

Chapter 15

Landscapes



NEW YORK'S NATURAL WONDERS

New York is not one of the largest states of the United States, nor does it have any large national parks to rival Yosemite or the Grand Canyon. But nearly every part of the state has unique and beautiful natural wonders. No matter where you live in New York, inspiring features of geologic interest are no more than an hour or two away.

For example, Niagara Falls is a broad sweep of thundering water that carries the outflow of four of the world's largest freshwater lakes over a 60-meter plunge. Other spectacular waterfalls include Taughannock Falls north of Ithaca and Kaaterskill Falls at the eastern margin of the Catskills.

The beaches of Long Island offer miles of white sand and pounding surf. And the freshwater beaches in the Finger Lakes and the Adirondack Mountains are famous for their scenic and recreational value. The Genesee River Gorge south of Rochester has impressive cliffs hundreds of meters high. Other gorges in the southern Finger Lakes region and along the Ausable River in the Eastern Adirondacks provide equally impressive experiences with their varied erosional forms.



Figure 15-1 The Hudson River passes through the Hudson Highlands near the center of this photograph. Many people consider this part of the Hudson one of the most scenic river passages in the nation.

The high peaks of the Adirondacks and natural limestone caverns of the Catskills are scenic travel destinations. The passage of the Hudson River through the Hudson Highlands (Figure 15-1) and cliffs of the Palisades make the Hudson one of America's most scenic rivers.



WHAT ARE LANDSCAPES?

A landscape is the general shape of the land surface. Landscapes include a variety of topographic features related to the processes that shaped the surface. For example, New York's glaciated landscapes include such diverse landforms as U-shaped valleys; rounded, grooved, and polished bedrock surfaces; drumlins and moraines. A landform is a single feature of a landscape. Landscapes are generally made of a variety of related landforms such as mountains, valleys, and river systems. Geological structures are major influences on landscapes. Figure 15-2 on page 342 shows how folding affects a landscape. Most land areas can be divided into regions that have similar landforms.



Figure 15-2 Folds in the rock layers have played an obvious role in shaping this Utah landscape.

ACTIVITY 15-1 LOCAL LANDFORMS

Collect or take photographs of notable landforms in and near your community. You can use original photographs, travel brochures, or images from the Internet. For each landform, write one to four sentences about the processes that formed it.

Most geologists think of a landscape as the product of geological events over hundreds, thousands, or even millions of years. Some events are building processes such as uplift, volcanic eruptions, and glacial deposition. Other equally important events, such as weathering and erosion, wear down the land surface. Therefore, landscapes are the surface expressions of opposing geological processes.



Plains

Most landscape regions can be classified as plains, plateaus, or mountains. Figure 15-3 shows New York State has examples of all three. **Plains** are usually relatively flat. That is, the range of elevations is small. Hill slopes are gentle and streams commonly meander over broad floodplains.

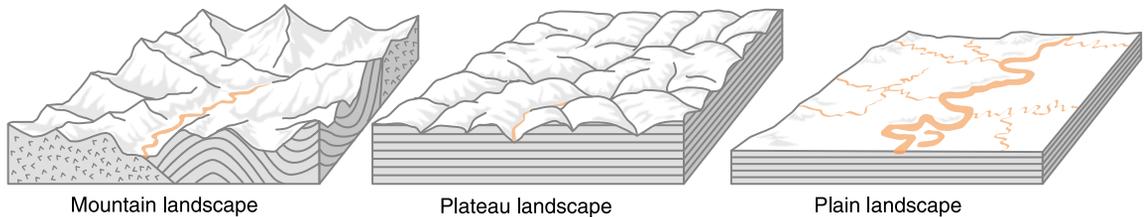


Figure 15-3 Based on their elevation and underlying bedrock structure, most landscapes can be classified as plains, plateaus, or mountains. Mountain landscapes have the greatest differences in elevation, reflecting their variable rock types and complex structures. The lower relief of plateaus and plains may be due to long-term erosion, or it may be due to flat-lying, sedimentary rocks.

The bedrock underlying plains can be any kind of rock that has been in place long enough to be eroded to a low level. Shale and other layered sedimentary rocks are especially common in plains landscapes. Soils tend to be thick and stable due to the low gradients. Much of the Mississippi Valley and central part of the United States is a plains landscape that is mostly underlain by flat layers of relatively soft sedimentary rock.



Plateaus

Plateau landscapes have more relief than plains but they are not as rugged as mountain landscapes. **Relief** is the difference in elevation from the highest point to the lowest point on the land surface. Some sources use the term tableland as a synonym for plateau. Indeed, some plateaus look like relatively level areas that are nearly as flat as plains but at a much higher elevation.

Parts of the Colorado Plateau of Arizona and Utah look like a plains landscape that has been pushed up more than 1000 meters. The Columbia Plateau of eastern Oregon was built up by fluid lava flows that spread over great distances. Flat-lying, sedimentary rocks underlie most plateaus, including the Colorado Plateau.

Landforms in the eastern part of the United States are generally more rounded than those in dryer areas of the West. Therefore, the Appalachian Plateau, the largest plateau in the eastern United States, is mostly a region of rolling hills.

Figure 15-4 These mountains in Alaska shows the great differences in elevation in mountain landscapes, which are often a result of differences in rock types and complex geologic structures.



Mountains

Mountain landscapes have the greatest relief. Figure 15-4 shows a rugged mountain region in Alaska. Variations in rock types, which are common in mountain areas, often include hard metamorphic and igneous rocks as well as weaker kinds of rock. The harder rocks are usually found in the highest areas, and the weaker rocks have been eroded to make deep valleys.

Tectonic uplift and deformed rock structures such as folds and faults contribute to the complexity and relief of mountain landscapes. A close look at the rocks in any major mountain area, such as the Rockies, the Alps, or the Himalayas, is likely to reveal a complex geologic history and a wide variety of rock types. Figure 15-5 shows the major landscape regions of the United States.



WHAT FACTORS INFLUENCE LANDSCAPE DEVELOPMENT?

The factors that influence landscapes are geologic and climatic. Geologic factors include crustal movement, rock type, and geologic structures. The major climatic factor in landscape development is the annual precipitation.

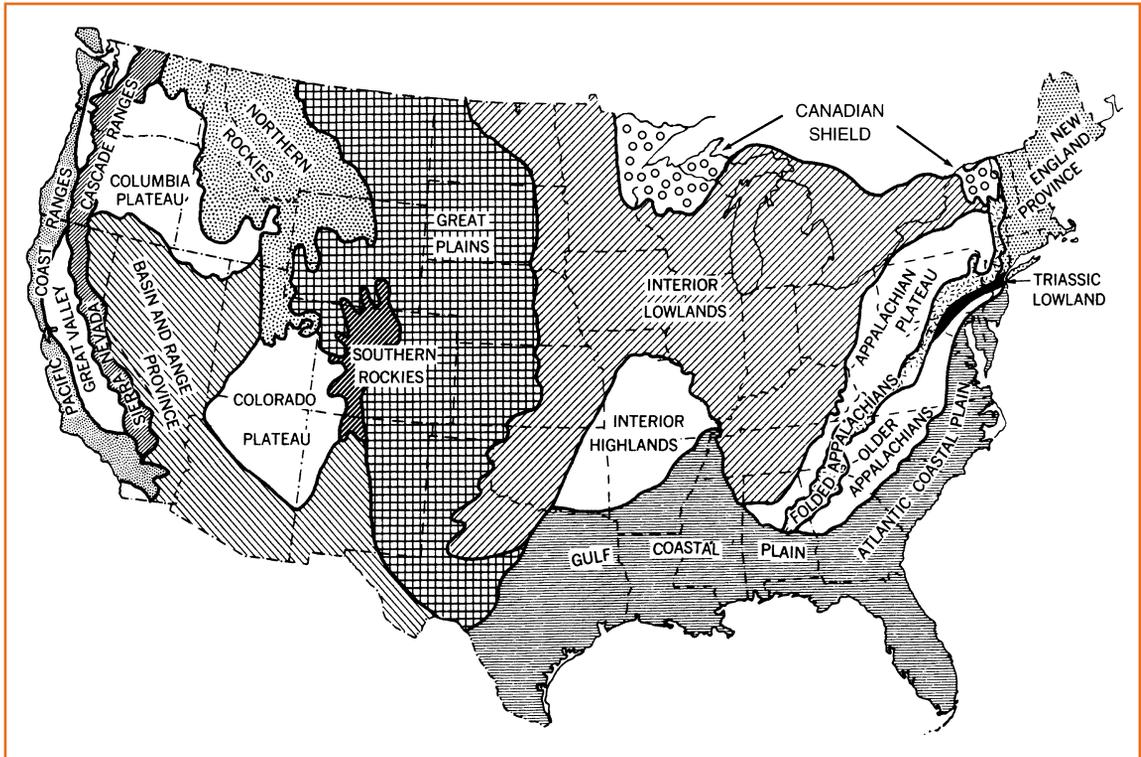


Figure 15-5 Landscape regions of the United States include plains, plateaus, and mountains.



Geologic Factors

Among geologic factors, vertical movement of Earth's crust is very important. Where Earth's crust is being pushed up, high peaks and deep valleys characterize young mountain ranges, such as the Himalayas of Asia. Rapid uplift and steep slopes also result in rapid erosion. Rivers that drain the great Himalayas carry more sediment into the oceans than rivers from any comparable area of Earth's surface.

The characteristics of rock types, especially their resistance to weathering and erosion, are very important in landscape development. The hardest rocks of any area usually are found at the highest land elevations. In places where some bedrock is more resistant to weathering and erosion than others, ridges tend to follow the hardest rock types. Valleys

in these areas generally follow the softer and/or fractured rock.

A major landform called the Niagara Escarpment runs from the Niagara River south of Lake Ontario across much of western New York State. An **escarpment** is a steep slope or a cliff of resistant rock that marks the edge of a relatively flat area. The Niagara Escarpment, which separates the lowlands along Lake Ontario from higher land to the south, owes its existence to a particularly hard sedimentary rock known as the Lockport Dolostone. (Dolostone is a sedimentary rock similar to limestone but with a slightly different mineral composition.) The Helderberg escarpment southwest of Albany and the steep eastern front of the Catskill Mountains are other notable New York State escarpment landforms. Figure 15-6 is a view across the Hudson River Valley toward the Catskill Mountains in the distance.

Geologic structures also influence landscapes. The Hudson Highlands, about 30 km north of New York City, is a block of Earth's crust that has been pushed up. (This can be seen in the background in Figure 15-1 on page 341.) The Highlands are bounded by geologic faults to the north and south. In addition, the Adirondack Mountains have been pushed up into a broad dome structure. The waves of hills of the Appalachian Plateau north of Harrisburg, Pennsylvania, are the direct results of large folds in the bedrock caused by compression of the crust. Faults are zones of crushed bedrock along which rel-



Figure 15-6 Looking west across the Hudson Valley. The Catskill escarpment, which marks the edge of the Catskill Mountains, is visible in the distance.

ative movement has occurred. These lines of weakened rock influence the course of streams and enable rapid erosion. The zigzag route of the Hudson River through the Hudson Highlands is probably a result of erosion along geologic faults. Faulting also controls the direction of many northeast-flowing streams in the high peaks region of the Adirondack Mountains.



Climate Factors

Climate is the other major factor in landscape development. A humid climate favors chemical weathering, which produces rounded, less angular landforms. Most of the hill slopes of New York State are rounded and gentle because of the relatively humid climate. A moist climate also allows plants to grow and protect soil from erosion. Desert areas sometimes have a steplike profile, with flat hilltops and terraces separated by steep escarpments. Figure 15-7 is a desert area in southern Utah. Notice the cliffs and terraces that make up most of this landscape. Figure 15-8 on page 348 illustrates the contrast between the rounded shapes of a humid landscape and the angular features of many desert landscapes.

The climate of New York State does not change very much from place to place. All of New York has a moist, temperate, mid-latitude climate. Therefore the landscape differences in New York State are not the result of differences in climate.

Figure 15-7 The angular, stepped profile of this area in Utah is due partly to the dry climate. With little plant cover, soil is washed away in summer thunderstorms, leaving steep rocky slopes.



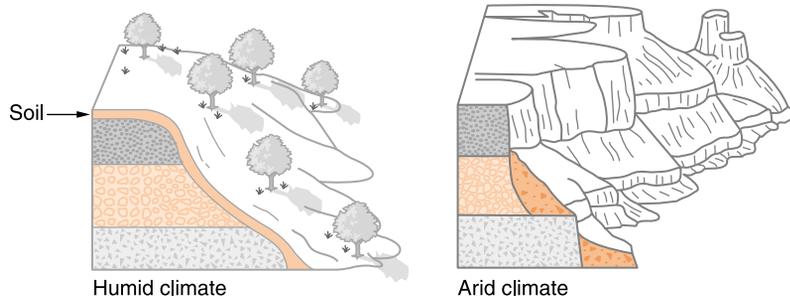


Figure 15-8 Landforms in humid climates are generally more rounded than those in desert regions. In arid climates, there are few plants to hold soil in place, so weak rocks are exposed to rapid erosion and slopes are more stepped and angular.

The variations seen in the New York landscape are caused by geological factors.



WHAT ARE THE LANDSCAPES OF NEW YORK STATE?

Figure 15-9 is the Generalized Landscape Regions map from the *Earth Science Reference Tables* that shows the landscape regions of New York State. This map can be used along with the Generalized Bedrock Geology map also in the *Reference Tables* to locate cities and other geographic features on the landscape map. For example, looking at the landscape region map and the bedrock geology map you can see that Watertown, Oswego, and Rochester are located in the Erie-Ontario Lowlands.

For such a small geographic region with a relatively uniform climate, New York has a remarkable variety of landscapes including plains, plateaus, and mountains. The boundaries between landscape regions are sometimes remarkably sharp and easy to see. For example, the eastern front of the Catskills is marked by a dramatic change in elevation from the lowlands along the Hudson River to a landscape nearly 1000 meters higher to the west. (See Figure 15-6 on page 346.) The Hudson Highlands are an uplifted block of land bounded by fault scarps both to the north and

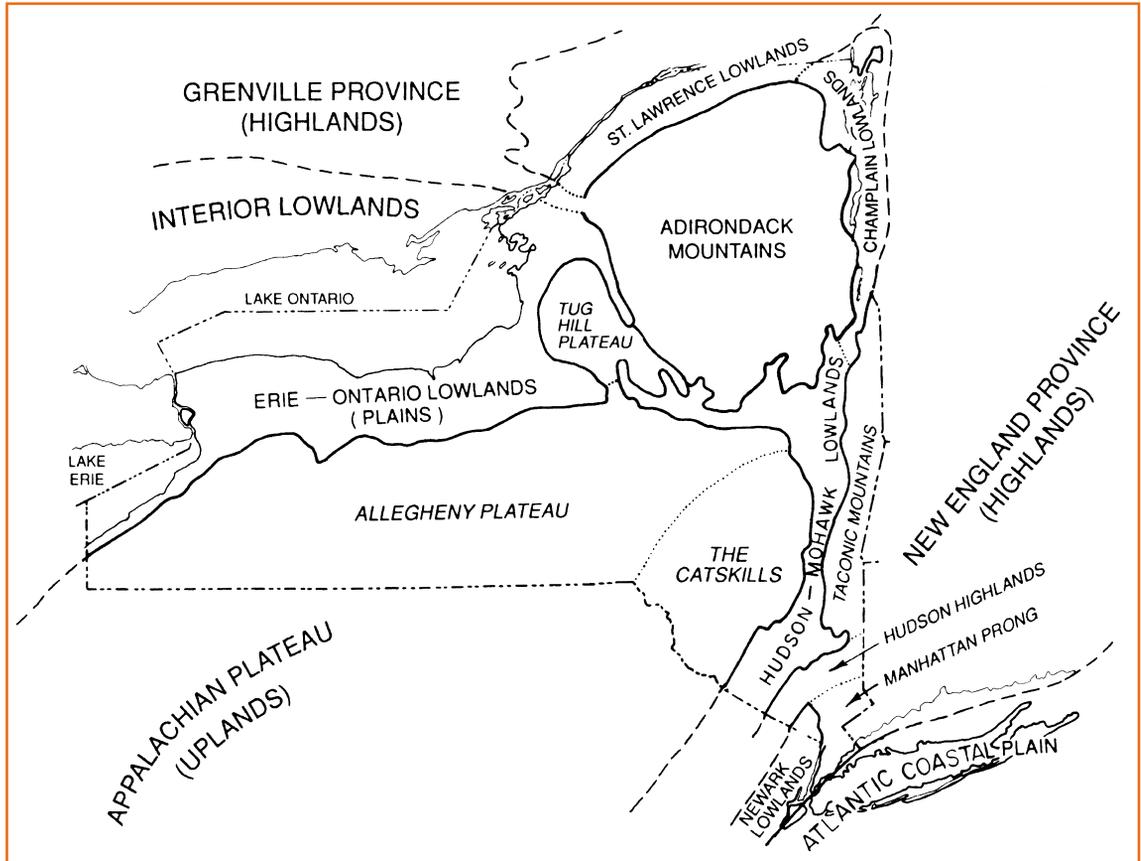


Figure 15-9 The landscape regions of New York include plains, plateaus, and mountains. In addition, there are several regions difficult to classify. Boundaries between landscape regions often follow changes in elevation and rock types.

to the south. However, the long boundary between the Allegheny Plateau and the Erie-Ontario Lowlands in western New York is more subtle, and the exact position of the transition is not easy to see in most places.

ACTIVITY 15-2 LANDSCAPE BOUNDARIES

If you live near a landscape boundary, draw that boundary on a local road map. In what ways does the land look different on the two sides of the boundary?



Long Island

A tour of New York State might start at the eastern end of Long Island where glacial moraines give this part of the island its split, fish-tail shape as seen on maps. Two moraines, which mark the most southerly advance of the recent continental glacier, dominate Long Island. These moraines form east-west lines of low hills on an otherwise low-lying and flat plains landscape largely composed of sandy outwash sediments. Wind, longshore currents, and wave action deposit and shape the sandy beaches and dunes along the south shore.

On Long Island, only the western end is hard metamorphic bedrock visible at the surface. This is within the boundaries of New York City, which also includes the bedrock islands of Manhattan and Staten Island as well as the Bronx, which is built on the bedrock mainland of North America.



The Hudson Valley

Continuing the journey upstream along the Hudson River, a traveler passes between the low region of the Newark Basin mostly hidden behind the higher cliffs named the Palisades and the rolling hills along the eastern side of the river. The Palisades themselves are composed of shallow intrusive igneous rock with a dark composition similar to basalt. Figure 15-10 shows the northern part of the Palisades.

Figure 15-10 The Palisades is a shallow igneous intrusion that forms cliffs along the western shore of the Hudson River. The cliffs extend from the New Jersey shore opposite New York City northward about 50 km into New York State.



Mostly on the east side of the Hudson River, the Taconic Mountains, the Hudson Highlands, and the Manhattan Prong are all underlain by very old metamorphic rock. This old rock gives them a complex landscape, but mostly without the steep slopes and high peaks of a true mountain landscape.



The Catskills-Allegheny Plateau

The Catskills rise above the western edge of the Hudson Valley. Although they are sometimes called the Catskill Mountains and they include some of the highest elevations in New York State, the Catskills are underlain by flat layers of sedimentary rock with rounded and even relatively flat summits. The Catskills are the higher, eastern end of the Allegheny Plateau, a large region of rolling hills that extends nearly to Lake Erie at the western end of the state. The Allegheny Plateau, an extension of the Appalachian Plateau, contains the Finger Lakes as well as other valleys deepened and U-shaped by the advancing continental glaciers.



Plains

Lakes Erie and Ontario, two of North America's Great Lakes, are bordered by a plains landscape that includes drumlins and other features of the ice ages. Local soils have a good mix of minerals due in part to the abundance of glacial till carried south from Canada. The lakes moderate the nearby climate of this agricultural region, extending the growing season. This plains landscape extends along the St. Lawrence River and around the Adirondack Mountains to join the valleys of the Hudson and Mohawk rivers.



Tug Hill Plateau and Adirondacks

Two landscape regions remain. The Tug Hill Plateau is a remote and sparsely populated highland that receives the greatest winter snowfalls in New York State.

The Adirondacks is New York's best example of a true mountain landscape. The land was pushed up onto a broad dome exposing at the surface ancient metamorphic rocks that were formed deep underground. Faulted stream valleys contribute to the mountain relief. The highest point in the state, Mt. Marcy, and some of the most scenic lakes are located in this region. Tourism is the mainstay of the economy since the area is too rugged and cold for good farming and it is too remote for commerce.

ACTIVITY 15-3 LANDFORMS OF NEW YORK STATE

As a class, collect photographs from individuals, from travel brochures, or from the Internet, and attach them at their appropriate place on a large wall map of New York State. Select photographs that show landforms characteristic of the various landscape regions of New York.

A similar project can be conducted collecting photographs of landform in the United States and placing them on a map of the United States.

TERMS TO KNOW

**escarpment
landform
landscape**

**mountain landscape
plains**

**plateau
relief**

CHAPTER REVIEW QUESTIONS

- Which kind of landscape is not likely to be underlain by flat lying sedimentary rocks?
 - lowlands
 - plains
 - plateaus
 - mountains

2. What kind of landscape region is often characterized by flat-lying layers of sedimentary rock that have been uplifted by forces within Earth without major folding and faulting, and then eroded to form deep stream valleys?
- (1) plains (3) mountains
(2) plateaus (4) coastal lowlands
3. The table below describes three landscape regions of the United States.

Landscape	Bedrock	Elevation/Slopes	Streams
A	Faulted and folded gneiss and schist	High elevation, steep slopes	High velocity, rapids
B	Layers of sandstone and shale	Low elevation, gentle slopes	Low velocity, meanders
C	Thick, horizontal layers of basalt	Medium elevation, steep to gentle slopes	High to low velocity, Rapids and meanders

Which choice below best identifies landscapes A, B, and C?

- (1) A—mountain, B—plain, C—plateau
(2) A—plain, B—plateau, C—mountain
(3) A—plateau, B—mountain, C—plain
(4) A—plain, B—mountain, C—plateau
4. In which part of the United States would you be most likely to find thin soils and steep, rocky slopes?
- (1) the Great Plains of Kansas and North Dakota
(2) the coastal plains of Florida and Louisiana
(3) the hills of the Appalachian Plateau
(4) the desert plateaus of Utah and Arizona

Base your answers to questions 5–15 on the *Earth Science Reference Tables*.

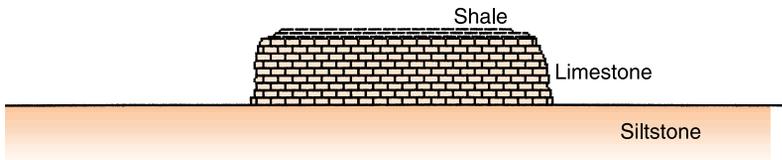
5. In the 1800s the Erie Canal was built from from the Albany area through Utica and Syracuse, then just south of Rochester to Buffalo. What landscapes did the canal follow?
- (1) The canal was built primarily through valleys in mountain landscapes.
(2) The canal was built mostly through plateau landscapes.
(3) The canal was built across plains landscapes whenever possible.
(4) The canal connected all the landscape regions of New York State.

6. Within New York State, the Genesee River and the Susquehanna River flow mostly through which landscape region?
- (1) the Hudson-Mohawk Lowlands (3) the Allegheny Plateau
(2) the Atlantic Coastal Plain (4) the Adirondack Mountains
7. Tilted, metamorphosed bedrock is typically found in which New York State landscape region?
- (1) Taconic Mountains (3) Tug Hill Plateau
(2) Atlantic Coastal Plain (4) Erie-Ontario Lowlands
8. The Catskills are actually a part of what larger landscape region?
- (1) the Adirondack Mountains (3) the Allegheny Plateau
(2) the New England Highlands (4) the Manhattan Prong
9. What is the smallest distance from the southern boundary of the Adirondack Mountains landscape to the northern boundary of the Allegheny Plateau?
- (1) approximately 10 km (3) approximately 100 km
(2) approximately 50 km (4) greater than 200 km
10. Which two locations are in the same New York State landscape region?
- (1) Albany and Old Forge
(2) Massena and Mt. Marcy
(3) Binghamton and New York City
(4) Jamestown and Ithaca
11. Buffalo, New York, and Plattsburgh, New York, are both located in landscape regions classified as
- (1) highlands. (3) plateaus.
(2) lowlands. (4) mountains.
12. It is feared that global warming could melt the polar ice caps and cause sea level to rise. Which part of New York State would most likely be flooded if this were to occur?
- (1) Allegheny Plateau (3) Adirondack Mountains
(2) Erie-Ontario Lowlands (4) Atlantic Coastal Plain

13. In which New York State landscape region is surface bedrock generally composed of metamorphic rock?
- (1) Tug Hill Plateau (3) Newark Lowlands
(2) Adirondack Mountains (4) the Catskills
14. What landscape region is located at 44°N latitude, 74°W longitude?
- (1) Allegheny Plateau (3) Adirondack Mountains
(2) Erie-Ontario Lowlands (4) Atlantic Coastal Plain
15. Which town or city is located within the New York State landscape region with the greatest difference in elevation from the highest to the lowest land levels?
- (1) Buffalo (3) Old Forge
(2) Rochester (4) Massena

Open-Ended Questions

16. How can a plains landscape change to a mountain landscape through time?
17. What kind of landscape is usually found where many types of bedrock have been folded and faulted?
18. The diagram below is a profile of a hill in a desert region. If the climate of the region were to become humid over a long time, such as the climate in New York State, what would the shape of the hill be in several thousand years? Draw a new profile in which erosion has taken place, but the maximum height of the hill is the same.



19. The Appalachian Plateau is a major landscape region of the United States. What two New York State landscape regions are parts of the Appalachian Plateau?
20. If you took an overland journey from Binghamton, New York, to Oswego, New York, what general change would you see in the topographic relief as you travel northward?