Play-Dough Topo

Grade Level: 5-12

Learner Objectives:

Students will:

- Visualize how a 2–dimensional topographic map represents 3–dimensional landscape
- Understand contour lines and contour interval
- Increase their spatial visualization skills

Setting: Classroom

Timeframe: 50-90 minutes, depending on the complexity of the model volcanoes

Materials:

- Copies of *"Play–Dough Topo"* student page
- Copy of *"Play–Dough Topo"* teacher discussion questions
- Soft modeling clay (pottery clay also works well but can be messy) You can substitute with homemade Play Dough made from flour and salt. See recipe below.
- Fishing line or clay cutting wire
- 1/4" dowel or a pencil

USGS science for a changing world

Living with a Volcano in Your Backyard- An Educator's Guide with Emphasis on Mount Rainier

Prepared in collaboration with the National Park Service

U.S. Department of the Interior
U.S. Geological Survey

General Information Publication 19

Overview

Students make a clay model volcano, and then create a topographic map of it.

Teacher Background

Mapmakers have devised an ingenious way to show three–dimensional ***topography*** on a two dimensional flat surface with the use of a ***topographic map.*** On these maps ***contour lines*** illustrate the variations in ***elevation*** of surface terrain. A contour line is defined as a line of equal elevation. If you were to walk on a contour line painted on the ground around the side of a hill you would neither go up nor down, but remain level. The elevation difference between adjacent contour lines, called the ***contour interval***, is selected to best show the pattern of the landscape. Relatively flat landscapes often are illustrated with a small contour interval of 10 feet or less. Maps in mountainous areas, however, often have a larger contour interval of 40 feet or more. The contour interval is usually printed under the scale at the bottom of topographic maps. Topographic maps can present a major challenge in the classroom, but practice in interpreting them is an excellent way to develop spatial relations skills and is a useful tool in its own right. This activity is designed to develop an understanding of what the contour lines on the map represent, as well as introduce the term "contour interval."

Activity last modified: February, 2007

- Blank paper (one per group)
- Spoon
- Pointed wooden tool or butter knife
- Pencil

Vocabulary: Elevation, topography, topographic map, contour line, contour interval, map scale

Skills: Model, interpret, compare, demonstrate, visualize

Benchmarks:

Geography:

1 – Uses maps, charts, and other geographic tools to understand the spatial arrangement of people, places, resources, and environments on Earth's surface

1.1 – Use and construct maps, charts, and other resources to gather and interpret geographic information

1.1.2b – Uses data and a variety of symbols and colors to create thematic maps, mental maps, and graphs depicting geographic information

1.2 – Recognize spatial patterns on Earth's surface and understand the processes that create these patterns

1.2.2b – Analyze how human spatial patterns emerge from natural processes and human activities

2 – Understands the complex physical and human characteristics of places and regions

2.1 – Describe the natural characteristics of places and regions and explain the causes of their characteristics

2.1.2 – Use observation, maps, and other tools to identify, compare, and constrast the physical characteristics of places and regions

Students should already be familiar with the basic concept of a map and ***map scale.*** You may want to create a map of your classroom or the playground using paces as measurement to help your students prepare. Students may use local street maps to chart the route they travel to come to school as preparation for this activity.

Before class begins, obtain modeling clay or play dough for this activity. Play Dough can be made with the recipe that follows.

A simpler no-mess topographic model can be assembled by following the instructions in the Extensions section.

Play-Dough Recipe

4 cups flour
1 cup salt
4 cups water
4 tablespoons oil
1/2 cup cream of tartar

Mix all ingredients in a saucepan. Cook and stir over low/medium heat until Play Dough is completely formed and no longer sticky. Allow to cool slightly before storing in an air tight container or zip lock bag. Just before class, separate the clay into equal amounts, approximately 450 grams (1 pound) for each group. In volume, this is equivalent to the amount contained within two adult hands clasped together.

During the activity, steps 1 through 4 can be displayed by projector, or printed as hard copy and distributed to student groups.

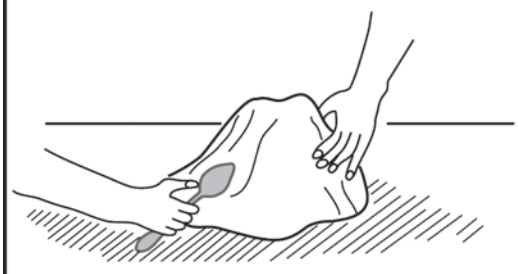
NOTE: This recipe makes 3 one pound lumps of Play Dough with a bit extra.

Procedure

1. Shape a Volcano:

Distribute 450 grams (1 pound) lumps of clay to each student or group. Each student (or pair or small group) places the the clay on a piece of scrap paper. They will shape the mound into a cone–pointy side up–roughly the shape of a stratovolcano like Mount Rainier. For more advanced classes, encourage students to make realistically shaped volcanoes, approximating the shape of Mount Rainier. Remind students that each side of the volcano may have a different slope, or steepness. Consider making U–shaped glacial valleys running down the sides of the model using the back of a spoon, and then putting in some smaller V–shaped valleys, representing those carved by rivers and streams, using a pointed wooden tool or a butter knife.

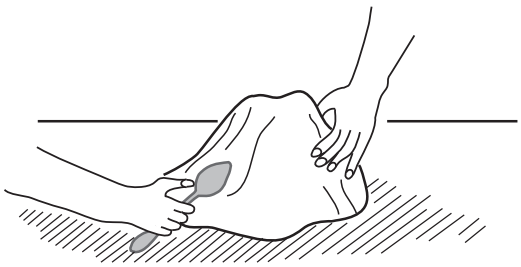
Step 1: Forming the model mountain



2a. Make a Vertical Hole for Alignment of Parts Later in the Activity:

Next, for all students, use the 1/4–inch wooden dowel (or a pencil) to make a vertical hole from the summit of the volcano, all the way down to the work surface. Remove the pencil and mark this spot on your paper. This mark will allow students to align the pieces of their model on the paper as they make a topographic map, so they should be able to see through it.

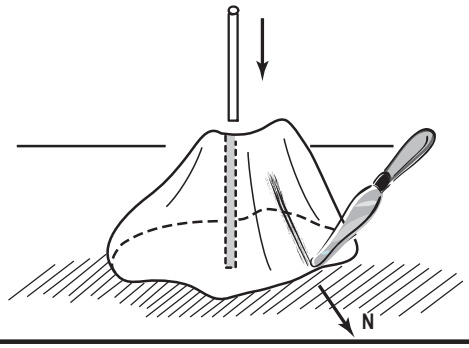
Step 1: Forming the model mountain



2b. Choose North

Choose a direction for north, such as the front of the classroom, and then make a straight groove down the outside of the model facing north. You will need to know where north is on your clay pieces, so, make the groove obvious.

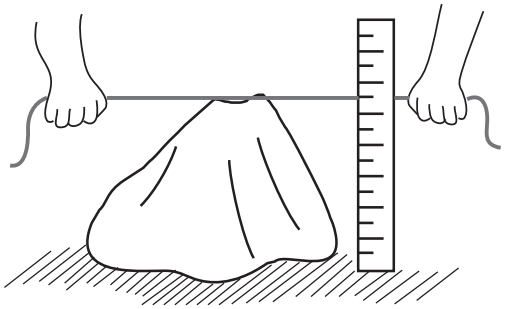
Step 2: Making the vertical hole and alignment notch.



3. Measure and Record Elevation

Measure the elevation of the volcano and record it at question #1 on the student page. To make this measurement, stretch the wire across the top of the volcano to a vertical ruler (see graphic). Each student or group should divide their answer by four or five to determine their contour interval, that is, the distance between each contour line to be drawn in Step 4. Rounding is permitted. Write answer on student page at question #2.

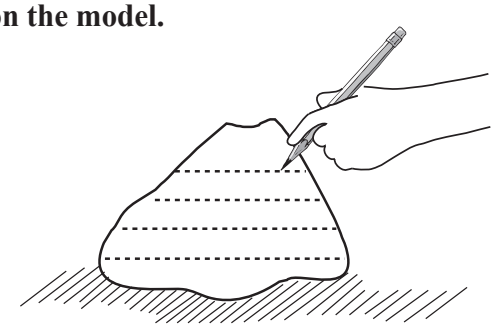
Step 3: Measuring the summit elevation.



4. Mark Dots to Show Elevation on the Model

Then, holding a pencil horizontal, ask students (or help them) to punch holes at each calculated contour interval, completely around their model. For younger children or with soft clay, use increments of 1 inch. For more advanced classes and with Play Dough, you may be able to make thinner slices, and so should use increments of 1 centimeter (~ .39 inch).

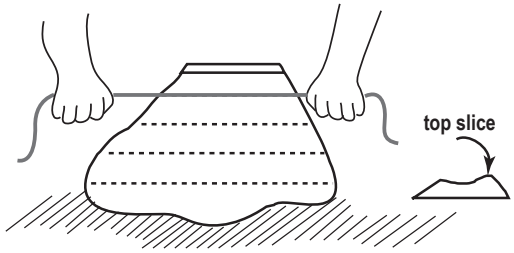
Step 4: Mark dots to show elevation on the model.



5. Slice the Model to Create Contour Lines

Next, using the wire tool or a length of fishing line wrapped securely around your hands, cut the model parallel to the work surface horizontally at the elevations marked by the dots. Tell students to try to keep their hands steady (advice for you if you are doing the slicing for younger classes) and to attempt to keep all slices parallel and of even thickness. Start with horizontal slices near the top. These slices, cutting through the model at one elevation, will make a slice that outlines the volcano at that elevation. Since the cut is all at the same elevation, the outline is a contour line. The distance from one cut to the next is the contour interval. Discuss these concepts with your class as the horizontal slicing continues.

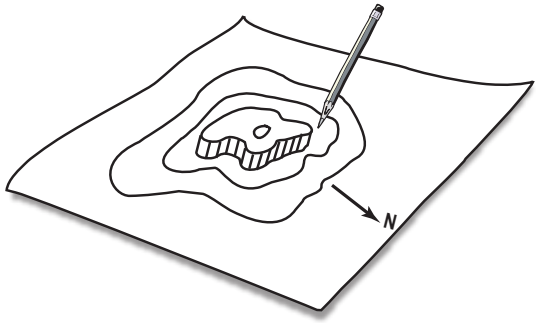
Step 5: Slice the model to create contour lines.



6. Trace the Outline of Each Slice on Paper to Make a Contour Map of the Play-Dough Volcano Model

Distribute a piece of blank paper to each group of students. This will be made into a paper map of each volcano. Starting with the bottom-most, largest slice, center it on the paper, with the "North" groove facing the top of the page, and mark the position of the groove with a tic–mark. Use a pencil to make a distinct dot on the paper in the center of the dowel–hole. This dot will be used for centering all of the other pieces. Finally, carefully trace the outline of the slice, paying attention to indentations and the shapes made by any valleys you may have carved. Remove the slab and center the next piece of your model over the "dowel–dot," lining up the "North–groove" with the direction of the tic–mark, towards the top of the page. Carefully trace the shape. Repeat until all of the slices have been centered and traced. You have just created a topographic map of your volcano!

Step 6: Tracing the shapes onto paper. creating a topographic map.



7. Reassemble the Volcano for Comparison with the Topographic Map

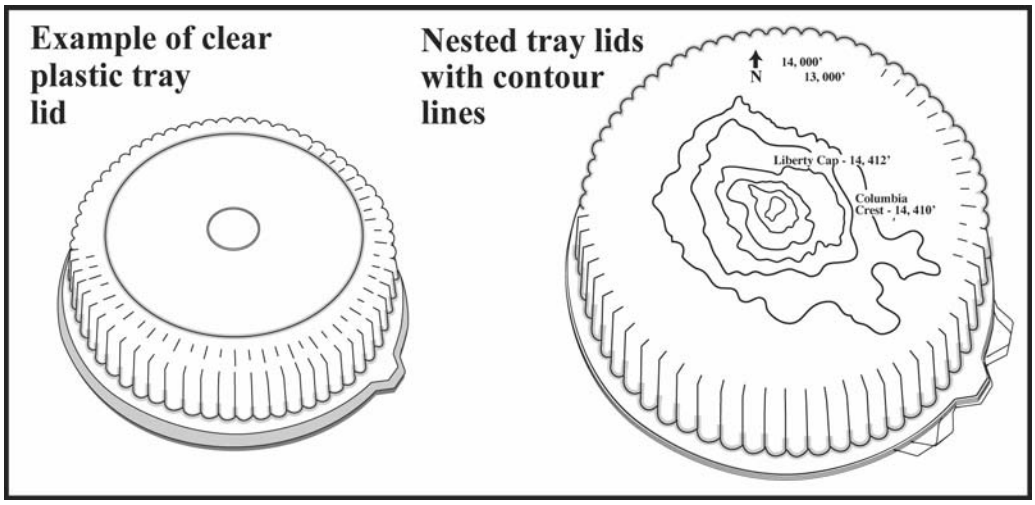
Reassemble your volcano and compare the three–dimensional model to your topographic map. Without smoothing the lines made by the cuts (your contour intervals), look down on both from above–they should match. Consider using the questions below to guide older students' inquiry. On their map, students should name their volcano, then list the contour interval, label the elevation of the summit, draw a north arrow, and state the name of the mapmaker. Consider drawing some hypothetical rivers as discussed in question #4. Color and border the map.

Adaptations

- Make a paper mache or clay model of a cone–shaped Cascade volcano. To illustrate how contour lines represent equal elevation, paint contour lines on your volcano.

Extensions

- ***Make a See-Through 3-D Salad-Tray Model of a Topographic Map***
  From a delicatessen, bakery, or grocery store, obtain approximately 8 clear plastic disposable tray lids that can be nested, for each student group. Obtain a topographic map of a volcano. Use a photocopier to adjust the size of the volcano's cone so that it is almost as large as the flat bottom of the tray lids. Use a marker to outline principal contours on the reduced-size map (1,000 foot contours on Mount Rainier). Use scissors to trim the map so that it fits snugly inside the first tray lid. Temporarily tape the map in place. Use a permanent marker to trace one contour line onto each tray lid. Add contour elevations and a North arrow to each tray lid. Admire your 3–D representation of a topographic map!



Assessments

Use questions on the ***"Play-Dough Topo"*** student page to assess students' ability to apply the concept of contours to a physical model. Look for students' grasp of contour lines, and of how the lines represent real landform features. Note how students' understanding of contour lines has progressed throughout the activity. For example, at the beginning of the activity, students may have a rudimentary understanding of how contours represent the landscape. Later, students can describe the landscape based on their reading of the contours, can produce their simple contour map based on the model, and can answer questions about it successfully.

References

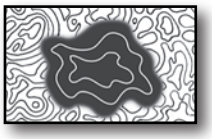
U.S. Geological Survey, 1971, Mt. Rainier National Park, Wash: U.S. Geological Survey Topographic Map, scale 1:50,000.

Steger, Theodore D., 1990, Topographic Maps: U.S. Geological Survey, 27 p.

Refer to **Internet Resources Page** for a list of resources available as a supplement to this activity.

Student Page

Name _____



Play-Dough Topo

Instructions: *Answer the questions below using your new knowledge of topographic maps.*

1. Find the elevation of your volcano in centimeters and inches. (one inch equals 2.54 centimeters)

2. Make four or five contour lines on your volcano. List the elevation of the contour lines on your volcano.

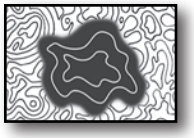
3. What is the contour interval of your topographic map?

4. Notice how the glacial and river valleys are represented on the topographic map. Do the two types of valleys look the same? Draw the rivers on your map using a dashed–and–dotted line and give each river a name.

5. How might you distinguish a valley from a ridge on a topographic map?

6. Notice how all of your lines form irregular circles or ovals. Imagine what would happen if you left the front door of your house and could only walk at one elevation, never traveling up or down–could you get back home? Do all contour lines in the world eventually have to connect back to themselves? Why or why not?

Teacher Page



Play-Dough Topo-Answers

1. Find the elevation of your volcano in both centimeters and inches.
Students' answers should make sense and have correct unit labels

2. Make four or five contour lines on your volcano. List the elevation of the contour lines on your volcano.

3. What is the contour interval of your topographic map?

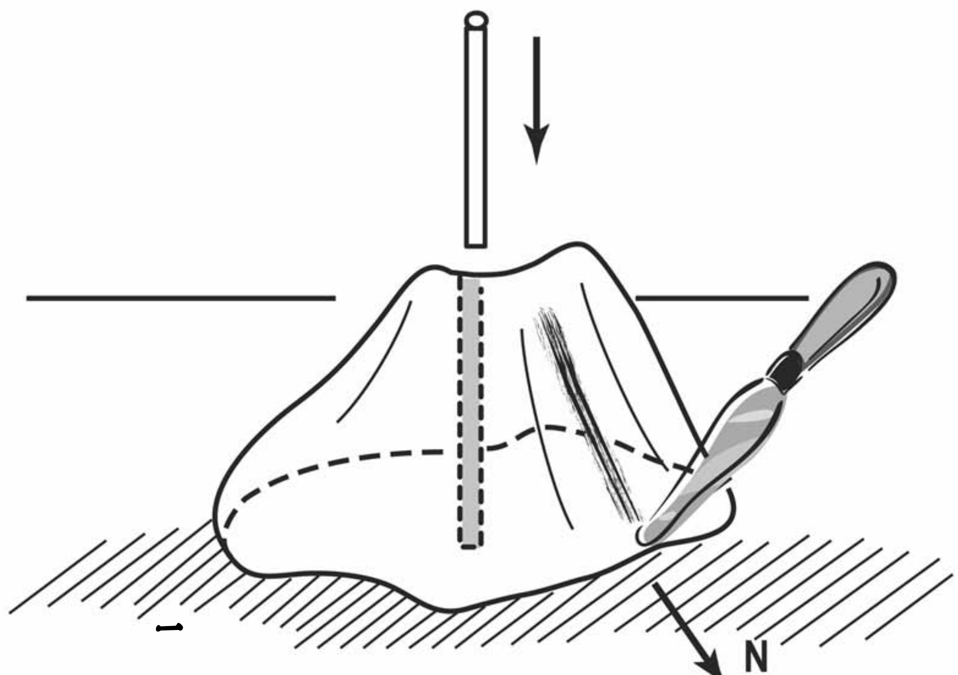
4. Notice how the glacial and river valleys are represented on the topographic map. Do the two types of valleys look the same? Draw the rivers on your map using a dashed-and-dotted line and give each river a name.
Glacial valleys should have a U shape pointing upstream while river valleys should have a V shape also pointing upstream. River marks should be drawn in on the diagram vertically underneath where they appear on the model.

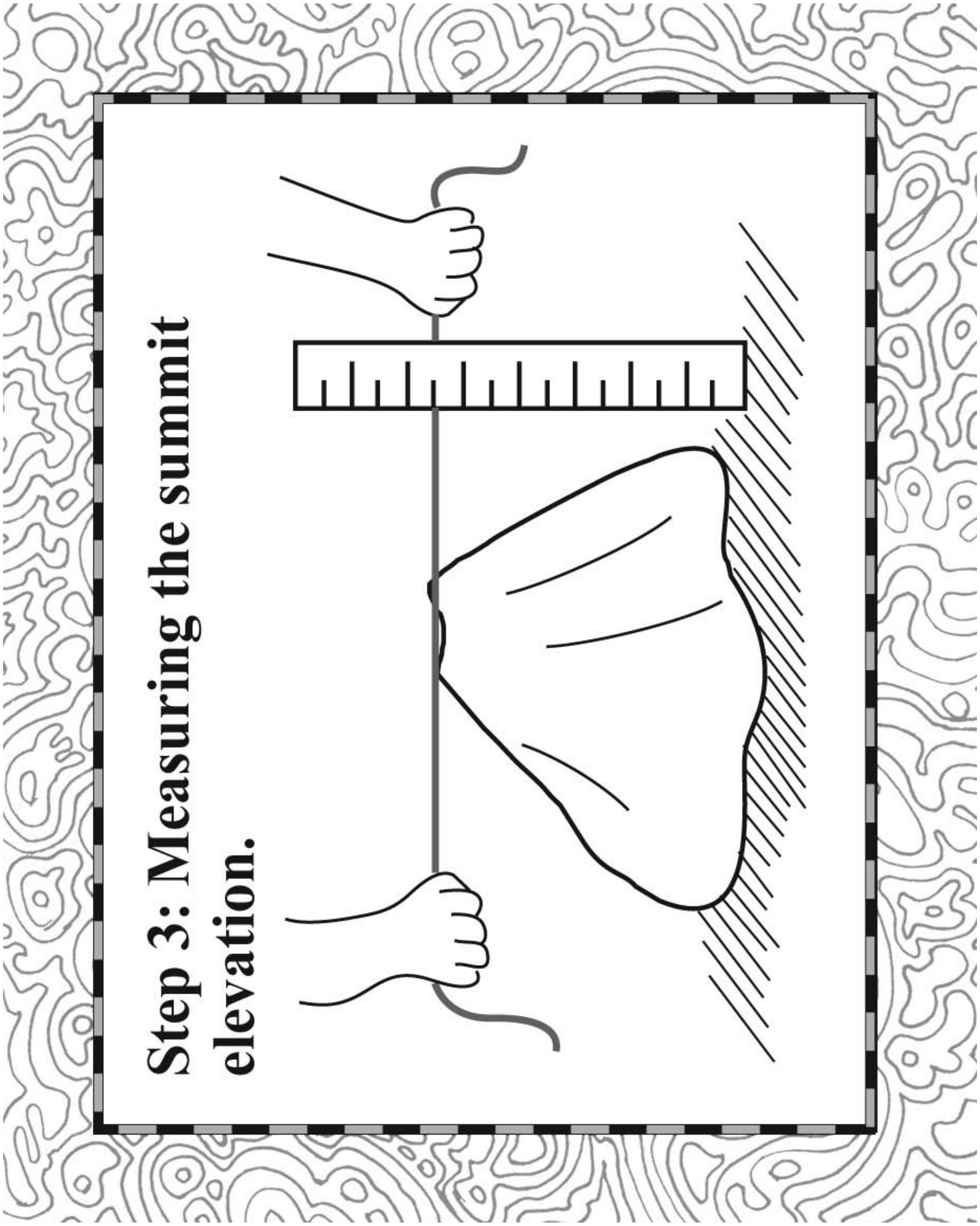
5. How might you distinguish a valley from a ridge on a topographic map?
Valley "V"s point upstream; ridge "V"s point downstream. Also, rivers do not flow on ridge tops, but in valley bottoms.

6. Notice how all of your lines form irregular circles or ovals. Imagine what would happen if you left the front door of your house and could only walk at one elevation, never traveling up or down–could you get back home? Do all contour lines in the world eventually have to connect back to themselves? Why or why not?
You would eventually return–all contour lines necessarily form complete polygons Think of the slices of your model volcano. If a contour line seemed to stop, at a cliff for example, does it actually stop? The elevation still exists; it just may run along a vertical wall for a while. There is no way that the line can stop until it runs back into its own tail. If students are having a hard time with this, consider making a contour map of your classroom, including the desks, to demonstrate how contour lines sometimes stack up, but always eventually close themselves.


Step 1: Forming the model mountain

Step 2: Making the vertical hole and alignment notch.

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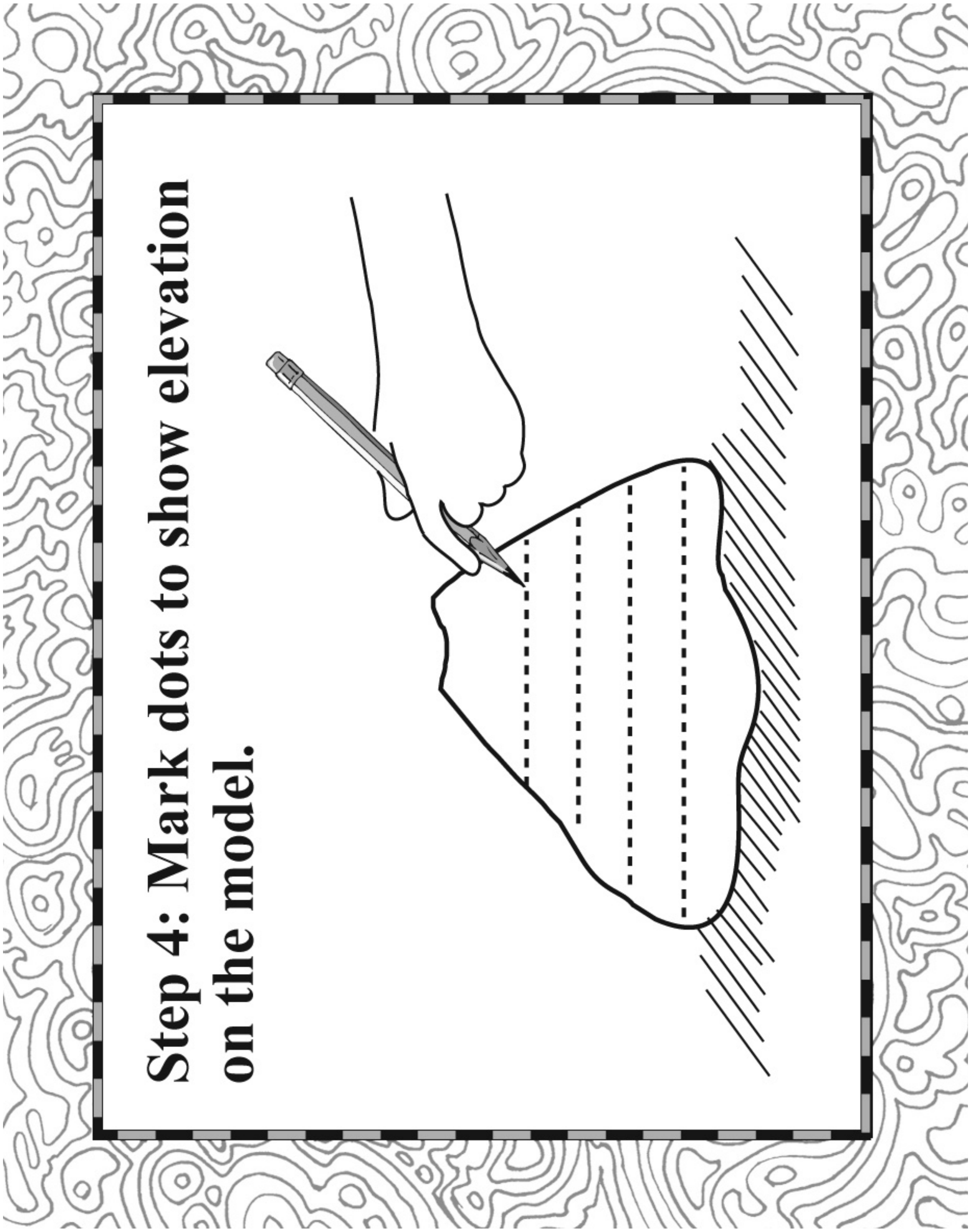
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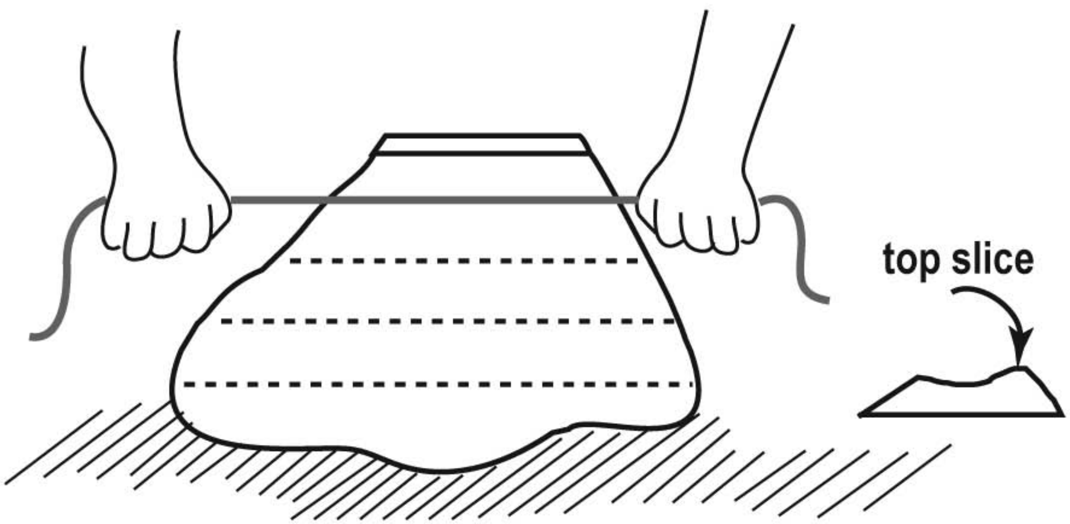

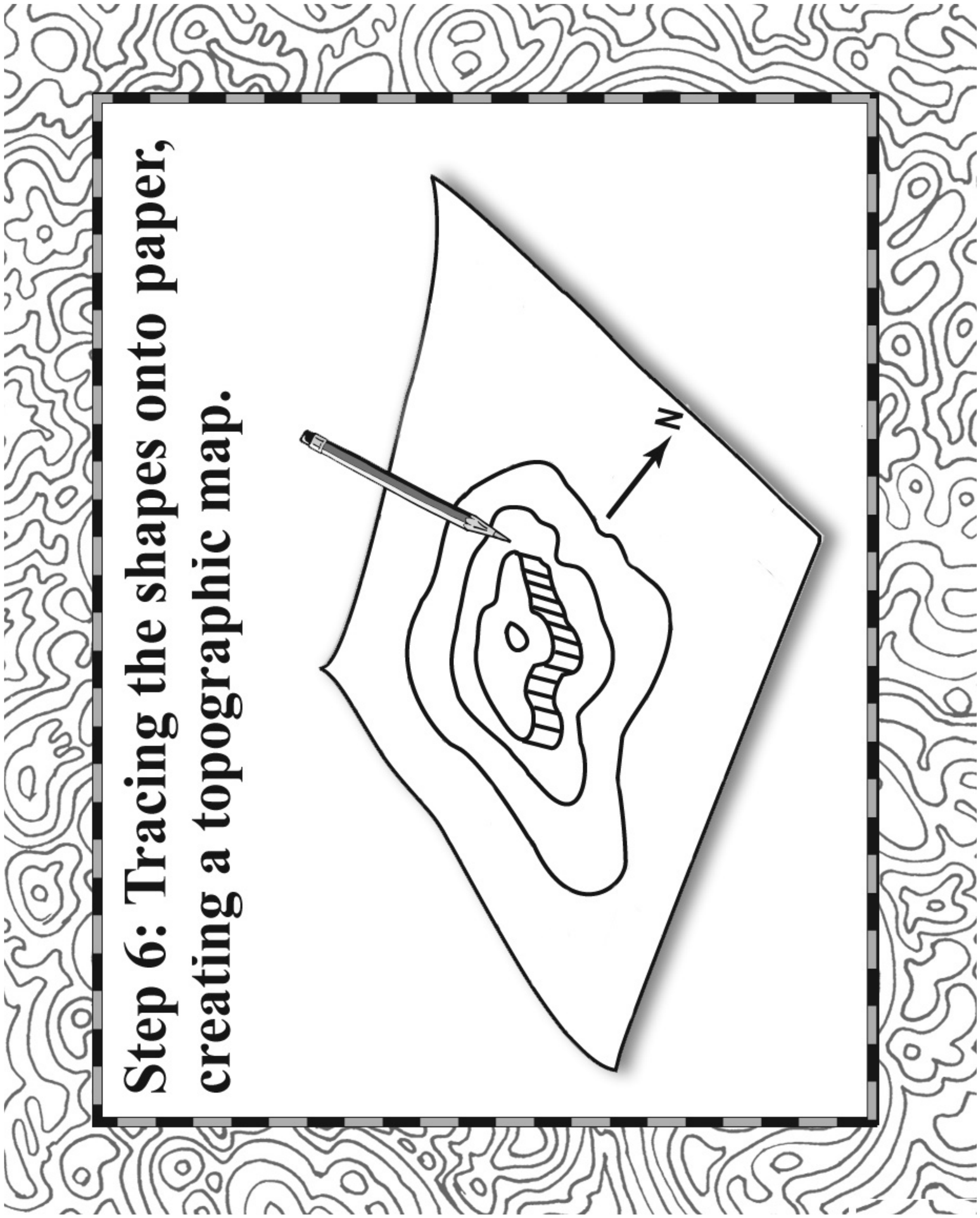
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