Build a Model of Your Watershed

Introduction to Topography

Outcomes

Participants will…

- Learn how to read a topographic map
- Use a topographic map to build a 3D model of their own watershed
- Discuss how a 3D watershed model can help their community make better decisions

Time

3 hours
(not including drying time)

Key words

Topography: the study of physical features on land and in the ocean

Topographic map: a map showing the physical features of an area; also called a contour map

Contour lines: a line on a map that connects all points of the same elevation (or depth) in a particular area

Contour interval: the distance between contour lines

Map scale: the relationship (or ratio) between distance on a map and the corresponding distance on the ground

Materials

- ☐ Topographic maps of watershed (at least one should be to scale)
- ☐ Ruler
- ☐ Crayons or markers
- ☐ Projector
- ☐ Computer with map file
- ☐ Poster paper
- ☐ Cardboard (same size as poster)
- ☐ Old office paper or newspaper
- ☐ Painter's or masking tape
- ☐ Popsicle sticks
- ☐ Glue
- ☐ Water
- ☐ Paint or baking pan
- ☐ Tempra paint (blue, green, black)
- ☐ Paint brushes
- ☐ Push pins or toothpicks
- ☐ Scissors and/or box cutters

Directions

(Prep) Gather all materials needed to build the model. You may want to cover tables to protect furniture from cut marks and glue.

Introduce and Activate Prior Knowledge

- ✓ **Ask**: Where does the water come from in your village? What are the names of your mountains? What are the other main natural features in your village?
- ✓ Introduce the activity by explaining **intended outcomes**.
- ✓ Review **key vocabulary** with a game OR using a topographic map as a model
- ✓ Use the **worksheets** to introduce participants to topographic maps

Prepare 3D Model Base

- ✓ On the topographic map of the watershed, **trace the thick contour lines**. Most of these are 50 m apart.
  - Where is the highest point? Lowest point?
  - Where are the steep areas? Flat areas?
- ✓ **Color the contour intervals** (light→dark or blue→green) to help visualize changes in elevation.
- ✓ Project (show) the map of the watershed on a wall and **trace the thick contour lines onto poster paper**.
  - It may be helpful to color contour intervals so that it is easier to keep track while building up the 3D model
  - Write elevations along contour lines

Confirm & Convert Copied Map Scale

Now that you've traced the watershed onto the poster paper, you need to confirm the scale of your copied map.

- Go back to your to-scale map. Measure the distance between two prominent points (e.g., 2 peaks) or the length of one of the grid squares.
- On your copied map, measure the distance between the same two points.
- If they are the same, then your map scale is the same as the original.
- If they are different, do this conversion to calculate the new RF scale:

$$\text{RF of new map} = \frac{\text{RF of base map} \times \text{distance on new map}}{\text{distance on base map}}$$

- Convert RF scale of new map to verbal scale to determine meters per inch for the new/copied map.

Build Up 3D Model

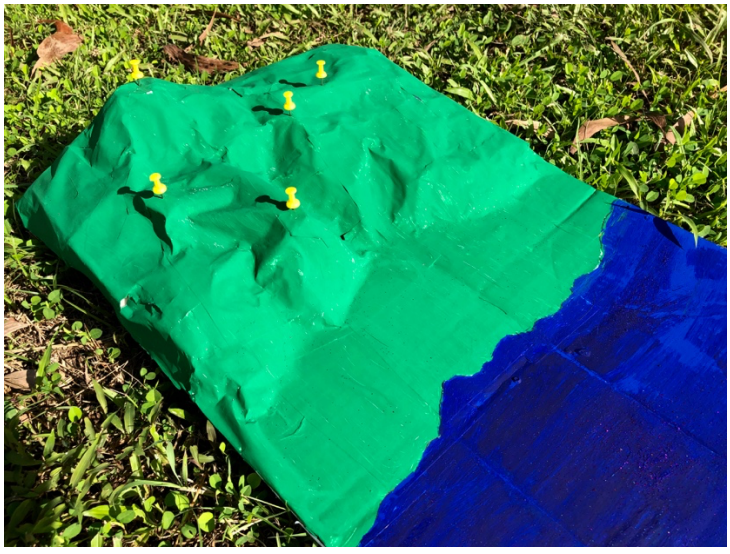
- ✓ Use popsicle sticks and tape to **build high points**
  - Measure out each popsicle stick to the proper height based on the copied map scale
  - Height of popsicle stick = height of peak in meters ÷ __inches per meter
- ✓ **Build up layers** using crumpled paper and tape. Use the ruler and topographic map to continually check that the model is the proper height.
- ✓ When all of the layers have been built, **cover the model with paper mache**.
  - Cut recycled paper into thick (1–2 inch) strips.
  - Paper mache recipe = 1 part water to 3 parts white glue.
  - Pour liquids into pan and mix. Dip one strip of paper into the mix at a time. Pinch the paper between your fingers and squeeze out excess.
  - Let it dry over night.

Bring 3D Model to Life

- ✓ Paint the watershed and ocean with tempura paint.
- ✓ Add details! Sprinkle glitter. Mark high points with toothpicks or push pins. Paint in rivers, roads, walking paths, reefs, houses, offices and markets. Mark special places and elevations with flags.

Debrief (*sample questions*)

- ✓ What else does our model need to represent our community?
- ✓ If a water drop falls on a mountain in this watershed, where does it go?
- ✓ How could we use this model to make better decisions for our community?
  - What would happen if sea level rose by 1 meter?
  - If something happens upstream, who is impacted and how?



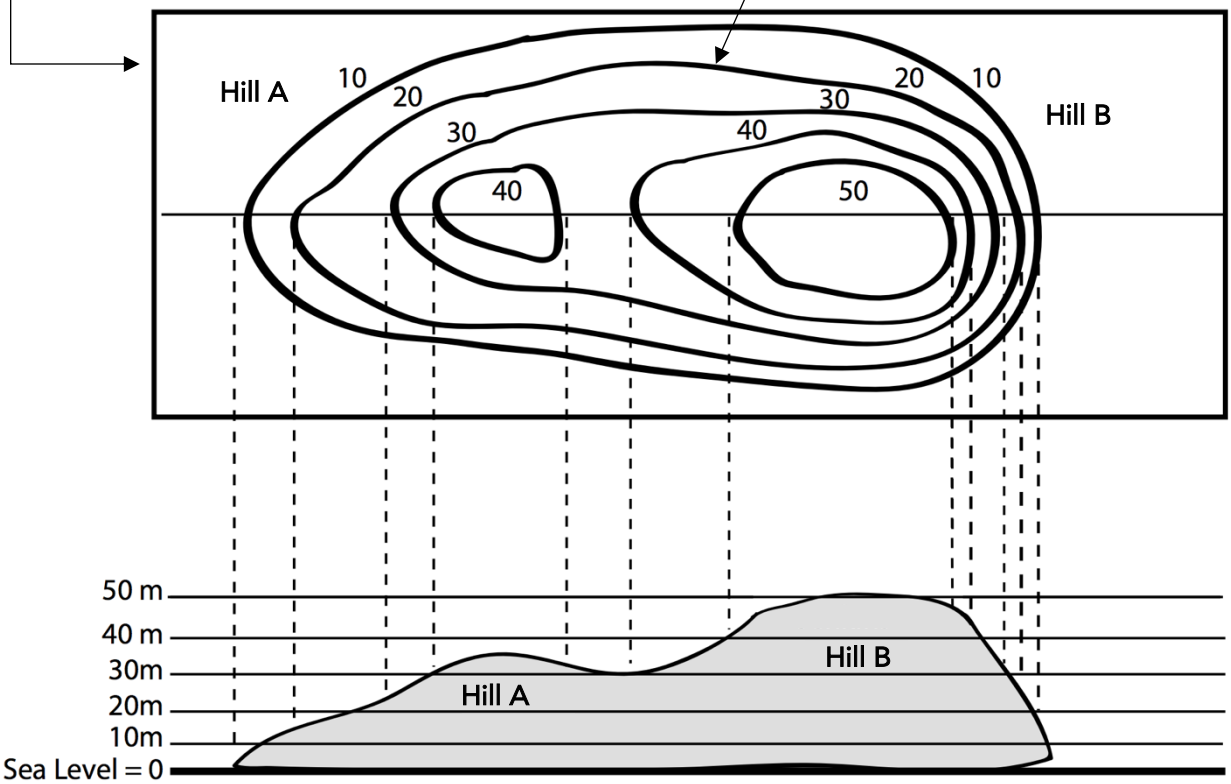
Name: _____

Topographic Maps #1

Topography is the study of natural, physical features on land and in the ocean.
What are some examples of natural/physical features on land? _____

Topographic maps show physical features of an area. This type of map can also be called a contour map.

Contour lines represent levels of elevation or height.



1. Color the elevations (heights) on the topographic map:
   50 m = blue | 40 m = red | 30 m = purple | 20 m = yellow | 10 m = green

2. How tall is Hill A? _____ How tall is Hill B? _____

3. Which peak is taller? By how much? _____

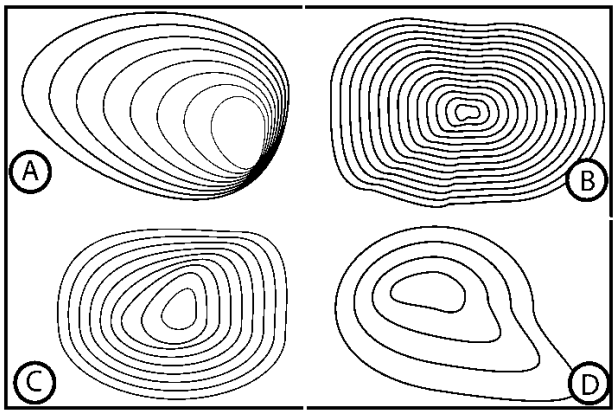
4. Which hill has contour lines that are closer together? _____

Based on: https://www.education.com/download/worksheet/113576/how-to-read-a-topographic-map.pdf

Name: _____

Topographic Maps #2

Contour lines can show the **steepness** or **flatness** of the natural features of an area.



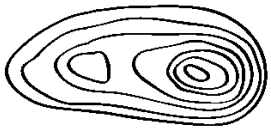
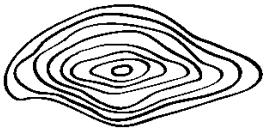
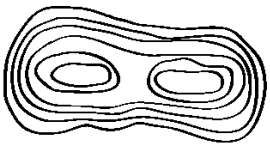
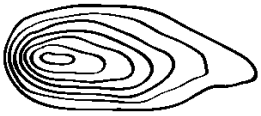
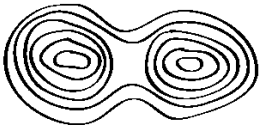
Which feature is the…

Steepest? _____

Flattest? _____

Tallest? _____

Match the contour image with the correct side view.

	Contour Map	***Side View***
A		
B		
C		
D		
E		
F		

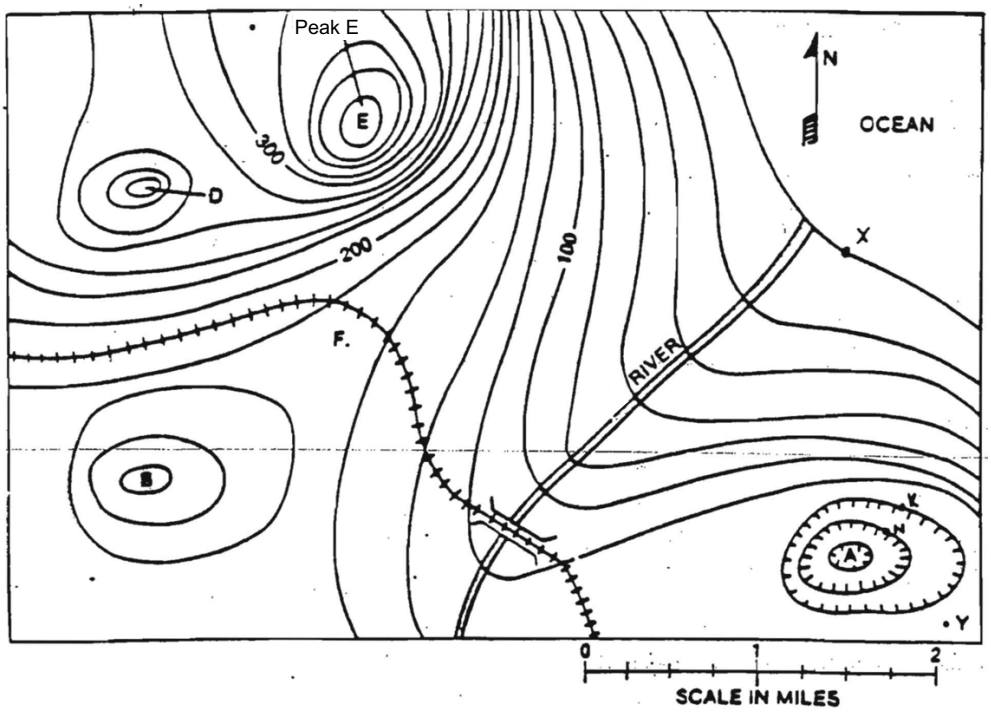
Which maps have 2 peaks? _____

Which maps have mountains with steep sides? _____

Source: https://www.education.com/download/worksheet/98027/topographic-map.pdf
https://www.education.com/worksheet/article/topographic-map-matching/

Name: _____

Topographic Maps #3



1. Each contour line in this map represents _____ feet. This is the **contour interval**.
2. What is the elevation of E? _____
3. What is the elevation of D? _____
4. What is the elevation of X? _____
5. Which side of Peak E is the steepest? _____
6. What is the distance between point B and point E? _____ miles

Hatched lines (++++++) represent **depressions**, like craters or holes. When reading a depression contour, the elevation of the first line is the same as the previous. The elevation of the next line decreases by the same amount as the contour interval.

7. What is the elevation of K? _____
8. What is the elevation of A? _____

Contour lines create a V-pattern when they cross a **valley or waterway**. The tip of the V *always* points uphill.

9. What direction does the river flow? _____

Name: _____

Topographic Maps #4

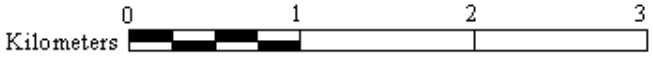
Map scale is the relationship (or ratio) between distance on a map and the corresponding distance on the ground. Map scale can be shown in 3 different ways:

(1) **Verbal Scale**: This is the easiest to understand because it uses familiar units.

Example: 1 inch equals 16 miles

(2) **Graphic or Bar Scale**: Bar scale is most useful when copying maps because the size changes with the map size. If you make a photocopy of a map, this will help you determine how big or small your new map is compared to the original.

Example:



(3) **Representative Fraction (RF) or Natural Scale**: RF says that 1 of any measurement on the map equals X of the same measurement on Earth. These can be written as fractions or ratios

Example: 1:1,000,000 (this is the same as 1/1,000,000)
This means that 1 of any measurement on this map equals 1,000,000 of the same measurement in real life

Maps can be classified as **large scale or small scale**. Large scale maps have a smaller RF denominator (number on the bottom or right of the fraction) and usually show more detail.

How to Convert from One Form of Scale to Another

Verbal Scale to RF

Verbal Scale = 1 inch equals 10 miles

1 inch = 10 miles

1 inch = 10 miles x 12 inches/foot x 5280 feet/mile

1 inch = 10 x 63360 inches

1 inch = 633,600 inches

1:633,600 = RF scale

RF to Verbal Scale

RF Scale 1:250,000

1 inch = 250,000 inches

1 inch = 250,000 inches ÷ 12 inches/foot

1 inch = 20,833.3 feet ÷ 5280 feet/mile

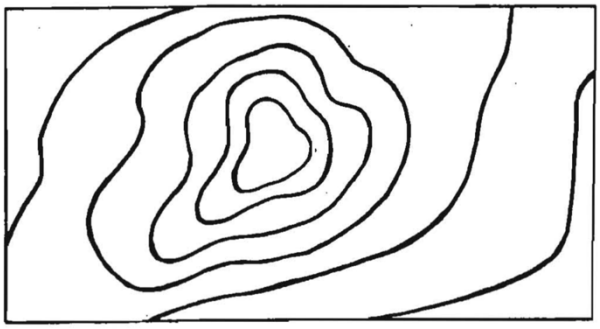
1 inch = 4 miles

1 inch equals 4 miles

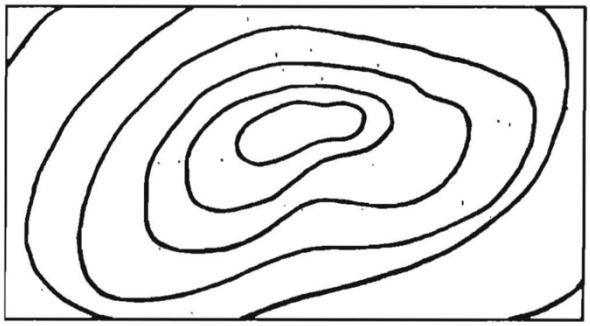
Source: http://groundwater.fullerton.edu/Maps,_Scale,_GIS_and_GPS/Guide_to_Map_Scale.html
https://www.hackettstown.org/cms/lib7/NJ01000669/Centricity/Domain/1045/MAP%20PACKET%20C.pdf

Name: _____

Practice Using Map Scale



Scale: 1:24 000 Contour interval: 50 feet



Scale: 1:62 500 Contour interval: 20 feet

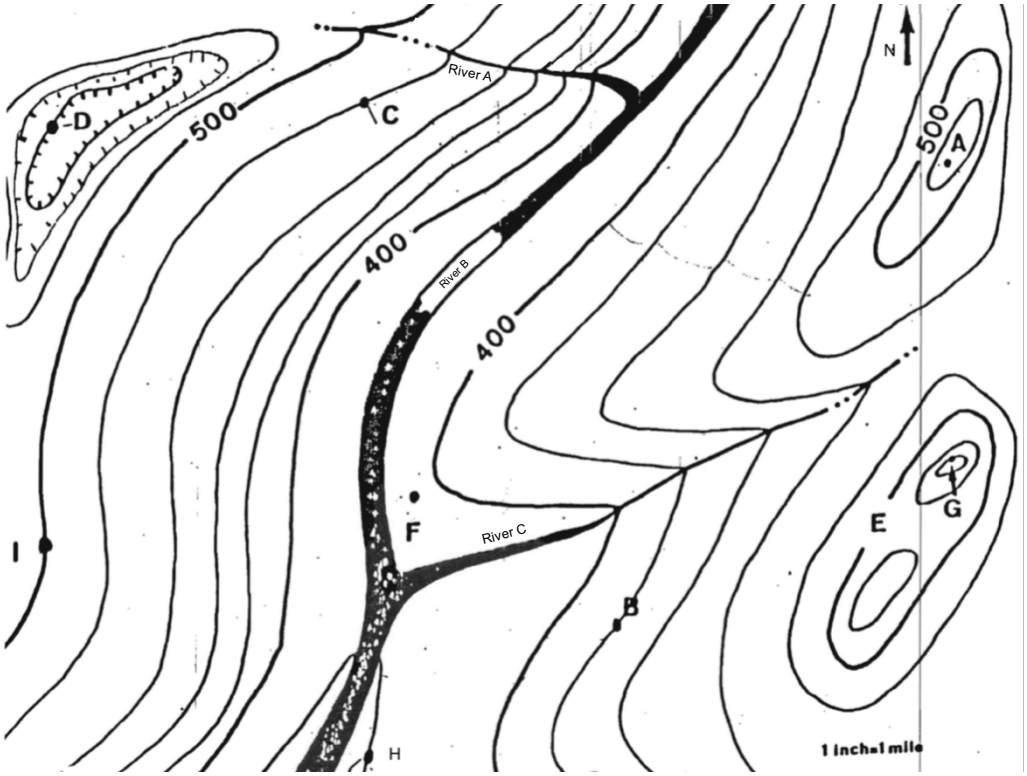
1. The 1 on each map scale represents 1 inch. What unit does 24 000 represent? _____
2. Which is the larger scale map? How do you know? _____
3. Which of the maps covers a larger area? _____
4. What is 1:25,000 in verbal scale? _____

5. How would you convert "1 inch equals 15 miles" to RF scale? _____

Source: http://groundwater.fullerton.edu/Maps,_Scale,_GIS_and_GPS/Guide_to_Map_Scale.html
https://www.hackettstown.org/cms/lib7/NJ01000669/Centricity/Domain/1045/MAP%20PACKET%20C.pdf

Name: _____

Topographic Maps: Practice



1. What is the contour interval of this map? _____ feet
2. Which side of the River B is steeper? _____
3. What is the feature of D? _____
4. What are the elevations for the following features?

   A _____ D _____ G _____

   B _____ E _____ H _____

   C _____ F _____ I _____

5. Which directions of the following streams flow?
   River B _____ River A _____ River C _____
6. How do you know which direction a river is flowing? _____
7. What is the distance between point E and D? _____ miles

Based on: https://www.hackettstown.org/cms/lib7/NJ01000669/Centricity/Domain/1045/MAP%20PACKET%20C.pdf