MapTEACH

PLACE-BASED GEOSPATIAL LEARNING AND APPLICATIONS IN ALASKA

Mapping Technology Experiences with Alaska’s Cultural Heritage

www.mapteach.org
MapTEACH: PLACE-BASED GEOSPATIAL LEARNING AND APPLICATIONS IN ALASKA

Place Based Geospatial Education for Alaska
Teacher and Student Guide
Grades 6-12

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Digital versions of this Teacher and Student Guide, as well as additional maps, PowerPoint Presentations, Software, and Data are available on DVD or online from MapTEACH at:

www.mapteach.org
MapTEACH (Mapping Technology Experiences with Alaska's Cultural Heritage) is an educational curriculum for middle and high school students designed to help them both (1) understand the physical and cultural features of their environment, and (2) use mapping technologies to enhance and portray that new understanding. As such, it emphasizes the integration of three focus areas: geoscience, local landscape knowledge, and geographic information science (GPS, GIS and remotely sensed imagery). MapTEACH gives Alaskan students the opportunity to make a connection between traditional ways of viewing the landscape, scientific ways of making observations about the landscape, and the process of using cutting-edge information technologies to gather and disseminate information about the landscape. At its core, this curriculum is place-based and interdisciplinary in nature, and seeks to connect students, teachers, community members and scientists in an exploration of the local landscape from multiple perspectives. Lessons are organized into the following sections for ease of use:

**Section 1: Place Names and Landmarks**
These lessons seek to answer the question “How do you know where you are?” by grounding students in an appreciation of their own mental maps and then expanding this to include understanding and documentation of the place names and landscape knowledge of local experts. This work is based on the belief that there are many ways to “know” where you are and that each way of knowing contributes to our overall understanding of the landscape.

**Section 2: Remote Sensing and Geology**
These hands-on lessons introduce students to remotely sensed imagery by exploring local air photo imagery, stereo pair photographs and topographic maps and by using these maps and imagery to evaluate river erosion and change over time. These lessons are not only interesting and relevant in their own right, but provide a solid introduction to the imagery used in several of the GIS lessons.

**Section 3: Global Positioning System**
These lessons guide students through the basic uses of handheld Global Positioning System (GPS) units by finding and placing geocaches, documenting waypoints, and downloading location information into a computer in order to create a map of a place or a journey.

**Section 4: Geographic Information Systems**
These lessons enable students to use GIS mapping technology to enhance and portray their understanding of the world around them by: (1) exploring the fundamental concept that maps are made of layers of data and a computer
allows us to stack these layers in many different ways; and (2) manipulating existing data layers and adding their own data to generate original maps of personal, cultural or scientific interest.

As can be seen in Tables 1 – 4 below, each section has a coherent set of goals and, with a few exceptions, lessons in each section are sequential so that they can be worked through in part or in whole in the order presented. In practice, however, the lessons are intended to be used in a variety of combinations, mixing and matching lessons from several sections to achieve desired learning outcomes and timeframes. Table 5 demonstrates how different elements of this curriculum might be adapted to suit unique classroom needs by describing several potential lesson sequences.

Several of the lessons included in the MapTEACH curriculum involve making digital maps using GPS and other data collected locally by students. Satellite imagery can be a useful and informative base map layer upon which students can display their own data. It is not feasible for MapTEACH to be able to anticipate every possible area that any given student project would need satellite base map data for, therefore we have developed two procedures so teachers (or advanced students) can generate their own image layers for use in their local-area digital mapping projects. These procedures can be found in the Appendix.

We expect and hope that as you become more familiar with this curriculum, you will find new ways to use and adapt these lessons and make them your own. We hope you will share these adaptations with us and also let us know what we might do next to make this curriculum more responsive to your needs.
<table>
<thead>
<tr>
<th>Lesson Name</th>
<th>Lesson Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNL 1 - Mental Maps</td>
<td>This activity introduces the essential question for the unit: “How do we know where we are?” and sets the stage for the unit through a mental map activity and class discussion.</td>
</tr>
<tr>
<td>PNL 2 - Simon Paneak Sketch Maps</td>
<td>Students examine and discuss the sketch maps and life story of Simon Paneak, a Nunamiut hunter from Anaktuvuk Pass, as an example of the extensive landscape knowledge often held by mature Alaska Native hunters and travelers.</td>
</tr>
<tr>
<td>PNL 3 - Working with Local Experts</td>
<td>Students become more familiar with local landmarks, place names and stories as they listen to and work with a local landscape expert.</td>
</tr>
<tr>
<td>PNL 4 - What's in a Name?</td>
<td>Students study an Inupiaq place names map of the John River area, read the accompanying stories, discuss their significance and then brainstorm a list of place names for their own area.</td>
</tr>
<tr>
<td>PNL 5 - Picking Points off a Paper Map</td>
<td>Students identify place names or landmarks on a topographic map and use TopoZone, a web-based mapping program, to determine the latitude and longitude of these sites. These coordinate locations can then be used in digital map-making or way-finding with a GPS.</td>
</tr>
<tr>
<td>PNL 6 - Place Names Field Trip</td>
<td>Students complete classroom preparation and go on a field trip to document local place names and landmarks.</td>
</tr>
</tbody>
</table>
## Table 2 - Remote Sensing/Geology Lessons

<table>
<thead>
<tr>
<th>Lesson Name</th>
<th>Lesson Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSG 1 – Air Photo Interpretation</td>
<td>This activity introduces students to color infrared (CIR) air photo interpretation. Students examine a CIR air photo of their community, identify prominent features and interpret what those features might be through use of an air photo key.</td>
</tr>
<tr>
<td>RSG 2 - Seeing in Stereo and Route Finding</td>
<td>At stations set up around the room, students view and interpret stereo pair air photos in three dimensions (3-D), compare them with topographic maps of the same area and determine which route is &quot;best.&quot; Students also discuss the advantages and disadvantages of each image with regard to finding your way.</td>
</tr>
<tr>
<td>RSG 3 – Evaluating Erosion</td>
<td>Students examine several air photos of Alaskan rivers and identify areas of erosion and deposition.</td>
</tr>
<tr>
<td>RSG 4 – Change Over Time</td>
<td>Students study a chronological series of images and maps of Fairbanks or Nenana, looking for evidence of changes over time.</td>
</tr>
</tbody>
</table>

## Table 3 - Global Positioning System Lessons

<table>
<thead>
<tr>
<th>Lesson Name</th>
<th>Lesson Summary</th>
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</thead>
<tbody>
<tr>
<td>GPS 1 – Introduction to GIS with Geocaching</td>
<td>Students learn how to use GPS units to perform a variety of tasks. They learn how to: adjust the settings of the units; enter and mark waypoint information; find geocaches; and place a geocache.</td>
</tr>
<tr>
<td>GPS 2 – Field Data Collection for GPS Data and Digital Photo Documentation</td>
<td>Students go on a field trip to collect geospatial data and other useful information to document sites of interest they encounter.</td>
</tr>
<tr>
<td>GPS 3 – Using Your Own Field Trip Data</td>
<td>Students make GIS maps using data they have collected on a local field trip with their GPS units and digital cameras. They download their photos and GPS waypoints into a CSV file and then make a map of their sites that includes photos they took on their field trip.</td>
</tr>
<tr>
<td>GPS 4 – Hotlinking to a Field Trip Data Document</td>
<td>Students create Word documents describing their field trip sites and then learn how to hotlink the points in a GIS project to these Word documents thus creating an interactive map.</td>
</tr>
<tr>
<td>GPS 5 – Using Track Log Data</td>
<td>Students make GIS maps using track log /trail data they have collected on a local field trip with their GPS units and digital cameras.</td>
</tr>
<tr>
<td>Lesson Name</td>
<td>Lesson Summary</td>
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</tr>
<tr>
<td>GIS 1 – Many Layers Make a Map</td>
<td>Students brainstorm a list of information portrayed on topographic maps sort that information into categories or themes and then trace a few layers onto mylar in imitation of GIS layers/themes.</td>
</tr>
<tr>
<td>GIS 2 – Introduction to GIS Using AEJEE</td>
<td>Students are introduced to the use of GIS as a way to make customized maps. Students learn to: add layers, set projection, modify the appearance of the map and label features on it.</td>
</tr>
<tr>
<td>GIS 3 – Working with GIS Data: View, Label, Measure and Identify</td>
<td>Students learn some of the key qualities of GIS that make it more dynamic and powerful than paper maps. They learn new ways to view the information held in a GIS, and begin asking questions and solving problems.</td>
</tr>
<tr>
<td>GIS 4 – Maps with Raster Images I: Statewide Shaded Relief</td>
<td>Students work with a shaded relief image of Alaska and answer questions about what they can observe.</td>
</tr>
<tr>
<td>GIS 5 – Maps with Raster Images II: Local Shaded Relief Base Map</td>
<td>Students use a shaded relief raster layer and several vector layers to make a base map, centered on their community. The base map they construct during this exercise will be used as a starting point for several future GIS lessons.</td>
</tr>
<tr>
<td>GIS 6 – Maps with Raster Images III: Satellite Imagery</td>
<td>Students use GIS to load and view true-color and enhanced satellite images of Alaska. Based on their knowledge of Alaskan geography and recent image interpretation experiences, they interpret features found in the satellite images.</td>
</tr>
<tr>
<td>GIS 7 – Community GIS: Geologic Hazards</td>
<td>By choosing an Alaskan community as a starting point, students investigate and map geologic hazards that may affect that community directly. In turn, students begin to see how the geology and climate of a place sets the stage for specific hazardous events.</td>
</tr>
<tr>
<td>GIS 8 – Community GIS: Natural Resources</td>
<td>Geological resources often play a critical role in the economies of Alaskan communities. During this lesson, students investigate the distribution of resources regionally and locally. The maps students make can help them explore current and potential resource use by their project communities.</td>
</tr>
<tr>
<td>GIS 9 – Community GIS: Land Management</td>
<td>Who decides what is done with land in Alaska? Using GIS tools and information, the students investigate land ownership and management units and the distribution of resources beginning with their project community and expanding outward. The maps students make can help them explore current and potential resource use by their project communities.</td>
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<tr>
<td>Course</td>
<td>Description</td>
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<tr>
<td>GIS 10 - Good Map - Bad Map</td>
<td>The teacher reviews basic cartographic guidelines, and then shows an example AEJEE map that is cartographically incorrect, incomplete, and poorly designed. Students critique the map. A correct, complete, and attractively designed map is then reviewed for comparison.</td>
</tr>
<tr>
<td>GIS 11 - Community GIS: Map Layouts</td>
<td>Beginning with the base map created in GIS 7 -Community GIS: Geologic Hazards, students make map layouts that can be saved and printed as paper maps and used for reports or presentations.</td>
</tr>
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<td>GIS 12 - Adding Coordinate Locations into a GIS</td>
<td>Students use Serpentine Hot Springs on the Seward Peninsula as an example site to learn how to manually add coordinate data into a GIS project by creating a <em>comma separated values</em> file (.csv) and importing it into an AEJEE project</td>
</tr>
<tr>
<td>GIS 13 - Hotlinking</td>
<td>Students modify the Serpentine Hot Springs csv file created in GIS 12 as an example site to learn how to hotlink data in a GIS project to a website about the hot springs, thus creating an interactive map.</td>
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<td>GIS 14 - Change Over Time - Shorefast Sea Ice</td>
<td>Students use GIS to analyze changes in the extent of shorefast sea ice. They extract information from multi-year and single year data and look for trends over time.</td>
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<tr>
<td>Goal</td>
<td>Time (Hours)</td>
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<tr>
<td>Brief introduction to GPS receivers</td>
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<tr>
<td>Brief introduction to GIS</td>
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<td>Landscape change over time</td>
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<td>Goal</td>
<td>Time (Hours)</td>
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RSG Lesson 1
AIR PHOTO INTERPRETATION
TEACHER INFORMATION

Lesson Summary: This activity introduces students to color infrared (CIR) air photo interpretation. Students examine a CIR air photo of their community, identify prominent features and interpret what those features might be through use of an air photo key.

Objectives: Students will begin to identify and interpret prominent landscape features in CIR air photos.

Estimated Time: 1 hour

Correlation to Alaska Standards:
Cultural E-2 Understand the ecology and geography of the bioregion they inhabit.
Geography A Make and use maps, globes and graphs to gather, analyze, and report spatial (geographic) information.
Science A-1 Develop an understanding of the processes of science.

BACKGROUND FOR THE TEACHER
Like maps, aerial photos and satellite images provide a bird's eye view of the Earth, but unlike maps, photos are direct images of the Earth and convey firsthand information. Low-flying airplanes and more-distant satellites record everything “indiscriminately.” Subtleties such as color variation, tone, texture, size and shape reveal patterns and features of the Earth that can't be seen in any other way. Such images portray not only roads or coastlines, but features not always noted on maps such as mountains, volcanoes, vegetation, sediment in water, sand dunes, sea ice extent and more.

Air photos are generally of two types: true color or color-infrared. True color photos capture the reflectance of visible light and portray the landscape in the blues, browns and greens we associate with the Earth. CIR photos capture the reflectance of the invisible infrared spectrum and portray the Earth in shades of red, blue, purple and other colors. This lesson uses photos in the CIR spectrum because although true color photos are more familiar looking, CIR photos reveal landscape features in much more detail. (See More Explorations and Teacher Resources for links to understanding light.)
Air photo interpretation involves recognizing and describing objects by key characteristics, many of which can also be helpful when viewing satellite images. Skillful interpretation of air photos is an art acquired only after considerable experience, but beginning students can comprehend common features in air photos with some basic instruction and time to practice. Some of the most common air photo features are described in the paragraphs and illustrations below.

Alaskan CIR air photos for this lesson can be obtained through the GeoData Center at the University of Alaska Fairbanks at the following address:

GeoData Center, Geophysical Institute
University of Alaska Fairbanks
903 Koyukuk Dr.
P.O. Box 757320
Fairbanks, AK 99775-7320
(907) 474-7598

MATERIALS
- Large (3' x 3') CIR image of community
- Color printer
- For each student:
  - 1 (8” x 8”) laminated CIR print of community
  - Copies of Student Exercise and Air Photo Key
  - Fine-tip Sharpie
  - Mylar overlay
  - Paperclips
INSTRUCTIONAL PROCEDURES

Gear-Up
1. Ask students “How might air photos and satellite images help you know where you are?”
2. Point to the CIR wall poster and ask what students notice first about it (the funny colors). Ask if anyone has seen this kind of image before and what they might know about what CIR is and why it is preferred for image interpretation? (Briefly explain what/why CIR is used.)
3. Examine CIR wall poster. Ask for observations and generally discuss image as a warm-up to lesson.
4. Explain/model the student activity for the day using the wall CIR and sample portion of worksheet to demonstrate the steps:
   - Examine wall CIR closely to get oriented and get a sense of all the variation in color, tone, pattern and texture that there is in the photo.
   - Secure and register mylar overlay to the wall CIR photo.
   - Find a feature of interest and outline it on the mylar using a fine tip Sharpie.
   - Spend some time exploring how to describe features and how to make inferences about what students see on the CIR wall photo.

<table>
<thead>
<tr>
<th>Feature #</th>
<th>Describe what it looks like</th>
<th>What do you think it is?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>Long, straight, grayish line leading into Nenana</td>
<td>Railroad</td>
</tr>
<tr>
<td>#1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td></td>
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</tbody>
</table>

5. Model observations of more subtle differences in color, tone, texture etc. (without “naming” the feature). Explain that interpretation of air photos requires close attention to differences; that if something looks different, it probably is different.
6. Emphasize that although the key is accurate, the colors in their own community photo may look a bit different and they will have to use what they know about where they live in order to interpret the photo.

Explore
Students work to identify and interpret features.
Generalize
- Have students exchange their worksheets and photos and check to see if students agree on the selections and interpretation.
- Alternatively, debrief activity by asking student volunteers to circle selected features on the wall CIR photo and explain their interpretations.
- Ask students to share questions and examples of disagreement and discuss the feature as a class to try and reach a consensus.
- Discuss why having a complete photo for reference is important.
- Ask again how air photos can help you know where you are.

Apply/Assess
See RSG Lesson 2 “Seeing in Stereo and Route Finding.”

MORE EXPLORATIONS
- Have students create a key for the CIR image of their community by viewing it on their computer and taking screen shots to create the key.

TEACHER RESOURCES


National Aeronautics and Space Administration. IMAGERS. “Lesson 5, Interpreting Satellite Imagery.” Available online at http://imagers.gsfc.nasa.gov/teachersite/RS5.htm (An interactive web site and teacher guide for grades 5–8 that can introduce students to remote sensing.)


### RSG Lesson 1
A I R  P H O T O  I N T E R P R E T A T I O N
S T U D E N T  E X E R C I S E

1. Examine the photo closely to get oriented and to get a sense of all the variation of color, tone, pattern and texture in the photo.

2. Secure the mylar to your photo using paperclips and “register” the photo by using your Sharpie to mark photo corners and large/distinctive landmarks such as a road or lake.

3. Find at least three features that you recognize. Outline and number them on the mylar layer and then describe and interpret them below.

<table>
<thead>
<tr>
<th>Feature #</th>
<th>Describe what it looks like</th>
<th>What do you think it is?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>Long, straight, grayish line leading into Nenana</td>
<td>Railroad</td>
</tr>
<tr>
<td>#1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Look more closely at your photo and select and number at least four more features that look interesting or distinctive. Use the key to help you figure out what they are and describe and interpret them below.

<table>
<thead>
<tr>
<th>Feature #</th>
<th>Describe what it looks like</th>
<th>What do you think it is?</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Air Photo Key

#### Vegetation Types

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="a.png" alt="Image" /></td>
<td>a. Tundra showing drainage pattern.</td>
</tr>
<tr>
<td><img src="b.png" alt="Image" /></td>
<td>b. Deciduous or &quot;leafy&quot; vegetation (red).</td>
</tr>
<tr>
<td><img src="c.png" alt="Image" /></td>
<td>c. Spruce forest (black) with some deciduous (red) trees.</td>
</tr>
<tr>
<td><img src="d.png" alt="Image" /></td>
<td>d. Mixed spruce (dark) and deciduous (red) forest on hillside with tundra (light) in valley bottom.</td>
</tr>
</tbody>
</table>

#### Water

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="e.png" alt="Image" /></td>
<td>e. Clear river meandering through lowlands. Curved patterns near the river bends show former river channels.</td>
</tr>
<tr>
<td><img src="f.png" alt="Image" /></td>
<td>f. Silty river flowing through deciduous forest.</td>
</tr>
<tr>
<td><img src="g.png" alt="Image" /></td>
<td>g. Small clear river (dark) flowing into big silty river with sloughs (light blue).</td>
</tr>
<tr>
<td><img src="h.png" alt="Image" /></td>
<td>h. Big clear lake in flats.</td>
</tr>
</tbody>
</table>
Remote Sensing/Geology Lesson 1
Air Photo Interpretation

Villages and Trails

k. Village and airstrip (white-gray). Trail from airstrip is a light pink line.

l. Straight trail running diagonally through varied landscapes. Another trail intersects with the straight trail in spruce forest.

Clouds

p. White clouds casting black shadows on tundra.

Rocks and Gravel

n. Narrow white gravel beach and spit on coast. The sediment plume in the water makes it look lighter in some places.

m. Bare rounded mountains (blue) surrounded by tundra and lakes. Snow (white) in near ridge top occurs in linear patches or dots.

Wetland

j. Marshy tundra with many small ponds.

i. Lakes and tundra. Old lakes (yellow arrow) have grown in and look brownish and round.
RSG Lesson 2
SEEING IN STEREO AND ROUTE FINDING

Lesson Summary: At stations set up around the room, students view and interpret stereo pair air photos in three dimensions (3-D), compare them with topographic maps of the same area and determine which route is “best.” Students also discuss the advantages and disadvantages of each image with regard to finding your way.

Objectives: Students will be able to interpret basic landscape features using topographic maps and stereo pair air photos and will select optimum travel routes based on this interpretation.

Estimated Time: 1 hour

Correlation to Alaska Standards:
Cultural E-2 Understand the ecology and geography of the bioregion they inhabit.

Geography A Make and use maps, globes and graphs to gather, analyze, and report spatial (geographic) information.

BACKGROUND FOR THE TEACHER
One of the great things about some aerial photographs is that the photos can be taken as “pairs” so that the areas shown in each photo overlap with areas in adjacent photos. With the use of stereoscopes and with training and practice, we can see the area of overlap in three dimensions—where valleys appear low and mountains appear to stick up off the surface of the photo (like seeing a 3-D movie). This 3-D effect works by getting your left eye to see only the left photo and your right eye to see only the right photo. Your brain then puts the two images together and you get 3-D. When you first try to see in stereo, it can sometimes be difficult to let your eye muscles relax and view images in 3-D. If you are patient though, you should be able to see in stereo after a few tries.

Viewing stereo pairs in this way is a critical skill for geologists because it allows them to look at the landscape and interpret what might be there, even before they visit that place for fieldwork and mapping projects.

MATERIALS
• Copies of Air Photo Pairs (Six air photo pairs)
• Copies of Route Finding Maps (Six different topographic maps that match the air photo pairs and show possible routes)
• Six stereoscopes
INSTRUCTIONAL PROCEDURES:

Getting Ready
Before class, follow the directions below to set up the stereoscope stations around the classroom by positioning the stereo pairs in 3-D view and taping the photos to the desk so they don’t move out of 3-D.

Tips for setting up stereo viewing
• Work in good light (near a window or lamp).
• Keep mirrors clean; don’t touch them with your fingers.
• Aerial photos are labeled right and left (if you switch them around, you will see negative relief).

To get a stereo view
1. Place aerial photos under stereoscope wide apart as shown in Figure 1.

Figure 1 – Stereoscope Set-up

2. Find an obvious feature that is visible and distinct in both air photos (lots of contrast in terms of color, brightness or shape). Lakes, gravel pits, bends in roads or rivers, mountains and islands can work well.
3. Place your left index finger on the contrasting point in the left image and your right index finger on the same point in the right image as shown in Figure 2.
4. Look through the stereoscope and raise your index fingers up and down one at a time so that you can see where you view your left and right fingers.

5. If your fingers appear to overlap as in Figure 3, the image should “pop” into 3-D. If it hasn’t, focus on the contrasting point that you picked. Do you see one or two of the points? If you see two, try to move the images together slightly.

6. If you bring the photos too close together your fingers will appear to be crossed like those in Figure 4.
7. If your fingers appear to be crossed, slide the images apart until your index fingers appear to overlap as shown in Figure 3.

8. If your fingers appear to be spread apart, slide the images together until your index fingers appear to overlap. (If this doesn’t work, try again. It takes practice.)

**Gear-Up**
- Ask students if any of them have ever seen a 3-D movie and if so, ask them to describe what it was like. Explain that today's lesson will allow them to see air photos in 3-D. In other words, not only will students be able to get some ideas about the landscape from the air photo clues they learned in Air Photo Lesson 1, but they will be able to see the topography of the area in 3-D.
- Direct student attention to the large CIR (overhead or wall photo) and ask for a volunteer to use an erasable marker to draw the “best” route from point A to point B. Discuss the kind of terrain crossed and whether everyone agrees that this is the “best” route. Discuss that “best” might mean different things to different people.
- Explain that the student’s job now is to rotate to each of the stations set up around the classroom where they are to view and interpret the stereo pair, compare it with the topographic map, and decide which of the marked routes would be “best” for travel using their worksheet as a guide.
- Emphasize precautions with regard to use of the stereoscopes.

**Explore**
Provide students with the Student Exercise sheet. Encourage them to make focused observations and to note their questions.
Generalize
• After students have visited each station, re-group the class to discuss the photos and maps. Show overhead transparency or Power Point slide of each photo/map, asking students first for their observations and inferences about the terrain and then asking them to discuss which route is best and why. Encourage students to add notes to their worksheets.
• Lead a discussion of the advantages and disadvantages of air photos and topographic maps by asking questions such as “If you were a martin trapper, which type of map would you want to look at before planning your trail and why?”

Apply/Assess
Provide each student or student pair with a copy of an air photo and a topographic map (or use stereo pairs if you have them). Ask students: “If you were going to create a snow machine trail from point A to point B, how might you use each of these images to help you decide the best route? Look carefully at each image, draw the route you might take and write a letter to your family describing the trail. Use lots of details and describe the plants, animals and other things you might see.

TEACHER RESOURCES
National Aeronautic and Space Administration. IMAGERS. “Lesson 5, Interpreting Satellite Imagery.” Available online at http://science.hq.nasa.gov/kids/imagers/teachersite/RS5.htm (An interactive web site and teacher guide for grades 5–8 that can introduce students to remote sensing.)


RSG Lesson 2
SEEING IN STEREO AND ROUTE FINDING
STUDENT EXERCISE

1. Look at the air photos through the stereoscope to see the image in three dimensions.

**DO NOT TOUCH THE MIRRORS OR MOVE THE PHOTOS** from their taped positions.

If you have trouble seeing the air photos in 3-D ask for help.

Make sure that everyone in the group takes a turn looking at the image in 3-D.

2. Look carefully at the landscape and at the routes drawn on the photos. Which route seems like the best way to travel (Route A or Route B)? Why do you think so?

3. Record your choice and reasons in the table below.

<table>
<thead>
<tr>
<th>Station Letter</th>
<th>Which Route is Best?</th>
<th>Why do you think so?</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RSG Lesson 3
EVALUATING EROSION
TEACHER INFORMATION

Lesson Summary
Students use their air photo interpretation skills and prior knowledge of river systems to interpret erosion and deposition features in several CIR air photos.

Objectives
Students will develop a better understanding of how running water changes the shape of the landscape.

Estimated Time
20 minutes

Correlation to Alaska Standards:
Cultural E-2 Understand the ecology and geography of the bioregion they inhabit.
Geography A Make and use maps, globes and graphs to gather, analyze and report spatial (geographic) information.
Science D-2 Develop an understanding of the origins, ongoing processes, and forces that shape the structure, composition, and physical history of the Earth.

BACKGROUND FOR THE TEACHER
As you know from RSG Lesson 1, air photos reveal patterns and features of the Earth that can’t be seen in any other way. They not only portray river channels, shorelines and islands, but through differences in color, tone, texture and size, air photos also reveal features such as gravel bars, vegetated islands and cutbanks and thus provide a window into erosion and deposition processes in river systems. Some of these features were represented in the Air Photo Key from RSG Lesson 1, but here we take a closer look at river processes as seen in air photos. The Major River Types handout provides background information for both you and your students, and an answer key is provided for you at the end of this lesson. This lesson is intended to supplement classroom study of erosion and deposition in river systems and work with stream tables, but can also be used to enhance student air photo interpretation skills.

MATERIALS
• Copy of Student Exercise and Major River Types handout for each student
• Air Photo Key from RSG Lesson 1 for each student

INSTRUCTIONAL PROCEDURES
• Review and discuss prior river and air photo studies
• Provide students with copies of Student Exercise and Major River Types handout.
Remote Sensing/Geology Lesson 3
Evaluating Erosion

- Have students work through exercise.
- Share and discuss student interpretation.

TEACHER RESOURCES


See RSG Lesson 1 for air photo interpretation resources.

STUDENT EXERCISE ANSWER KEY
1. The Kobuk River is a meandering river.
2. The white material on the inside bend is gravel and indicates that point A is a point bar.
3. Erosion would occur at point B.
4. The multiple stream channels indicate that the Tanana River is a braided river.
5. Point A is a cutbank, indicating that erosion was taking place.
6. The white and gray material on the inside bend is a gravel point bar and indicates that point B is an area of deposition.
7. Yes, the airport is located on the eroding, outside bend of the river.
8. The Yukon is a split channel river.
9. The banks of split channel rivers are typically very stable, and bars and islands (which are really a special kind of bar that happen to be in the middle of the river) are more erodible. Therefore we would expect erosion to occur at point A.
10. Islands are typically more rounded on the upstream side and elongated on the downstream side, indicating this river is flowing from right to left.
RSG Lesson 3  
EVALUATING EROSION 
STUDENT EXERCISE  

Using your air photo interpretation skills and what you’ve observed and learned about river and beach erosion, answer the questions about the images that follow.

The Kobuk River runs through this image. To determine what type of river it is, use your “Major River Type” handout.

1. The Kobuk River is a _______________________ river.

2. Use your “Major River Type” handout to find a term that can be used to describe the feature at point A. What is it?

__________________________________________________________________________________________
3. Where would you expect erosion to occur, at point A or point B? __________

![Figure 2 - The Tanana and Nenana Rivers near Nenana](image)

The Nenana River joins the Tanana River at the village of Nenana. To determine what type of river the Tanana River is, use your “Major River Type” handout.

4. The Tanana River is a _______________________ river.

5. Do you think erosion or deposition was taking place at point A when this aerial photograph was taken in 1986? __________________

6. Where would you expect deposition to occur, at point A or point B?________

7. Find the Nenana Airport in Figure 2. Do you think that erosion is a problem for the Nenana Airport? __________________
Figure 3 – The Yukon River

The Yukon River runs through the middle of the image above. To determine what type of river it is, use your “Major River Type” handout.

8. The Yukon River is a ______________________ river.

9. Where would you expect erosion to occur, at point A or point B? __________

10. Which direction do you think the river is flowing across the image: from right to left or from left to right? (Hint: look for clues on the “Major River Type” handout.)

________________________________________
Remote Sensing/Geology Lesson 3
Evaluating Erosion

- **Meandering River**
  - Flow is contained in a single channel.
  - There is a pool or deep water on the outside bend where the greatest erosion occurs at outside bends and result in cutbanks.

- **Split Channel River**
  - A split channel river has multiple branching channels, separated by many gravel bars and islands.

- **Braided River**
  - A braided river has multiple branching channels, separated by many gravel bars and islands.

- **Vegetation Islands**
  - Vegetated Islands

- **Relatively Stable banks**
  - Gravel bars along the sides or in the middle of the river are more stable than the banks resulting in bank, shifting, or channel shifting in a channel that does not shift or move its banks.

- **Active Channel**
  - The active channel carries most of the flow during floods.

- **Flood Channels**
  - Flood channels only carry water during floods.

- **Point Bars**
  - A point bar at each inside bend where new material is deposited.

- **Cutbank**
  - A cutbank at each outside bend where material is removed.

- **Pool**
  - A pool at each outside bend where the material is deposited.
Lesson Summary: Students study a chronological series of images and maps of Fairbanks or Nenana, looking for evidence of changes over time.

Objectives: Students will understand that maps and images capture and reflect the changing nature of the landscape.

Estimated Time: 30 minutes to 1 hour

Correlation to Alaska Standards:
Cultural E-2 Understand the ecology and geography of the bioregion they inhabit.
Geography A Make and use maps, globes and graphs to gather, analyze, and report spatial (geographic) information.
Science A-1 Develop an understanding of the processes of science.

BACKGROUND FOR THE TEACHER
Maps and images represent the landscape at a particular point in time. Comparison of different map or image vintages can yield visual clues and valuable insights into how a place has changed over time. Depending upon the data available, changes in infrastructure, land cover or watershed characteristics are just a few of the observations one might be able to infer from image comparisons. For example, in handout RSG4A Fairbanks Time Series 1, which includes four sets of data and ranges from a 1949 air photo to a 2003 SPOT 5 satellite image, one can easily see such things as: massive housing and road development in the Chena Ridge area; the creation and expansion of the Fairbanks International Airport; the disappearance of Marconi Slough; the cutting off of Deadman's Slough by airport construction; and the on-going erosion and build-up of sandbars and banks in the Tanana River.

There are various ways that one might want to use such a time series, but two ideas are presented below.

MATERIALS
Option 1
- One set of RSG4B images per student pair
- One Student Exercise for each student
- Overhead or slide of each image for class discussion
Option 2
- One color print of RSG4C time series per student
- One to two sheets of mylar per student
- Colored pencils
- Paper clips
- Overhead of each image for class discussion

INSTRUCTIONAL PROCEDURES
Getting Ready
- There are four different data choices for this exercise:
  - RSG4A: Fairbanks Time Series 1. Four maps/images including the dates the maps/images were created.
  - RSG4C: Fairbanks Time Series 2. Includes just 2 of the 4 maps/images included above, but these are enlarged for easy tracing.
  - RSG4D: Nenana River Series.
- Any of these data sets will work for this activity but it is written with the Fairbanks data sets in mind.
- Make color copies of the time series you will be using.
  - Option 1: For each student pair, make one color copy of the RSG4B and cut images apart. Compile image sets of all four images for each student pair.
  - Option 2: Make a color copy for each student of RSG4C

Explore
Option 1
1. Ask students how they think Fairbanks and its surrounding area might have changed since about the end of World War II until the present. Record their predictions on the board. Hand out a set of RSG4B – Undated Fairbanks Time Series 1 images to each student pair.
2. Explain that the student’s task is to carefully observe, compare and analyze the images and to order them in a time sequence from the earliest map/image to the most recent.
3. Students should record the order and observations on their student guide, justifying their inferences as directed.

Answer Key for RSG4B

<table>
<thead>
<tr>
<th>Earliest Map/Image</th>
<th>Most Recent Map/Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black and White Air Photo (1949)</td>
<td>CIR Air Photo (1978)</td>
</tr>
</tbody>
</table>
4. When students finish, ask them to share/explain the order they chose. Have them use the overhead to point out observations.

5. Prompt students to think about observations they might have missed. Prompt further by asking such questions as:
   - Why do you suppose there was so much more development on the north side of the Tanana River? What can you see in the images that might explain this?
   - Why do you suppose Marconi Slough disappeared?
   - How stable do you think Byers Island is and why do you think so?

Option 2

1. Ask students how they think Fairbanks and its surrounding area might have changed from about the end of World War II until the present. Record their predictions on the board.

2. Hand out color copies of RSG4C - Fairbanks Time Series 2, mylar, paper clips and colored pencils to each student.

3. Explain that the student’s job will be to carefully observe the photos, noticing things that have changed as time progresses. They should pick one particular theme to focus on (for example roads, housing developments, water bodies or one river in particular).

4. Explain that students will now use mylar to trace the feature they have chosen. Model the student activity using the overhead projector to demonstrate the steps:
   - Secure mylar to the topographic map with paper clips.
   - Identify a very prominent feature that is in both images and “register” the image by tracing that feature clearly. (This registering process will serve as a reference that students will use to align their second image.)
   - Instruct students to use just one color to thoroughly trace chosen feature on the topographic map.
   - Once students have finished with the topographic map, have them remove the mylar, align the “registered” feature on the mylar layer with the same feature on the Spot 5 satellite image, and secure the mylar with paper clips.
   - Have students choose a different color for the second image and trace feature.

5. When students finish, give them some time to analyze and record how their feature has changed over time.

6. Have students use the overhead projector to share observations.
7. Prompt students to think about observations they might have missed. Prompt further by asking such questions as:
   - Why do you suppose there was so much more development on the north side of the Tanana River? What can you see in the images that might explain this?
   - Why do you suppose Marconi Slough disappeared?
   - How stable do you think Byers Island is and why do you think so?
RSG Lesson 4
CHANGE OVER TIME
STUDENT EXERCISE

1. Carefully examine the four images of Fairbanks. Arrange them in order from
the earliest image to the most recent image, and write the photo names in
order in the boxes below.

<table>
<thead>
<tr>
<th>Earliest Map/Image</th>
<th>Most Recent Map/Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>C</td>
<td>D</td>
</tr>
</tbody>
</table>

2. Compare A and B. Why do you think B is a more recent map/image than A?
Write down at least three observed differences supporting your placement.

________________________________________________________________________
________________________________________________________________________

3. Compare B and C. Why do you think C is a more recent map/image than B?
Write down at least three observed differences supporting your placement.

________________________________________________________________________
________________________________________________________________________

4. Compare C and D. Why do you think D is a more recent map/image than C?
Write down at least three observed differences supporting your placement.

________________________________________________________________________
________________________________________________________________________
RSG4A: Fairbanks Time Series 1

Air Photo 1949

Air Photo 1978

USGS Topographic Map 1954
Revised 1972, 1973, 1994

SPOT5 Satellite Image 2003
Fifty-three Years of Landscape Change in the Nenana Area, Alaska

This series of images shows how the landscape around Nenana has changed since 1950. Dramatic changes have taken place in the course of Tanana River just upstream of Nenana next to the air strip, and about 4 miles downstream of Nenana. The course of Nenana River has also undergone major changes about 2-1/2 miles above its confluence with Tanana River. Expanding infrastructure and other human impacts are also readily observed in this sequence of images.

REMOTE SENSING/GEOLGY LESSON 4

Fifty-three Years of Landscape Change in the Nenana Area, Alaska

This series of images shows how the landscape around Nenana has changed since 1950. Dramatic changes have taken place in the course of Tanana River just upstream of Nenana next to the air strip, and about 4 miles downstream of Nenana. The course of Nenana River has also undergone major changes about 2-1/2 miles above its confluence with Tanana River. Expanding infrastructure and other human impacts are also readily observed in this sequence of images.

Compiled 6/6/19 by Alaska Division of Geological & Geophysical Surveys - MapTEACH Project
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