



THE SCIENCE OF SNOW

When clouds get really cold, frozen water droplets form small ice crystals.

What are they called?

These ice crystals are **snowflakes**.

Then what happens?

After snowflakes land on the ground and start to pile up, they form a **snowpack**.

What is a **snowpack**?

A snowpack is made up of millions and millions of snowflakes. The size and shape of the snowflakes can make the layers of a snowpack strong or weak.



What makes a layer strong?

The strong layers are dense and made up of small, round snow grains. They are packed closely together and are stuck to each other very tightly.

What makes a layer weak?

The weak layers are much more loosely packed.

What may happen when weak and strong layers are in the same snowpack?

An Avalanche!

The layers constantly change because of the changing temperature in the air and within the snowpack. When the weak layers prevent the strong layers from sticking together, the strong layers slide over the weak layers.

When this movement of the snowpack happens on a steep mountain, it can cause an avalanche. From inside a snowpit, Snow Rangers study snowpacks so they can warn people about possible avalanches.

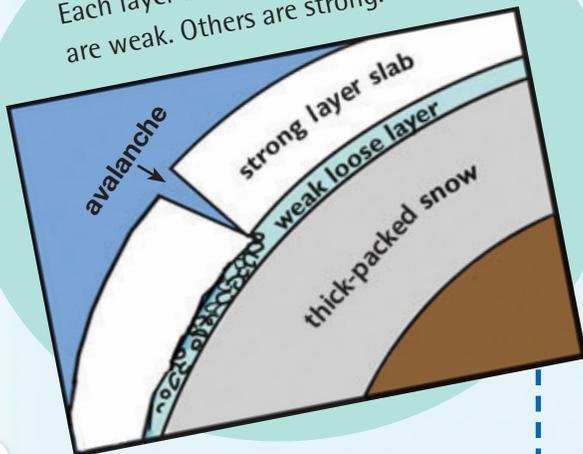
Activity



Every time it snows, or when the snow drifts, another layer is added to the snowpack. With each additional layer, the snowpack becomes a little bit thicker.

What are the layers like?

Each layer is different. Some layers are weak. Others are strong.



Create Your Own Avalanche

Phase 1

- Put two books on the floor, one on top of the other, to represent the ground and a slab of snow.
- Slowly lift one end of the bottom book off the floor.
- See how long it takes the slab of snow to start sliding.

Phase 2

- Sprinkle some salt between the two books to represent a layer of loose snow below the hard slab of snow on top. Slowly lift one end of the bottom book off the floor.
- Does the avalanche happen sooner this time?

Phase 3

- Add a third book above the top book to represent people hiking or skiing on top of the snow.
- Sprinkle salt between the bottom book (ground) and middle book (snow) but not between the middle book and top book (people).
- Does the avalanche happen even faster now?

Discussion: In which phase of your experiment did the avalanche happen soonest? Why? What does this experiment tell us about how some types of snowpacks are more likely to cause an avalanche than others? Based on this experiment, do you think avalanches are a bigger danger on steeper mountains? Why?



AMAZING FACTS

Snowflakes are born in clouds and every one grows differently. As a snowflake falls from the cloud to the ground, it passes through many different layers of air.

Each layer of air, whether it is

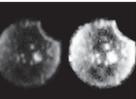
HOT **COLD**
Wet Dry

changes the way a snowflake develops.

Each snowflake follows a unique path to Earth. No two snowflakes are exactly alike.

It can take a snowflake 2 hours to fall from the cloud to the ground because it drifts through the air at only a few miles per hour.

Shapes of Crystals

Shape	Name	How They Are Formed	Effect on Snowpack	Actual Image
	Columns (hollow or solid)	At 14–21 degrees Fahrenheit (°F)	unstable	
	Needles (simple, cluster or crossed)	At 25–21 °F	unstable	
	Stellar Plates	At 14–10 °F	stable	
	Stellar Dendrites	At 14–10 °F	stable	
	Irregular	At 3–10 °F	stable	
	Graupel	When snow crystals fall through very moist air	unstable	
	Hail	When precipitation becomes coated with a layer of ice	unstable	
	Ice pellets	When rain falls through very cold air	unstable	
	Rime	When extremely cold water droplets freeze almost instantly on a cold surface	unstable	

Activity



BE A SNOWFLAKE SLEUTH!

Gather together your detective tools—black construction paper and a magnifying lens.

Catch snowflakes, ice pellets, or hail on the paper. Use your magnifying lens to look at their shapes. Compare them with the shapes of crystals in the chart. How many different shapes can you find?

Keep a record of different shapes for different times of the day. What differences do you see?

Ask your friends to do the same activity. Share your findings. How do your friends' findings differ from yours?

What clues can you get from these observations? How could the snowflakes you recorded affect a snowpack?





MEET CUTLER,

THE AVALANCHE RESCUE DOG



In front of the ranger station, Snow Ranger Chris Joosen helps Cutler gear up for a rescue mission.

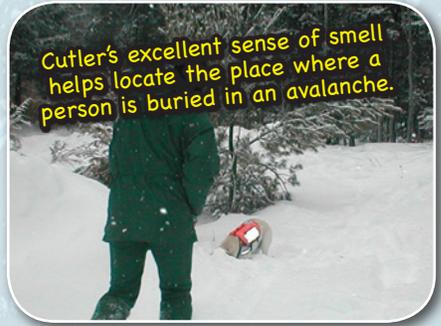
Hi! My name is Cutler. I'm a Yellow Labrador Retriever, but I'm more than somebody's pet. I'm the Forest Service Avalanche Rescue Dog. I work with Lead Snow Ranger Chris Joosen, who adopted me in 2001 when I was just 9 weeks old. I was actually a gift to the Forest Service from Darcy Kane, a dog breeder in New Hampshire. Darcy said the gift had a string attached. (Back then, I loved to play with strings!) The string (or stipulation) was that the Forest Service would train me to be an avalanche rescue dog.



Cutler and Chris head out together in search of a missing person.

I absolutely love my name: Cutler. It's the same name as a river on Mount Washington, which is where I work—at the Mount Washington Avalanche Center. Mount Washington is the tallest mountain in the Northeastern United States.

My job is to find people who are buried in the snow. When hikers or skiers get trapped in the snow, human searchers have trouble finding them because they cannot see them. That's when they call on me. I can sniff out the buried hikers with my excellent sense of smell. You can see me digging through the snow in the photos on this page.



Cutler's excellent sense of smell helps locate the place where a person is buried in an avalanche.



Cutler and Chris work together to rescue the person who is buried in the avalanche.



Cutler and Chris get closer to the rescue.



Even though he is covered in snow, Cutler is happy for a good day's work.



Read more about Cutler's home at Mount Washington:

Mount Washington: <http://www.mountwashington.com>.

Mount Washington Observatory: <http://www.mountwashington.org>.

White Mountain National Forest: http://www.fs.fed.us/r9/forests/white_mountain/about/wmnf_flyer.pdf.

Word Watch

avalanche: A large mass of snow, ice, earth, rock, or other material moving swiftly down a mountainside.



HAVE FUN WITH WINTER GAMES!

Cutler, the Forest Service Avalanche Rescue Dog, has used his extraordinary sense of smell to locate a hiker who is buried in an avalanche. Help the Snow Rangers reach Cutler so they can rescue the hiker.



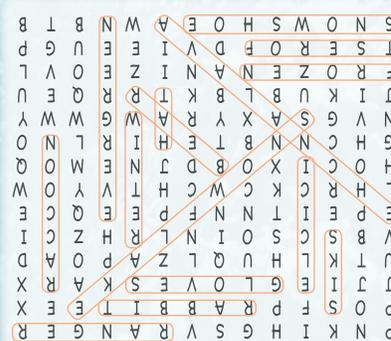
Start

Word Search

Look for words that are in this adventure guide. Words can appear forward, backward, or diagonally.

P	N	K	I	H	G	S	V	R	A	N	G	E	R
P	O	S	F	P	R	A	B	B	I	T	E	E	X
J	J	I	E	G	L	O	V	E	S	K	A	R	X
U	T	K	L	H	U	Q	L	Z	A	P	O	A	D
V	B	S	C	S	O	I	N	L	R	H	Z	C	I
E	P	E	I	T	N	N	F	P	E	E	Q	C	E
L	H	R	C	K	C	W	C	H	T	V	Y	O	W
H	O	C	I	X	O	B	D	J	N	E	M	O	Q
G	H	C	N	N	B	T	E	H	I	R	L	N	O
N	V	G	S	A	X	Y	R	A	W	G	W	W	Y
J	I	K	U	B	L	B	K	T	R	R	Q	E	U
F	R	O	Z	E	N	A	N	I	Z	E	O	V	L
T	S	E	R	O	F	D	V	I	E	E	U	G	P
S	N	O	W	S	H	O	E	A	W	N	B	T	B

- avalanche
- frozen
- rabbit
- snowflake
- bear
- gloves
- raccoon
- snowshoe
- evergreen
- hat
- ranger
- winter
- forest
- icicle
- skis





DISCOVER THE THRILL OF THE CHILL.....

People Have Been Having Fun in Winter for Years!

We learned about winter fun from Nordic and Asian cultures dating back 5,000 years ago. At that time, people traveled long distances across frozen landscapes. To stay warm and travel quickly, they invented ice skates, skis, sleds, and snowshoes.

Why and How Did People Invent Snowshoes?

People most likely invented snowshoes after they watched how easily the snowshoe hare and lynx travel across the snow. These animals have very large feet compared with their body size. Bigger feet allow an animal to spread its weight over a larger surface area (which means less weight per square inch). This physical feature helps keep the animal on top of the snow.



AMAZING FACTS

American pioneers used snowshoes to explore the western part of the United States.

During winter in the 1800s, when snow in the Great Plains piled very high, trappers, hunters, and explorers often had only one way to travel—with snowshoes.

American Indians Wore Snowshoes To Travel Through Snowy Forests.

They made their snowshoes from long pieces of wood and strips of leather. With snowshoes, the American Indians could trek over soft snowdrifts and through landscapes that would have been impossible to walk through with moccasins.

- ✿ The Athabaskan Indians in the Northwest and the Algonquin Indians in the Northeast made snowshoes that worked very well and were also very beautiful.
- ✿ Before the Spaniards introduced horses to America, the Plains Indians wore snowshoes when they hunted buffalo.



Today, We Use Snowshoes for Fun Winter Activities, Sports, and Physical Fitness.

We take Snow Ranger-guided snowshoe walks to discover how plants, animals, and people adapt to winter. We also have snowshoe races—some races are over a long distance, some are for speed over a short distance, and some even involve jumping over hurdles! Snow Rangers, snow researchers, and people who need to travel in snowy areas that they can't reach with motorized vehicles use snowshoes.

Many schools in the United States—even schools located in areas that seldom have snow (see You Don't Need Snow for Snowshoes on page 9)—offer snowshoeing as part of their physical education programs to help fight obesity.



ON SNOWSHOES!



Activity



MAKE YOUR OWN SNOWSHOES!

Before you begin to design and make your snowshoes, think about these two important factors:

1. The platform of the snowshoe must be much larger than your foot.
2. The platform must be firmly attached to your foot so it will not fall off.

Choose the material for the platform. It could be any of the following recycled materials:

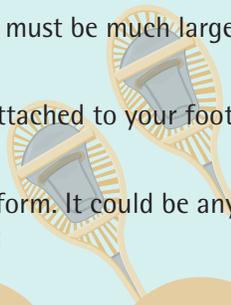
Shoe boxes
(the bigger,
the better)

or

Cardboard

or

Gallon-size
plastic
milk jugs



Choose the material for attaching the platform to your foot. Choose one of the following:

- Long shoelaces (or several shoelaces tied together).
- Large, thick rubber bands.

Strap the platform to your boot just before you are ready to go outside. Be careful when you walk. Lift your foot up high, just as if you were wearing flippers. You don't want to trip over your big, snowshoed feet! Now you know what it is like for Snow Rangers to walk around in the snow.

You Don't Need Snow for Snowshoes

You can make snowshoeing a fun activity wherever you live. Some kids like to snowshoe on soft surfaces, such as thick grass or pine needles. Kids at the beach enjoy snowshoeing through soft sand or over dunes. The main difference between these surfaces and the snow surface is their roughness. To protect the bottoms of their snowshoes from too much wear, these kids often put duct tape on the bottom of their snowshoes.

DID YOU KNOW?

Just about everyone can play in the snow. Adaptive sports programs give people with disabilities the opportunity to enjoy the outdoors.

- People with physical disabilities use sit skis, monoskis, and outrigger skis.
- People with limited vision or blindness participate in assisted blind skiing programs. They don't let their disabilities get in the way of getting outside and enjoying winter sports.
- The National Sports Center for the Disabled is one of many institutions around the world that helps people with disabilities participate in outdoor sports.
- The National Sports Center for the Disabled recommends snowshoeing as an excellent workout for the able and disabled alike.

