Mapping Your Watershed

Adapted from: TIDES – South Slough NERR
Time requirement: 2 to 4 class periods (1.5 to 3 hours total)

Summary of Activity: This laboratory activity is designed to help students look critically at a landscape using remote sensing imagery to identify habitats present and develop a classification scheme of natural and human derived land uses. The participants will become familiar with Google Earth and Google Maps by looking at their entire watershed and features. Then students will closely examine part of their watershed to identify land use and land cover on an overlay. They will then compare their personal maps within small groups to discuss their findings. Students will work to ground truth their findings around the school area, making a personal account of what a specific area or point on the map looks like by describing in both words and photos. An extension of the activity includes a discussion on the effects of land use in terms of permeability and how it relates to the watershed's health.

Concepts to Teach: Interconnectedness, cycles, various coastal habitats

Standards Addressed:
Grade 6:
6.2E.1, 6.3S.1, 6.3S.2, 6.4D.1, 6.4D.3
Grade 7:
7.2E.1, 7.2E.4, 7.3S.1, 7.3S.2, 7.3S.3, 7.4D.1, 7.4D.3
Grade 8:
8.3S.2, 8.4D.1, 8.4D.2, 8.4D.3

Goal(s): Students will look critically at their local landscape using remote sensing imagery and ground truth to identify habitats present in a coastal watershed and develop a classification scheme of natural and human derived land uses.

Specific Objectives:
- Students will be able to describe what an orthographic photo is and why it is useful.
- Students will be able to explain in simple terms what GIS is and how it can be used to interpret data.
- Students will be able to explain what remote sensing is and why it can be useful in understanding coastal watersheds.
- Students will be able to identify land uses and explain how they relate to the overall watershed health.

Vocabulary: (See glossary in Additional Resources section)
Analyze, Classification, Estuary, Geographic Information System (GIS), Global Positioning System (GPS), Ground truth, Interpret, Orthographic photo, Remote sensing, Resolution, Scale, Spatial, Watershed

Required Materials: One computer with Google Earth, Computer lab with Google Maps or Google Earth, Aerial photos printed of study area, Mylar overlays (3 per student), Tape, Magnifying lenses, Overhead markers in different colors

Prerequisites: Students may have an easier time understanding and using the skills of this activity if they are familiar with the concept of watersheds and their features. If not, a short introduction or activity to have students explore a watershed will be sufficient.

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Background

Changes in the landscape, shoreline, and estuary over time are now being studied using tools that were only beginning to be used by cutting edge scientists in the past years. As computers have become more powerful and the Internet has developed into a high-speed method for transferring vast amounts of data, the ability to remotely observe and interpret the ecosystems of the earth has improved dramatically. With a high-speed Internet connection and free software, an Internet user can view aerial images of almost any location on earth (visit www.googlearth.com) and attempt to interpret the features included in the image. The resolution of the image or the sharpness of the rendering of the features depicted will determine to some degree how successful an interpretation can be made. Some features are fairly easy to guess the nature of such as forests, farm fields, roads, bridges, and parking lots. Other parts of the image such as the particular use of a building or group of buildings must be inferred by looking for clues. How land is used or converted can greatly affect the overall health of a watershed. These land features can be more closely studied to look at how they affect permeability of water within the watershed.

Remote sensing imagery has improved greatly over the past decade and the availability of high quality digital images has made the use of these resources for classes much more accessible. However, acquiring specific images at very high resolution still remains somewhat difficult and expensive. For this exercise using a Google Earth image is sufficient if locating an orthographic photo is difficult.

The activity relies on low cost, low-tech items to bring the concept of the Geographic Information System into the classroom in a way that is meaningful to the students and useable for the class. Acquiring tools such as specialized GIS software and sufficient computers and lab space to run this exercise is assumed to be out of reach for most schools at this time, however, the same activities can be conducted using such resources if they are available.

Preparation

Review the power point “Mapping Your Watershed” and become familiar with the above vocabulary terms. If desired, replace photos with the local study site the class will be mapping. It is also a good idea to familiarize oneself with Google Earth including the features and layers. These act as a great visual for students and can work as ground

truths (photos linked to gps points) or as an example of GIS layers (roads). The timeline scale may also start an interesting discussion with students about seasons, tides, land use change or changes to the habitats.

Print out enough copies of the base orthographic photo of the area around your study area so that each student has a copy. Ideally the class will study the watershed of the site they will be visiting so a ground truth is possible. Provide enough Mylar and pens so that each student, or group has at least 2 sheets and access to 4 different colors of pens (these sets may be shared by teams of 2-3 students at a time).

In advance, try the steps in this activity yourself to have an example and better idea of the scope of the lesson.

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Lesson Procedure/Activity Description

GIS & Working with Google maps

1. Describe the nature of the mapping activity that the students will be participating in and how the nature of remote sensing has changed over time. Use the **PowerPoint** presentation "Mapping Your Watershed" to introduce the concept of mapping land use and habitats. Additionally, if you have not shown the class "Impacts of Land Development on Oregon's Waters", you may want to do so. Define the vocabulary terms listed for this activity.

2. Use a computer with **Google Earth** to show the classroom a modern day technology that most people can access that shows orthographic satellite images of the Earth. Introduce them to the concept of layers that can be explored such as roadways and labels for specific locations as well as added videos and photos that can be considered ground truths. It is hard to understand what exactly certain buildings are used for or what a certain place looks like unless you can find clues or see it for yourself at ground level.

3. (*Students should bring a notebook to write down possible habitats and land uses they identify on Google earth.)* Students can explore a similar concept on Google Maps in the computer lab. They can look at different views from traditional map styles to satellite imagery similar to Google earth. **Have them locate common areas that they've been to like their school, a local park or the grocery store they often visit and compare it to nearby locations. What is different? What looks the same? Is that how you expected it to look from the air?**

4. Now, engage the students in a **discussion of the possible land and water uses** of the coast after defining the area of study (for this exercise we are using an image of part of your school's watershed). Have the students **locate your school on Google Maps in satellite image so they can zoom in and out of the area to get a closer look.** Remember to ask them to think broadly in terms of **who comes and goes from the area** depicted in the photo and what the nature of the activities they are involved in includes.

Now have students use Google to find and list the land and water uses and the types of facilities related to these uses (Residential, Industrial, Agricultural, Livestock, Commercial, Fishing, Silviculture etc.). Students should then identify the watershed habitats present (Forest, Meadow, Sand Dune, River, Creek, Reef, Marsh, Tide flat, Channel, etc.) These examples will be placed into two categories (the two Mylar sheets) "Transportation/waterways" & "Habitats". Please note that Habitats includes both natural and human derived places like dunes, marshes, forests as well as residential areas and farm fields.

Mapping the watershed

1. After developing a list of land uses go back to the classroom to begin mapping. Hand each student an orthographic photo from the school's watershed to study. Magnifying glasses may come in handy. Start with the first layer of Mylar, which will be **labeled** "Transportation/waterways". Have the students start by tracing roads and parking lots in one color and waterways including small streams, drainage channels etc. in another color. Make sure the students remember to have a key for their colors and the layer title.
2. Next have students attach a second layer of Mylar overlay to identify boundaries of different "habitat" types. A new color can distinguish different areas as long as a key with labels is present on the layer. Have students **start with what they know to get practice.**

3. When the students have completed the labeling of the maps, discuss the land uses present. Write the categories on the board in front of the room and ask each group to estimate and report the percentage of their map, which is covered by each Land Use or Habitat Type. Total these for the entire class and this will give your class a picture of the natural and human uses of the landscape and seascape within your watershed. If desired students can engage in a discussion of the implications of the habitat types/changes/uses present on the health of the watershed and the local streams.

Ground Truth

Identify the area where you will be conducting your ground truth sampling on the map. Try to identify watershed uses and habitat that might have an impact on that area. Discuss the idea of positive and negative impacts to the area relating the idea of natural impacts being as significant as human induced impacts and the combination/interaction of impacts.
Have the class walk to the study site to make observations and take photos after pinpointing their position on their map. If desired, these ground truths can be added to Google Earth or the classroom's wiki site.

Assessment

- Check maps for understanding, clarity and usefulness. Remind students their maps are only useful if another person can pick it up and interpret it or they can use it weeks later and still understand what was being displayed.
- Challenge students to show their work on calculating the & area of each habitat type on their maps
- Have students work on an inquiry project using their data from their maps as a jumping off point or background for the study

Adaptations & Extensions

After students have completed the two layers of Mylar land use identification, have students work on a third layer identifying permeable and non-permeable surfaces. Have a discussion with students about land use types and habitats and how they have an effect on the water cycle within the local watershed. For example: how might a straight ditch affect drainage as compared to a meandering creek or wetland area?

Have students layer on a third sheet of Mylar over the top of their two previous layers. Have students pick two colors, one permeable and one non-permeable. Have students estimate how much of the watershed is in each category and discuss the implications of this. How might a different area of the watershed look (perhaps the South Slough interpretive center or downtown Coos Bay?)? How might this affect nearby estuarine environments like the tide flats or salt marsh across Cape Arago Hwy? The ocean?

Additional Resources

Glossary

- Analyze- to consider something in detail in order to discover essential features or meaning
- Classification- to distribute things, like habitat types, into categories
- Estuary- Where fresh water and salt water meet
- Geographic Information System (GIS)- a system of hardware and software used for storage, retrieval, mapping and analysis of geographic data
- Global Positioning System (GPS)- a navigational system involving satellites and computers that can determine the latitude and longitude of a receiver
- Ground truth- data that is collected on location
- Interpret- to make sense of something or assign meaning to it, in this case remotely sensed data.
- Orthographic photo- a photo that shows an area of land at a 90 degree angle such that there is no effect from perspective
- Remote sensing- the process of measuring a parameter like temperature, rainfall, etc. from a distance.
- Resolution- the number of pixels per square inch on an image, more pixels indicate a better picture
- Spatial- pertaining to or having the nature of space
- Watershed- the entire geographical area drained by a river and its tributaries

Standards Addressed:

Grade 6:
6.2E.1- Explain the water cycle and the relationship to landforms and weather.
6.3S.1- Based on observation and science principles, propose questions or hypotheses that can be examined through scientific investigation. Design and conduct an investigation that uses appropriate tools and techniques to collect relevant data.
6.3S.2- Organize and display relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions.
6.4D.1- Define a problem that addresses a need and identify science principles that may be related to possible solutions.
6.4D.3- Describe examples of how engineers have created inventions that address human needs and aspirations.

Grade 7:
7.2E.1- Describe and evaluate the environmental and societal effects of obtaining, using, and managing waste of renewable and non-renewable resources.
7.2E.4- Explain how landforms change over time at various rates in terms of constructive and destructive forces.
7.3S.1- Based on observations and science principles propose questions or hypotheses that cane be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools and techniques to collect relevant data.
7.3S.2- Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions including possible sources of error.
7.3S.3- Evaluate the validity of scientific explanations and conclusions based on the amount and quality of the evidence cited.
7.4D.1- Define a problem that addresses a need and identify constraints that may be related to possible solutions.
7.4D.3- Explain how new scientific knowledge can be used to develop new technologies and how new technologies can be used to generate new scientific knowledge.

Grade 8:
8.3S.2- Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions including possible sources of error. Suggest new investigations based on analysis of results.
8.4D.1- Define a problem that addresses a need, and using relevant science principles investigate possible solutions given specified criteria, constraints, priorities and trade-offs.
8.4D.2- Design, construct, and test a proposed engineering design solution and collect relevant data. Evaluate a proposed design solution in terms of design and performance criteria, constraints, priorities, and trade-offs. Identify possible design improvements.
8.4D.3- Explain how creating a new technology requires considering societal goals, costs, priorities, and trade-offs.