

## A Mountain Experience

# Math and Science In the Mountains

Water, rocks, trees and animals are all part of the mountain environment that will host you for your ski or snowboard lesson. Here are some ways to study them.



## A Mountain Experience

As you prepare for your class trip to one of Utah's ski areas, there are many things to study along the way. Water, rocks, trees and animals are all part of the forest environment that will host you for your ski or snowboard lesson.

Complete the activities before the trip. Use the Information as a resource for the answers and explore other options at the library or on the Internet to help you learn more about the mountain forest environment.

## Weather

Weather simply refers to the condition of the air on earth at a given place and time. It could be warm or cold, dry or wet, blowing or calm. Two things – heat or the sun and water influence the condition of the air and how it reacts to create weather.

Sun causes water to evaporate from oceans, lakes and rivers. The water vapor rises until it cools and condenses into tiny droplets that form clouds. The droplets become larger as more moisture is evaporated into the air. When the droplets get too heavy, they fall to the earth as rain, sleet, hail or snow.

Here are some simple facts to help you predict the weather.

- Air temperature is measured with a thermometer.
- Humidity measures the amount of water vapor in the air. Warm air can hold more water than colder air. Psychometers are used to measure humidity.
- When warm air rises and cools, it often causes the clouds to release moisture. Cool air weighs more than warm air.
- The kind of precipitation that hits the earth is dependent on the air temperature near the ground. Above freezing temperatures equals rain. Below freezing equals snow and near freezing equals sleet.
- Hail forms when snow pellets bounce around in the clouds and become covered in layers of ice before falling to earth.
- Air pushes down on the surface of the earth. This pressure changes

- when weather conditions change the weight of the air.
- Air pressure is measured with a barometer.
- Cool air forms high-pressure systems; warm air forms low-pressure systems.
- Fronts are responsible for most weather changes. They occur when a large mass of cold air meets a large mass of warm air.
- Cold fronts often cause heavy precipitation; warm fronts generally cause light precipitation.
- Wind is created when air moves from and area of high-pressure to an area of low pressure.
- Wind speed is measured with an anemometer; wind direction is measure with a wind vane. A windsock or flag can help you determine wind direction as well.
- When clouds hit the mountains, they rise quickly and shed moisture.
- Dew and frost are caused when water vapor touches cooler surfaces. If it's below freezing, the vapor forms frost.
- Fog is a cloud at ground level.
- Clouds can help predict the weather. Look at the cloud chart.

Utah's geography contributes greatly to the snow in our mountains, especially when the air passes over the Great Salt Lake and the water is warm. The air gathers lots of moisture and then drops it on the ski resorts in the form of snow.

Utah can also have an "inversion" in the weather during the winter. This happens when the cold air is trapped on the valley floor and forms a fog layer that gets stuck below the warm air. If we have an inversion, the ski resorts are sunny and warm and the cities are cold and gray.

#### Weather Lore

Weather lore is weather wisdom based on local observations of common weather patterns and things that precede them or the actions of animals, birds and insects. Native Americans say that when a circular rainbow surrounds the sun, moisture will soon follow. The tighter the circle, the sooner the moisture will arrive. This is called a "sun dog." Here are examples of other weather lore.

- "Red sky at night, sailor's delight. Red sky in morning, sailors take warning." (A red sunset is usually followed by dry nights. A red morning sky means rain is on the way).
- "Mackerel sky and mare's tails make tall ships carry low sails." (Certain clouds are often followed by high winds.)
- "Onion's skin very thin, mild winter coming in. Onion's skin thick and tough, coming winter cold and rough."
- "A sun-shiny shower won't last half and hour." Showers when the sun shines are brief.
- "Squirrel's tail fluffy, winter will be blustery."

### Making It Snow

Most of the ski areas in Utah have snowmaking systems in place. Some systems are bigger than others, especially at ski areas on the leeward side of the range where the weather is drier. Look for small guns that stand on the snow, tower nozzles that are high off the ground or big round machines that look like cannons.

Man-made snow consists of two ingredients – water and air, just like natural snow. However, the shape of the snow

crystal is different. Natural snow has six tiny arms called dendrites. Man-made snow forms a more compact six-sided crystal with less air. It packs more densely than natural snow.

In traditional snowmaking systems, water and air are pumped through a network of hoses and pipes on the mountain. A hydrant, acting like a big faucet, controls the amount of air and water that flows into a snowmaking gun. The air and water collide in the gun where the water droplets are blown apart by the compressed air. The tiny water particles are then shot out of the nozzle into the cold air where they fall to the ground as snow. Snowmakers must adjust the settings on the snowmaking guns and hydrants depending on air temperature and humidity to achieve the desired snow quality. Add more water for heavier snow or more air for lighter snow.

Snow cannons use only water and a giant fan. The fan propels moisture into the air where it condenses and freezes to form snow crystals. Snow cannons can make much more snow than the air and water guns. They are also quieter and less expensive to run. However, they are more expensive to purchase and the snow from these machines is much wetter and denser.

The relationship between temperature and humidity is very complicated when it comes to making snow. Sometimes, if the air is very dry, it's possible to make snow when air temperatures are above freezing. Likewise, on a humid day, it may not be possible to make snow even if the thermometer says the temperature is below freezing. The best snowmaking conditions are zero degrees Fahrenheit, 20% relative humidity and calm winds.

### Cloud Types

A cloud is a collection of tiny droplets of water or ice crystals. They are so small and light that they can float in the air. Heat and sun cause water on earth from rivers and lakes to go into the air and change into a gas called water vapor. This process is called evaporation. When the air rises, it expands and cools. Cool air can't hold as much water vapor as warm air, so some of the water vapor condenses onto tiny pieces of dust and forms a tiny droplet around each dust particle. When billions of these droplets come together, they form a cloud.

Water and ice in the clouds scatter all light and make them appear white. If they get thick enough, all the light doesn't make it through and they become dark.

Some clouds are so low they touch the ground. Others are high in the sky. Pilots can predict the weather just by watching clouds and the direction they are moving in and by studying their shapes.

Here is a description of the three main types of clouds.

Cirrus Clouds: high thin wispy clouds composed of ice. They are white and mean fair weather, but usually indicate a change in the weather within 24 hours.

Cumulus Clouds: fluffy lower clouds that look like pillows or cotton balls. They mean that fair weather will continue unless they "grow" during sunny days and become huge, puffy dark clouds or cumulonimbus clouds. Then heavy rain, hail, winds and lightning may be on the way.

Stratus Clouds: low flat gray clouds that

are layered. When stratus clouds are close to the ground, they are called fog. They usually mean light rain, drizzle, and snow flurries or overcast skies.

Clouds are often a combination of the three main types of clouds. Cirrostratus clouds are very thin sheet-like high clouds that often cover the whole sky. They usually mean rain or snow in 12-24 hours. Cirrocumulus clouds are small round puffs that appear in long rows and sometimes look like scales on a fish. They are usually winter clouds and mean fair, but cold weather.

Altostratus clouds are gray or blue-gray, and cover the entire sky. They form ahead of storms with lots of rain or snow. Nimbostratus clouds are wet looking gray clouds that bring light to moderate continuous rain or snow. Stratocumulus clouds are low, puffy gray clouds with blue sky in between. They rarely mean rain, but can form into nimbostratus clouds. Altocumulus clouds are gray puffy masses and mean late afternoon thunderstorms. Cumulonimbus clouds are thunderstorm clouds and bring heavy rain, snow, hail, and lightning. There are some special clouds as well. Lenticular clouds look like flying saucers and form over the mountains and are cause by a wave wind pattern over the mountains. Contrails are condensation trails left behind jet aircraft.

Study the clouds for several days and record your observations each day. Predict the weather for the next day. Predict the weather at the ski area. Check your predictions on the Ski Utah website. Go to www.skiutahlocals.com and pull up the weather report for the ski area you will be visiting.

Date	Time	Cloud Type	Percent Coverage	Next Day Weather

#### **Weather**

Although most of you will travel less than 50 miles for your ski or snowboard lesson, the ski area weather might make you feel like you just left the country and went to the North Pole. For every 1000 feet of elevation gain, the temperature drops 3.5 degrees F.

1)	Find the base elevation and the top or peak elevation of the resort where your class will be taking ski and snowboard lessons and the elevation of the city closest to where you live. If your city is not listed in the information section, look it up.
	a. What is the difference in elevation between the two locations?
	b. Predict the temperature at the bottom of the mountain
	c. Predict the temperature at the top of the mountain.
	d. Predict mountain temperatures for several days before your trip.
	Discuss have very will dropp to accommodate these differences
	e. Discuss how you will dress to accommodate these differences

2)	log	ouds can help us predict the weather. Observe the clouds for several days and g what you see. Read the information on cloud types to help you identify what ey mean.
	a.	Are the clouds fair weather clouds? Storm clouds?
	b.	Are they high or low?
	c.	What color are they?
	d.	Can you predict tomorrow's weather from observing the clouds?
	e.	Look at the mountains. Are the clouds different over the mountains than they are in the valley?
	f.	Look for a "Sundog." Predict when moisture will fall (see what Native Americans say about a "Sundog."). Try predicting the weather from local weather lore. How accurate are the predictions?
	g.	Record your observations for several days.
3)	a.	ownload the Beaufort Wind Scale and the Wind Chill chart from the website links. How windy is it at school?  If the wind is the same at the mountain, how cold will it feel? (Hint: you also need to know the temperature at the bottom and/or top of the mountain; then look at the wind chill chart). Will you dress differently for this?
	c.	Observe temperatures and wind velocity for several days before your trip. Do you see a pattern? Is the pattern going to change before your ski trip (Hint: look at the wind direction and cloud formations and then check your prediction by reading the weather forecast in the daily newspaper or on the internet.
	d.	Record your observations.

4)		ok at a water cycle picture.  What happens when the warm air hits the mountains?
	b.	Will it rain or snow? Why?
5)		i resorts often make snow to ensure that snow depths are deep enough for skiing d snowboarding.
	a.	Can you guess what two ingredients are needed to make man-made snow?
	— b.	Can the resorts make light snow? Heavy snow? How?
	c.	Why does man-made snow pack more densely than natural snow?
	d.	Explain why the ski resorts can make snow when the temperature in the city is above freezing.
	e.	Can the resorts make snow if the temperature at the resort is above freezing? Explain.
	f.	Why do resorts on the leeward side of the Wasatch Range generally make more snow?
	g.	Predict the snowmaking forecast at the ski area for the week before you ski.
	h.	Here's a brainteaser for the class. Do you think the man-made snow enters the water cycle, just like natural snow?



#### The Environment

The valleys of Utah are often a combination of mountain forests and desert environments mixed together. Some of the lower sections of the valleys are desert along. The lower the elevation the less rain and warmer the temperature will be. The higher the elevation the cooler the temperatures and more rain an area will receive. As the bus travels towards the ski area, you will pass through a variety of environments or biomes from low elevation valley bottoms to forested areas with mixed evergreen and deciduous trees to sub-alpine conifer forests. If you were to travel to the peaks of some of the ski areas, you would also encounter an alpine environment or biome.

The lower elevation valley bottoms usually don't have forests except for cotton-woods and willows near the streams. A forest is best described as a biome that is dominated by trees. Look around the valley. There are trees, but they do not cover the majority of the valley.

Mid-elevation foothills get slightly more precipitation than the valleys and tend to have woodlands (smaller than forests) and forests of trees that can survive drought. These include pinyon pines, junipers, oaks and maples. This would be a mixed evergreen and deciduous forest found at elevations of 5000-8000 feet. These forests are thickest on north or east facing slopes. South and west facing slopes are hottest and driest and will not have as many trees.

The oaks and maples are deciduous trees with large flat leaves that are green in the summer and turn red and yellow in the fall before dropping off for the winter. Because it gets so cold, these trees have adapted to the winter by going into a period of dormancy or sleep. Deciduous trees' flowers begin to grow again in the spring and continue throughout the summer.

Pinyon pines and junipers belong to the evergreen family. Evergreens are trees that have needle-like leaves that stay green all year long. These adaptations help them survive in areas that are very cold or dry.

Small animals like squirrels and chipmunks are attracted to mid-elevation forests. They store and eat seeds from the leafy trees. Deer fawns are also well adapted to this environment. Its spotted coat camouflages it in the forest. Other animals found in these forests include jackrabbit, red fox, mule deer, cottonwood rabbit, coyote and even moose at times.

As you make your way towards the ski area and higher elevation, the mixed forests eventually give way to coniferous forest biomes. Conifers are also evergreens because they have needles instead of leaves. They also have cones instead of flowers. Douglas fir trees become more common and are often mixed with pinyon, juniper, and quaking aspen, a deciduous tree found at higher elevations.

If you go a little higher on the slopes or go to one of the ski areas that has a higher base elevation, you will see forests of englemann spruce and sub-alpine fir. Look for these at 8,000-10,000 feet of elevation. They will be mixed with Douglas fir as well as several pine trees including lodge pole, limber, and ponderosa pines.

Many of the same animals found in mixed forests are also found in coniferous forests. Some have adaptations that allow them to live in the forest all year long.

Chipmunks, squirrels and mice hibernate for the winter. Others develop a thick coat of fur or change the color of their fur to match the snowy surroundings. Moose wander over large areas in order to find food year around.

## The Environment

Utah is a very diverse state. It's possible to move from a very hot, desert environment to a cool forest environment or biome in as little as 10-15 miles.

1)	Re	ad about wetlands, forests and deserts; look at an environmental map of Utah.
	a.	Name the ski resort's environment You will also need a map of Utah for this to compare the city and resort locations with the colors and numbers on the environment map.
	b.	Look at pictures of Utah's plants and animals; predict what plants and animals you might find at the resort
	c.	Predict what trees you will find in southern resorts versus northern resorts.
	d.	How do you tell the difference between a pine tree and a fir tree? (Hint: how do the needles grow?)
	e.	What adaptations would plants and animals need to make in order to live at the ski resort's elevation from summer to winter?
	f.	Ask your ski instructor to identify several trees at the ski area. Are they the ones you predicted you would see?
2)	W	atch for changing environments on the bus ride to the ski area.
	a.	Ask your teacher to point out south-facing and north-facing sides of the mountains as you travel to the ski area. Is the vegetation different? Can you guess why? (Hint: south-facing slopes receive more sun and are often
		warmer than their north-facing twins).
	b.	Is the vegetation different on north and south-facing slopes as you go higher in elevation?
	c.	What causes the "red trees" you see in many of the canyons or on the slopes of the resorts?

## Rocks, Minerals and Miners

Utah is an uncommon landscape with three major land formations. They are the Rocky Mountains, the Colorado Plateau and the Basin and Range Provinces.

The Rocky Mountains make up the northeastern part of Utah. If you ski at any of the ski areas between Provo and Logan, you will be skiing in the Rocky Mountains. If you ski at Brian Head, you will be skiing on the Colorado Plateau. The Basin and Range Provinces stretch west from I-15 towards Nevada. These mountains are generally drier and have less snow pack than the other two major land formations in Utah.

Within these areas, Utah varies in elevation from Beaver Dam Wash, 2,350 feet above seas level in the south to Kings Peak in the Uinta Mountains at 13,528 above sea level. Most of Utah's cities are located between 3,000 and 7,000 feet above sea level. Temperatures vary widely. Higher valleys and mountains are cooler, while the lower elevations in the south of the state have higher temperatures.

There are three major categories of rocks and all are found in Utah. They are igneous rock, metamorphic rock and sedimentary rock. Although most of the rock in Southern Utah is sedimentary, all three types are represented in northern Utah and the Wasatch Range.

Igneous rocks always come from volcanic action. Most of the time they are exposed by wind and water erosion. Rock climbers in Big and Little Cottonwood Canyon climb on a form of igneous rock called granite. It is about 30 million years old.

Sedimentary rock is composed of many tiny grains of sand deposited by water and wind. Limestone, sandstone and shale are forms of sedimentary rock. At one time, the Salt Lake valley was covered by freshwater Lake Bonneville. You can see the ancient lake levels by observing the "bathtub ring" along the benches. This lake is responsible for depositing tons of sand and gravel on its shoreline. Sand and gravel was also deposited at the mouth of the canyons by streams and glaciers that were formed high in the mountains.

The work of two prominent glaciers is visible to those who ski in Big and Little Cottonwood Canyon. Canyons cut by a glacier have a U-shape. Little Cottonwood's glacier made it all the way to the mouth. The Big Cottonwood glacier stopped at Reynolds Flats, just below Solitude. Look for the U-shape in upper Big Cottonwood and all of Little Cottonwood.

Red Rock Country in Southern Utah is composed of sedimentary sandstones containing high amounts of iron deposits. Sandstone is a porous rock and is prone to bleaching and erosion, creating beautiful colors and formations.

Metamorphic rock is formed when any type of rock has been under great temperature and pressure. Limestone becomes marble under heat and pressure. Geologic road signs showing several metamorphic rock examples exist on the Big Cottonwood Canyon road.

Many towns in Utah began as small mining towns. Park City, Alta and the upper part of Big Cottonwood Canyon were mining communities in the late 1800s. Gold, silver, lead, zinc and copper were minerals found in veins in the rock. Although at least one mine in Park City

operated until 1982, the primary function of the canyons changed in the 1940s when the first ski lift was built at Alta. The Spiro Tunnel in Park City was regarded as one of the most unusual ski lifts in the

world. In 1964-65, skiers rode in mining cars to the center of the mountain. They were then hoisted in mine cages to the snow on the surface. Today, Park City uses water from the tunnel for snowmaking.

#### Rocks Minerals and Mountains

Utah is known for its rocks. Many of the rocks were mined for precious minerals.

1)	Ide	entify the three types of rock.
	a.	Ask your teacher to point out sandstone on the way to the ski area. Why is it red or brownish in color?
	1.	
	р.	Can you find granite anywhere on the trip to the ski area?
	c.	Observe a cliff or rock wall while at the ski area. Can you guess what kind of rocks and minerals are in the cliff or rock wall?
2)		ocks contain minerals and mining of those minerals was a big part of Utah's story.
	a.	What minerals were mined in Park City, Big Cottonwood Canyon and Little Cottonwood Canyon?
	b.	Why was it harder to mine in Big and Little Cottonwood than it was in Park City?
	c.	Ask your ski instructor to name something at the ski area that was part of mining history.
3)		ost of Little Cottonwood is U-shaped while Big Cottonwood is U-shaped at the top d V-shaped from the middle to the bottom.
	a.	Why are they shaped this way?
	b.	Can you see it? If you ski in Big or Little Cottonwood, look for the U-shape and V-shape in the canyon.

4)	Mo	ost of the rock in Southern Utah is sedimentary rock.
	a.	Why is it called Red Rock Country?
	b.	What mineral deposit gives the rock its color?
	c.	Why does Southern Utah rock have so many weird shapes and forms?
5)	St	ump your Park City instructor!
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	a.	If you ski at Park City, ask your ski instructor if he/she knows what the ski area does with the water from the old Spiro Mine Tunnel.

### ◆ Math Fun at the Ski Area

Math skills can be part of the ski area experience too. Try your hand at these brainteasers.

1)		ti areas often talk about the amount of skiable terrain available for different skill vels of skiers and snowboarders.
	a.	Ski resort "A" has 2200 acres of skiable terrain. If 700 acres are for intermediate skiers and 900 acres are for advanced skiers, how many acres are available for beginner skiers?
	b.	Ski resort "B" has 3500 acres of skiable terrain. If 575 acres are for advanced skiers and 1550 acres are for intermediate skiers, how many acres are available for beginner skiers
2)	Sk	xi areas have lifts that carry two people, three people or four people.
	a.	If a lift has 29 chairs and each chair holds 3 people, how many people are on the lift when all the chairs are full?
	b.	If a lift has 100 chairs and each chair holds 4 people, how many people are on the lift when half the chairs are full?
	c.	If a chairlift is 1500 feet long, and travels at 300 feet per minute, how long will it take one chair to get to the top?
	d.	How many times per hour will one chair reach the top? Remember, it must also go to the bottom after it drops you off and it will travel to the bottom at the same rate of speed as it does on the way up, 300 feet per minute.
	e.	If 24 people get off a chair every minute, how many people get off the chair in one hour?
	f.	Check out the snow reports on www.skiutahlocals.com and graph the snow depth for several weeks before your trip.

## Ski Area Information

#### Beaver Mt.

Base Elevation: 7,200 feet Peak Elevation: 8,800 feet

#### Snowbasin

Base Elevation: 6,391 feet Peak Elevation: 9,350 feet

#### Wolf Mt.

Base Elevation: Peak Elevation:

#### Park City

Base Elevation: 6,900 feet Peak Elevation: 10,000 feet

#### **Deer Valley**

Base Elevation: 6,570 feet Peak Elevation: 9,570 feet

#### The Canyons

Base Elevation: 6,800 feet Peak Elevation: 9,990 feet

#### Brighton

Base Elevation: 8,755 feet Peak Elevation: 10,500 feet

#### Solitude

Base Elevation: 7,988 feet Peak Elevation: 10,035 feet

#### Alta

Base Elevation: 8,530 feet Peak Elevation: 10,550 feet

#### Snowbird

Base Elevation: 8,100 feet

Peak Elevation: 11,000 feet (used to be 11,300 feet but they cut the top off the

mountain to build the tram!)

#### Sundance

Base Elevation: 6,100 feet Peak Elevation: 8,250 feet

#### **Brian Head**

Base Elevation: 9,600 feet Peak Elevation: 11,307 feet

## Approximate elevations of major cities in Utah

Salt Lake: 4,200 feet Provo: 4,500 feet Ogden: 4,400 feet Logan: 4,500 feet Cedar City: 5,200 feet St. George: 2,800 feet

## Math and Science in the Mountains Charts and Support Information Website Links

#### **Cloud Identification Chart**

asd-www.larc.nasa.gov/SCOOL/cldchart.html

#### Water Cycle Chart

ga.wwater.usgs.gov/edu/watercycleprint.html

#### **Beaufort Wind Scale**

www.marine waypoints.com/marine/wind.shtml

Note: search for Beaufort Wind Scale for more charts

#### Wind Chill Chart

www.weatherimages.org/data/windchill.html

#### Plants, animals, rocks, biome information

www.usoe.k12.ut.us/curr/Science/core/4th/4thSciber/4THINTRO/intro.htm



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