Section 4
Maps in Earth Science

Key Concept Topographic and geologic maps include detailed information about Earth's surface and composition.

What You Will Learn
- Contour lines show elevation and landforms by connecting points of equal elevation.
- Geologic maps show the distribution of geologic features in a given area.

Why It Matters
Topographic maps and geologic maps tell scientists important information about the features of Earth's surface.

Imagine that you are going on a camping trip in the wilderness. To be prepared, you want to take a compass and a map. But what kind of map should you take? Because there won't be any roads in the wilderness, you can forget about a road map. Instead, you will need a topographic map.

Topographic Maps
A **topographic map** is a map that shows surface features, or topography (tuh PAHG ruh fee), of an area. Topographic maps show both natural features, such as rivers, lakes, and mountains, and features made by humans. Topographic maps also show elevation. **Elevation** is the height of an object above sea level. The elevation at sea level is 0 m.

Contour Lines
On a topographic map, *contour lines* are used to show elevation. Contour lines are lines that connect points of equal elevation. For example, one contour line would connect points on a map that have an elevation of 100 m. Another line would connect points on a map that have an elevation of 200 m. **Figure 1** illustrates how contour lines show the shape of the landscape.

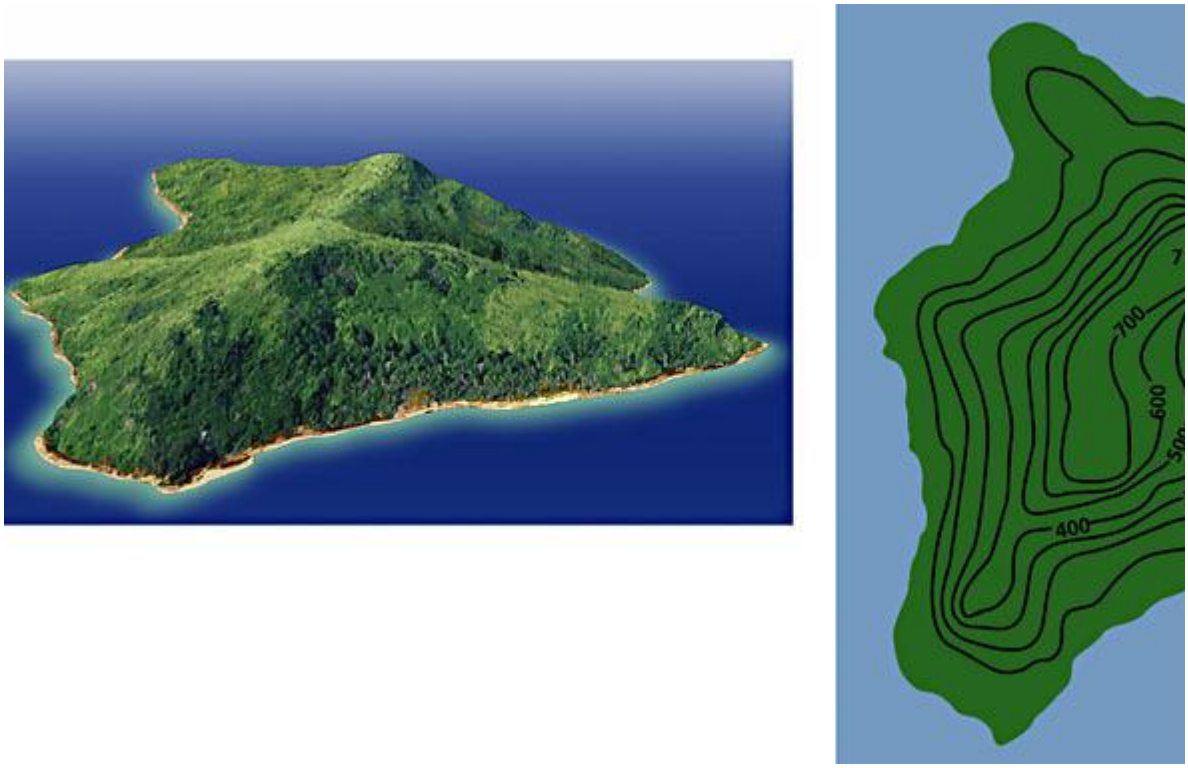


Figure 1 A drawing gives little information about the elevation of the island (left). In the topographic map (right), contour lines have been drawn to show elevation.

Contour Interval

The difference in elevation between one contour line and the next is called the *contour interval.* For example, a map that has a contour interval of 20 m would have contour lines every 20 m of elevation change, such as 0 m, 20 m, 40 m, and 60 m. A mapmaker chooses a contour interval based on the size of the area being mapped and the area's relief.

Relief is the difference in elevation between the highest and lowest points of the area being mapped. For example, the relief of an area that has mountains is high. Therefore, a large contour interval, such as 100 m, would be used. A flat area has low relief. In that case, a small contour interval, such as 10 m, would be used. The spacing

of contour lines also indicates slope, as shown in **Figure 2.** Contour lines that are close together show a steep slope. Contour lines that are spaced far apart show a gentle slope.

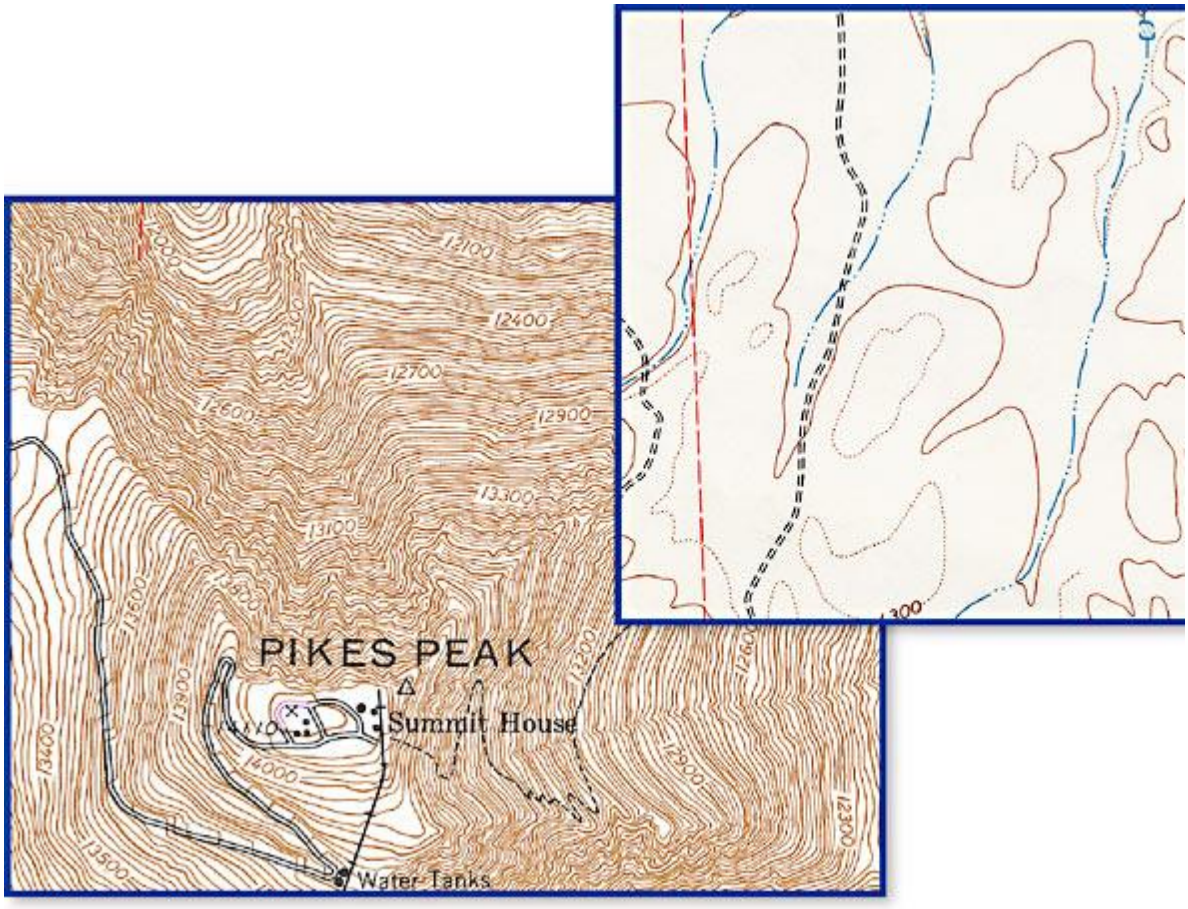


Figure 2 The topographic map on the left shows the steep slopes of Pikes Peak in Colorado. The map above shows a flatter valley in Big Bend Ranch State Park in Texas.

Standards Check How could you use a topographic map to determine the relief of an area?

Index Contour

On most topographic maps, an index contour is used to make reading the map easier. An *index contour* is a darker, heavier contour line that is usually every fifth line and that is labeled by elevation. You can see index contours on both of the topo graphic maps shown in **Figure 2.**

Reading a Topographic Map

Topographic maps, like other maps, use symbols to represent parts of Earth's surface. **Figure 3** shows a topographic map. The legend shows some of the symbols that represent features on the map. Colors are also used to represent features of Earth's surface. In general, buildings, roads, bridges, and railroads are black. Contour lines are brown. Major highways are red. Bodies of water, such as rivers, lakes, and oceans, are blue. Cities and towns are gray or red, and wooded areas are green.

The Rules of Contour Lines

Reading a topographic map takes training and practice. The following rules will help you understand how to read topographic maps:

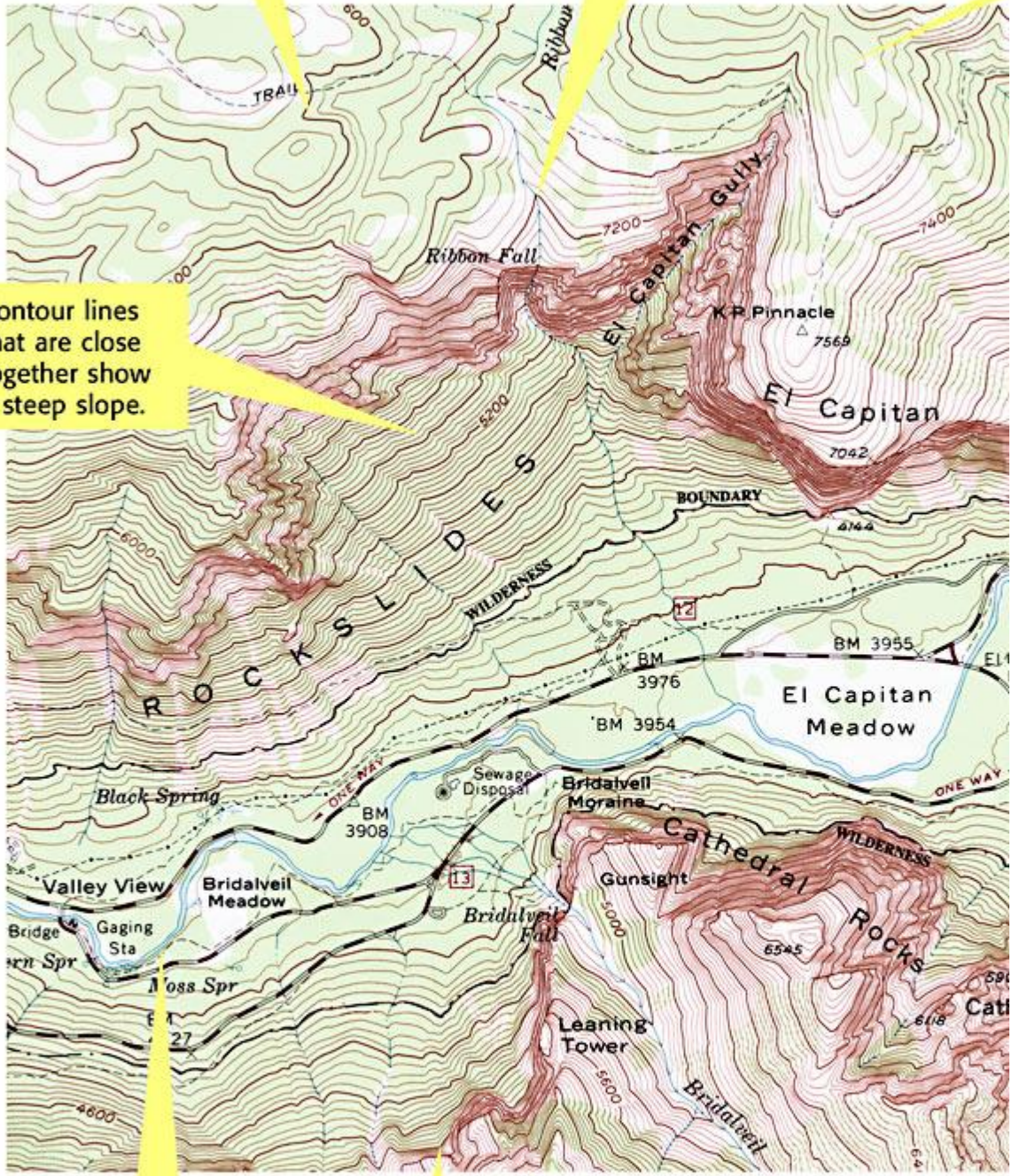
- Contour lines never cross. All points along a contour line represent one elevation.
- Contour line spacing depends on the slope of the ground. Contour lines that are close together show a steep slope. Contour lines that are far apart show a gentle slope.
- Contour lines that cross a valley or stream are V shaped. The V points toward the area of higher elevation. If a stream flows through the valley, the V points upstream.
- The tops of hills, mountains, and depressions are shown by closed circles. Depressions are marked with short, straight lines inside the circle that point downslope to the depression.

Figure 3 Topographic Map of El Capitan

Contour lines that are far apart show a gentle slope.

Contour lines that cross a valley or stream are V shaped. The V points toward the higher elevation.

The to
shown
circles.



Contour lines that are close together show a steep slope.

Rivers and streams are blue.

Contour lines are brown.

Building	■□▨▨	Lake or po
Highway	———	Railroad t
Trail	- - - - - -	Vegetated
Depression	◯	Stream

Geologic Maps

Maps that show the distribution of geologic features in a given area are called **geologic maps**. **Figure 4** shows a geologic map. Geologic features include different types of rocks and rock structures, such as folded, tilted, or broken rocks.

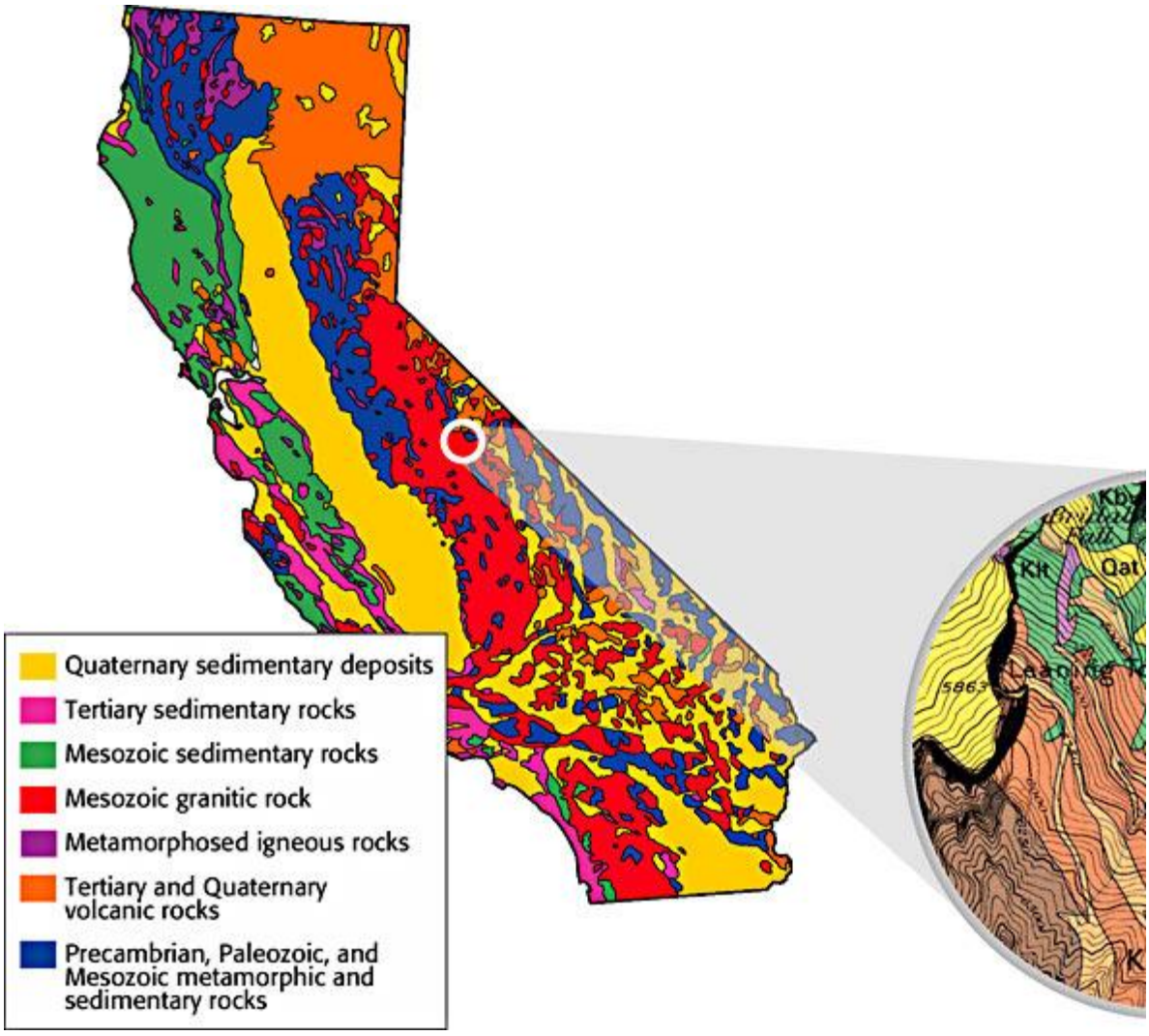


Figure 4 A generalized geologic map of California, such as the one below, shows the major geologic units in the state. The inset is a closeup geologic map of Yosemite

Valley.

Geologists make geologic maps by physically walking over an area. They record on a *base map* bodies of rock and geologic structures that they see. A base map is often a topographic map. Geologists use a topographic map to identify features, such as hills, valleys, and streams. They use those features to help find their location and record information. A base map is commonly printed in light colors or as gray lines so that information on the map is easy to see and understand.

Rock Units on Geologic Maps

The most important features shown on a geologic map are rocks that are seen at the surface of an area. Rocks of a given rock type and age range are called a *geologic unit.* On geologic maps, geologic units are identified by color. Geologic units of similar ages are given shades of colors in the same color family, such as different shades of blue.

Geologists also give each geologic unit a set of letters. This set of letters is commonly a capital letter followed by one or more lowercase letters. The capital letter stands for the age of the rock. The lowercase letters represent the name of the unit or the type of rock. For example, the El Capitan Granite in Yosemite Valley, shown in **Figure 4,** dates to the Cretaceous Period. On geologic maps, a capital *K* (the letter for *Cretaceous*) is placed on rock of the El Capitan Granite. A lowercase *ec* is used to designate the El Capitan rock formation. Therefore, the letter pair *Kec* is used to indicate the El Capitan Granite.

Other Structures on Geologic Maps

Geologic units are not the only geologic features shown on geologic maps. A contact line shows places where two geologic units meet, called *contacts.* In addition, contact lines can be used to identify where rocks have been deformed. The shapes of contact lines indicate where rock layers have been folded. Other symbols are used to show whether rocks are horizontal or tilted. Geologic maps also show the locations of breaks in rocks called *faults.* These structures and many others are recorded on geologic maps.

Standards Check Describe how you could use a geologic map to find a place where rocks have been deformed.

Section Summary

- Contour lines connect points of equal elevation. They are used to show the shape of landforms.
- The contour interval is determined by the size and relief of an area.
- Geologic maps are designed to show the distribution of geologic features in a given area.
- Geologic units are the most important features shown on a geologic map.
- Geologic maps also show places where geologic units meet, where rocks are folded, and where rocks are broken.

Chapter Summary

The Big Idea

Scientists use a variety of tools, including maps, to perform tests, collect data, and display data.

Section 1

Tools and Measurement

Key Concept Scientists must select the appropriate tools to make measurements and collect data, to perform tests, and to analyze data.

- Scientists use tools to make observations, take measurements, and analyze data.
- Scientists have determined standard ways to measure length, area, mass, volume, and temperature.

Graduated cylinders and beakers are used when dealing with volume of fluids.

Section 2
Models in Science

Key Concept Models are ways of representing real objects or processes to make the natural world easier to understand.

- Physical models and mathematical models are two common types of scientific models.
- Theories and laws are models that describe how the universe works.

This orange is a physical model of Earth.

Section 3
Mapping Earth's Surface

Key Concept Maps are tools that are used to display data about a given area of a physical body.

- Maps can be used to find locations on Earth and to represent information about features of Earth's surface.
- Most maps are made from data collected by a process called remote sensing.

Models of Earth use longitude as one way to reference location.

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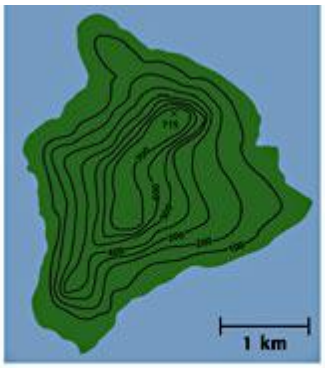

A topographic map uses contour lines to show changes in elevation.