SECTION 4 Topographic Maps

DISCOVER ACTIVITY

Can a Map Show Relief?

1. Carefully cut the corners off 8 pieces of cardboard so that they look rounded. Each piece should be at least 1 centimeter smaller than the one before.

2. Trim the long sides of the two largest pieces so that the long sides appear wavy. Don't cut any more than one-half centimeter into the cardboard.
3. Trace the largest cardboard piece on a sheet of paper.
4. Trace the next largest piece inside the tracing of the first. Don't let any lines cross.
5. Trace the other cardboard pieces, from largest to smallest, one inside the other, on the same paper.
6. Stack the cardboard pieces in the same order they were traced beside the paper. Compare the stack of cardboard pieces with your drawing. How are they alike? How are they different?

Think It Over

Making Models If the cardboard pieces are a model of a landform, what do the lines on the paper represent?

You are an engineer planning a route for a highway over a mountain pass. You need to consider many different factors. To design a safe highway, you need a route that avoids the steepest slopes. To protect the area's water supply, the highway must stay a certain distance from rivers and lakes. You also want to find a route that avoids houses and other buildings. How would you find the best route? You could start by studying a topographic map.

GUIDE FOR READING

- What is a topographic map?
- How do mapmakers represent elevation, relief, and slope?
- What is the Global Positioning System?

Reading Tip As you read, make a list of main ideas and supporting details about topographic maps.

Mapping Earth's Topography

A **topographic map** is a map showing the surface features of an area. Topographic maps use symbols to portray the land as if you were looking down on it from above. **Topographic maps provide highly accurate information on the elevation, relief, and slope of the ground surface.**

Figure 16 Topographic maps provide the data necessary for the planning of highways, bridges, and other large construction projects.

Math TOOLBOX

Scale and Ratios

A ratio compares two numbers by division. For example, the scale of a map given as a ratio is 1 : 250,000. At this scale, the distance between two points on the map measures 23.5 cm. How would you find the actual distance? Begin by writing the scale as a fraction.

$$\frac{1}{250{,}000}$$

Next, write a proportion. Let d represent the actual distance between the two points.

$$\frac{1}{250{,}000} = \frac{23.5 \text{ cm}}{d}$$

Then write the cross products.

$$1 \times d = 250{,}000 \times 23.5 \text{ cm}$$
$$d = 5{,}875{,}000 \text{ cm}$$

(*Hint:* To convert cm to km, divide d by 100,000.)

Uses of Topographic Maps People find many uses for topographic maps. Businesses use them to help decide where to build new stores, housing, or factories. Cities and towns use them to decide where to build new schools. Topographic maps have recreational uses, too. If you were planning a bicycle trip, you could use a topographic map to see whether your trip would be flat or hilly.

Scale Topographic maps usually are large-scale maps. A large-scale map is one that shows a close-up view of part of Earth's surface. In the United States, most topographic maps are at a scale of 1 : 24,000, or 1 centimeter equals 0.24 kilometers. At this scale, a map can show the details of elevation and features such as rivers and coastlines. Large buildings, airports, and major highways appear as outlines at the correct scale. Symbols are used to show houses and other small features.

Coverage Most nations have a government agency that is responsible for making topographic maps. In the United States, that agency is the U. S. Geological Survey, or USGS. The USGS has produced about 57,000 topographic maps at scales of either 1 : 24,000 or 1 : 25,000. The maps cover all of the United States, except for parts of Alaska. Each map covers an area of roughly 145 square kilometers.

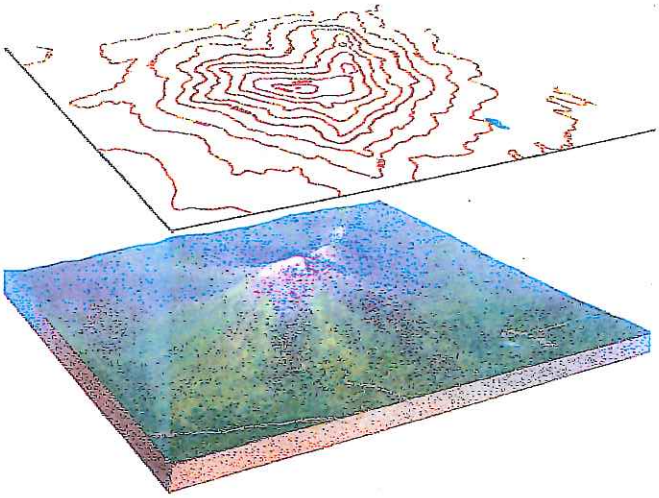
Symbols Mapmakers use a great variety of symbols on topographic maps. If you were drawing a map, what symbols would you use to represent woods, a campground, an orchard, a swamp, or a school? Look at Figure 17 to see the symbols that the USGS uses for these and other features.

Checkpoint *In the United States, what agency is responsible for producing topographic maps?*

Figure 17 Maps made by the U.S. Geological Survey use more than 150 symbols.

Commonly Used Map Symbols

Contour line: elevation	Primary highway	River
Contour line: depression	Secondary highway	Stream
Building	Divided highway	Waterfall or rapids
School; church	Railroad tracks	Marsh or swamp
Built-up area	Airport	Rock or coral reef
Campground; picnic area	Woods	Breakwater; wharf
Cemetery (Cem)	Orchard	Exposed wreck



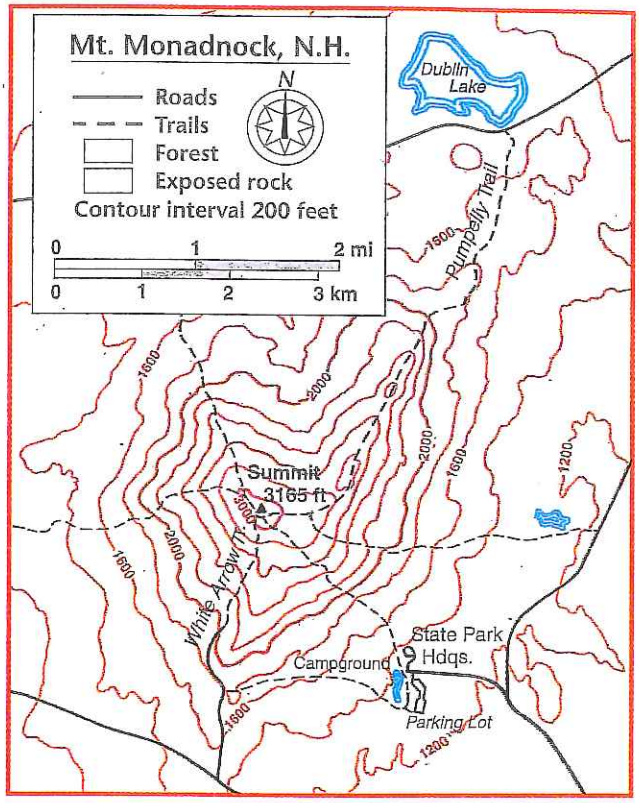


Figure 18 The contour lines on a topographic map represent elevation and relief. ***Comparing and Contrasting*** *What information does the topographic map provide that the photograph does not?*

Showing Relief on Topographic Maps

To represent elevation, relief, and slope on topographic maps, mapmakers use contour lines. On a topographic map, a **contour line** connects points of equal elevation.

The change in elevation from contour line to contour line is called the **contour interval.** The contour interval for a given map is always the same. For example, the map in Figure 18 has a contour interval of 200 feet. If you start at one contour line and count up 10 contour lines, you have reached an elevation 2,000 feet above where you started. Usually, every fifth contour line is darker and heavier than the others. These lines are labeled with the elevation in round units, such as 1,600 or 2,000 feet above sea level. Most USGS maps give contour intervals in feet rather than meters.

Looking at a topographic map with many squiggly contour lines, you may feel as if you are gazing into a bowl of spaghetti. But if you follow the rules listed in *Exploring Topographic Maps* on the following page, you can learn to read contour lines. Reading contour lines is the first step toward "seeing" an area's topography by looking at a topographic map.

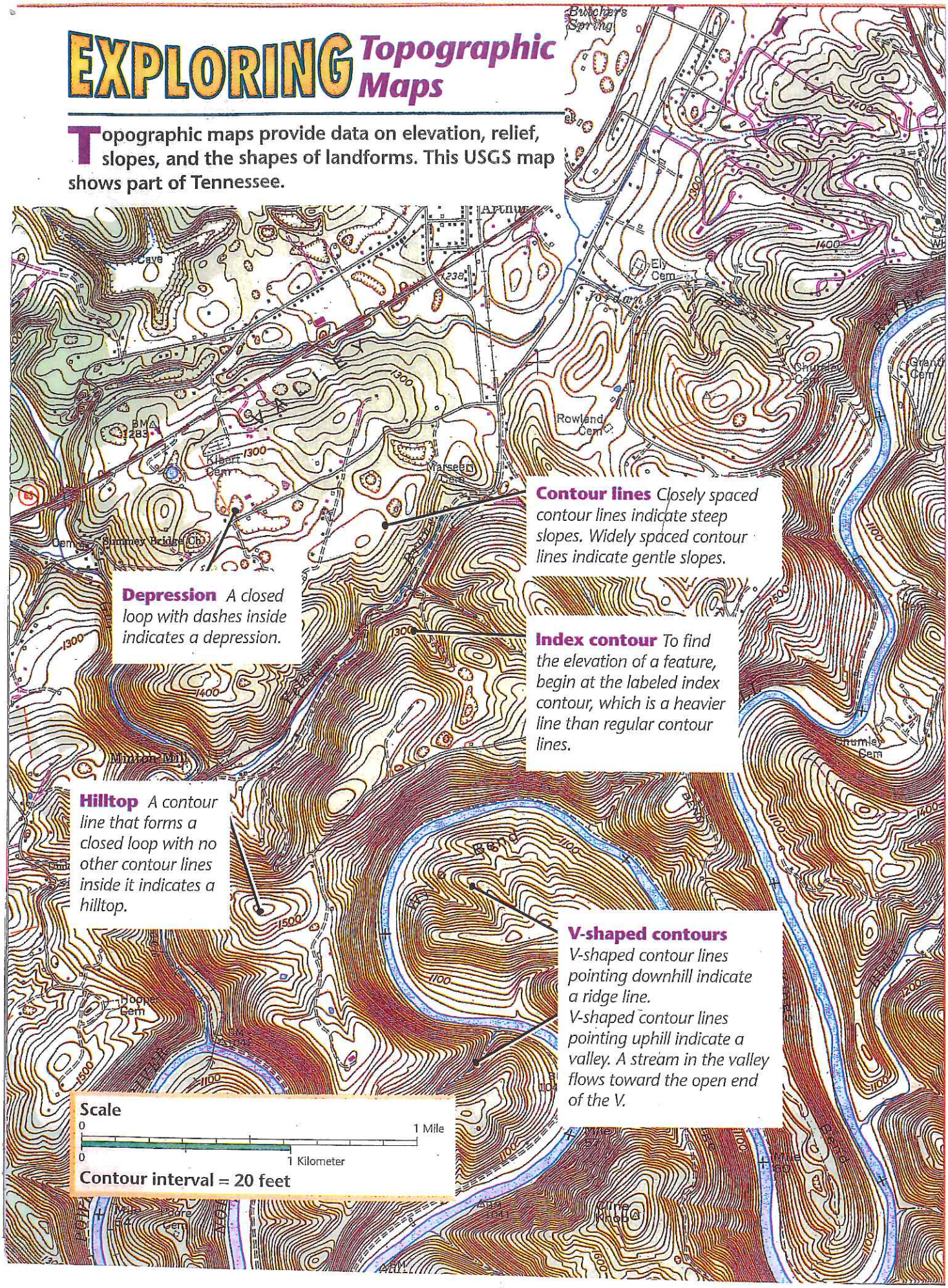
Interpreting Data

ACTIVITY

You are planning to hike up Mt. Monadnock. Use the topographic map in Figure 18 to determine which route is steeper: the White Arrow Trail or the Pumpelly Trail. What is the difference in elevation between the park headquarters and the summit?

EXPLORING Topographic Maps

Topographic maps provide data on elevation, relief, slopes, and the shapes of landforms. This USGS map shows part of Tennessee.



Contour lines *Closely spaced contour lines indicate steep slopes. Widely spaced contour lines indicate gentle slopes.*

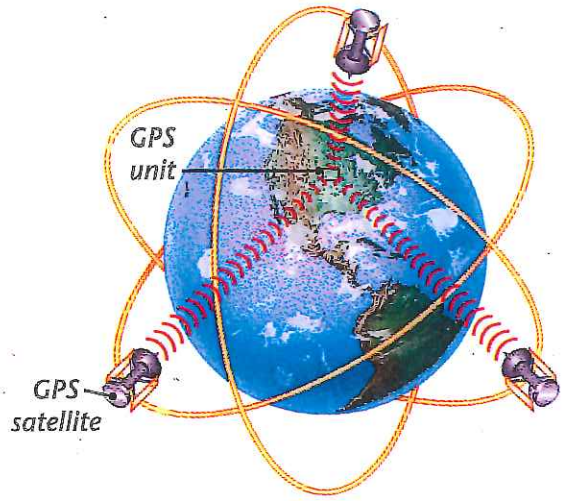
Depression *A closed loop with dashes inside indicates a depression.*

Index contour *To find the elevation of a feature, begin at the labeled index contour, which is a heavier line than regular contour lines.*

Hilltop *A contour line that forms a closed loop with no other contour lines inside it indicates a hilltop.*

V-shaped contours
V-shaped contour lines pointing downhill indicate a ridge line.
V-shaped contour lines pointing uphill indicate a valley. A stream in the valley flows toward the open end of the V.

Scale
0 — 1 Mile
0 — 1 Kilometer
Contour interval = 20 feet



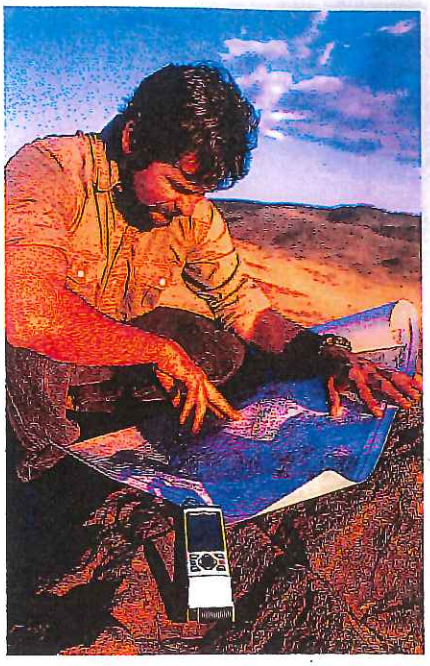


Figure 19 The GPS network includes 24 satellites. Three satellites (left) must be above the horizon to pinpoint the location of the user (right). The user's latitude and longitude appear on the screen of a portable GPS unit like the one in the photograph.

Global Positioning System

INTEGRATING TECHNOLOGY

Today, surveyors, pilots, and mapmakers around the world rely on the **Global Positioning System,** or GPS, to determine locations precisely. **The Global Positioning System is a method of finding latitude, longitude, and elevation of points on Earth's surface using a network of satellites.** At any given moment, there are between five and eight GPS satellites above the horizon in a given area. A hand-held unit the size of a cellular phone picks up signals broadcast by these satellites. A computer inside the GPS unit then calculates the user's location and elevation.

Engineers can use GPS to locate points on the ground for a construction project. Airplanes, ships, and hikers can use GPS to navigate. Some cars now contain both a GPS unit and a digital road map stored in a computer. Using GPS, the computer determines the car's location and suggests a route to your destination.

Section 4 Review

1. What kind of information does a topographic map provide about landforms?
2. How do topographic maps represent elevation and relief?
3. What would the highest and lowest points in an area look like on a topographic map?
4. What is the role of satellites in the Global Positioning System?
5. **Thinking Critically Interpreting Maps** Look at the map on page 38. Where is the highest elevation? Where do you find the steepest slopes? The gentlest slopes?

CHAPTER PROJECT

Check Your Progress

On a large piece of paper, draw your map to scale. Locate all natural and human-made features on the map using the measurements you recorded on your rough sketch and the symbols you brainstormed earlier. Include a north arrow, a legend, and scale on your map. Show the topography of the land by using contour lines or other symbols that show how the land slopes.