Understanding Earth's Surface Through Map Reading

Level: Grades 3–5
Facilitator Guide

LESSON DETAILS

Objective: Students will analyze block models and local topographic maps to deepen their understanding of topography and its representation on topographic maps.

Standards

NVACSS and NGSS

- **4-ESS2-2:** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- **4-ESS1-1:** Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.
- **5-ESS3-1:** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- **DCI:** Earth Materials and Systems
- **SEP:** Analyzing and Interpreting Data; Developing and Using Models
- **CCC:** Patterns; Scale, Proportion, and Quantity; Stability and Change

Career Readiness

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

Materials

- building blocks like wooden blocks, duplos, or **paper foldable blocks**
- graph paper
- colored pencils
- topographic map of your area or state with visible contour lines (such as: **Nevada Contour Map**)
- optionally, an **Augmented Reality Sandbox**

Lesson Summary

Students begin engaging with topography by examining a shaded relief map of Nevada, identifying elevation changes and their representation. Next, they examine landscape block models and create maps to practically understand these elevation concepts. Students then turn to a topographic map of Nevada, focusing on contour lines and map features. Students can then interact with an augmented reality sandbox, if available, and/or learn to create cross-sections from block models. The lesson concludes with students constructing block models from a topographic map and discussing practical land uses aligned with their models.

Preparation

For **Explore**, stack the number of blocks indicated in each cell on the diagrams below. For example, if a cell has a 3 you would stack three blocks on top of each other.

1	1	3	3	3	2	2	1
1	1	3	3	3	2	2	1
1	1	3	3	3	2	2	1
1	1	3	3	2	2	2	1
1	1	2	2	2	2	2	1
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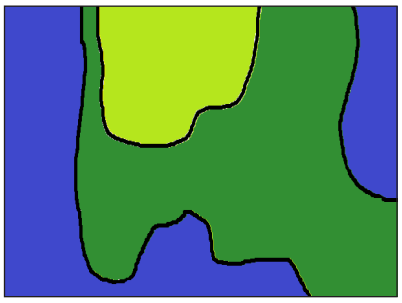
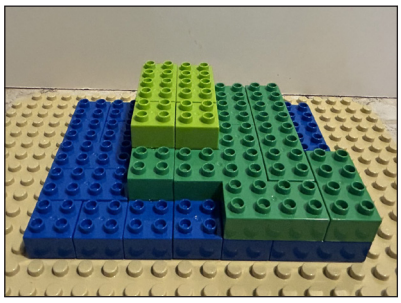
1	1	1	1	2	2	2	2
1	1	1	1	1	1	2	2





4	3	2	1	1	2	3	4
4	3	2	1	1	2	3	4
4	3	2	1	1	2	3	4
4	3	2	1	1	2	3	4
4	3	2	1	1	2	3	4
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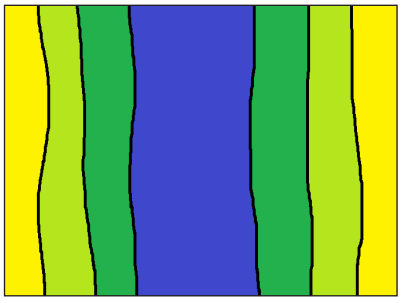

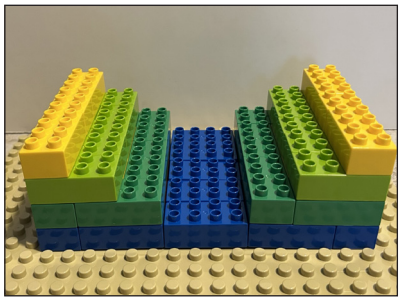

2	3	4	5	5	4	4	3
2	3	4	5	6	6	5	4
2	3	4	4	5	5	5	4
2	3	4	4	4	4	4	4
2	2	3	3	3	3	3	3
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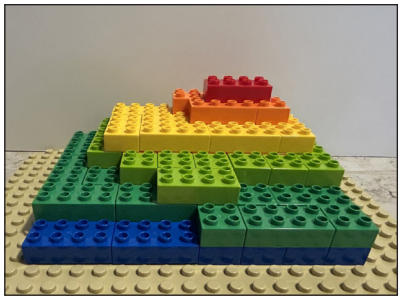
1	1	1	1	2	2	2	2



- For **Explore**, provide large-celled graph paper and colored pencils at each station.
- For **Elaborate**, build two block models with opposite topographic features—one representing a raised elevation (hill) and the other a depression (hole). The models should be identical in shape so that their contour lines appear the same on a map, except the depression model would include hash marks on its contour lines to indicate a lower elevation.

Engage

1. Ask students to share what they know about maps and what maps show.
2. Project a shaded relief map of Nevada (**Physical map of Nevada**) and ask students:
   - *What do you notice? What patterns do you see?*
   - *How do you think the land changes across the state?*
   - *Where might high areas be located? Low areas?*
   - *Where might flat areas be located?*
3. Discuss features of this map, such as using color to portray how high the land is, i.e., elevation.
4. Discuss with students how this map uses color to portray elevation, with red identifying areas with high elevation and green with low elevation.

Explore

1. Set up block models at different stations (as described in preparation) and have students travel in groups to visit the different stations. As they are at each station, have them come up with a map of the model on graph paper.
2. Discuss the block models and student maps as a class. Have students share what they included and portrayed in their maps. Talk about how the maps from each station are similar and different (i.e., did they map the models the same or did their method change?) Also discuss the ways they portrayed elevation.
3. Decide on a method for best mapping the models as a class, and key items to include on a map (e.g., a title, direction, scale).
4. Optionally, have students visit one station again and make a new map of the model following the class guidelines.
5. Discuss with students how the block models compare to real landscapes (e.g., models show distinct height levels, unlike the gradual elevation changes in nature).

Explain

1. Provide each student group with a topographic map of Nevada (**Nevada Contour Map**). Ask them to observe the map and record initial observations about how this state map is similar and different from the previous map in **Engage**, as well as the features they see in this map.

2. Introduce contour lines and explain their significance in showing elevation and topographic features.

3. Select a portion of the map to look at more in depth by drawing a box in an area of the state. Work as a class to use the contour lines on the map to identify and mark the highest and lowest elevations, and hilly versus flat areas, within the boxed area.

4. Using the topographic map, have students identify and label various geographical features such as rivers, lakes, mountains, valleys, and plateaus that may be found within the boxed area.

5. Discuss how people create and use topographic maps. Ask students to examine the symbol legend and find examples of each symbol on the map. This can include symbols for man-made structures like roads and bridges.

6. Encourage students to think in 3D from the map:

   a. Ask students to consider how the landscape and area might look in real life from the map.

   b. Explore the area previously discussed in step 1 in Google Earth. Begin with the satellite view to give students a bird's-eye view of the terrain similar to the map.

   c. Use the 3D button to toggle between 2D and 3D views.

   d. Drag the "street view" pegman to various points of interest to explore these locations at ground level.

   e. Consider giving students 5-10 minutes to navigate Google Earth on their own.

Elaborate Topographic Maps

1. Share the pre-built hill and depression models with students. Ask them to make observations of each model and comparisons between each other and the previous models.

   - *What similarities and differences do you see between these two new models?*
   - *What do you notice about these landforms compared to the others we've built?*
   - *What might cause a depression in the ground?*

2. Sketch the top-down-view of each model onto paper to begin to create a contour map.

3. Discuss with students how the contour lines of a depression aren't initially identifiable from a raised elevation. Introduce the tick marks on contour lines denoting a depression. Add them to the contour map of the hole.

4. Color the maps to match the models.

Elaborate Cross Section

1. As a class, examine a cross section of one of the block models from the Explore activity. Select a line for the cross-section that runs along the natural alignment of the blocks (e.g., along rows rather than diagonally).

2. Physically remove this line of blocks to help visualize and understand what a cross-section represents. Alternatively, observe the model from the side and make a cross section of the bricks along the edge.

3. Have the students work in groups to make a diagram of the blocks that were removed.

4. Optionally, have each group share their cross-section drawings with the class. Discuss the variations and work together to agree on a standardized class cross-section that best represents the model.

Evaluate

1. Distribute one model topographic map from the handouts to each student group. Assign maps at different difficulty levels (A, B, C) based on group skill levels, with A being the simplest and C the most complex.

2. Instruct students to construct a 3D landscape model using the same building blocks you used in Engage. Emphasize the importance of accurately representing the contour lines and topographic features indicated on their assigned map.

3. Facilitate a discussion comparing the various models built by students. Focus on how well each model represents the topographic data and discuss variations in interpretation and execution.

   - *Which aspect of the model building was most challenging and why?*

   - *How did this activity change your understanding of how landscapes are represented on maps?*

4. Provide students with three scenarios, each of which to go along with the three landscapes.

    a. Scenario to go along with Map A: This area features a gentle, rolling hill, typical of some regions in Nevada away from the mountain ranges. It's a popular spot for local hikers and bikers. The varying elevations provide excellent opportunities for moderate hiking and offer panoramic views of the surrounding desert landscape.

    b. Scenario to go along with Map B: This map shows a large, flat area, ideal for farming in Nevada. Here, large machines are used to plant and harvest crops like alfalfa, which is widely grown throughout the state for livestock feed. The flatness helps in efficiently managing the water needed for irrigation, ensuring that crops get the right amount of water while reducing the amount of wastewater runoff.

    c. Scenario to go along with Map C: This map depicts an active surface mining site, known as an open pit mine, common in Nevada's mining industry. In these sites, machinery and workers dig deep into the Earth to extract valuable minerals like silver, a resource that has historically been significant for Nevada's economy.

5. Have students match the scenario with each landscape and explain their choices.

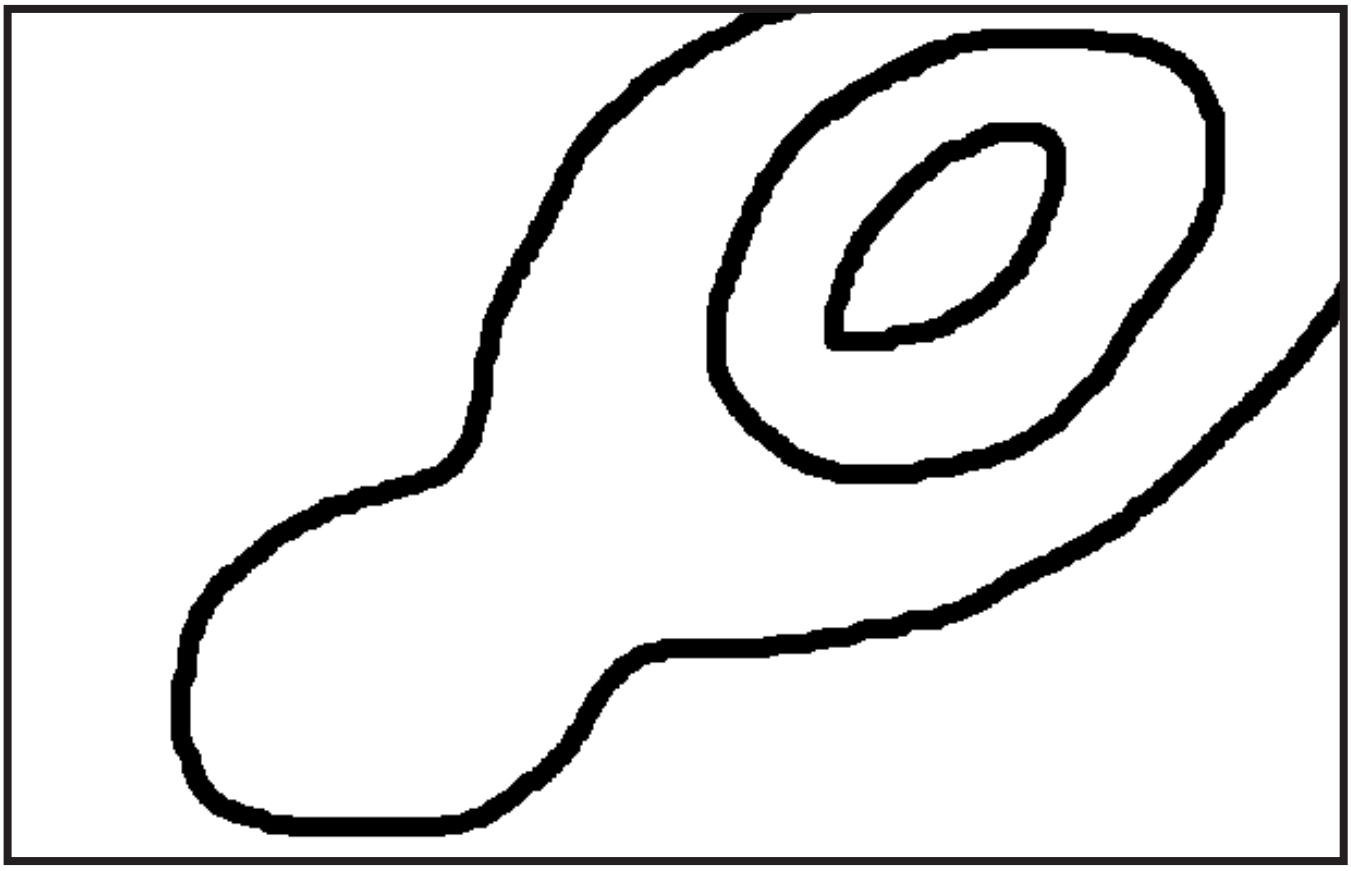
Extend Hands-on Topography

Depending on access, borrow or create an augmented reality sandbox for students to experience mapping and topography in real time. Read more about the **AR sandbox**.

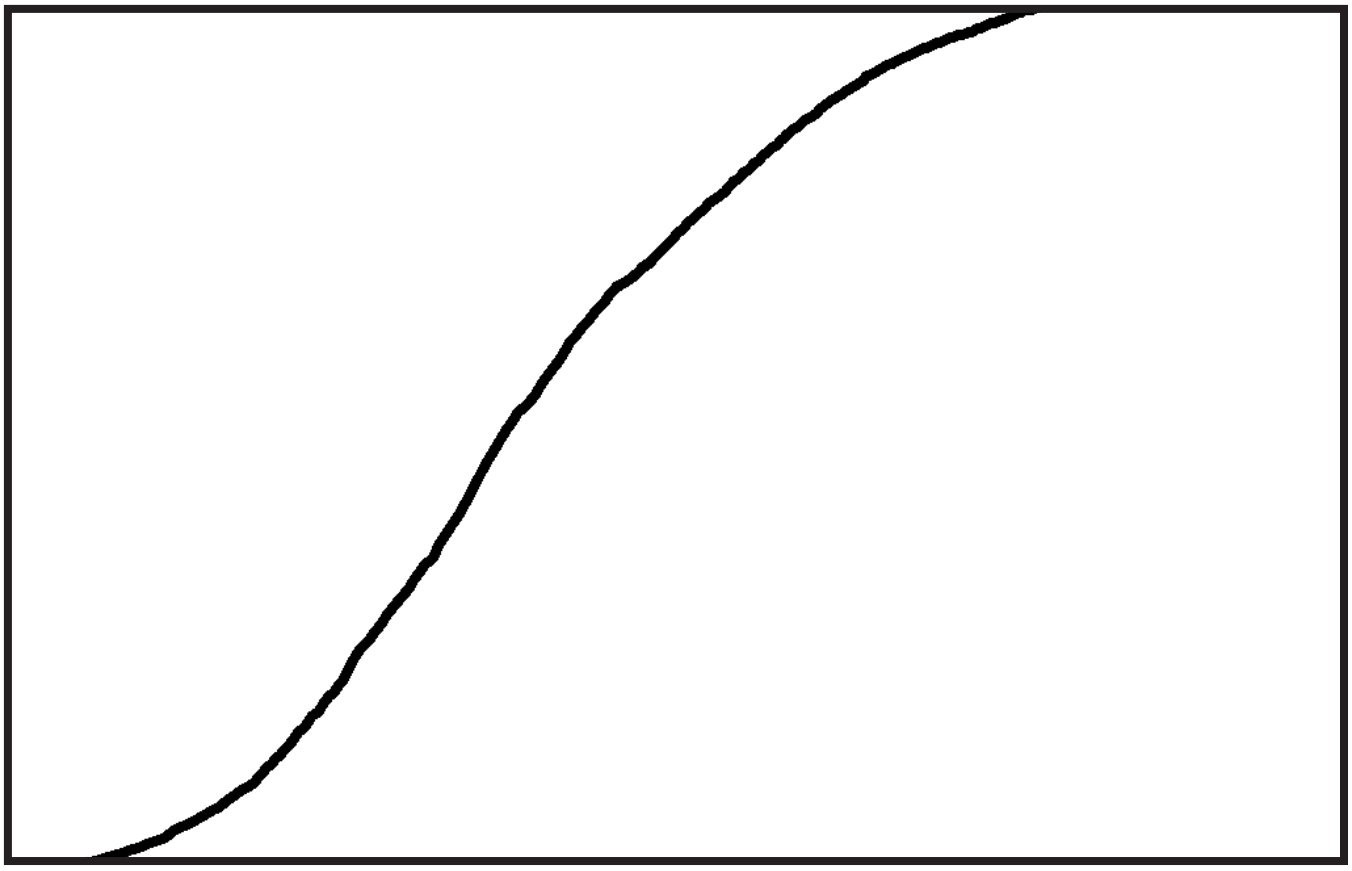
HANDOUTS

Large-celled Graph Paper

Topographic Map – A



Topographic Map – B



Topographic Map – C