bright Girls

Broadening Research Interest in Geoscience, Habitat, and Technology (BRIGHT)

Investigation 4: INTERPRETING SATELLITE IMAGERY

Grades 9-12

Time requirement: 2 hours

Next Generation Science Standards (NGSS)

Science and Engineering Practices
Scientific Investigations Use a Variety of Methods • New technologies advance scientific knowledge. • Scientific investigations use a variety of methods, tools, and techniques to revise and produce new knowledge.
Disciplinary Core Ideas
Influence of Engineering, Technology, and Science on Society and the Natural World • Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications.
Crosscutting Concepts
Scale, Proportion, and Quantity • Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly. **Patterns** • Empirical evidence is needed to identify patterns.

OVERVIEW

Students use Google Earth to interpret satellite imagery of an area of interest, ideally prior to field exploration.

LEARNING OBJECTIVES

Students will be able to:

- interpret satellite images.
- identify features for further field research.

INSTRUCTIONAL APPROACH

Engage students by asking them to share their own prior knowledge of satellite imagery and experience with the field area of interest. Connect to students' lives by looking up images of familiar locations.

SCIENCE BACKGROUND

Google Earth Pro

Google Earth Pro is a free program that offers satellite imagery of our planet (as opposed to Google Mars, Google Moon, and Google Sky). The instructor should practice navigating Google Earth and using its tools prior to the investigation.

- Get started with Google Earth Pro: https://support.google.com/earth/answer/148186?hl=en&visit_id=636989036087113424-849851300&rd=1
- Google Earth Help: https://support.google.com/earth#topic=7364880
- Google Earth Tutorial: https://www.dickinson.edu/download/downloads/id/2833/google_earth

Interpreting satellite imagery
(https://earthobservatory.nasa.gov/features/ColorImage)

Scientists at NASA's Earth Observatory recommend the following tips for interpreting satellite imagery, with which students will gain experience over the course of this investigation.

- Look for a scale
- Look for patterns, shapes, and textures
- Define colors
- Find north
- Consider prior knowledge

Look for a scale

Google Earth Pro's image scale varies due to the dynamic zoom feature. In addition to looking for clues to scale in their particular view, students can turn a Scale Legend on and off (in the View menu).

Look for patterns, shapes, and textures

Identify key features in a satellite image by matching patterns, shapes, and textures to those of maps (e.g., bodies of water like rivers, lakes, and oceans). In contrast to the randomness characteristic of natural features, human land use results in identifiable patterns, like geometric shapes (circles, rectangles, squares) from farming and logging, or straight lines (e.g., roads, canals, and land use boundaries). Geological features like faults can also show up as straight lines in satellite images, while volcanoes and craters can be circular and mountain ranges may look like wrinkles.

Define colors

Satellite instruments measure different kinds of light, which affects the colors of satellite imagery. True-color images use red, green, and blue wavelengths of visible light; their colors are similar to what one would expect to see from space (see table below). False-color images use infrared light, resulting in unexpected colors like red vegetation. Google Earth uses true-color imagery.

Feature type	Common colors	Example reasons for variation
Water	Black, blue, brown, green, gray	Depth, suspended sediment, light reflection
Ice, snow	White, gray, blue	Debris cover
Plants	Varying shades of green, red, orange, yellow, brown	Vegetation type, season
Bare ground	Brown, tan, red, white, gray, black	Mineral content of soil, fires
Cities	Silver, gray, brown, red	Building materials
Atmosphere	White, gray, brown, black, tan	Source: clouds, fog, smoke, haze, dust, ash

Find north

If students know which way is north, they can determine the orientation of other features like mountain ranges, which they can then match to a map. Google Earth Pro's default orientation is north up. The compass feature adjusts as students change their view, so they can always tell which way is north.

Consider prior knowledge

What do students already know about an area, that they can connect to what satellite imagery shows?

MATERIALS

- Computers with Google Earth Pro (free), 1 per pair of students
- Projector
- Easel paper pad
- Markers, at least 1 per pair of students
- Rite in the Rain 4x6" notebooks, 1 per student

ACTIVITY

Setup

1. Install Google Earth Pro (free) on all computers.

2. Choose a nearby field area, e.g., a habitat for a species of interest. Ideally, Google Earth exploration will precede a field trip.

3. Navigate to the area of interest in Google Earth. Consider how you will ask students to find it (e.g., will they search by place name or latitude and longitude?). Note features that students may wish to investigate further in the field.

4. Project Google Earth and/or student instructions, if desired.

Investigation

2 hours

Orientation

30 minutes

1. Have students work in pairs to open Google Earth. Encourage them to find familiar and/or favorite places, e.g., lakes, mountains, parks, rivers, schools, and trails.

2. While students are working with their partners to find the locations they have chosen, review and demonstrate, or ask a student volunteer to demonstrate, navigation in Google Earth:
    - zooming in and out
    - switching from map view to street view and back
    - adjusting vertical exaggeration
    - changing imagery date
    - using ruler tool
    - making placemarks
    - turning photos layer on and off
        - photos may be helpful for identifying features or viewing them from additional perspectives
        - discuss possible issues with user-submitted photos, e.g., locations may be inaccurate.

3. Ask pairs of students to share with other pairs:

    - *Where did you go? Why?*
    - *How much did you zoom in?*
    - *What level of detail were you able to detect?*
    - *How can you get a sense of scale in a particular view?*

4. Start a list of helpful tips for interpreting satellite imagery, posted in a prominent spot. Ask a volunteer to add "look for a scale" to the list.

Interpreting satellite imagery

1.5 hours

1. Have students navigate to the area of interest. Once there, encourage them to look for a scale. Let students decide where they will record their satellite image interpretations (their responses to the subsequent discussion questions): in their notebooks? In Google Earth screenshots (if so, how will they save and share them)? In a shared document?

2. Ask students:

    - *What else can we look for in a satellite image, besides a scale, to help us interpret it?*

    Accept student responses as value-neutral. Ask a volunteer to add students' ideas and "look for patterns, shapes, and textures" to the list. Ask students what patterns, shapes, and textures they notice in the satellite images of the area of interest. Remind them to separate observations (e.g., a blue linear feature) from interpretations (e.g., a river).

3. Ask a volunteer to add "Define colors" to the list. Ask students:

    - *Is this satellite image true- or false-color? How can you tell?*
    - *What colors do you notice, and to what types of land cover do you think they correspond?*

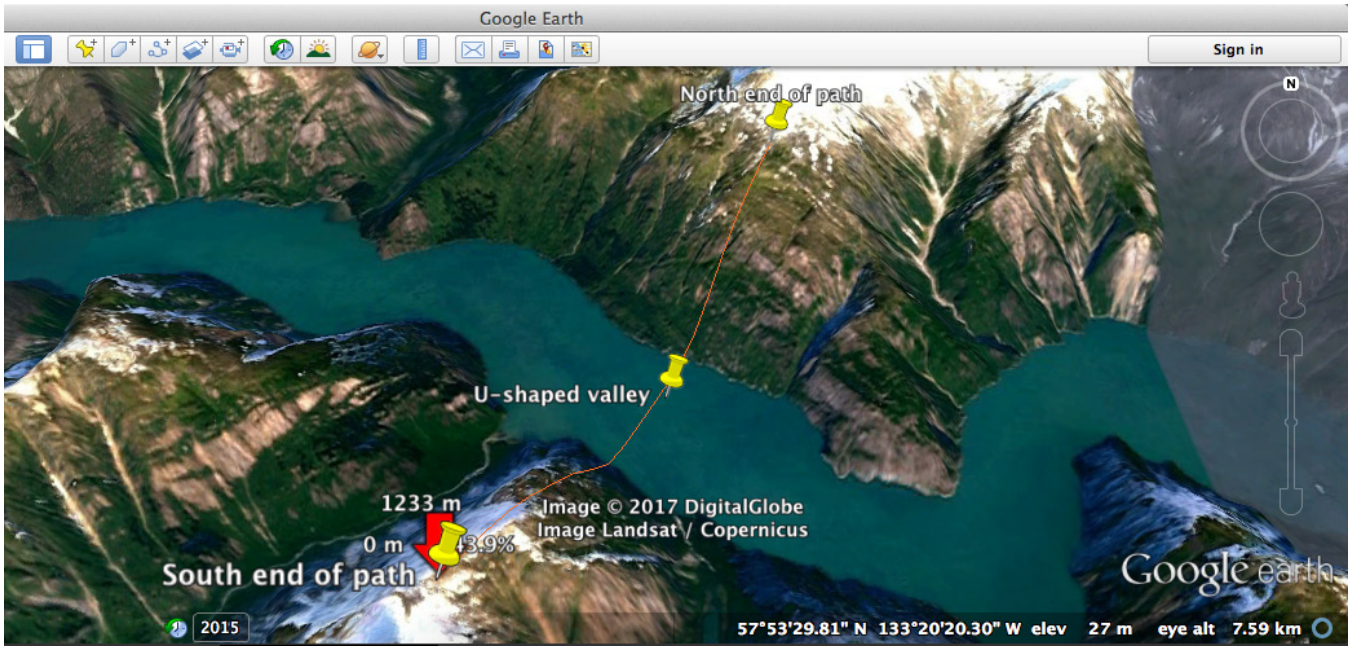
4. Ask a volunteer to add "Find north" to the list.

    - *How can you tell which way is north in Google Earth?*

5. Ask a volunteer to add "Consider prior knowledge" to the list.

    - *What do you already know about this area? How does that relate to what you see in Google Earth?*
    - *For what years does Google Earth have satellite imagery of this area? How does it change over time?*

6. Have students create and post a table of observations and interpretations next to the imagery interpretation tips list. Ask each group to add their observations about the field area and the interpretations they made from those observations (see example satellite image and table entries below).



Observations	Interpretations
curving teal band	Tidewater (fjord)
Green areas	Temperate rainforest
White lines	Freshwater (streams and waterfalls)
White patches	Snow, glacier ice
Grey and brown areas	Bare ground, rock

Extension

30 minutes

1. Based on their interpretations, ask students to create maps with placemarks for locations where they would like to make measurements, collect samples, and take pictures in the field.

2. Help students save and export their maps. For example, they could take screenshots of Google Earth and save them in Google Drive. Alternatively, they could save their placemarks as a shareable KML (Keyhole Markup Language) file, which they could then save in Google Drive or email to themselves. In this way, they can reopen their placemarks in Google Earth on a different computer for later revision. For assistance with creating KML files, refer to https://helpwiki.evergreen.edu/wiki/index.php/Creating_KML_Files.

Placemarks of sampling locations in Tracy Arm, Juneau, Alaska. Google Earth screenshot by Alayna, Kalila, and Meredith

OTHER RESOURCES

What is KML?
http://desktop.arcgis.com/en/arcmap/10.3/manage-data/kml/what-is-kml-.htm

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