

Hiking High and Low

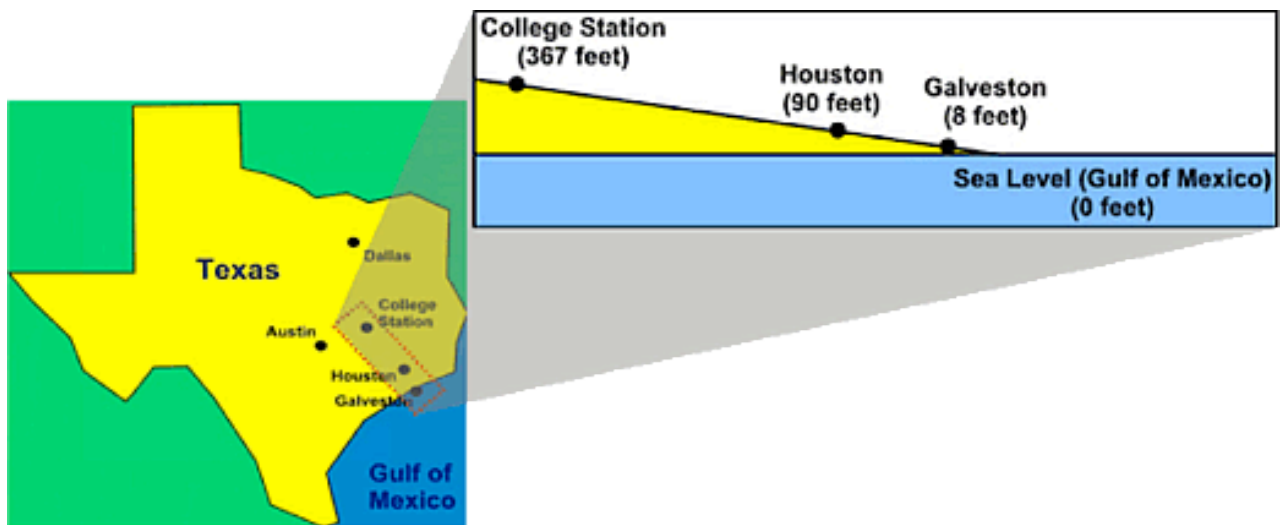


You have learned how to add and subtract positive and negative numbers. As you complete this project, you will discover how positive and negative numbers are used in hiking guides to describe changes in elevation.

WHAT IS ELEVATION?

Because you cannot see the ocean from your classroom, you may not realize that your school could be hundreds to thousands of feet higher than the level of the ocean. The height of any place on land above sea level is called its elevation.

Look at this map and diagram of Texas. When we measure elevation we are measuring from sea level , therefore sea level itself is called “0 feet”. As the land rises above sea level, the elevation increases. The town of College Station is 367 feet above sea level, while the town of Galveston is only 8 feet above sea level.



UNDERSTANDING CHANGE IN ELEVATION

Now, imagine that you drive from Galveston to Houston. Because you start at an elevation of 8 feet, and you end at an elevation of 90 feet, you have experienced an increase in elevation of 82 feet.

Therefore, scientists would say that you have experienced an elevation change of 82 feet. Notice that, in this case, 82 is a positive number because your elevation has increased by 82 feet.

What if you drove from College Station to Houston? Now, your elevation would decrease, instead of increasing. In this case, you began at 367 feet above sea level, and you descended to 90 feet above sea level. Therefore, scientists would say that you have experienced an elevation change of -277 feet. Notice that, in this case, 277 is a negative number because your elevation has decreased by 277 feet.

$$\text{Elevation Change} = \text{Final Elevation} - \text{Starting Elevation}$$

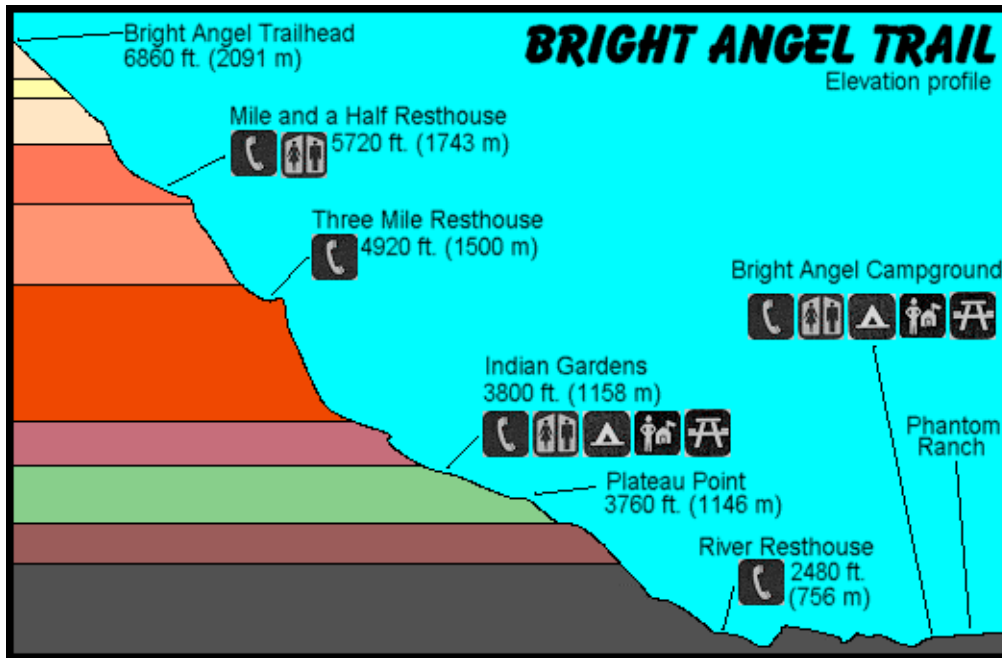
Change in elevation is equal to the final elevation minus the starting elevation.

Therefore, *increases in elevation will be positive numbers*
and *decreases in elevation will be negative numbers*.

CALCULATING ELEVATION CHANGE

The diagram below is a part of a hiking guide for Bright Angel Trail in the Grand Canyon. Notice that it shows the contour, or shape, of the land by using a cross-section. This type of diagram is known as an elevation profile. This elevation profile also labels special features along the trail and marks their

elevation above sea level in both feet and meters. Use this diagram to answer the questions below.



1. If you hiked from Indian Gardens to Three Mile Resthouse would your elevation increase or decrease?
2. Calculate the exact change in elevation, in feet, for a hike from Indian Gardens to Three Mile Resthouse. Show your calculation.
3. If you hiked from Bright Angel Trailhead to Three Mile Resthouse would your elevation increase or decrease?
4. Calculate the exact change in elevation, in feet, for a hike from Bright Angel Trailhead to Three Mile Resthouse. Show your calculation.
5. In a hiking guidebook you read the descriptions of several hikes. You have decided to go on the hike with an elevation change of -1280 feet. (Notice that this is a negative elevation change.) Based on this information, where will you be starting and ending your hike?
6. In general, which hikes would be less difficult: those with positive elevation changes or those with negative elevation changes? Explain.

HIKING GUIDEBOOKS

Hiking guidebooks provide written descriptions of hikes. These written descriptions help hikers choose hikes that are appropriate for their skill level. They also help hikers make detailed plans for their hike, by providing information such as: the amount of time a hike will probably take, a map of the route, and a list of features found along the trail.

Hiking guidebooks often tell the elevation change between certain points along the hike. This information helps hikers know whether most of the hike is uphill or downhill. It also helps them understand how difficult the hike will be. Look at the sample hike descriptions below. These descriptions are from real hiking guidebooks. Use them to answer the questions. As you read, watch for information telling about elevation.

HIKE TO TITUS CANYON

Death Valley National Park, California

This 26-mile, one-way road through Titus Canyon begins at Ranger Station #26 (just off Nevada Highway 374) at an elevation of 3,400 feet. The trail then climbs west, crossing the California border at 5,250 feet. It then descends through steep, narrow canyons and twisted rock layers to cross an alluvial fan and emerges onto the floor of Titus Canyon at an elevation of 200 feet. Due to problems related to severe heat, this hike should only be attempted between November and February. Be sure to take a minimum of 2 liters of water for each hiker.

1. Fill in the chart below to show the elevation of each point along the hike.

Landmark	Elevation
Ranger Station #26 (Start of Hike)	
Trail Crosses California Border	
Floor of Titus Canyon (End of Hike)	

2. As you hike from Ranger Station #26 to the California border, are you hiking uphill or downhill? How do you know?

3. Calculate the exact change in elevation from Ranger Station #26 to the California border. Think about whether this number should be positive or negative.
4. As you hike from the California border to the floor of Titus Canyon, are you hiking uphill or downhill? How do you know?
5. Calculate the exact change in elevation from the California border to the floor of Titus Canyon. Think about whether this number should be positive or negative.
6. As you read, notice that this guidebook uses both positive and negative elevation change in its description.

HIKES IN THE ANGELES NATIONAL FOREST

Pasadena, California

Hike 13, Big Tujunga to Grizzly Flat and Vasquez Falls. This hike is 5 miles roundtrip. The start of the trail is reached by taking Foothill Boulevard in Sunland to Mount Gleason Avenue, which becomes Big Tujunga Canyon Road. In 7.25 miles you reach a parking lot on the left. The elevation of the parking lot is 1840 feet.

Begin hiking by following the dirt road, ford the stream if the water is not too high, and work your way upstream, fording the stream two more times. About one mile from the start, at the point where the Big Tujunga Creek changes its course from southwest (upstream) to northwest (downstream) look for a wide, flat bridge crossing the stream. The change in elevation between the parking lot and the bridge is 300 feet. There is an additional elevation change of 620 feet between the bridge and Grizzly Flat, which is 2 miles farther down the trail. Cross Grizzly Flat heading northeast to Vasquez Falls, reached in 0.25 mile.

The condition of the trail after Grizzly Flat may be poor. Think underbrush, including extensive poison oak, makes the trail undesirable to some hikers. Should you choose to proceed, follow the trail an addition 0.75 miles to Vazquez Falls. Expect an elevation change of -240 feet between Grizzly Flat and Vazquez Falls.

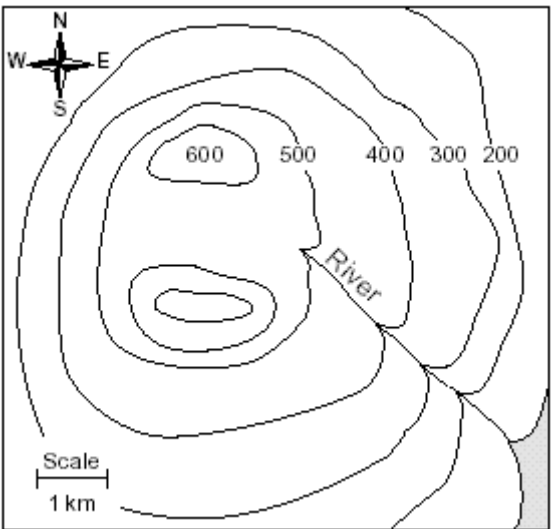
1. Use the chart below to record and organize the elevation information given to you in this description.

Section of Hike	Starting Elevation	Elevation Change	Final Elevation
Parking Lot → Bridge	1840 feet	+300 feet	
Bridge → Grizzly Flat			
Grizzly Flat → Vazquez Falls			

2. Which sections of the hike are downhill and which are uphill? How do you know?
3. After you have reached Vazquez Falls, you will need to hike back to your car, which you left in the parking lot. On the return trip, what will the elevation change be between Vazquez Falls and Grizzly Flat? Use words, pictures, and math to explain your answer.

TOPOGRAPHIC MAPS

Another way that scientists illustrate the elevation of land is by using topographic mapping. On a topographic map, the elevation of the land is shown using contour lines. A curved line is drawn connecting all of the points that have the same elevation. Look at the small topographic map below.



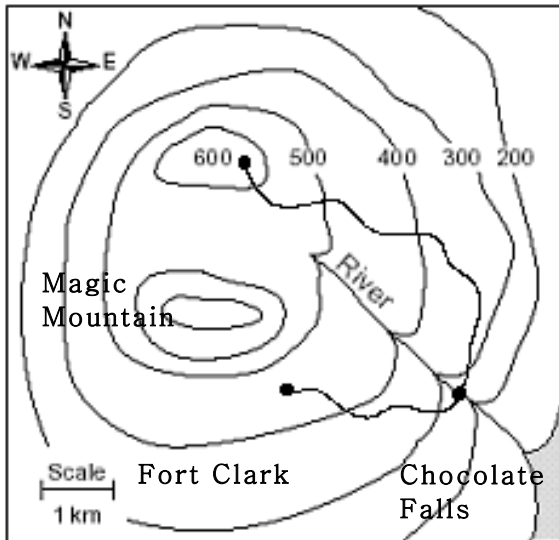
Find the contour line labeled 500 feet. This means that any point touching that line is exactly 500 feet above sea level. Likewise, any point touching the line labeled 400 feet is exactly 400 feet above sea level.

If a point is approximately half way between the contour line labeled 400 and the contour line labeled 500, we can estimate that its elevation is approximately 450 feet.

TOPOGRAPHIC HIKING MAPS

Often, hiking guidebooks include a topographic trail map. Again, this information allows hikers to understand the changes in elevation they will experience during the hike. Look at the trail drawn on the hiking map below. Use it to answer the questions.

Magic Mountain Trail Map



What is the elevation of Fort Clark? _____

What is the elevation of Chocolate Falls? _____

What change in elevation would you experience if you hiked from Fort Clark to Chocolate Falls?

What change in elevation would you experience if you hiked from the top of Magic Mountain to Chocolate Falls?

Your Challenge

Create three topographic hiking maps and the trail descriptions to go with them! Follow the steps below to complete your project.

- ☐ Choose one of the four topographic maps included at the end of this packet.
- ☐ Use pencil to draw a trail onto the map.
- ☐ Your trail must have at minimum of two uphill sections and two downhill sections.
- ☐ Use a dot and a name to label at least four landmarks on your trail.
- ☐ These landmarks might be buildings, parks, picnic areas, campgrounds, bodies of water, bridges...anything you can imagine!
- ☐ Feel free to use humor and creativity as you name your landmarks!
- ☐ At the top of your map, add a title to give a name to the entire hike.
- ☐ Create a chart to show the change in elevation between each of the points on your hike.
- ☐ Remember that increases in elevation are shown using positive numbers and decreases in elevation are shown using negative numbers.
- ☐ When your trail and all of your landmarks are finalized, trace them using colored pencils, markers or pens.
- ☐ Write a trail description (at least one paragraph long) for your hike. Your trail description should include at least three of the following:
 - Instructions about where/how to start the hike
 - Descriptions of the features of each landmark along the trail
 - Exact elevation change between each of the landmarks (either positive or negative)
 - Warnings about possible dangers
 - Advice about the best elements of each hike
 - Suggestions about what to bring

To get ideas for writing your own trail description, you may choose to read more real hiking guides at these websites:

<http://www.haleakala.national-park.com/hike.htm>

http://arizona.sierraclub.org/trail_guide/HIKE17.HTM

http://gorp.away.com/gorp/trailfinder/trail_details.tcl?trailid=25

Repeat each step to create two additional trail maps and descriptions.

REFLECTION

Answer the following questions:

- ☐ How is a negative elevation change similar to a financial debt? How would you explain to a friend why negative numbers would be used in both of these cases?
- ☐ In what other careers or academic studies might a person need to calculate elevation change? Are these jobs or tasks that you would enjoy? Explain.
- ☐ What did you enjoy most about this project? Why? What did you enjoy least about this project? Why?
- ☐ What questions has this project made you wonder about?

SUPER CHALLENGE: Research and calculate the exact change in elevation that you would experience if you drove from the highest point in the United States to the lowest point in the United States. Use words, numbers, drawings and/or symbols to explain your answer.

GOING BEYOND

What land area has the lowest elevation in the world?

<http://www.extremescience.com/DeadSea.htm>

What area – on land—has an elevation of negative 1300 feet? That's right! The elevation of this location is 1300 feet below sea level. Visit this site to find out more!

What land area has the highest elevation in the world?

<http://www.extremescience.com/HighestElevation.htm>

What area – on land – has an elevation of 29,035 feet? Visit this site to find out more!

How can you add two things, but end up with less than you had when you started?

<http://mathforum.org/library/drmath/view/57883.html>

Think about how negative numbers might provide a solution to this puzzler. Then, visit the site to read an expert's answer.

Student and Teacher Evaluation

	4	3	2	1
My final project is accurate, and shows that I have applied mathematical ideas or learned new mathematical ideas.	I did a great job! This is a good example of my best work.	I did a good job, with just a few areas to improve.	If I could do this again, there are several things I would change.	There are many ways that I could have done better on this.
COMMENT:				
I followed each step in the directions carefully.	I did a great job! This is a good example of my best work.	I did a good job, with just a few areas to improve.	If I could do this again, there are several things I would change.	There are many ways that I could have done better on this.
COMMENT:				
I used my creativity and imagination to create a final project that is unique and represents my own thoughts and ideas.	I did a great job! This is a good example of my best work.	I did a good job, with just a few areas to improve.	If I could do this again, there are several things I would change.	There are many ways that I could have done better on this.
COMMENT:				
I made effective use of class time. I was able to get myself started quickly, answer questions for myself, and stay on task.	I did a great job! This is a good example of my best work.	I did a good job, with just a few areas to improve.	If I could do this again, there are several things I would change.	There are many ways that I could have done better on this.
COMMENT:				
My presentation was clear and detailed. The students in the class learned new information about my topic.	My presentation was well done. Students learned about the topic.	My presentation was good, but there are one or two things I would improve.	Students learned a few new facts, but I could have been louder or more organized.	I needed to be more prepared for my presentation.
COMMENT:				