their essays and, as a class, discuss what evidence they used to inform their description of the landscape. What additional information would they like to have to get a better idea of what was here before the school?

ACTIVITY 2

Making Observations and Drawing Conclusions

Time: 90 minutes

1. Tell the students that in Activity 1 they did what an ecologist does before going out to do research. The ecologist studies available resources at his or her desk before going out to "the field." Now it is time for the students to go out and make their own observations and collect field data.
2. Before going outside, tell the students that they are going to make observations about the school building and the physical environment closest to the school building. Discuss with students what they may observe and the kind of data they may collect, using the following questions:
 - On which part of the school building does the sun shine during the hottest part of the day? (The walls of the building can absorb sunlight depending on what it is made of, and what color it is.)
 - From which direction is the wind coming? What part of the building does the wind hit?
 - Observing the vegetation around the school building, is it the same now as it was before the school was built?
 - Do you expect to see animals? What kind?
3. Go outside and have the students walk around the building. *It is best if you take them outside during a time of day when the sun is shining on one side of the building.* First they will collect observational data. Use worksheet titled *Observational Data* as a guide.
4. Once they've made observations and filled out the worksheet, find a place to gather outside. If necessary you can do the next section in the classroom.
5. Use the following questions to guide discussion of their observations and draw conclusions:
 - Did you expect the building to feel warmer where the sun was hitting it?
 - What do you call the type of heat transfer when you touch the building? (Conduction)
 - Did the temperature feel warmer standing near the building? (Convection)
 - What organisms might prefer the sunny side of the building versus the shady side?
 - What observations did you make to support your answers?

Observing Ecosystem Response to Human Activity: An Exploration of the School Yard

- Which side of the building would you prefer?
 - Which side of the building was the wind hitting?
 - On a windy, rainy day, on which side of the building would you prefer to stand?
 - How would the side of the building you chose be different than the other side?
 - Do you think other living organisms would make the same decision? Why?
 - How would you describe the changes in ecosystem from before the school was built to now?
 - Would you say the changes in the physical environment have been positive or negative? What reasons can you give for your answer?
6. If the class cites negative impacts, ask the students what could be done to improve the physical environment around the school. How could the original ecosystem be brought back (without removing the school, of course)? (Note: Many, but not all, schools have preserved areas around the school where forest, wetlands and streams can be found.)

ACTIVITY 3

Measuring and Recording Data

Time: Two 60 minute sessions

This activity adds more depth and requires measurements, data recording and graphing. These data the students collect may be used to support or disprove some of their conclusions from Activity 2. They should use a notebook to collect data and record observations. They should place a date and time at the top of the page each time they collect data. Various nature journaling activities can be incorporated into this activity as well as weekly data collection. You can also do this activity just once, as written.

Temperature

1. During the same time of day that they went out to make observations in Activity 2, have the students measure the surface temperature using an infrared thermometer in the following locations:
 - On the side of the building where the sun is shining
 - On the ground next to the building
 - On the grass
 - On other surface features
2. Repeat on the opposite side of the building.
3. Have the students plot the temperatures against the surface types for each side of the building.
 - Why are the temperatures different between the building surface and the grass?
 - How does this ability of the building to “hold” heat affect the local ecosystem?

Wind

1. Keep a daily log of wind speed and direction. Use a wind vane or the flag to identify the direction (north, south, east, west) the wind is blowing. You can also look up the local weather for wind direction and speed. At the same time, record air temperature and precipitation.
2. Over time, ask students if they can identify any pattern among wind direction, temperature and precipitation. Once they have more data than they did in activity 2 ask: What side of the building would living organisms prefer to live, if they couldn’t move every time the wind switched direction?
3. If there is a prevailing wind – have these winds affected the type of vegetation that grows on the windy side of the building vs. the protected side (Note: prevailing winds in NC are typically from the southwest or during Sept-Oct from the northeast with average speed 8-10 mph).

Observing Ecosystem Response to Human Activity: An Exploration of the School Yard

Evaporation

1. After a rain, on which side of the building do the students expect the water to evaporate more quickly? To test their hypotheses, have the students place paper cups with measured amounts of water in them on the sunny and shady sides of the building. Place a cup next to the building and then every meter further away from the building. Measure and record the change in the amount of water in each cup after 24 hours.
2. Ask students to graph their results.
 - Did their results support the student's assumptions? If not, what are some reasons for the difference?
 - How does this information explain the distribution of plants and animals around the building?

Extensions

All Things Are Connected – connecting biotic/abiotic components of the ecosystem

During activity 1, the students identified trees native to your area and found pictures of these trees. To extend activity 1, assign one tree species each to a small group of students. Take them outside to walk the school property and ask each group if they can find their assigned tree on school grounds. Ask the students to examine their tree and the surrounding biotic and abiotic components. Have them draw the ecosystem components and make connections with arrows or through some other creative method to show the relationship between the tree and its ecosystem. Have them write a poem about their discoveries.

Tree ID and Compass Course

This is a fun and orderly outdoor activity that allows students to practice compass work and tree identification, which have a role in all the activities in this lesson. Prior to going out, identify 5 trees on the school grounds and post a laminated number on each tree. Set a compass course using direction and paces from a starting point to each numbered tree. Provide a group of 4 students with course directions (direction and paces to each tree), a compass, a tree ID book (to make it easier, you can provide photocopies of the pages for just those trees), and a piece of paper labelled 1-5. Have each group follow the course and when they find the correct tree (it will have a number on it), they should identify it and continue on the course. You can either send one group at a time while the others are doing another activity or you can set another course in reverse to allow more groups to work at the same time.

Roofs, Walls and Eaves, micro habitats around your school building

During activity 2, students explored the physical environment in which organisms live. If students are finding a variety of organisms on the walls and in the plants and soil along the building, you may wish to delve more deeply into the habitat needs of these organisms. For background information and discussion questions, see *The MINTS Book, Chapter 5. Roofs, Walls and Eaves, Virginia Tech Museum of Natural History*, page 151 - 176, <http://www.outreach.geos.vt.edu/museum/ERCmaterials/Kits/MINTS/The%20MINTS%20Book.pdf>.

Assessment

Now that students have considered the landscape and organisms before and after the school was built, ask them to reflect on the following questions either through discussion or in writing.

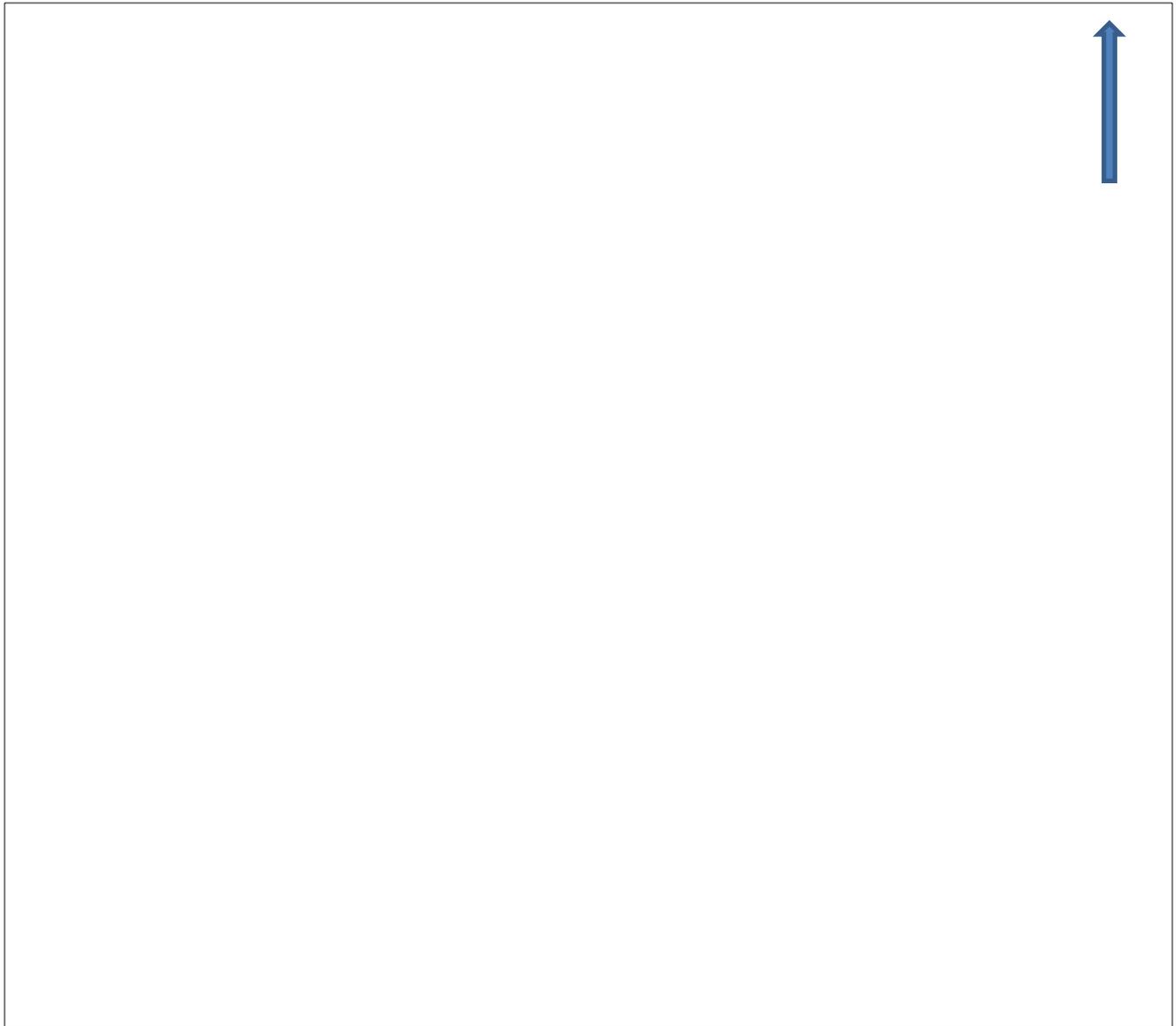
- How did changes in the ecosystem where the school is located affect organisms that live there?
- How did these changes affect people?
- How did the animal population change or adapt?
- How are these changes or adaptations related to the change in plants and trees?

Observing Ecosystem Response to Human Activity: SCHOOLYARD OBSERVATIONAL DATA Worksheet

Name(s) _____

What time is it? _____

Below, draw the school building as if you are looking down on it. Use a compass to find north. Now stand so the top of your paper is facing north. Make sure the arrow in the drawing area below is facing north.



Observing Ecosystem Response to Human Activity: SCHOOLYARD OBSERVATIONAL DATA Worksheet

1. Draw an arrow showing what part of the building the sun is shining on right now. Draw a picture of a sun by the arrow so you know what it represents.
2. Based on what you know about the movement of the sun, will that side of the building always get the most sun (throughout the day) or will it change? If you do not know, what can you do to find out?
3. Place your hand on the building where the sun is shining. Does it feel warm or cool? Why?
4. Use a wind vane or the flag to identify the direction (north, south, east, west) the wind is blowing. You can also look up the local weather for wind direction and speed. Draw an arrow showing what part of the building the wind is hitting right now. Write wind by the arrow so you know what the arrow represents.
5. Look against the side of the building. What types of plants are growing there? Do you see any insects, spiders or signs of animals? Describe what you see.
6. Go to the opposite side of the building. Does the building feel warmer or cooler or the same as the other side? How can you explain your observations?
7. Look against the side of the building here. What types of plants are growing on this side? Do you see any insects, spiders or signs of animals? Describe what you see.

Exploring the Geographical Region and Ecosystems of the Tar-Pamlico Watershed

Maps Can Tell You Where The Water Is

A map can tell you a lot about your environment. You may have already seen many different kinds of maps, such as road maps, that help you find your way from place to place. When we want to learn about our environment, we often use a special map called a "Topographic Map" or "Topo Map" for short.

A topo map tells you about the shape or topography of the land. Topo maps can also show you where important land features such as roads, rivers, lakes, buildings and even hills are located. Look at the topo map below.

Can you find the pond?

Can you find the stream?

Can you find the building near the pond?

Can you find the dirt road?

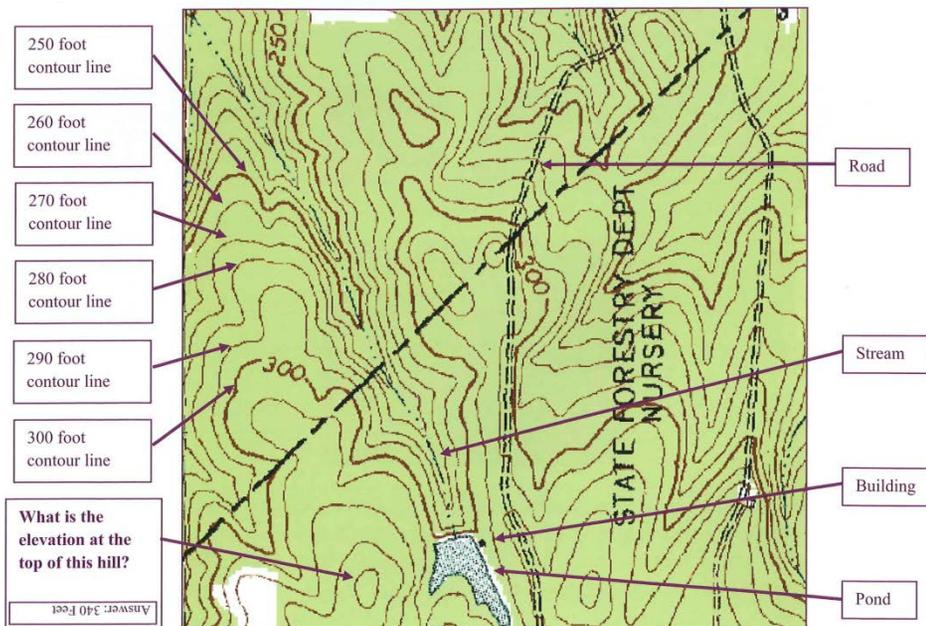
Ponds and lakes are blue.

Streams are blue dashed and dotted lines.

Buildings are small black squares and rectangles.

Dirt or 'unimproved' roads are black double dashed lines.

The most important thing on a topo map is all those curvy brown lines. Those lines are called **contour lines**, and they tell us about the shape of land. Each contour line represents an elevation on the ground. For instance, look at the thick brown line that runs through the "F" in the word "Forestry" written on the map. Trace that line around to your left until you get to the number "300." That means that every place along that line is 300 feet above sea level. Each line on this map represents a difference in height of 10 feet from the one next to it. This means the line next to the 300 foot line represents 290 feet and the one on the other side represents 310 feet. Do you know which one is which? You can find out by locating the next thick brown line, which is the 250 foot contour line. If you count each line by 10 from that line back to the 300 foot line (250, 260, 270, 280, 290, 300) you will know which way is up and which way is down.



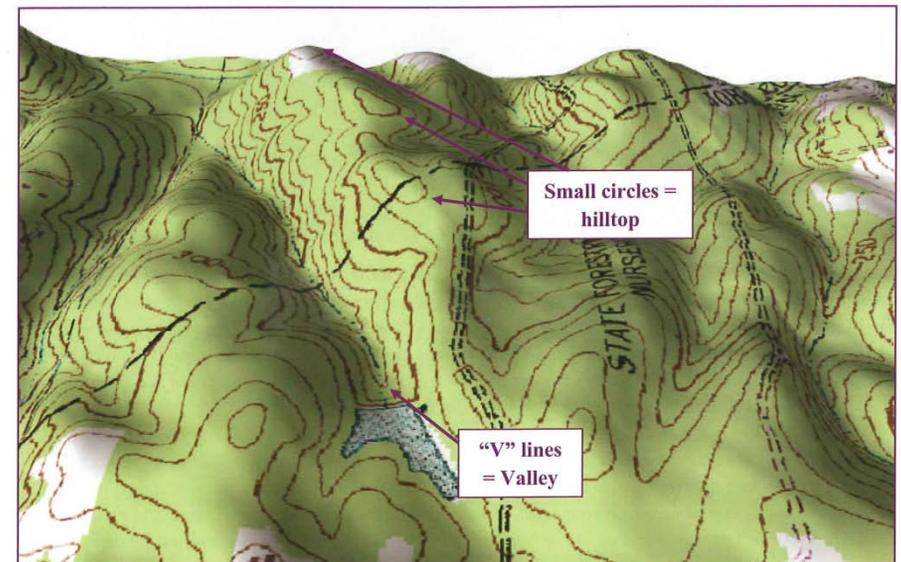
Does this look familiar? It is the same map you were just looking at. It has been enhanced with 3D features to help you understand what the land actually looks like.

Can you see the hills and valleys?

Look how the stream flows right down the lowest part of the valley, just like they do on the ground. You can see that contour lines always make a "V" where there is a valley. Because water always flows downhill, the streams flow right through the point of that "V" in the bottom of the valley.

Do you also see where the topo lines make a small circle? Small circles mark the top of a hill.

Now, look back to the previous page and take a look at that map. You can tell all of this information from a regular topo map, too, now that you know how to read the contour lines.



This activity is used with permission from the publication *Where the Water Goes...from Your Yard to the Ocean* by the NC Forest Service.

© Institute for the Environment at UNC Chapel Hill