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

Investigation 7: LANDSCAPE CHANGE DETECTION

Grades 9-12

Time requirement: 45 minutes

Next Generation Science Standards (NGSS)

Science and Engineering Practices
Analyzing and Interpreting Data • Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

Disciplinary Core Ideas

Earth and Space Science
• ESS2: Earth's Systems
  ○ ESS2.A: Earth Materials and Systems
    ▪ Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes.

Crosscutting Concepts
Patterns • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. **Stability and Change** • Much of science deals with constructing explanations of how things change and how they remain stable.

OVERVIEW

Students use aerial photography and satellite imagery to detect landscape change over time in Google Earth.

LEARNING OBJECTIVES

Students will be able to:

- investigate spatial and temporal variation in landscape characteristics.
- discuss the impact of human activities on landscapes.

INSTRUCTIONAL APPROACH

This investigation complements and extends the previous satellite imagery investigation. Guiding questions include:

- What are natural and anthropogenic environmental changes and why should we care? How do we detect them?
- Over what time scales does landscape change occur? How do we know? For which time scales do we have data?

SCIENCE BACKGROUND

Satellites and aircraft capture remote sensing images of the Earth's surface. Scientists use these film or digital images for mapping and geospatial analysis. (https://archive.usgs.gov/archive/sites/www.usgs.gov/pubprod/aerial.html)

The U.S. Geological Survey (USGS) topographic map series is based on aerial photographs taken from 1937 through 1980. (https://www.usgs.gov/centers/eros/science/usgs-eros-archive-aerial-photography-aerial-photo-mosaics?qt-science_center_objects=0#qt-science_center_objects)

MATERIALS

- Computers with Google Earth Pro (free), 1 per pair

- Aerial imagery

- Projector

ACTIVITY

Setup

1. Use https://earthexplorer.usgs.gov/ (in the U.S.) to obtain aerial photography, as old as possible (e.g., black and white, ca. 1950s), of your area of interest. Ideally, Google Earth exploration will precede or follow a field trip. Consider if you will add this aerial imagery to Google Earth for students prior to the investigation, or save it, e.g., on Google Drive, and have them open it in Google Earth.

2. Ensure all computers are charged and have Google Earth Pro (free).

3. Post the list of helpful tips for interpreting satellite imagery and table of observations and interpretations from investigation 4.

Investigation
45 minutes

1. Revisit the list and table from investigation 4 (interpreting satellite imagery). Discuss:

    - *For what years does Google Earth have satellite imagery of our area of interest?*

    - *What changes did you notice from older to newer satellite images?*

2. Let students know that most satellite imagery is from the 1970s or later, while aerial photography may be from as long ago as 1937. Have students work in pairs to open Google Earth, add the aerial photography layer, and navigate to the area of interest.

3. Ask a student volunteer to demonstrate or describe how to change the satellite imagery date and turn the aerial photography layer on and off. Encourage students to follow along with their partners, and circulate to assist them.

4. Have students compare the historical aerial photography to current satellite imagery. Discuss:

- *How has the landscape changed over time? How do you know?*

- *Why do you think this change occurred?*

- *What different types of impacts do you notice?*

5. Encourage students to use placemarks, lines, and polygons (or other tools, as appropriate) to document landscape changes in their area of interest. Students create a map (by taking a screenshot of Google Earth), e.g., of a river channel or glacier's terminus through time.
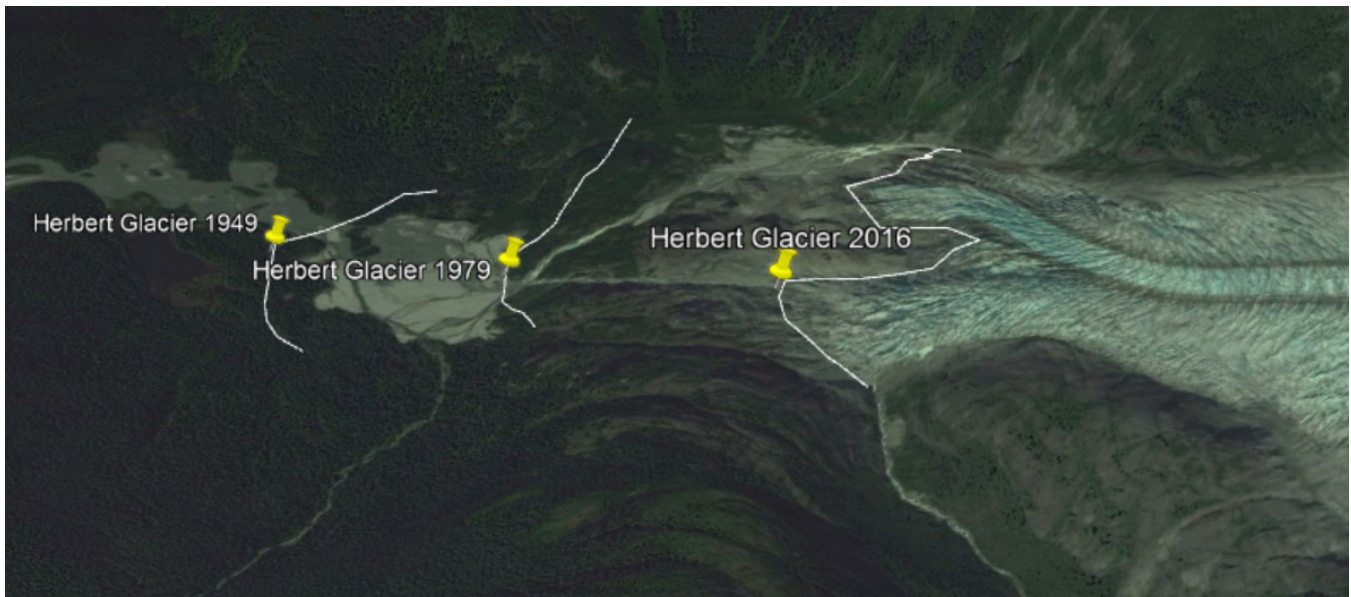
Student change detection map of the terminus of Herbert Glacier, Juneau, Alaska.

Student change detection map of the Tanana River, Fairbanks, Alaska.

Extension

An alternative to change detection in Google Earth would be using printed satellite images and aerial photographs. Each student gets a set and a sheet of transparent film, on which they document change with an ultra fine tip permanent marker. Each student identifies changes individually, then compares them with those others noticed.

Another extension is exploring Google Earth Timelapse:
https://earthengine.google.com/timelapse/

OTHER RESOURCES

USGS Earth Explorer help:
https://lta.cr.usgs.gov/EEHelp/ee_help

USGS aerial photography:
https://www.usgs.gov/centers/eros/science/usgs-eros-archive-aerial-photography-aerial-photo-mosaics?qt-science_center_objects=0#qt-science_center_objects

How to interpret a satellite image:
https://earthobservatory.nasa.gov/features/ColorImage

Introduction to satellite imagery:
https://www.pgc.umn.edu/guides/commercial-imagery/intro-satellite-imagery/