

Getting to Know Your Satellite Imagery and GLOBE Study Site



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Purpose

To introduce students to the Landsat TM images of the GLOBE Study Site, the iterative nature of mapping and how to identify land cover types in images

Overview

Students outline and label areas in their school's Landsat TM image to create a simple land cover map. They use this map to locate areas for field study.

Student Outcomes

Science Concepts

Geography

- How to use maps (real and imaginary)
- The physical characteristics of place
- The characteristics and distribution of ecosystems

Scientific Inquiry Abilities

- Use maps, aerial photographs and other tools and techniques on order to create a land cover map.
- Recognize and analyze differing viewpoints on land cover classification and reach a consensus.
- Identify answerable questions.
- Design and conduct scientific investigations.
- Use appropriate mathematics to analyze data.
- Develop descriptions and predictions using evidence.
- Recognize and analyze alternative explanations.
- Communicate procedures, descriptions, and predictions.

Level

All

Time

One to two class periods for the initial mapping

Materials and Tools

- Hard-copy Landsat TM images of the 15 km x 15 km GLOBE Study Site, true-color and false-color infrared
- Clear plastic sheet(s)
- Fine point markers
- Road maps and topographic maps, if available
- Aerial photographs, if available

Preparation

Print or make color copies of the satellite image.

As a demonstration, copy the example maps to transparency film and use them to illustrate the process.

Prerequisites

Students need only be familiar with the area in their GLOBE Study Site.



Background

The Landsat Thematic Mapper (TM) image of a school's GLOBE Study Site can be used to identify land cover types once students understand what the colors on the different printed images represent. (For more information, see the *Manual Classification Tutorial*.)



In the "true-color" image, which represents the surface of the Earth approximately as we would see it from space, vegetation ranges from light green to very dark green, sometimes appearing almost black. Water is blue to black unless it is carrying suspended sediments when it can appear gray to green. Exposed mineral material (rocks, sand, buildings) is white to purple. This image is good for identifying developed areas and areas of exposed rock and sand. It does not clearly distinguish specific vegetation types, or between dark vegetation and water.



In the "false-color infrared" image, which mimics an aerial infrared photograph, red hues are associated with live vegetation. Very bright shades indicate vigorously growing vegetation. For example, a grassy area might show as a bright pink color, whereas a dense stand of coniferous trees would appear as a very dark red. Intermediate shades can represent deciduous and mixed deciduous/coniferous trees. As a very general rule, "the brighter the red, the shorter the vegetation." Senescent, or "dead" vegetation is shades of green or tan. In this view, water is almost always black and mineral material, including buildings, rock, sand, and bare soil, appear in shades of blue, purple and white.



What To Do and How To Do It

1. Review the process students will carry out using the illustrations accompanying this exercise. They show the development of a student map for the Beverly, MA satellite image. Figure LAND-SS-2 shows the Beverly image in false-color infrared, this is the satellite image to use as the base layer.

Step 1: Water bodies are outlined and labeled.

Step 2: Elements of the area's transportation system are outlined and labeled. (The labels from the previous diagram have been eliminated for the sake of clarity.)

Step 3: Residential and commercially developed areas are outlined and labeled.

Step 4: Some vegetated areas, a golf course, beaches, and some "unknown" areas are outlined and labeled.

Step 5: The final land cover type map with all areas outlined and labeled.

2. Place the plastic overlay on top of the school's printed image and mark the corners of the image. This will help to realign the overlay if it moves.
3. Using a fine point marker, outline areas that represent homogeneous land cover types, and label them appropriately (forest, field, urban, etc.).
4. Outline areas of land cover that the class is not sure of. Ask students to suggest ways they can make an educated guess about the land cover in these areas. Use road maps, topographic maps and aerial photos, if available, to assist you. Recruit students who live near these areas to try to identify them.

The number of land cover types students identify will depend on a school's geographic location. In heavily urban areas, students may be able to identify only a few types, as most developed land cover types appear similar in both satellite images. This is because these land cover types are highly reflective and thus appear bright in the images. In areas where there is a variety of land cover types, including natural vegetation, cultivated and developed areas, there may be more discernible land cover types, but many small areas may make identification difficult.

How can we identify land cover types in unknown areas?

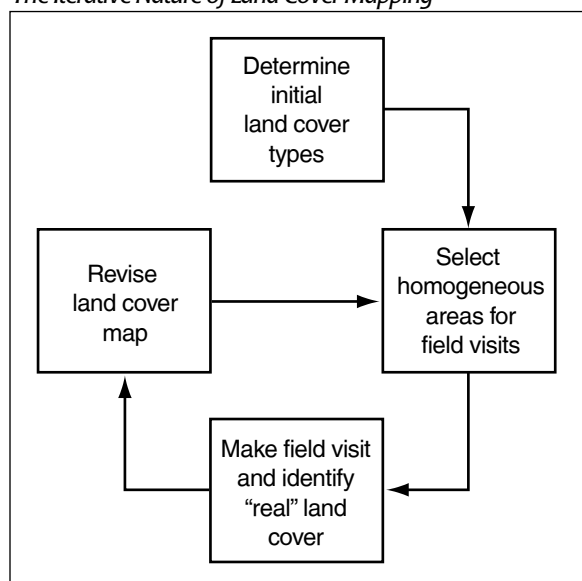
Using the overlays, locate areas that appear to have uniform land cover and seem to measure at least 90 m x 90 m (3 pixels x 3 pixels) in size. These are potential Land Cover Sample Sites, which can now be visited.



The Job Is Not Done!

The map is only the first step in a “cyclic” process. Usually, some of the areas identified are “guesses” and there are areas for which the land cover type is unknown. The next step is to visit these areas to validate their land cover type. After visiting an area and determining its real land cover, return to the map and either correct it or update it. Return to the field to visit more areas, and continue the process of correcting and updating the land cover type map. Such a process is called “iterative,” and each new map represents a new “iteration” in the process. Figure LAND-SS-1 represents this process.

Figure LAND-SS-1:
The Iterative Nature of Land Cover Mapping

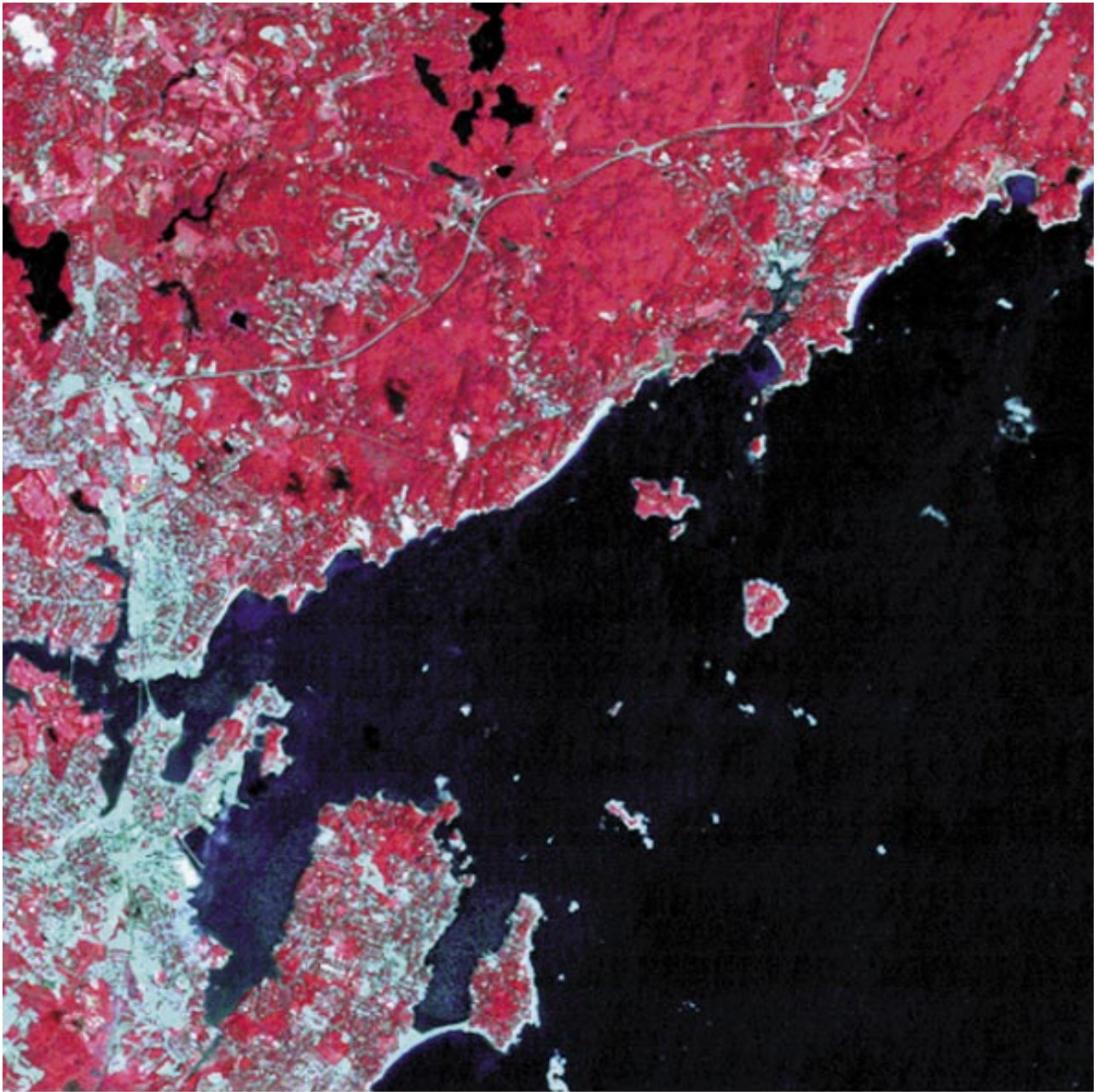


Assessment

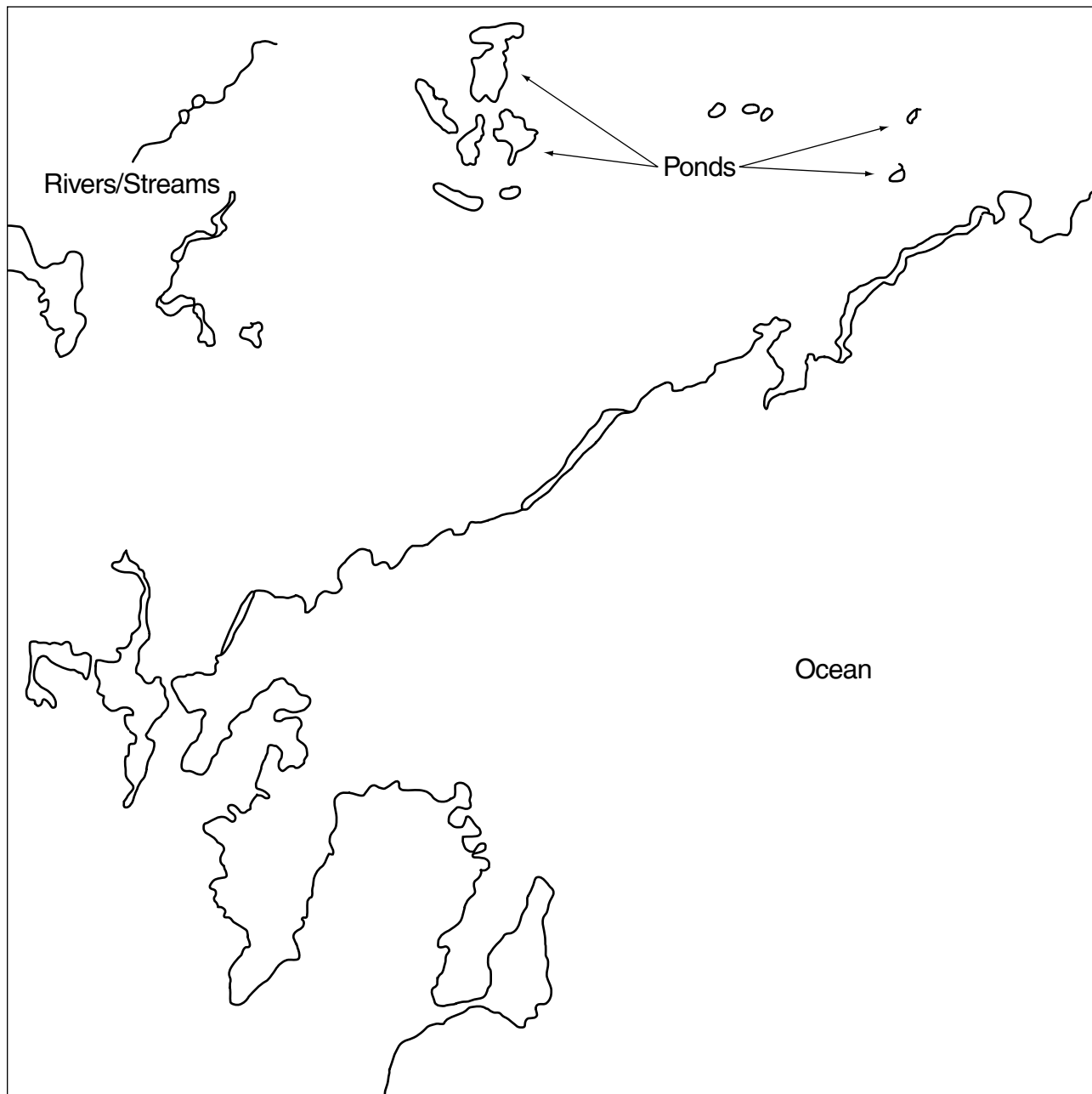
Assess students’ understanding of the mapping process by asking them to explain both what they did and why they did it. Some leading questions might include:

- How many different land cover types were you able to distinguish in the satellite images?
- Which land cover types are easiest to identify in the true-color image? In the false-color infrared image? Why do you think this is the case?
- What land cover types that exist on the ground do you think are difficult to identify on the satellite images?
- If you live in coastal or estuarine areas, how would the position of the tides (high or low) affect your land cover mapping?
- How would the time of year your satellite image was acquired affect land cover mapping in your part of the world?
- What other conditions at the time your image was acquired might influence your land cover mapping? (Clue: In the Beverly, MA, image, the “unknown areas,” which show both white and black, are small cumulus clouds and their shadows!)
- Consider when the satellite image was acquired. What has changed in the satellite image since then?
- TM images are always acquired in the morning. If you live in a mountainous area, how will this effect what you see in the image? Where will the shadows of hills and mountains be?

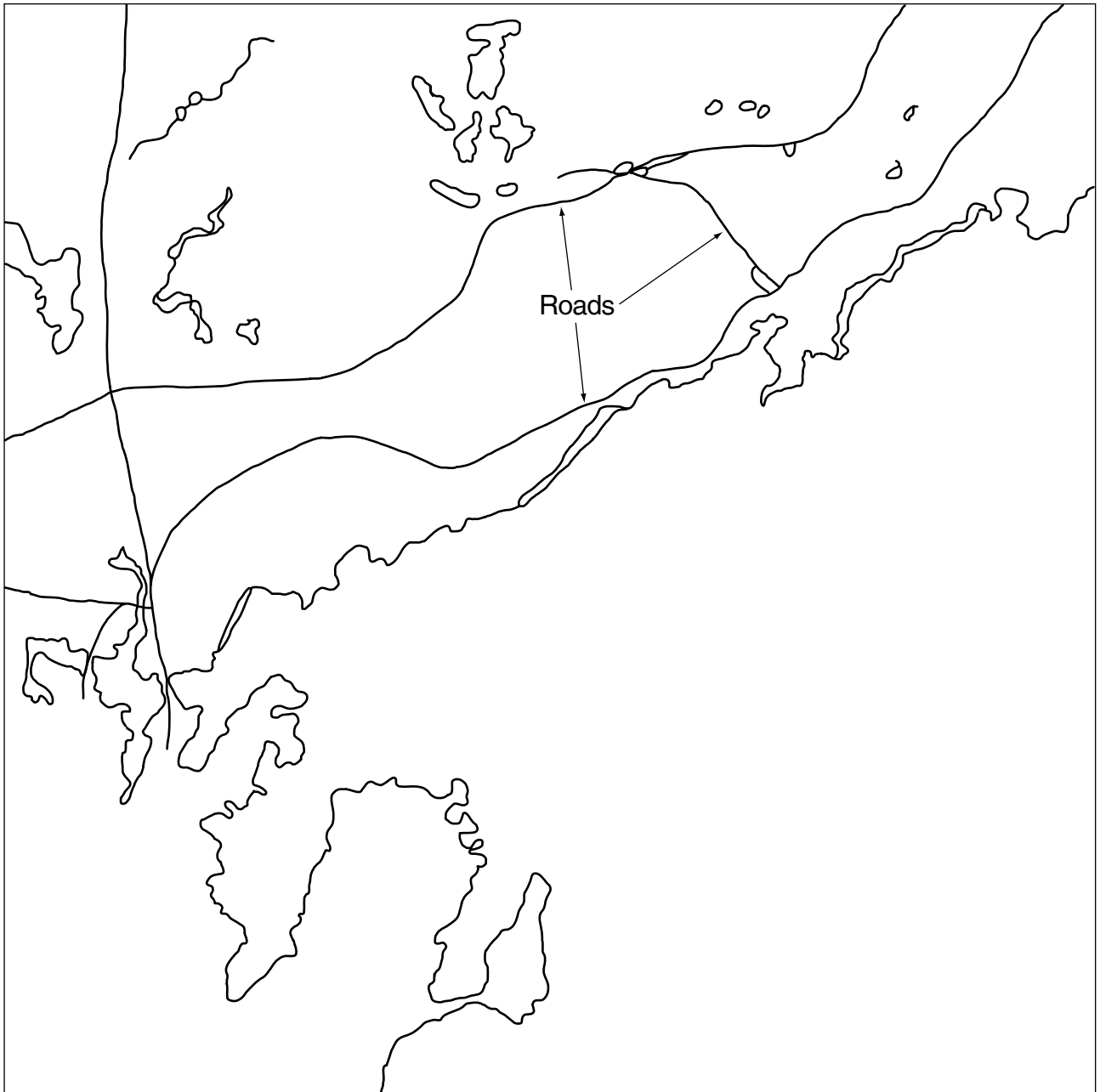
Figure LAND-SS-2: Beverly, MA, in false-color infrared



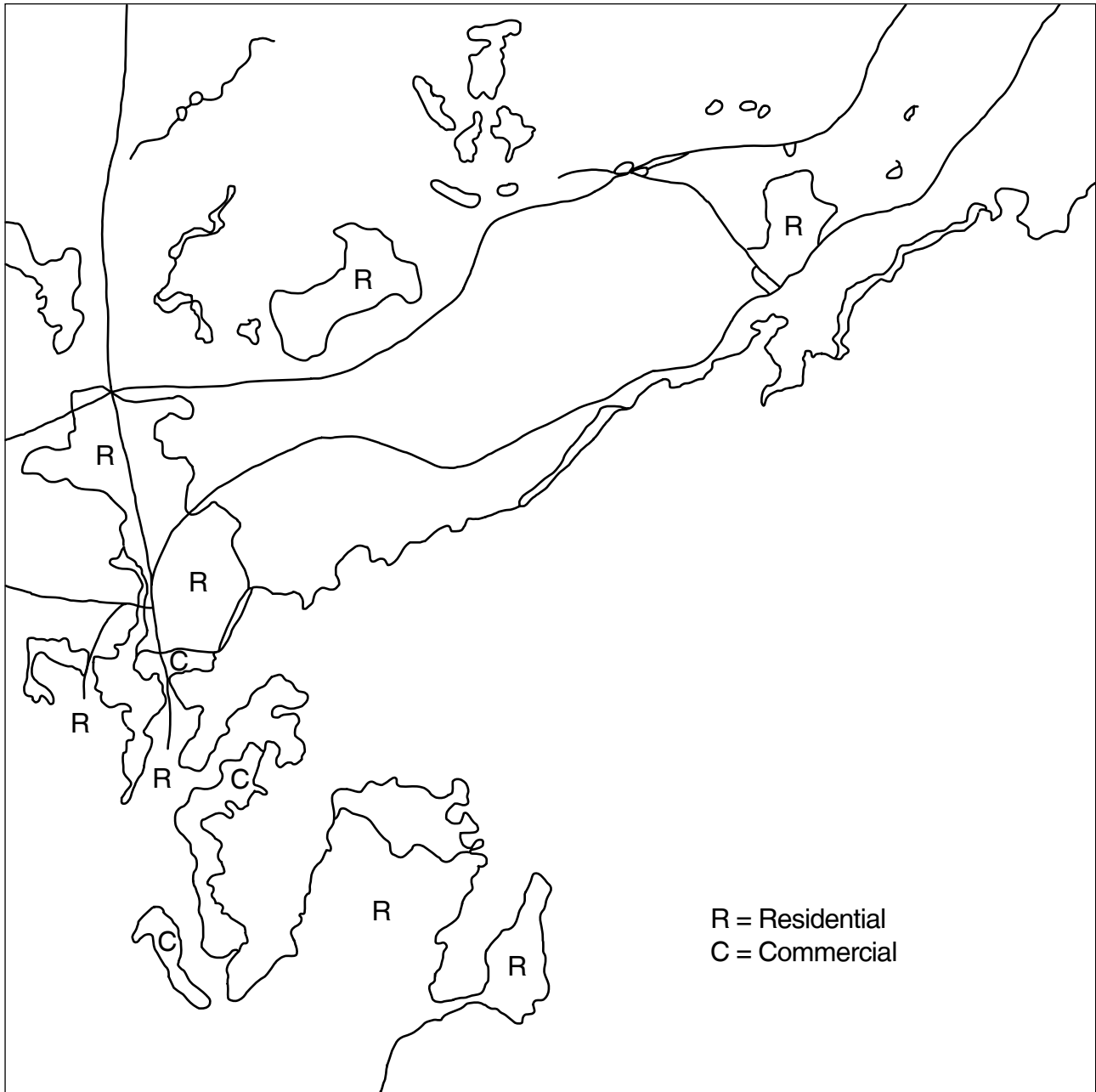
Step 1: Water Bodies are Identified



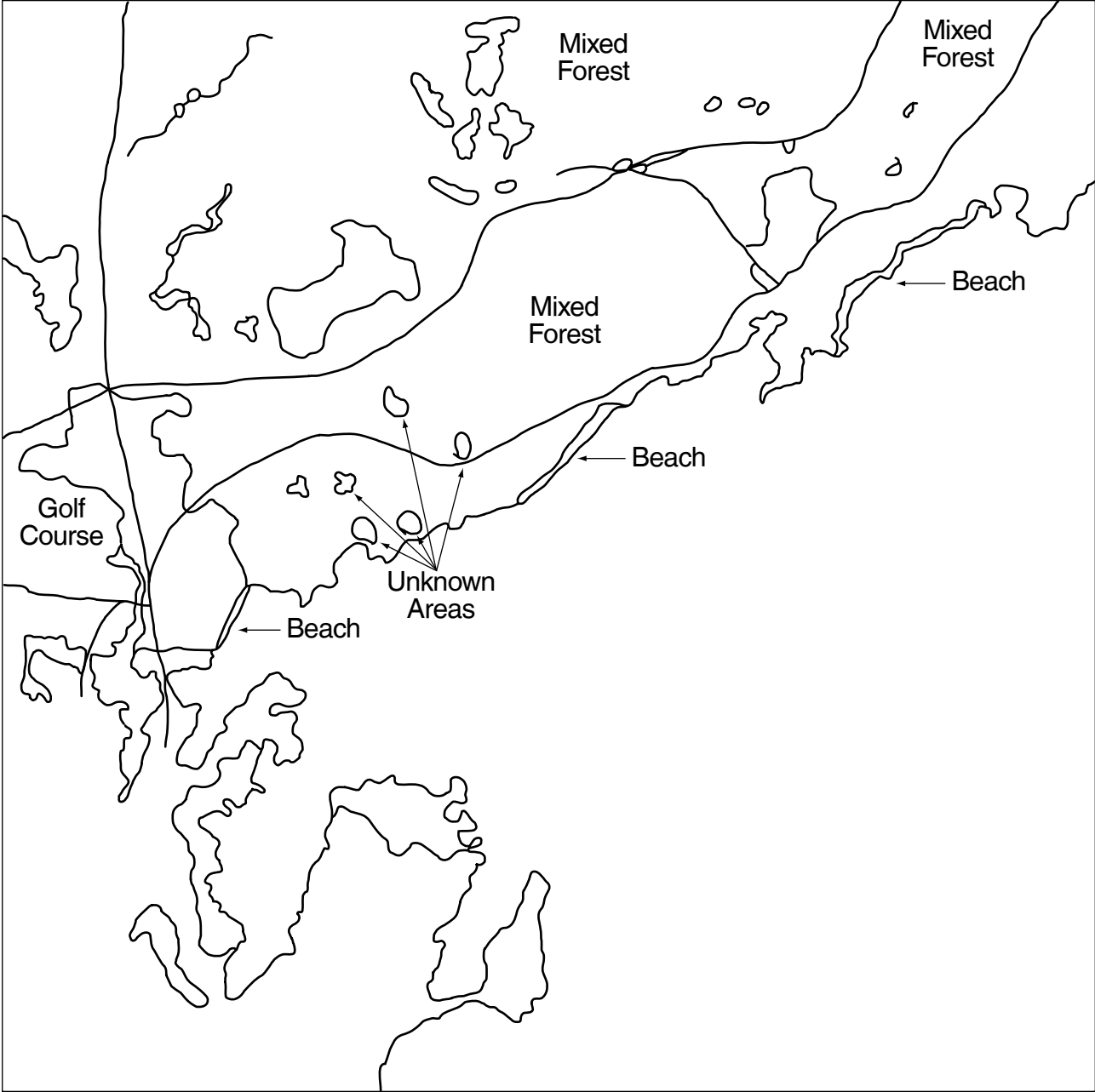
Step 2: Transportation Features are Added



Step 3: Buildings and Developed Areas are Added



Step 4: Vegetated Areas and Other Features are Added



Step 5: A Student Land Cover Map

