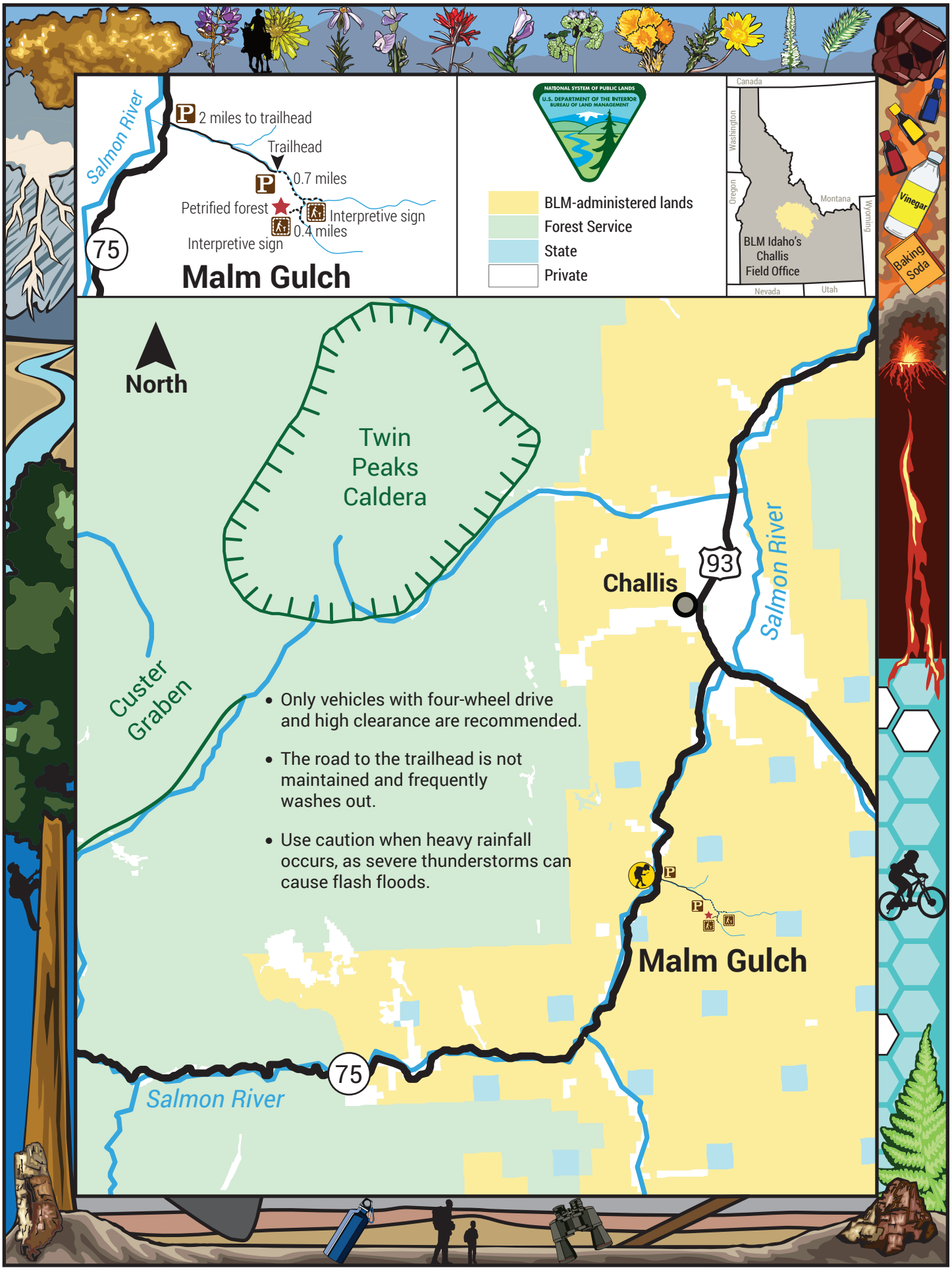
U.S. Department of the Interior • Bureau of Land Management

BLM

Junior Explorer

Discover the Malm Gulch Petrified Forest



- Only vehicles with four-wheel drive and high clearance are recommended.
- The road to the trailhead is not maintained and frequently washes out.
- Use caution when heavy rainfall occurs, as severe thunderstorms can cause flash floods.

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Welcome

Hello Junior Explorer!

Are you ready for an adventure? In this activity book, you will explore the Malm Gulch area. It is a petrified forest located about 10 miles south of Challis, Idaho. Fifty million years ago, this area of Idaho was much different. The climate was cool and wet, just like you see now on the Pacific coast. Large sequoia or redwood forests covered the mountains, and ferns blanketed the forest floor. All of that changed when geological activity in the area increased. Violent volcanic eruptions showered the area with volcanic ash, changing the environment and turning trees into a vast petrified forest. All that remains of these forests today are a few tree stumps—some almost 6 feet in diameter—in the Malm Gulch area. As you trek along the short Malm Gulch hiking trail, try to imagine this dry area covered with giant trees and lush ferns.

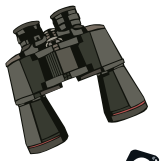
Today, the area is managed by the Bureau of Land Management (BLM) Challis Field Office. The BLM installed fences in the 1970s to protect the last examples of this ancient petrified forest from vandalism. Please enjoy these last remnants, but do not harm them. Leave them as they are so others can appreciate them too.

Earn your Junior Explorer award and certificate by visiting the Malm Gulch area. Do this on a weekend afternoon with your family or maybe on a field trip with your class. Once you have completed at least 7 of the 10 activities in this book, you are on your way to protecting America's public lands and becoming a Junior Explorer for the Malm Gulch area. Then, say the pledge at the end of this book. Sign the certificate, and bring or mail it to the BLM.

If sending the certificate by mail, send to the following address:

Bureau of Land Management
Challis Field Office
1151 Blue Mountain Rd.
Challis, ID 83226

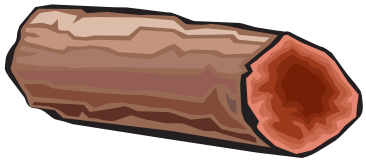
Nature is a great place to learn as long as you know how to be kind and safe. During your adventure, remember the following tips.



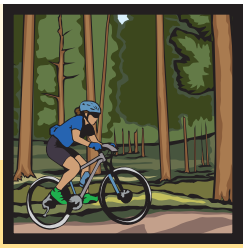
Be Kind to Nature: If you see a wild animal, stay quiet, and watch it from a distance. Take binoculars if you can. That way you can watch animals closely without disturbing them. If you see or have any trash, be sure to pick it up and pack it out in your backpack.

Explore the Outdoors Safely: Before setting off on your journey, bring your water bottle with you. Your adventure may be hot and dry at certain times of the year, and there is no water onsite. Also, watch your footing since the trails in this area are rocky and uneven. Wear good shoes or boots that will support and protect your feet and ankles. Lastly, look out for rattlesnakes, which are occasionally seen in the area.

Leave What You Find: The remaining petrified trees within Malm Gulch can never be replaced. If they are damaged, they will be gone forever. Enjoy looking at these treasures, but please be respectful and leave everything as you find it for others to enjoy. If you're careful now, more Junior Explorers like you can see and learn about the area.



What are Public Lands?



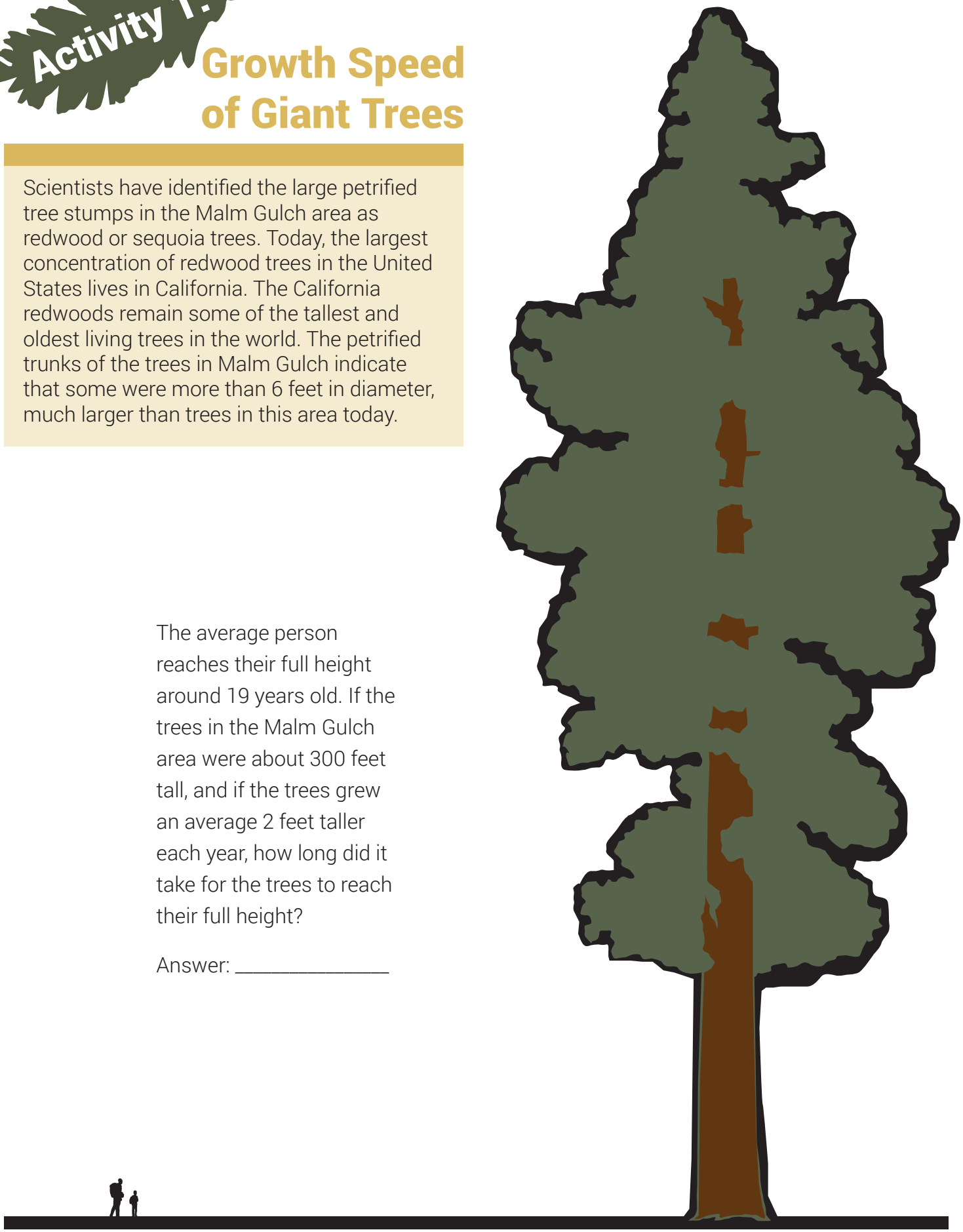
Public lands are set aside for everyone to use! The BLM manages more than 245 million acres of public land, mostly in the West. Public lands are located in many types of environments, such as forests, mountains, deserts, grasslands, tundra, lakes, and rivers.

Many different activities happen on public lands. Sometimes wild horses live on these lands. Sometimes oil, coal, and other minerals come from these lands. Sometimes historical landmarks are taken care of on these lands. And often, people enjoy outdoor activities on these lands, such as camping, hiking, mountain biking, fishing, rock climbing, horseback riding, and boating.

Since public lands are available for everyone, we must use the lands responsibly and be good stewards. We all have to work together to take care of the land so that future Junior Explorers can enjoy it too.

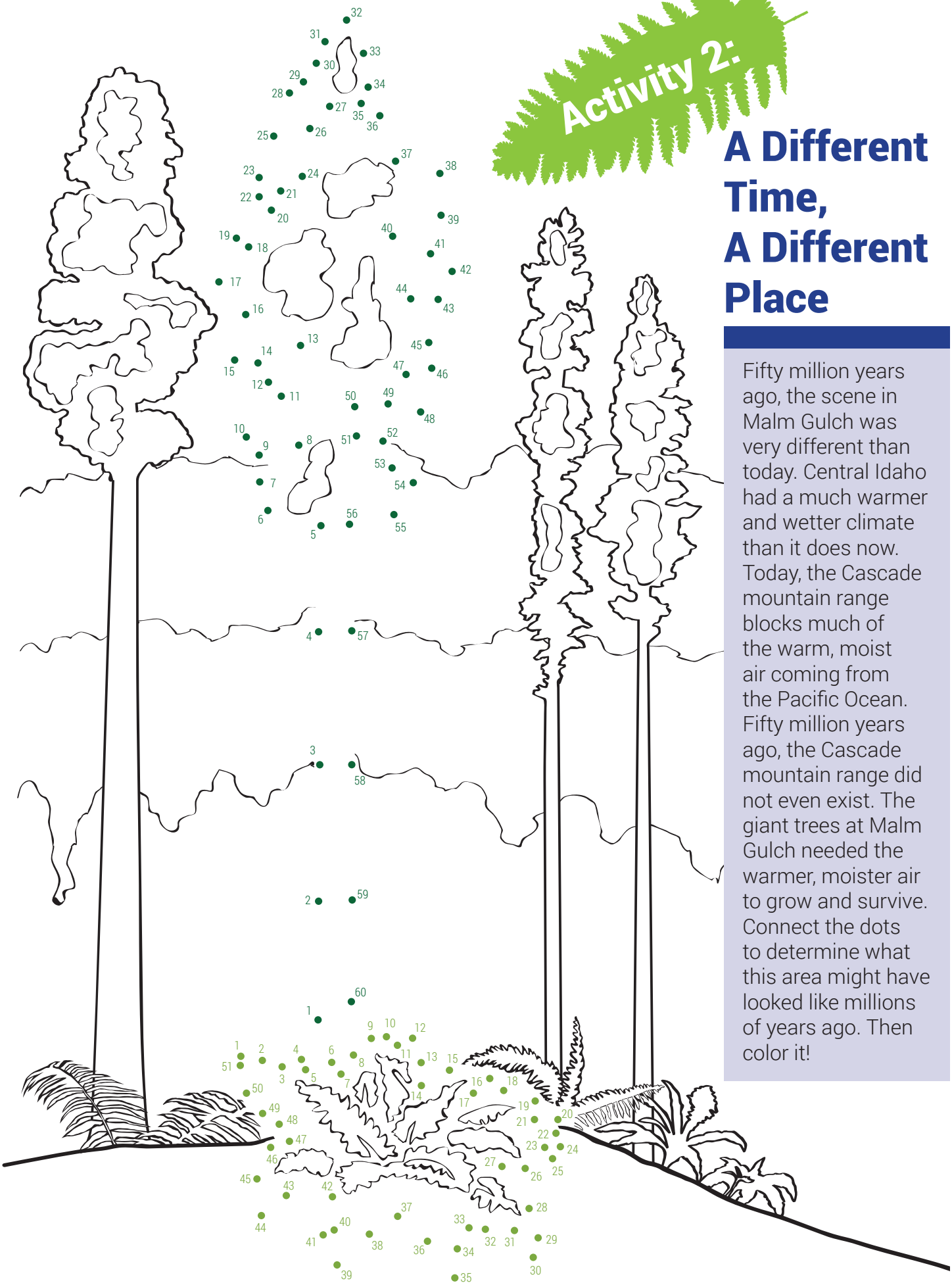
Activity 1: Growth Speed of Giant Trees

Scientists have identified the large petrified tree stumps in the Malm Gulch area as redwood or sequoia trees. Today, the largest concentration of redwood trees in the United States lives in California. The California redwoods remain some of the tallest and oldest living trees in the world. The petrified trunks of the trees in Malm Gulch indicate that some were more than 6 feet in diameter, much larger than trees in this area today.



The average person reaches their full height around 19 years old. If the trees in the Malm Gulch area were about 300 feet tall, and if the trees grew an average 2 feet taller each year, how long did it take for the trees to reach their full height?

Answer: _____



Activity 2:

A Different Time, A Different Place

Fifty million years ago, the scene in Malm Gulch was very different than today. Central Idaho had a much warmer and wetter climate than it does now. Today, the Cascade mountain range blocks much of the warm, moist air coming from the Pacific Ocean. Fifty million years ago, the Cascade mountain range did not even exist. The giant trees at Malm Gulch needed the warmer, moister air to grow and survive. Connect the dots to determine what this area might have looked like millions of years ago. Then color it!

Activity 3:

Geological Activity Reshapes Our Earth

In 1980, a volcano called Mount St. Helens erupted in Washington State. About 48 million years ago, in the Challis area, geologists think at least six volcanic eruptions were hundreds of times more powerful than the Mount St. Helens' eruption. Two types of volcanic eruptions happened in the Challis area. First, sheets and rivers of molten rock called lava erupted from volcanic vents (cracks and holes in the earth). Later, multiple volcanic eruptions sent up clouds of hot gas, ash, and pumice that covered the entire area. Today, people see the white and pastel-colored soils and rocks in the Malm Gulch area, which are remnants of the ash deposits. The heat of the eruptions destroyed most of the trees in the Malm Gulch forest. However, volcanic ash buried some trees that eventually became the petrified logs you see today.

Draw a picture of what this eruption might have looked like. Don't forget to show the giant trees—some were buried and others burned up!

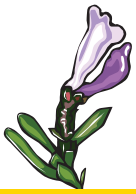
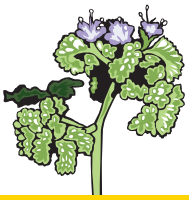
CRAZYWEED GREASEWOOD HAWKSBEARD LAVA ASTER

Activity 4:

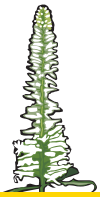
Colorful Ash Cultivates Unique Growth

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

The pastel-colored hills (pale greens, pinks, and yellows) that dominate the Malm Gulch area tell of a time long ago when volcanic ash engulfed this area. Very few plants live in these soils because the soils are powdery, very crumbly, and easily eroded. In spite of these challenges, some plants have adapted to this harsh environment. The Challis milkvetch, Challis crazyweed, and wavyleaf thelypody include some of the plants unique to the area. In the puzzle, find the names of plants that grow in the Malm Gulch area.

MILKVETCH PAINTBRUSH PENSTEMON PHACELIA RABBITBRUSH RICEGRASS



SAGEBRUSH SUNRAY THELYPODY WHEATGRASS WILDRYE

Activity 5:

Undercover Work

Volcanic ash buried the tree stumps at Malm Gulch about 48 million years ago. Why do you think we can see these tree stumps now? To learn how they were uncovered, decode the message by using your detective skills and the secret code.

1 = P
2 = D
3 = E
4 = S
5 = O
6 = W
7 = T
8 = N
9 = I
10 = L
11 = A
12 = H
13 = R
14 = V
15 = M
16 = F

1. After the volcanoes covered the Malm Gulch area with volcanic ash and pumice, a very _____ process began. This
   4 - 10 - 5 - 6
   process is called _____. Erosion is caused by
   3 - 13 - 5 - 4 - 9 - 5 - 8
   many different factors, including wind, water, ice, and gravity.

2. First, _____ gradually broke down and
   6 - 3 - 11 - 7 - 12 - 3 - 13
   loosened the soil and rock covering Malm Gulch. The loose soil and rock was then transported by _____ rolling
   6 - 11 - 7 - 3 - 13
   down the mountain. This loose material is called sediment.

3. The sediment was eventually transported to other locations or washed down into _____ and
   4 - 7 - 13 - 3 - 11 - 15- 4
   _____.
   13 - 9 - 14 - 3 - 13 - 4

4. Sometimes, abrupt movement of large amounts of soil and rock from higher elevations to lower elevations occurred, which is called a _____.
   10 - 11 - 8 - 2 - 4 - 10 - 9 - 2 - 3

5. Over time, this erosion and weathering uncovered the _____ trees you see today in the
   1 - 3 - 7 - 13 - 9 - 16 - 9 - 3 - 2
   Malm Gulch area.

Activity 6:

Volcanoes Aid Mineral Creation

Because of past volcanic activity in this area, the area is rich in minerals. Molten rock deep in the earth (called magma) heated water deep beneath the earth's surface. Hot water holds many more elements than cold water. The mineral-rich hot water rose to the surface. As the water cooled, the different minerals crystallized.

Prehistoric people used glasslike volcanic rocks, like obsidian and fine-grained basalt to make tools, knives, spears, and arrowheads. Today, as in the past, miners search for minerals in this area. Besides well-known minerals like gold and silver, miners can find dozens of different kinds of gemstones in Idaho, such as agate, garnet, opal, and topaz. The elements in a mineral cause its crystals to grow in specific shapes. Some look like cubes, tilted boxes, or long thin fibers. Grow your own crystals by conducting the experiment described below.

Gather the following materials:

- salt
- sugar
- two clear plastic cups
- hot water
- small circles of cardboard to cover cups
- spoon

Instructions:

1. Pour about 2 inches of hot water into a cup.
2. Stir sugar into the water until no more will dissolve. This may take a while. Keep doing this until you're sure no more will dissolve.
3. Do the same with another cup of hot water. This time add salt until no more will dissolve.
4. Cover each cup with a piece of cardboard, and set them in a place away from heaters, direct sunlight, drafts, or anything else that could cause the temperature to change.
5. Leave the cups in a safe place where they will be undisturbed for several days.
6. When the crystals are large enough to clearly see their shapes, remove a few. You may want to use a magnifying glass to see the crystals even better. Notice the shape of the entire crystal and also the shape of individual flat sides.

Draw a sugar crystal.

Draw a salt crystal.

How are they different?

How are they similar?

Activity 7: Rock Layer Formation

After you visit the trees in Malm Gulch, drive toward Challis along Highway 75. If you look closely, you will see examples of folding in the rocks that form the river canyon. These rocks show geologists where ancient mountain-building events occurred. Generally, rock layers are deposited in flat layers. But when geologic events occur, such as volcanic eruptions or earthquakes, those flat rock layers can become folded or tilted. Rock layers can also be eroded to form caves or canyons. Younger layers of rock may also cut through or intrude into one or more layers of older rock.

Diagrams 1 and 2 demonstrate the oldest and youngest layers of rock. Study these diagrams.

Diagram 1

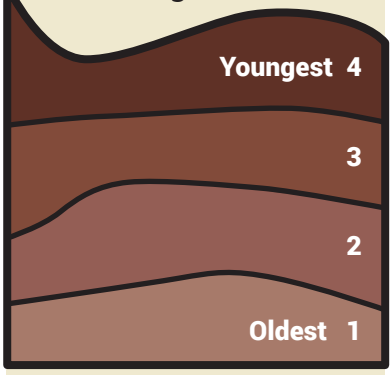
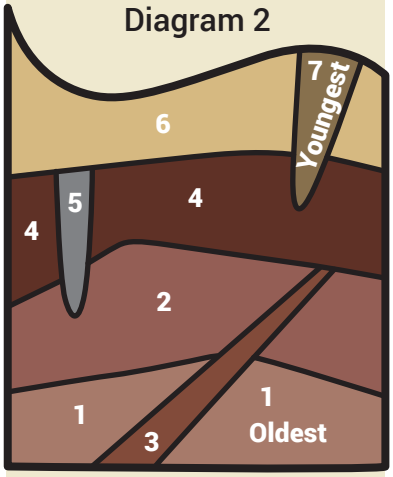


Diagram 2



Based on what you've learned about geologic layers, list the layers in order from youngest to oldest for Diagrams 3 and 4.

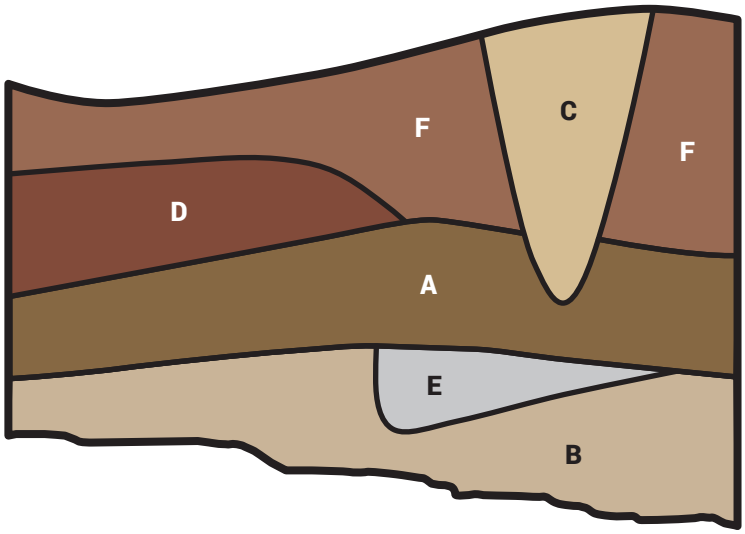


Diagram 3

_____
Youngest
_____
_____
_____
_____
_____
Oldest

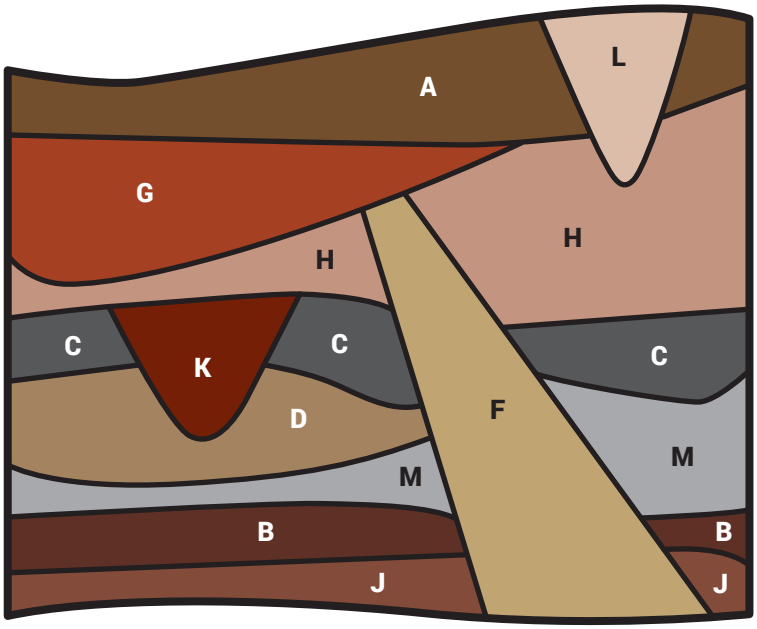
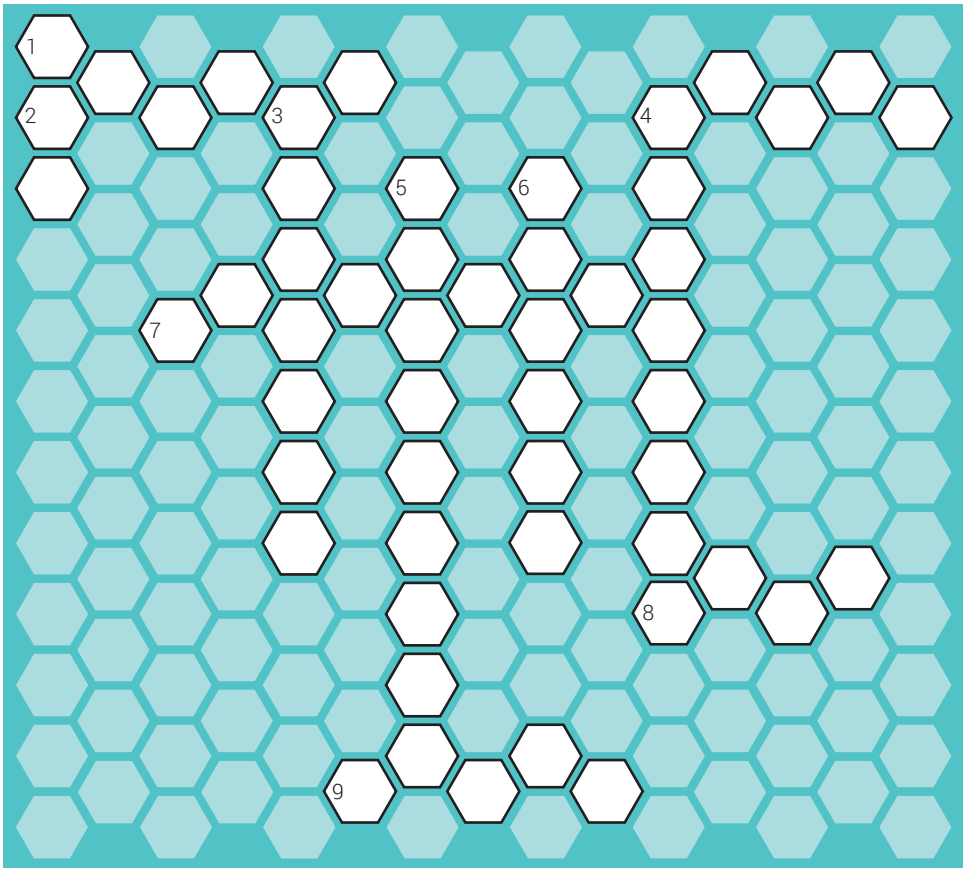


Diagram 4

_____
Youngest
_____
_____
_____
_____
_____
_____
_____
_____
_____
Oldest



Across

2. Volcanic ash contains a high amount of an element called _____.
4. Over time, the trees' _____ degraded or dissolved. (see page 9 for a hint.)
7. Agate, opal, and topaz are types of _____. (See page 9 for a hint.)
8. Erosion is a very _____ process. (See page 8 for a hint.)
9. The state in which Malm Gulch is located. _____ (See page 2 for a hint.)

Down

1. Volcanic pumice and _____ once covered the trees in Malm Gulch.
3. Millions of years ago, the _____ of Idaho was warmer and wetter. (See page 5 for a hint.)
4. The chemical elements in a mineral cause its _____ to grow in specific shapes. (See page 9 for a hint.)
5. When wood is fossilized or turned to stone, it is called _____.
6. Because Idaho is rich in minerals, _____ can find dozens of different gemstones. (See page 9 for a hint.)

Activity 8:

Petrification Process

The trees in the Malm Gulch area became **petrified**. Petrified means the remains of the wood turned into a fossil or stony material. Very specific steps must happen for wood to become petrified. First, volcanic **ash** covered the trees at Malm Gulch. The ash contained a high amount of an element called **silica**. As time passed, the trees' **cells** degraded or dissolved. As the silica in the ash was dissolved in water, it slowly filled spaces in the tree where cells had once been. Slowly over time (thousands of years), the trees became petrified.

Based on the highlighted words in this paragraph and previous knowledge you learned in this activity book, complete the crossword puzzle.

Activity 9: What Am I?

You have learned a lot about the Malm Gulch area. You have specifically learned about the petrified tree stumps, rock layers, minerals, and volcanic activity. Now, unscramble the words based on the following clues.

1. I am, possibly, the type of tree that used to grow in the Malm Gulch area.

   I am also one of the oldest and tallest tree types in the world.

   W D O O E R D ___ ___ ___ ___ ___ ___ ___

2. When I erupt, I release hot gas, ash, and pumice.

   I can also release sheets of molten rock called lava.

   C O N V O A L ___ ___ ___ ___ ___ ___ ___

3. When chemical elements combine, I am made.

   I become rich in the earth because of volcanic activity.

   E R L A M I N ___ ___ ___ ___ ___ ___ ___

4. I happen over time as a result of wind, water, ice, and gravity.

   Because of me, the petrified trees at Malm Gulch were uncovered.

   R E O S N I O ___ ___ ___ ___ ___ ___ ___

5. I am the study of the earth and rocks and how they change.

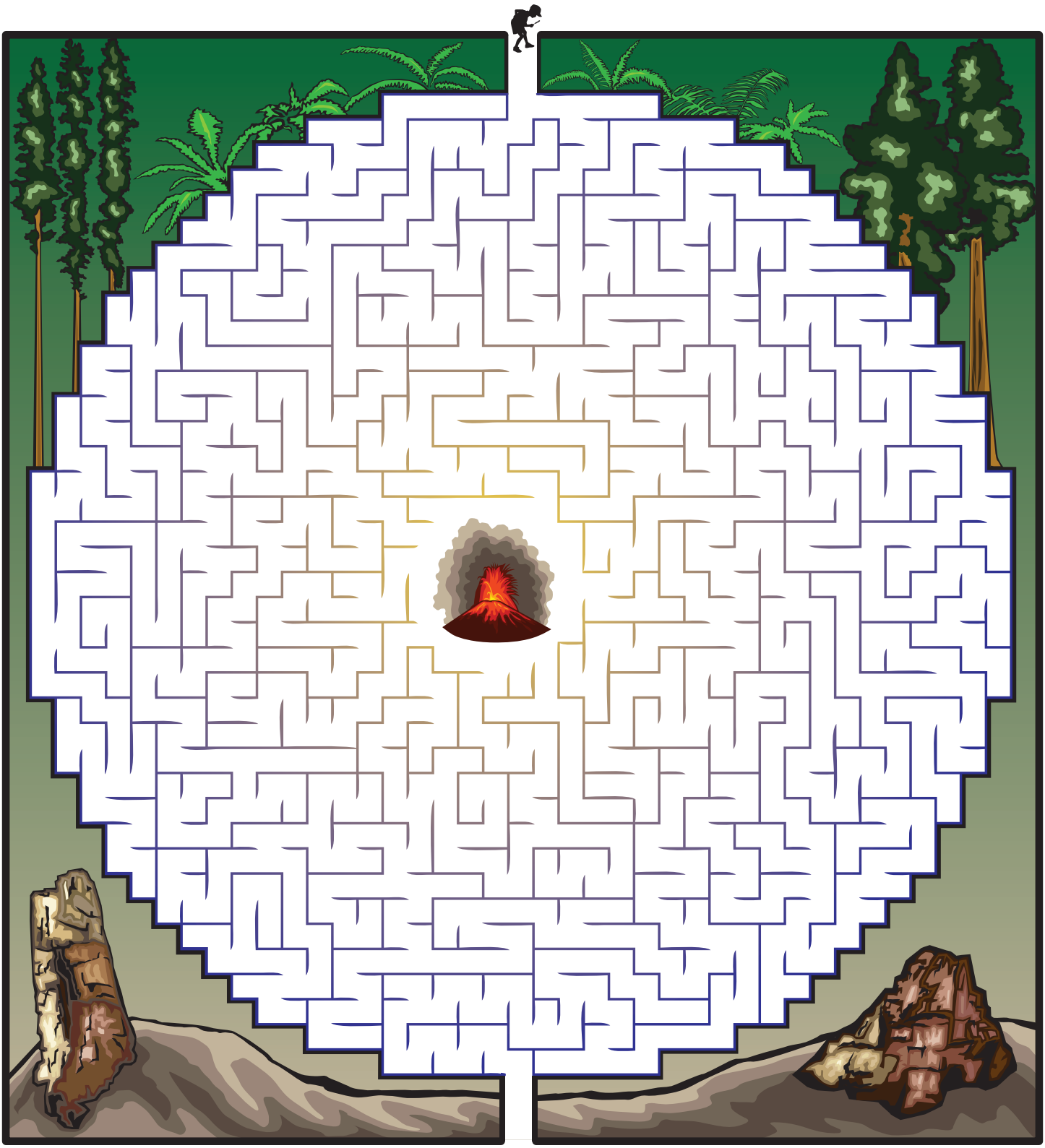
   People that study me often become geologists.

   G L O E O Y G ___ ___ ___ ___ ___ ___ ___

Activity 10:

A-Mazing Volcanoes

As you can see, the Malm Gulch area has changed significantly over time. Help this Junior Explorer travel in time, from 50 million years ago back to the 21st century. Watch out for the lava and the deep ash deposits!

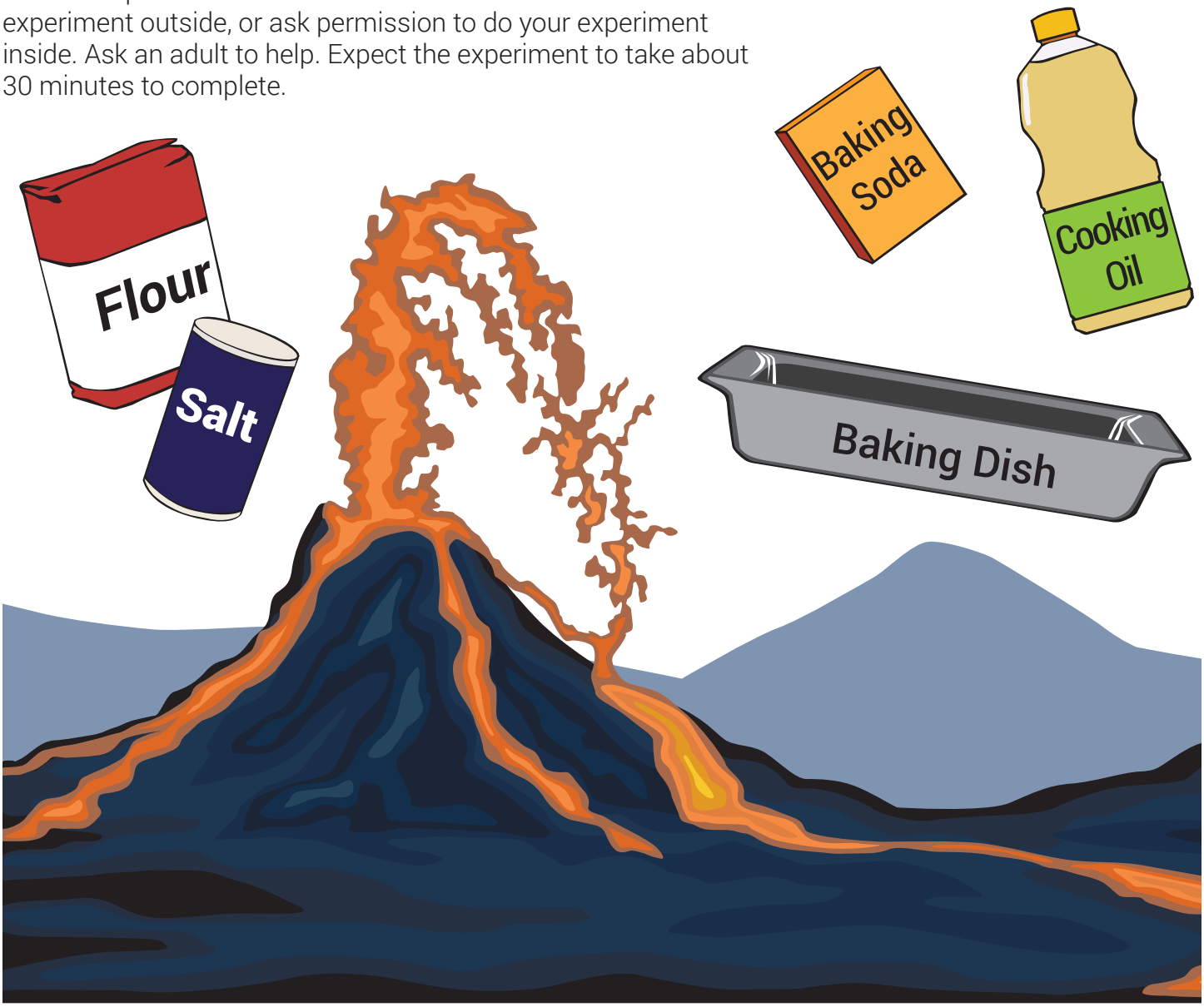


Bonus Activity: Make Your Own Volcano

The Twin Peaks caldera, west of Challis, is roughly 12½ miles in diameter. Although the caldera was not the source of the volcanic ash in Malm Gulch, the Twin Peaks caldera is a very visible example of volcanic activity in this area. Now that you have learned a little about volcanic activity, you can build your own volcano! This baking soda and vinegar volcano is a simple science experiment that mimics a real volcano. You can do this experiment outside, or ask permission to do your experiment inside. Ask an adult to help. Expect the experiment to take about 30 minutes to complete.

What You Need:

- 6 cups of flour
- 2 cups of salt
- 4 tablespoons of cooking oil
- 2 tablespoons of baking soda
- warm water
- plastic soda bottle (empty)
- dish soap
- food coloring
- vinegar
- baking dish or other pan



Instructions:

1. First, make the mixture for the "cone" of the volcano. To do this, mix 6 cups of flour, 2 cups of salt, 4 tablespoons of cooking oil, and 2 cups of water. The resulting mixture should be smooth and firm (more water may be added if needed).

2. Stand the soda bottle in the baking dish, and mold the dough around it into a volcano shape. Don't cover the hole or drop dough into it.

3. Fill the bottle most of the way full with warm water and a few drops of red food coloring.

4. Add 6 drops of dish soap to the bottle contents. The soap helps trap the bubbles produced by the reaction, which creates better lava.

5. Add 2 tablespoons of baking soda to the liquid. Slowly pour about 1 cup of vinegar into the bottle. Watch out—eruption time!

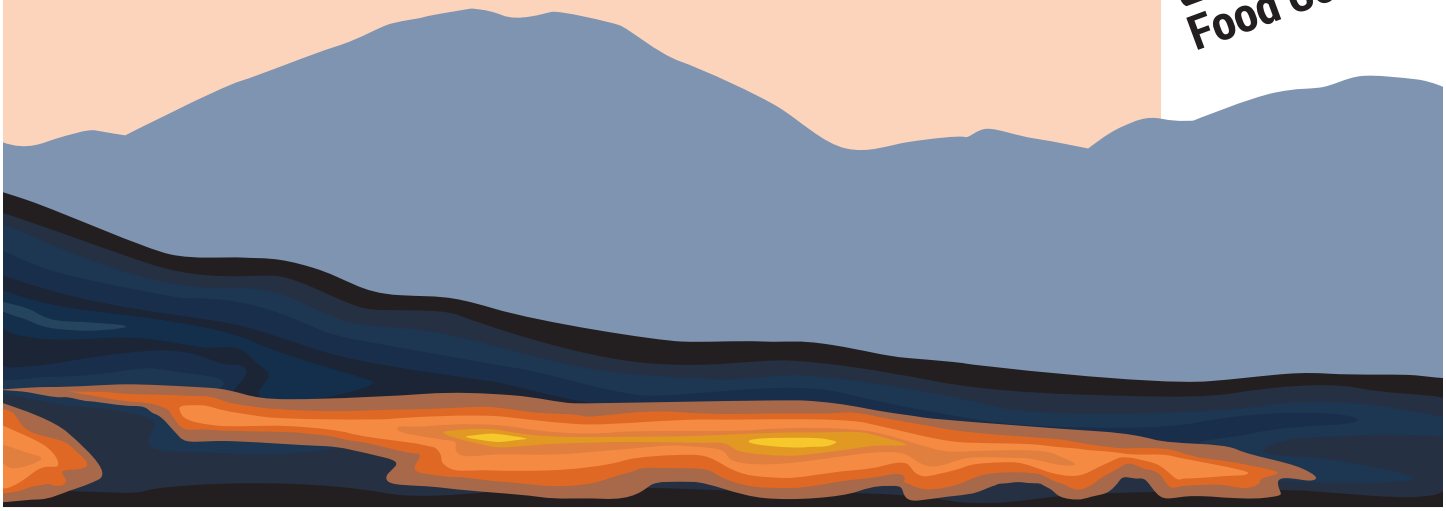
6. Clean up when you are done.

Tips:

The "lava" happens as a result of a chemical reaction between the baking soda and vinegar. In this reaction, carbon dioxide gas is produced, which is also present in real volcanoes.

As the carbon dioxide gas is produced, pressure builds up inside the plastic bottle, until the gas bubbles (thanks to the detergent) out of the "volcano."

The red food coloring results in red-orange lava. Add some red, yellow, and even purple, for a bright display!



Junior Explorer Pledge

As a Bureau of Land Management Junior Explorer, I promise to:

- Do all I can to help preserve and protect the natural and cultural resources of our public lands.
- Be aware of how my actions can affect other living things and the evidence of our past.
- Keep learning about the importance of nature and our heritage.
- Share what I have learned with others.

Date

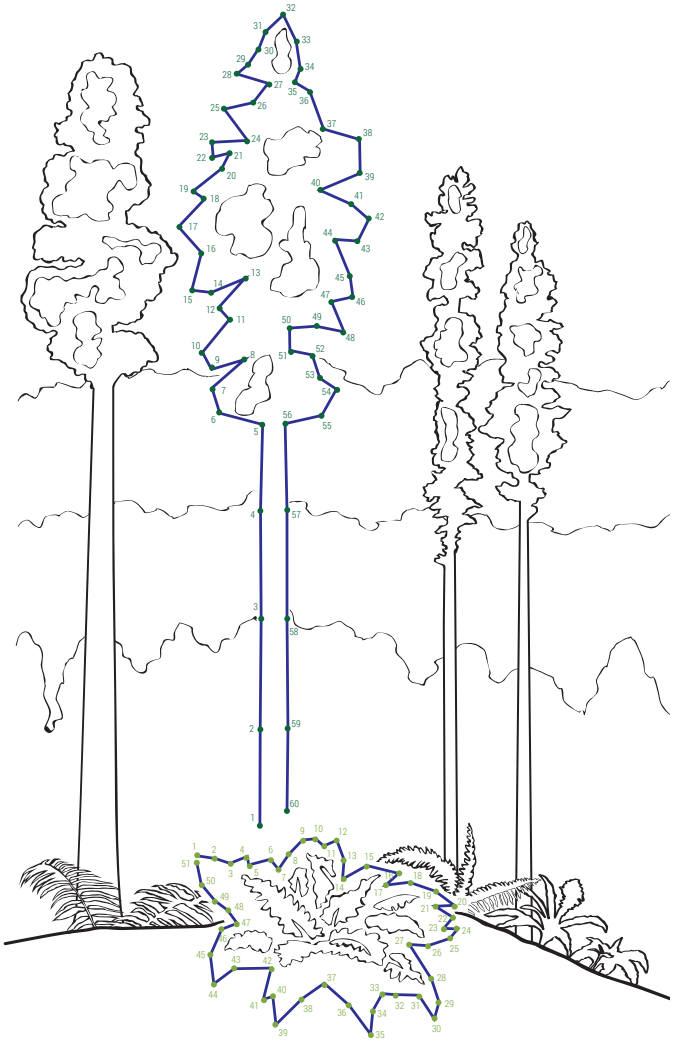
Explorer Signature

Answer Key

Activity 1: Growth Speed of Giant Trees

300 ÷ 2 = 150 years

Activity 2: A Different Time, A Different Place



Activity 4: Colorful Ash Cultivates Unique Growth

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

Activity 5: Undercover Work

1. slow, erosion
2. weather, water
3. streams, rivers
4. landslide
5. petrified

Activity 7: Rock Layer Formation

Diagram 3: C, F, D, A, E, B

Diagram 4: L, A, G, F, H, K, C, D, M, B, J

Activity 8: Petrification Process

Across

2. silica

4. cells

7. gemstones

8. slow

9. Idaho

Down

1. ash

3. climate

4. crystals

5. petrified

6. miners

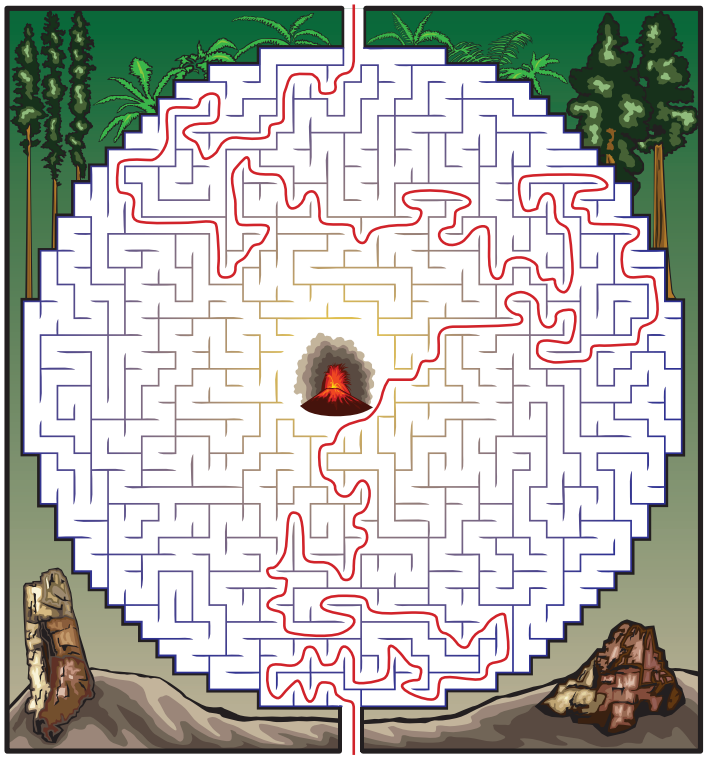
Activity 9: What Am I?

1. redwood

2. volcano

3. mineral

4. erosion

5. geology

Activity 10: A-Mazing Volcanoes