# Understanding Earth's Surface Through Map Reading

NVMA Nevada Mining Association EST. 1913

Level: High School
Facilitator Guide

## LESSON DETAILS

**Objective:** Students will analyze maps and construct models to deepen their understanding of resource distribution and human settlement.

## Standards

### NVACSS and NGSS

- **HS-ESS2-1:** Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
- **HS-ESS3-1:** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- **DCI:** Earth Materials and Systems; Plate Tectonics and Large-Scale Systems Interactions; Natural Resources; Human Impacts on Earth Systems
- **SEP:** Developing and Using Models; Analyzing and Interpreting Data; Engaging in Argument from Evidence
- **CCC:** Patterns; Scale, Proportion and Quantity; Stability and Change; Cause and Effect

### Career Readiness

- **1.2.6:** Demonstrate lifelong learning skills by continually acquiring new industry-related information and improving professional skills.

## Materials

- colored pencils, markers, pens
- rulers
- printed copies of maps (population density, geologic, topographic, etc.) or access to a device to look at maps online (e.g., computer, tablet)
- plain paper
- trays*
- shaving cream or whipped cream*
- playing cards or graham crackers*
- clear containers*
- sand*
- gravel*
- clay*
- water*
- food dye*
- organic material (e.g., leaves)*
- stream table (or tray)*

* These materials go along with the models described in **Explain**. Feel free to deviate and modify these materials.

## Lesson Summary

Students begin by viewing various land-use images and consider distribution of human settlement. They then investigate geologic, topographic, and resource distribution maps alongside a population density map to explore how Earth's processes influence where people live. Next, students construct physical or digital models to simulate key geologic processes responsible for resource formation. Using the case study of the Carlin Trend, Students will analyze how geology influences resource distribution and human settlement. Finally, students create an infographic linking geologic processes to resource availability and predict how Nevada's landscape may evolve due to natural processes and human activities.

## Preparation

- In **Explain**, groups will create models of a geologic process. It would be best to create a bin for each group that includes materials that might be of interest to use in addition to other materials for students to consider.

- In **Elaborate**, students will conduct a case study about Carlin Min near Elko, NV. If you want to use a different case study, prepare materials relevant to the location you choose.

## Engage

1. Share images of various land uses in Nevada, such as **this collection,** which shows areas of dense population, mining operations, agricultural lands, and natural reserves.

2. Ask students to identify patterns they notice and discuss:

    - *Why do people live in some areas but not others?*

    - *Why are certain locations better for farming while others are known for mining?*

    - *What role might geology play in these patterns?*

3. Introduce the concept that Earth's geologic processes shape where natural resources are found, which in turn influences human activity.

    - *Why do you think the location of minerals would have an influence on where people live?*

    - *Do you know any examples of times when the discovery of a mineral caused people to move?*

## Explore

1. Divide students into groups and have each group explore one type of map (e.g., geologic, topographic, thematic map related to resource distribution such as soil or minerals, geographic) for a location (e.g., Elko, Las Vegas).

    a. **Nevada Geology**

    b. **Nevada Mineral Explorer**

    c. **Nevada Geology: Faults**

    d. **Nevada Soils**

    e. **Nevada Topographic Map Index**

2. Ask all groups to examine a population density choropleth map (**Nevada Population Density**) for the same location. (Choropleth maps show ranges of values for some parameter using colors.)

3. Have each group analyze their assigned map and record patterns or key observations between their map and the population density choropleth map.

4. Have students complete a Claim, Evidence, Reasoning, Rebuttal (CERR) exercise:

   a. Claim: Each group develops a claim about how geologic features and natural resources influence human activity.

   b. Evidence: Groups provide supporting evidence from their maps.

   c. Reasoning: Students explain their initial reasoning for why they think patterns exist, considering geologic processes. (This will be expanded upon in **Explain**, where students can then revise their reasoning.)

   d. Rebuttal: Ask students to consider counterarguments or factors that might challenge their claim (e.g., technological advancements, climate, infrastructure).

5. Facilitate a discussion about how the results students got from the mineral tests are related to the properties of these minerals.

## Explain

1. Begin by asking students to brainstorm how Earth's internal and surface processes contribute to the formation and distribution of natural resources. Key processes include:

   a. Igneous Processes: Formation of mineral deposits due to cooling magma (e.g., gold, copper, lithium) or water heated by geothermal sources.

   b. Sedimentary Processes: Accumulation of fossil fuels, groundwater, and sedimentary minerals (e.g., coal, oil, natural gas, limestone).

   c. Tectonic Activity: Creation of mountain ranges (thereby creating metamorphic rocks and veins that concentrate valuable minerals) and earthquakes

   d. Erosion & Deposition: Transportation and sorting of minerals and nutrients (e.g., placer gold, fertile floodplains, deltas).

2. Have students work in groups to develop a physical and/or use a digital model of at least one of the geologic processes discussed. Some example models include:

   a. **Plate tectonics and mineral deposits**

- Physical model: Use shaving cream and playing cards (alternatively you can use graham crackers and whipped cream) to simulate plate movement, subduction, and mountain formation.
- Digital model: **Visible Geology** or **Tectonic Explorer**

**b. Sedimentary basin**

- Physical model: Layer sand and clay in a clear container, then pour dyed water in gradually to simulate how groundwater and fossil fuels can accumulate in porous rock. Leaves could be included between layers to represent organic matter being compressed.
- Digital model: **EarthViewer**

**c. Erosion and deposition**

- Physical model: In a stream table or a tray, create a landscape with sand. Pour water over it and observe how the sediment erodes, is transported, and deposits in different areas.
- Digital model: **Managing an Agricultural System - High-Adventure Science Interactive**

3. Ask students to review and refine their claim, evidence, reasoning and rebuttal from **Explore**, making any necessary revisions based on new insights.

4. Discuss the models and maps as a class:

   ▸ *How does your model accurately portray the geologic process? What are the limitations of your model? How could your model be improved?*

   ▸ *What predictions can you make about resource locations in Nevada based on your model?*

   ▸ *How does resource distribution in Nevada relate to geologic history?*

   ▸ *How might different geologic processes operate over short vs. long timescales in Nevada?*

   ▸ *How does Nevada's topography, influenced by faulting and basin formation, impact where people live and where resources are extracted?*

## Elaborate

1. Examine how geology and resource distribution have shaped human activity by exploring the Carlin Trend, one of world's richest gold mining regions. The Carlin Trend, located in northeastern Nevada, has been a major center for gold production since large-scale mining began in the 1960s. Have students use the maps provided in Explain to examine the Carlin Trend and select one or more readings/videos from the resources below.

a. **Meet a Nevada Mineral: Gold - Nevada Mining Association**

b. **Carlin Gold Systems Explained**

c. **Nevada's Carlin Trend - Rock & Gem Magazine**

d. **Elko, Nevada Gold Mining History - YouTube**

e. **Mining In Nevada**

f. **The Native American Tribes of Nevada**

2. Facilitate a class discussion and exploration of the Carlin Trend.

   ▸ *Why is the Carlin Trend so rich in gold?*

   • Examine geologic maps to understand how ancient hot springs and hydrothermal activity helped form Nevada's gold deposits.

   • Discuss how faulting and mountain-building processes created the underground conditions that concentrate gold into mineable deposits.

   ▸ *How has gold mining influenced Nevada's economy and towns?*

   • Research mining boomtowns like Elko, Carlin, and Battle Mountain, comparing historical settlement patterns to modern mining operations.

   • Discuss how gold mining led to infrastructure development, including roads, railways, and housing, and how some towns declined after mining slowed.

   ▸ *What are the environmental and social impacts of gold mining?*

   • Examine modern open-pit mining techniques and discuss their environmental footprint, including land disturbance and water use.

   • Introduce mine reclamation efforts, where companies restore land after mining is complete—what does this look like in Nevada?

   • Discuss the impact of mining on Indigenous lands and communities, considering historical and present-day perspectives.

   ▸ *Comparing Past and Present: Mining Then vs. Now*

   • Compare traditional placer mining (e.g., panning for gold) with today's high-tech heap leaching and cyanide processing methods.

- How has mining safety and environmental regulation changed since Nevada's early gold rush days?

▸ *Who are the stakeholders in gold mining?*

- Consider different perspectives, including mining companies, local communities, Indigenous groups, environmental organizations, and global markets.
- Debate the benefits and challenges of gold mining for Nevada today.

3. You may also want to discuss:

- The historical presence of Indigenous communities in the area, which includes the **Newe Sogobia (Western Shoshone)**.
- The environmental impacts of gold mining, including water usage and resource sustainability.
- Other stakeholders who have an interest in gold mining, including those far away from NV

## Evaluate

1. Have students work with their group to create an infographic about their geologic process from **Explain** and how it leads to resource formation (e.g., gold, copper, rare earth elements, groundwater, fossil fuels). On the bottom half, have students include a map highlighting where this process occurs in Nevada.

2. Discuss the infographics as a class and have each group make predictions about how their process might shape Nevada's landscape in the future, for example in 100, 1,000, or 1 million years. Also, discuss how human activities might influence or be influenced by these changes.