"Mt. Idaho"
A lesson and activity on Topographic Maps

Inspired by "Potato Mountain", Penn State College of Agricultural Science which was adapted from "Trees + Me = Forestry", by Robert Hanson (1996), The Pennsylvania State University

North Carolina Geological Survey

Background:

Maps play a crucial role in our society. Maps can give us direction, orientation, topography, navigation, location, and land features just to name a few. Topographic maps, specifically, can help us to understand Earth's terrain and landforms which may allow us to predict future hazard events and to explain changes in the geosphere.

Targeted Grade Level(s):

9^{th} – 12^{th}

2023 Science Standard(s):

ESS.EES.2 Analyze how the geosphere is shaped by plate tectonics and the rock cycle.
ESS.EES.2.4 Carry out investigations to explain how the rock cycle and rates of weathering, erosion, and soil formation influence Earth's systems.

Objectives:

1. To gain an understanding of topographic maps and the information being displayed
2. To demonstrate a basic understanding of how to read a topographic map
3. To gain an understanding of how to convert 3-D features into 2-D maps

Materials:

1. Idaho russet potato(es) plus slicing equipment such as a knife or mandolin
2. Waxed paper or a white board
3. Sharpie markers
4. Lesson and activities provided in this packet

Estimated Time:

1 class period

Teacher Info:

- The following packet contains a lesson on topographic maps. You may use this as a template for your own instruction or you could choose to distribute it to your students.
- Have the potatoes pre-sliced and soaking in water to limit prep time during class.
- Idaho russet potatoes work best and should be wiped pretty dry before using them in the activity.

TOPOGRAPHIC MAPS LESSON

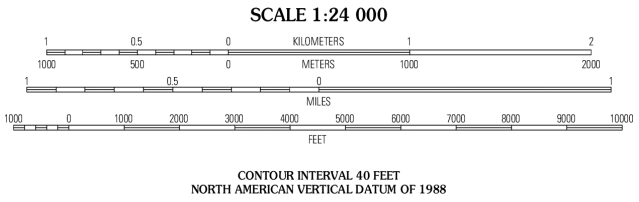
Types of Maps

A map is a drawing of a portion of an area. That area could be Earth, it could be your state or county, your neighborhood, or it could even be an area of the moon. Most maps show areas or places in two dimensions, which means they show length and width but no depth. When you look at a Google Street map for directions, the trees, building, and landforms are two dimensional, or flat. A topographic, map on the other hand, is able to show the elevation of features on the map (how high or low a place or feature is relative to sea level) and their depths. With practice, you can learn to see the flat features of a topographic map in three dimensions (with depth).

Features of Maps

All maps, whether they are street maps or topographic maps, have common and important features. Without these features, it would be difficult or impossible to read the map. Features include:

- **Title**: You need to know what you're looking at.
- **Legend or Key**: These explain what the symbols on the map represent in real life, on the ground.
- **North Arrow**: All maps should have an arrow pointing north so that you can orientate yourself and the features of the map.
- **Scale**: A scale tells you how much real distance is represented by a unit of measurement on the map and will be shown as a scale or ruler on the map. Example: 1:24,000- inch scale means that one inch on the map equals 24,000 inches on the ground in real life. It will look something like the image to the right.



- **Elevation**: This is height above or below sea level (sea level is always zero feet).
- **Contour Interval**: This feature will only appear on topographic maps. It will be listed near the scale and will tell the user the difference in elevation between two contour lines on the map (see below).

Topographic Maps

How do you see things in three dimensions (3-D, with depth) on a topographic map? By using the thin, brown lines on the map. These lines are called **contour lines**, and they connect points of equal elevation on the map. This means that if you could transport yourself onto the map and walk along a contour line, you wouldn't go uphill or downhill. The elevation of the land along that contour line is the same elevation, either above sea level or below sea level.

The elevation of the land is shown on every fifth contour line (or less, depending on the map). Find a contour line marked with an elevation and then find the next line marked with an elevation. If the number increases to a higher elevation, that indicates uphill. If the number decreases to a lower elevation, that indicates downhill. See the next page for more information.

Contour lines spaced closely together = steep terrain

Contour lines spaced far apart = flat terrain

Contour lines make a circle = peak or high point

Find the elevation of two contour lines to see if elevation increases (uphill) or decreases (downhill)

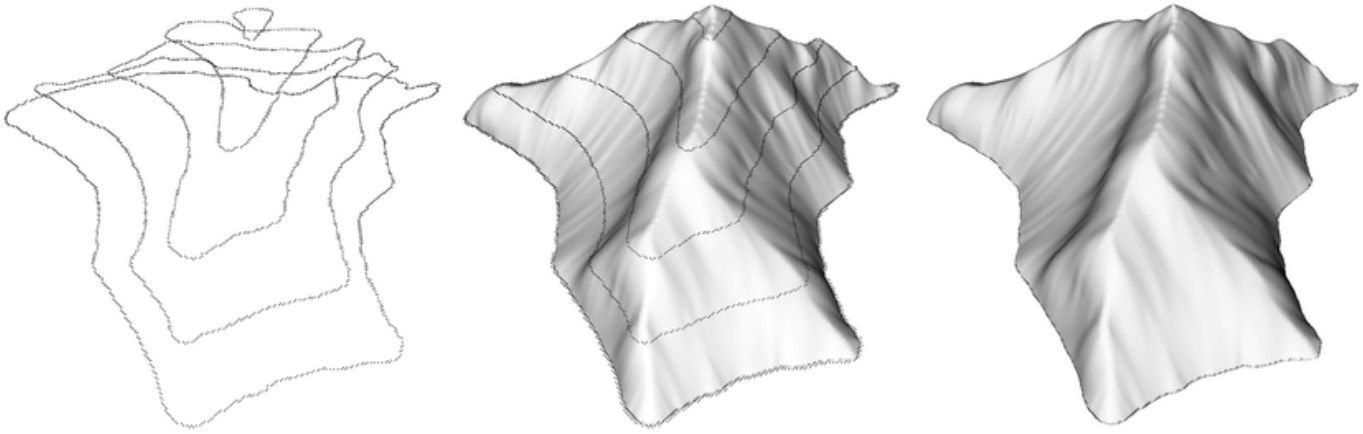
Contour lines in a circle with hatch marks = depression or low area

4 Rules of Topographic Maps

These four rules of topographic maps are fixed. They never change, regardless of what topographic map you're looking at.

1. All points along the same contour line are all at the same elevation.
2. All contour lines eventually connect with themselves.
3. Contour lines never, ever cross each other.
4. Contour lines never, ever split or branch off.

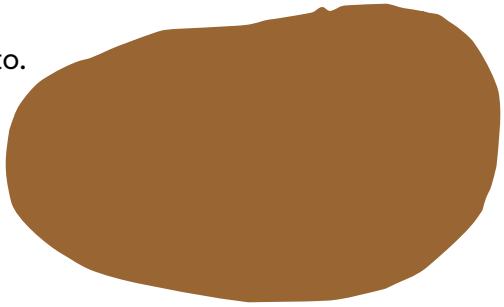
And there you have it – basic topographic map rules and concepts. The next few pages will outline the Mt. Idaho map activity, and discussion questions, including questions specifically about the mountain region of North Carolina.



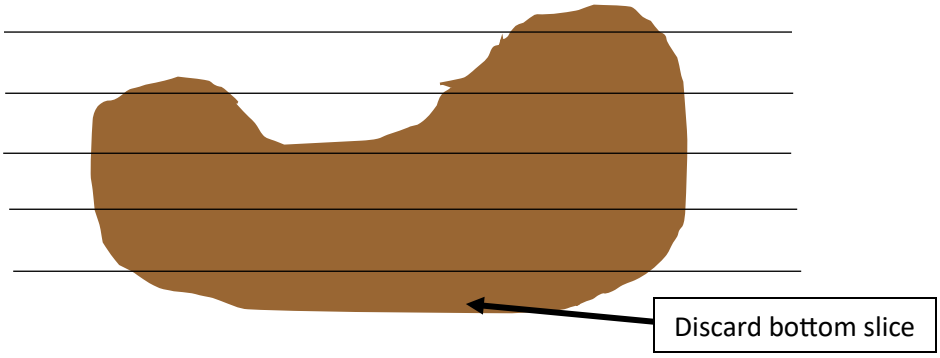
Reconstructed model of Mt. Everest from only five topographic contour lines (https://www.researchgate.net/figure/Reconstructed-model-of-Mt-Everest-from-only-five-topographic-contours-The-interpolation_fig5_4188082)

Mt. Idaho Activity #1

1. Start with a perfectly good Idaho russet potato. You're looking at a side view of the potato.



2. Carve a notch into the potato, making sure to leave one side/peak of the potato mountain higher than the other side/peak. Then slice the potato into thick-ish slices using a sharp knife or mandolin. Slices should be ¼" to ½" thick – not thin like potato chips. Discard the bottom piece so that you have a flat surface on the bottom.



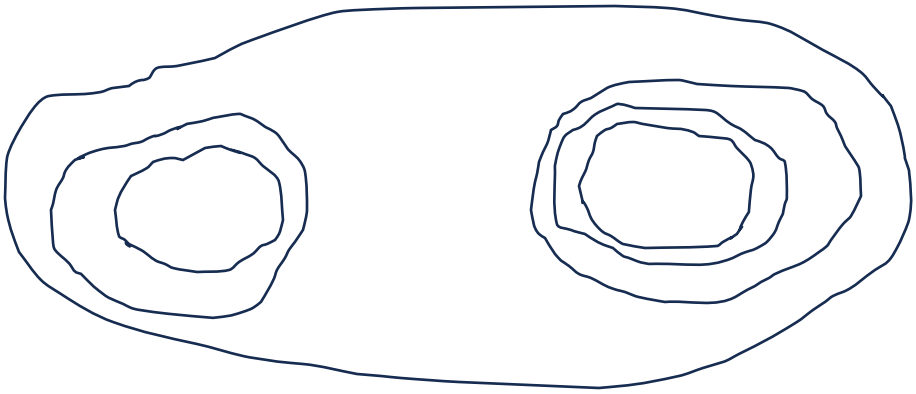
Side view of the potato. Use only the top slices so that you have a flat bottom surface.

3. Students should observe Mt. Idaho from the sides and from the top. Point out the 2 "peaks", the steepness of the "hills" leading to the peaks, and the valley that was carved between the two peaks.

4. Place the **dry**, flat-bottomed potato on a sheet of wax paper. Normal paper won't work for this activity as it will make the paper soggy, and you won't be able to draw lines. As an alternative, you could do the following steps on a white board, working from the bottom slice to the top slice.

    a. Place the whole, dry, sliced potato on the sheet of wax paper. Outline/trace the bottom slice with a sharpie marker. Remove the bottom slice of potato and move it to the side.
    b. Outline/trace the next bottom slice. Remove the this slice and place it on top of the first slice you traced (to re-create the whole potato).
    c. Continue outlining/tracing the bottom slices, removing them after tracing, and re-stacking the slices to the side until all slices have been traced on the wax paper.
    d. What you should be left with on the wax paper is a topographic representation of Mt. Idaho. The lines you traced are the contour lines.

Your contour lines/topographic map of Mt. Idaho should look something like this.



5. Placed the re-stacked potato next to the topographic representation that you created. Observe the following:

a. The lines that you drew are called contour lines and represent areas of equal elevation.
b. The two peaks appear as two closed circles.
c. The peak on the right has a steeper side leading up to it on the left (lines are closer together).
d. The smaller peak on the left has sides that aren't as steep, so the contour lines are spaced farther apart.

Mt. Idaho Activity #2

Matching – Match each image below with the appropriate description.

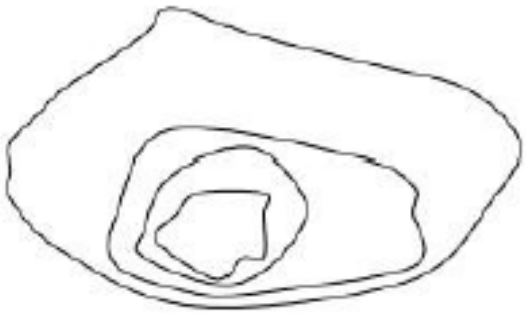
1. _____ Gentle slope on all sides

2. _____ Steep bottom side

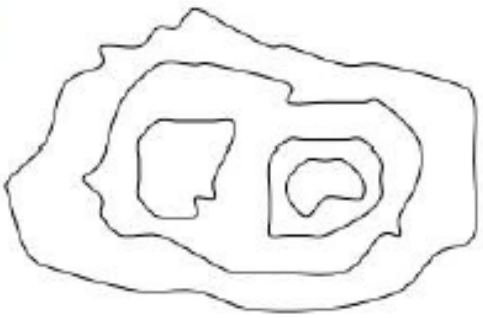
3. _____ Round hill with two peaks

4. _____ Two peaks, higher right peak

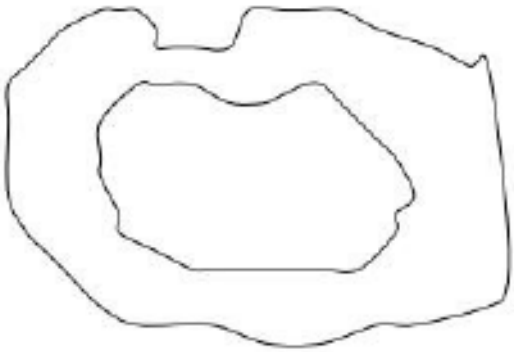
A.



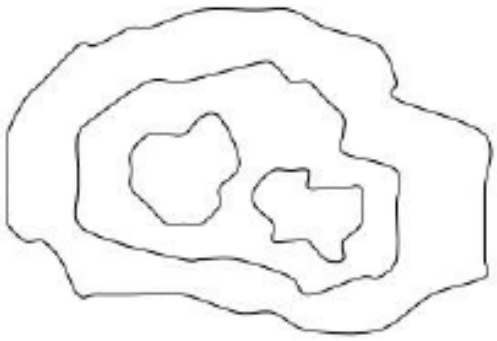
B.



C.



D.



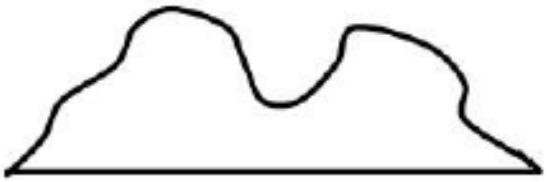
Mt. Idaho Activity #3

Match each side profile image with the appropriate set of contour lines.

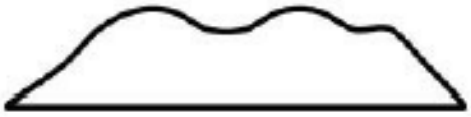
1. _____

2. _____

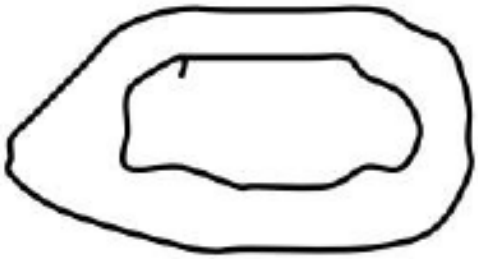
3. _____



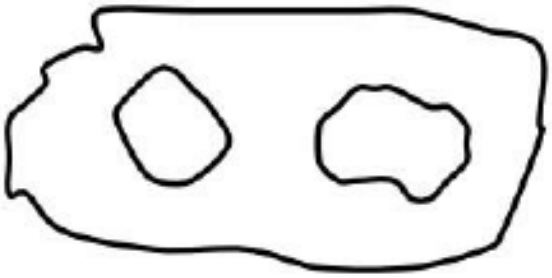
4. _____



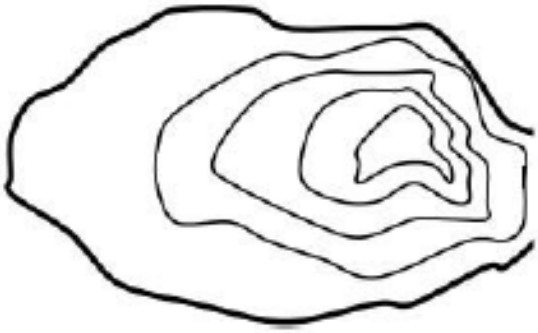
A.



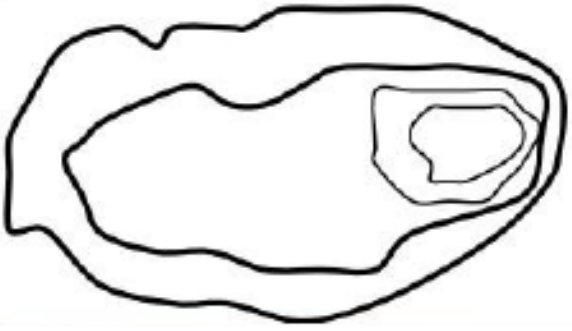
B.



C.



D.



Downloading a Map for Activity #4

1. Go to this USGS topographic map view website: https://ngmdb.usgs.gov/topoview/

2. On this page, click the salmon-colored circle that says “View and Download maps now”

3. A map of the U.S. will appear on your screen. In the instruction box on the right, do the following:
    a. Click on the ‘Map Name’ tab
    b. Directly underneath the search bar (‘Search by map name’), slide the moveable slider bar to the far right, next to 2023 (the left side will say 1880)
    c. Click the red/pink circle that says 24K (right underneath the slider bar)
    d. Type ‘Boone, NC’ in the ‘Search by map name’ search box and hit enter
    e. On your screen, you will see a pink box highlighting the Boone topographic map
    f. In the instructions box on the right side, you should see a Boone, NC listing with a small thumbnail of a map and options to download the map as a JPEG, KMZ, GeoTiff, or GeoPDF. Click on the GeoPDF to download the map.
4. Now that you have the Boone topographic map downloaded, you can make copies for each student, or show the map on a classroom screen and answer the questions below. You can zoom in and out to show details, as necessary.

Activity #4
Discussion / Critical Thinking Questions

1. Find the map scale. What is the scale of this map? What does that mean?

2. What is the contour interval of this map? What does that mean?

3. Find Howard Knob on the map. To find it, zoom in a bit and look for the town of Boone in the north central section of the map. Scroll north of Boone, past Hillcrest but just south of ASU Lake. Zoom in to 125% (by using the zoom feature) and look at Howard Knob. There’s a contour line that makes a closed circle. What does that mean?

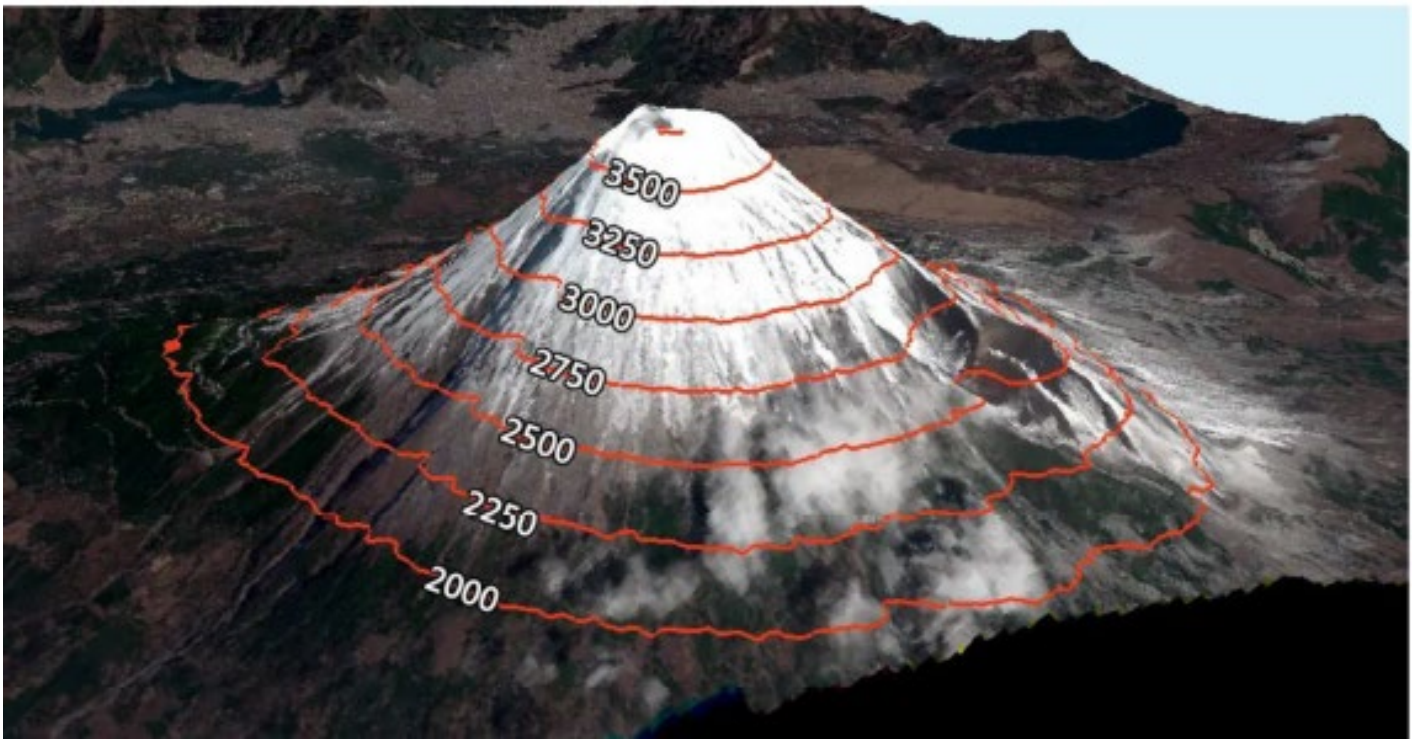
4. Now that you know the contour interval, determine the elevation of Howard Knob. To do this, find a contour interval marked with an elevation nearby and count contour lines and elevation moving towards Howard Knob. What is the elevation of Howard Knob?

5. What side of Howard Knob (north, south, east, or west) has the steepest slope? How do you know this?

6. What is the elevation at ASU Lake, just north of Howard Knob? How much does the elevation drop between Howard Knob and ASU Lake?

7. How might weathering and erosion affect the land and terrain around Howard Knob? What could happen if the area experiences a hurricane with flooding rains?

8. Do you think soil forms at the top of Howard Knob or at the base of the mountain, near ASU Lake? Explain your answer.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