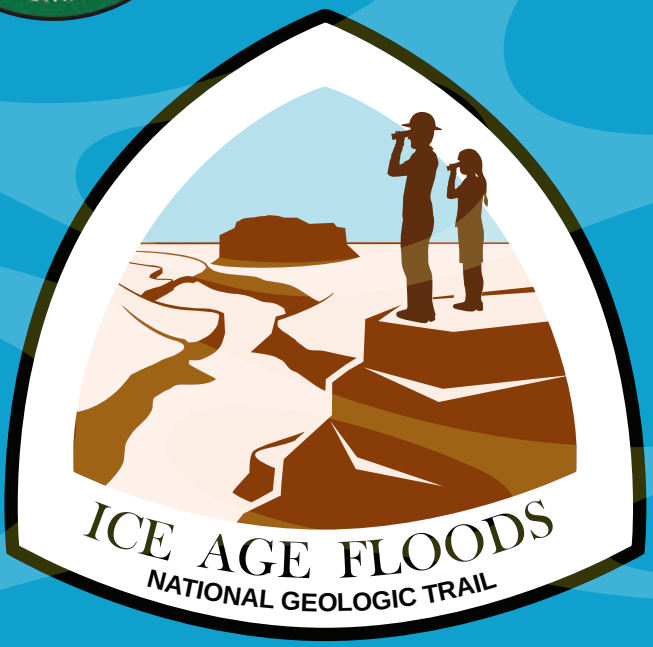
MEGAFLOOD ADVENTURE

JUNIOR RANGER

EXPLORE • LEARN • PROTECT

Junior Ranger
ACTIVITY BOOK



Who are the **Junior Rangers?**

EXPLORE, LEARN, and PROTECT

That's the Junior Ranger motto! As a Junior Ranger, you can explore the parks, learn about nature and history, and help protect them by learning and following the park rules.

To earn *your* Junior Ranger badge, complete as many pages as you can and visit at least **TWO** sites on the trail. Return your booklet to a Field Ranger, or mail it to the address on the credits page, fill out the certificate, and take your pledge!

Pledge to **Leave No Trace!**

★ **Know Before You Go**
Be prepared! Bring clothes to protect you from the cold, heat or rain. Use maps to show you where you'll be going so you won't get lost. Learn about the areas you visit before you head out.

★ **Choose the Right Path**
Stay on the main trail to protect nature and keep from wandering off by yourself. Steer clear of flowers or small trees.

★ **Trash Your Trash**
Pack it in. Pack it out. Put litter, even crumbs, in trash cans or carry it home.

★ **Leave What You Find**
Leave plants, rocks, and other items as you find them so the next person can enjoy them.

★ **Be Careful With Fire**
Use a camp stove for cooking. Use existing fire rings to protect the ground from heat. Keep your fire small. Make sure the fire is *out* and *cold* when you leave.

★ **Respect Wildlife**
Observe animals from a distance and never approach, feed or follow them!

★ **Be Kind To Other Visitors**
Make sure the fun you have outdoors does not bother anyone else. Listen to nature, and avoid loud noises.

I, _____, pledge to apply Leave No Trace *principles wherever I go!*

Leave No Trace™
Center for Outdoor Ethics | LNT.org

Floods of Lava

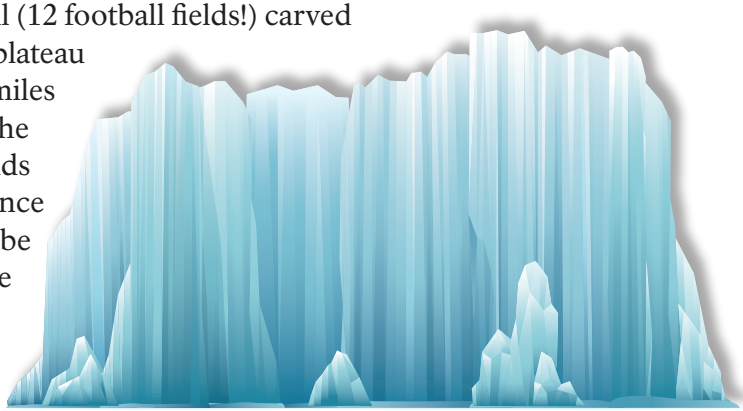
Around 15 million years ago, massive floods of lava oozed out of giant cracks in the ground called **fissures**. The lava spread all over the Pacific Northwest through Idaho, Oregon and Washington. When the lava cooled, it formed thick layers of basalt rock. The massive layers make up the bedrock of the landscape you see throughout the trail. As lava cools, it shrinks and cracks. The top of the flow hardens into smooth irregular cliffs, while the bottom hardens into columns. Each layer of columns represents a different lava flow.

Basalt layers also come in different types of colors. Some are black, gold or red. Some areas look as though they're covered in lime-green moss. This "moss" is actually a living algae called **Lichen**.

Draw some basalt layers you've found along the trail!

What are the Ice Age Floods?

Around 15,000 to 18,000 years ago—during the last Ice Age—a giant sheet of ice spread across northern Montana, Idaho, and Washington. **The Cordilleran Ice Sheet** created huge, solid **ice dams** along the rivers in the northwestern United States. In Montana, an ice dam on the Clark Fork River created the massive glacial lake Missoula. The lake had an area of 1,528 square miles, more than 10 times the size of Seattle! As the depth of the lake increased, cracks formed in the dam causing it to burst. Giant floods 4,200 feet tall (12 football fields!) carved through the basalt plateau at speeds up to 65 miles per hour, creating the Channeled Scablands we see today. Evidence of these floods can be seen throughout the Ice Age Floods National Geologic Trail.



The Trail's Many *Ecosystems*

Grassland & Shrub Steppe

Open, dry, and rocky with lots of shrubs and grasses.

Forests

A few open areas, mostly dense forests with all different trees.

Wetlands

Marshy areas with water-loving plants, animals, and trees.

Check off what you've seen on the Ice Age Floods Trail

Try to get 3-in-a-row!

★ *Bonus challenge! Can you get a blackout?*

Do You See Me?

BIRDS OF PREY

Check off any birds you've seen!

Osprey ☐

Hawk ☐

Falcon ☐

Raven ☐

Eagle ☐

Owl ☐

Solving the *Megaflood Mystery!*

Uniformitarianism

Founded by geologist James Hutton, a theory that landscapes were shaped through slow, continuous, uniform processes. These processes are the same in the past, present, and future. We can observe these processes today and know they have happened before, and will happen again.

Examples:

River valleys, the Grand Canyon, mountain-building.

Catastrophism

Theory that landscape features are primarily formed from catastrophic events that were sudden, violent, rare, and widespread. These were short-lived events outside our present experience, knowledge, or nature and have greatly modified the surface of the earth.

Examples:

Volcanic eruptions, earthquakes, landslides, asteroid impacts.

How can we explain the unusual landscape of the

Channeled Scablands?

The Clues

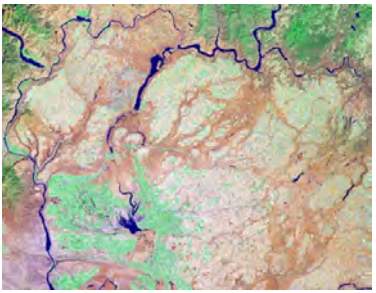
When geologist J Harlen Bretz first came to the area, he knew something was up. River valleys are usually v-shaped, but the Columbia gorge is u-shaped which suggests something greater had happened. Something...

catastrophic.

With reinforcement from geologist Joseph T. Pardee's previous research, Bretz found clues around the channeled scablands to prove his theory!

Pardee discovered these giant ripple marks, ranging from 13 to 30 feet tall, formed from flood waters traveling at a rate of at least 50 miles per hour.

Satellite images of the scablands, from the Mariner 9 spacecraft, revealed braided-stream patterns similar to riverbeds. This reinforced Bretz's cataclysmic flood theory.



This is a massive erratic boulder from a different area, carried from miles away by the megafloods.

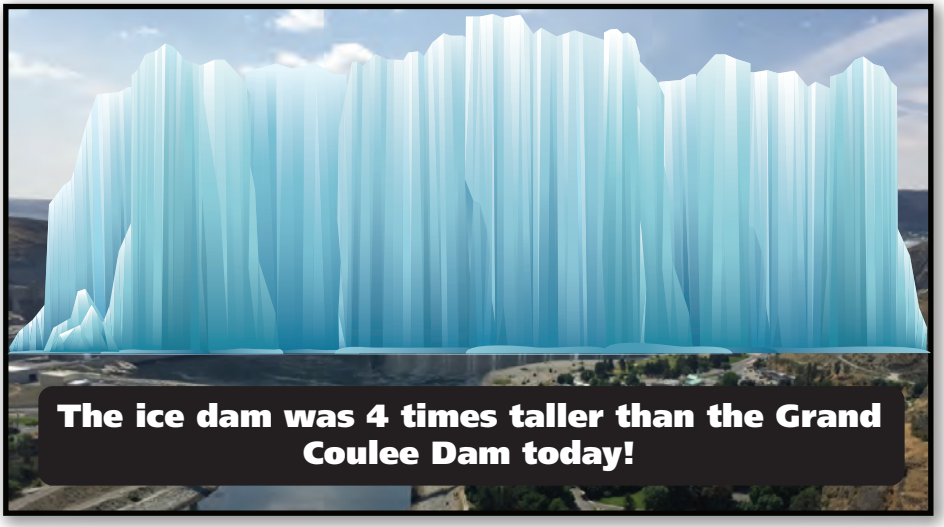
Which theory explains these clues? Circle one.

Uniformitarianism **Catastrophism**

Grand Coulee Dam Visitor Center

Coulee Dam, Washington

The Grand Coulee Dam sits at the location of another kind of dam: an enormous ice dam! It formed from the **Okanogan lobe** of the Cordilleran Ice Sheet. When the ice dam burst, it sent walls of water gushing through the **Grand Coulee**, carving out what we see today!



Look around at the displays and **watch a video** they are showing in the theater upstairs.

Which video did you watch?

What ecosystem do you see around the dam?

Sun Lakes-Dry Falls State Park

Coulee City, Washington

During the Pleistocene epoch, Dry Falls was a waterfall

10 times bigger

than Niagara Falls!

Before the Cascade Mountain Range was formed, the area was lush and home to rhinoceros and camels. About 35 miles from Dry Falls, the bones of a rhinoceros were found! It is now known as the **Blue Lake Rhino** and is said to be 14.5 million years old!

Megaflood Wordsearch

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

Potholes
Swirling whorls of water that grind giant, pit-like depressions into the rockbed.

Mesa
A flat-topped hill with steep sides (like Steamboat Rock!)

Ripplemarks
Tall and long grooves in the landscape caused by flooding.

Coulee
A dry, steep-walled, trench-like gorge or valley representing an abandoned river channel.

Bretz
Last name of geologist J Harlen Bretz, the first to come up with the "catastrophic flood theory."

Rhythmites
Thick, graded, horizontal layers of flood deposits that are evidence of multiple floods years apart.

Basalt
The type of rock that makes up the Columbia Plateau.

Pleistocene
The time in which the last Ice Age occurred.

Cataract
A tall, now-dry cliff formed during the Ice Age Floods.

Fissure
Giant cracks in the ground that oozes lava.

Steamboat Rock State Park

Electric City, Washington

Steamboat Rock used to be an island after the ice dams changed the course of the river. This geologic formation is **800 feet tall** and **4,000 feet wide!**

Circle which formation Steamboat Rock is!

Buttes are *taller* than they are *wide*.

Mesas are *wider* than they are *tall*.

Butte

or

Mesa

Dry Falls Visitor Center is full of info on the Ice Age Floods and the Grand Coulee! Walk around and write down 3 things that you learned.

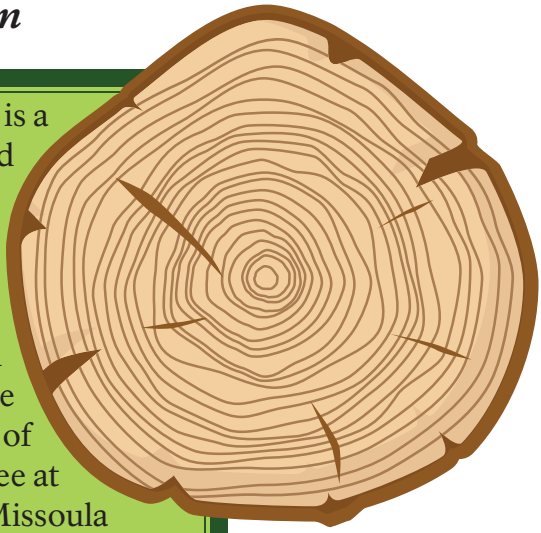
1. _____

2. _____

3. _____

Gingko
Petrified Forest

Vantage, Washington



Petrification is a process where trees and wood are turned to stone. The trees are buried and protected from natural forces, transforming the wood to solid rock over huge amounts of time. Most of the wood you see at Gingko is from the Missoula Floods, so you can see how the trees looked 13,000 years ago!

Take the **The Trees of Stone Interpretive Trail** 2 miles west of the Visitor Center. On the trail you'll see lots of fossils, erratics, and petrified logs. Pick your **favorite thing** and **draw it!**

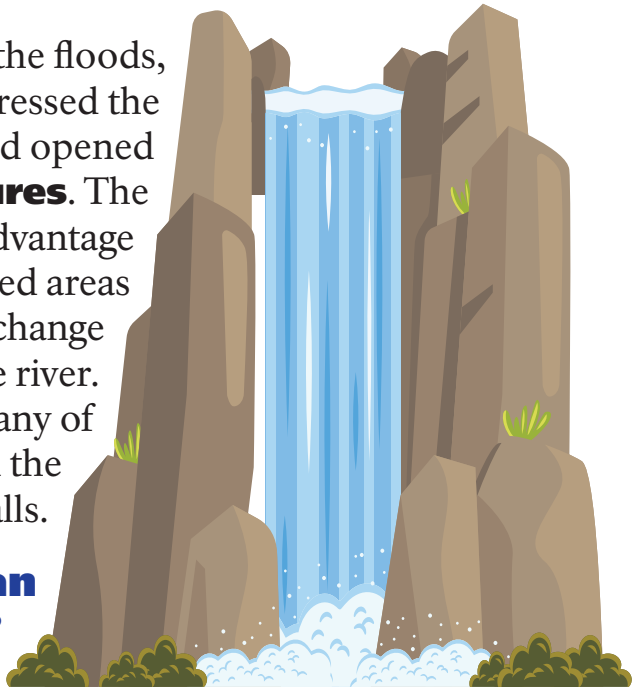
BONUS: Gingko Petrified Forest has its own Junior Ranger program. Complete it to earn another badge!

Palouse Falls State Park

Lacrosse, Washington

Long before the floods, tectonic forces stressed the basalt bedrock and opened **deep fractures**. The megafloods took advantage of these weakened areas and used them to change the course of the river. Palouse Falls has many of these cracks in the canyon walls.

How many can you find?



Columbia River Gorge
National Scenic Area

Cascade Locks, Oregon

Even though the landscape looks different from the parks in Washington and Montana, the Ice Age Floods carved out this spectacular gorge, too. As you're driving through the Columbia River Gorge, you will see different types of waterfalls!

Plunge
Drops vertically and away from the cliffside, losing contact with bedrock.

Horsetail
Shaped like a horse tail, dropping vertically and maintaining contact with bedrock.

Cascade
Tumbles along a series of rock steps.

Block
Pours over a wide section of a stream.

Fan
Descends from a stream above and gets broader or "fans out" at the bottom.

Segment
Separates into several parts.

Tier
Falls, falls, and falls again creating several "tiers" that can be viewed at once.

Punchbowl
Pours out of a narrow opening in the stream and into a pool.

Some of the waterfalls you can drive to include Latourell, Multnomah, Bridal Veil, Wahkeena, Horsetail, and Starvation Creek. However, there are dozens of waterfalls you can hike to!

Visit three waterfalls and write down what shape they are!

Waterfall Name	Type of Shape

Tualatin Ice Age Trail

Tualatin, Oregon

Tualatin was once home to elephants, mastodons, ground sloths, and mammoths! The Tualatin Library has a **13,000-year-old mastodon skeleton**. Be sure to check it out!

The Tualatin Ice Age Trail includes

Tualatin Heritage Center
Tualatin Public Library
Community Park
Visitor Information Center & Commons

plus at least seven more!

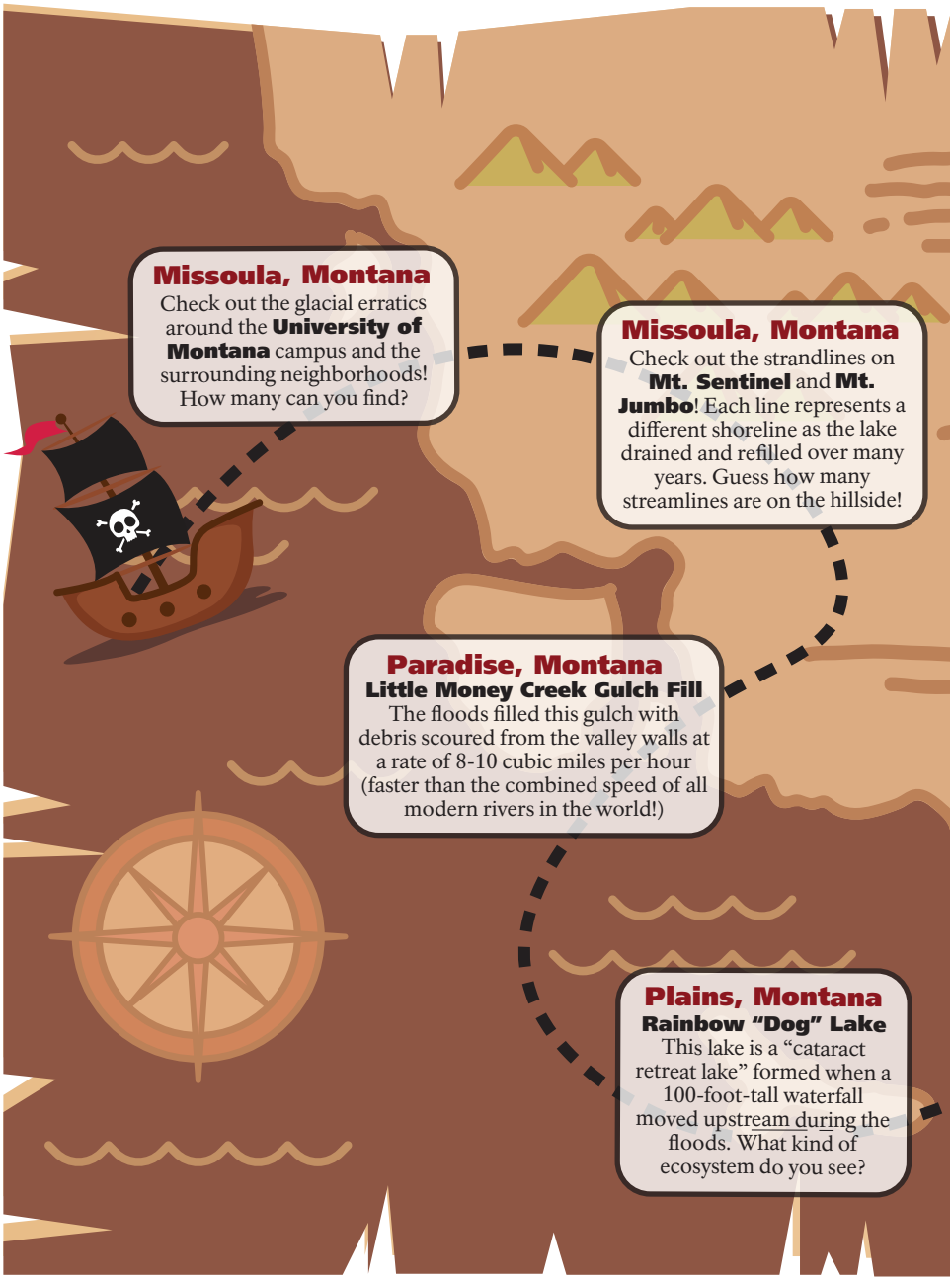
The Library is a great starting point. They'll be able to direct you to other spots. The trail provides lots of info on Tualatin's prehistoric inhabitants and the Ice Age Floods!

Try to hit at least three stops, and complete three activities from the trail!

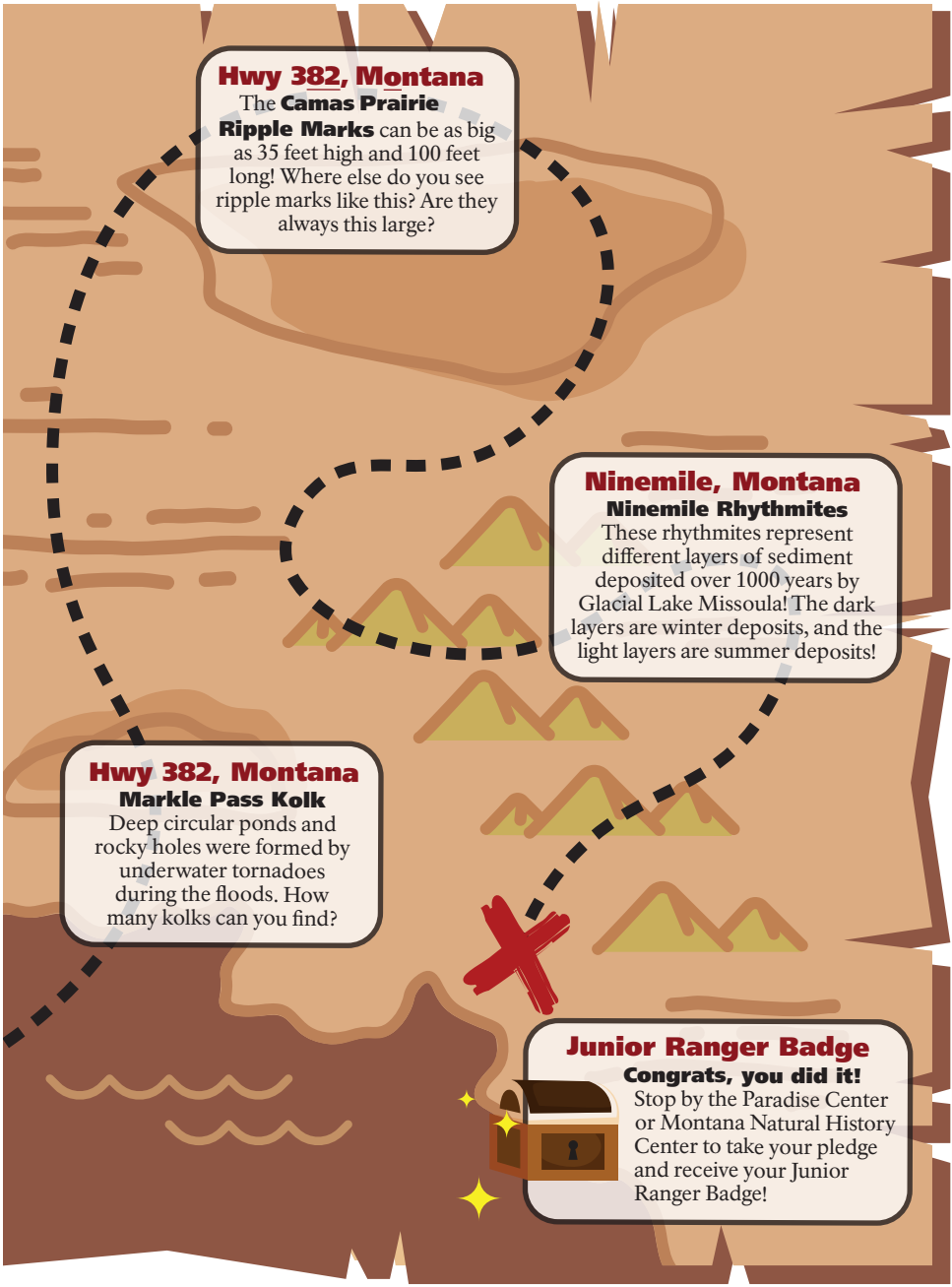
- ☆ Check out the **bones and fossils** they have on display at the Tualatin Library.
- ☆ Take a picture with **Brian Keith's mastodon** sculpture in the Tualatin Commons.
- ☆ Find out the weight of the **erratic boulders** at the Tualatin Heritage Center.
- ☆ Learn the story of the **Tualatin Mastodon** at the Heritage Center.
- ☆ See the **Willamette Meteorite**.
- ☆ Take the **Fields Bridge hike** and describe what ecosystem you're walking through. (Make sure to read the signs along the trail!)
- ☆ Visit the **Sherwood & Lake Oswego fault**.
- ☆ Visit the **mastodon dig site**.

This extinct species of ground sloth, **Megalonyx**, was numerous around 11,000 years ago. Unlike its tiny, tree-dwelling cousin, the ground sloth was twice as tall as a full-grown human!

Glacial Lake Missoula Area



Take a self-guided driving tour of the Glacial Lake Missoula area in Montana to some Ice Age Flood features! The whole tour is about **255 miles** and takes **4 hours**. Don't forget to pick up a map from the **Missoula Natural History Center**!



Hwy 382, Montana

The **Camas Prairie Ripple Marks** can be as big as 35 feet high and 100 feet long! Where else do you see ripple marks like this? Are they always this large?

Ninemile, Montana

Ninemile Rhythmites

These rhythmites represent different layers of sediment deposited over 1000 years by Glacial Lake Missoula! The dark layers are winter deposits, and the light layers are summer deposits!

Hwy 382, Montana

Markle Pass Kolk

Deep circular ponds and rocky holes were formed by underwater tornadoes during the floods. How many kolks can you find?

Junior Ranger Badge

Congrats, you did it!

Stop by the Paradise Center or Montana Natural History Center to take your pledge and receive your Junior Ranger Badge!

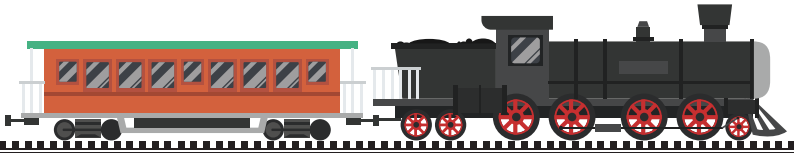
Paradise Center

Paradise, Montana

The **Paradise Visitor Center** was the town's elementary school from 1910 to 2013. Today, it's home to exhibits about the historic railroad town and the Missoula Floods, and even hosts a community theatre and art studio!

Walk around the Paradise Center and complete the following activities!

- ○ Go to the interactive map of Montana in the Missoula Floods exhibit. See how much of Montana was drowned by Glacial Lake Missoula.
- ○ Take a ride on the old merry-go-round outside.
- ○ Check out the classroom exhibit. What differences do you see between this classroom and yours?
- ○ Learn about the town of Paradise when it was still a railroad town.



Montana
Natural History Center

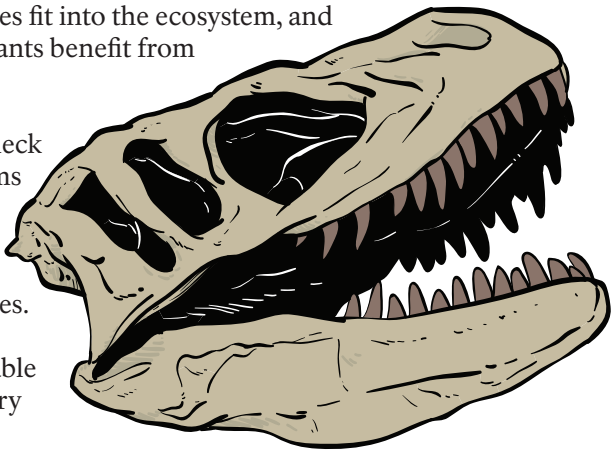
Missoula, Montana

Standing nearly 7 feet tall is the **North American Camelops**. This extinct ancestor of modern camels lived between 3.6 million to 11,700 years ago. Only skeletal evidence has been found, so scientists still don't know if the Camelops had a hump!

The museum is home to many hands-on activities and exhibits!

Complete at least 3 of the following activities.

- ☐ Learn what a Naturalist is and develop some of your own Naturalist skills. Be sure to check out the Naturalist Lab for fun activities!
- ☐ See a life-size replica of a Tyrannosaurus rex skull and check out fossils from thousands-to-millions of years ago!
- ☐ Watch the "Great Floods" video in the Glacial Lake Missoula exhibit
- ☐ Learn how to garden for pollinators, and check out butterflies, feathers, and other specimens under a microscope!
- ☐ Learn about how wildfire has shaped our forests, how mountain pine beetles fit into the ecosystem, and what animals and plants benefit from fire.
- ☐ Explore geology! Check out all the rocks, gems and minerals you can find around Montana! Pick out some of your favorites.
- ☐ Explore the touch table in the Kids' Discovery Room.



How to receive your badge...

1. Email pictures of your book to IAFL_Program_Manager@nps.gov.

2. Mail your completed booklet to:

Ice Age Floods NGT
1008 Crest Drive
Coulee Dam, WA 99116

Make sure to clearly print your name and return address on the lines below. We will return your booklet when we send you your badge.

Congratulations on completing the Ice Age Floods National Geologic Trail Junior Ranger program!

Junior Ranger Pledge

As a Junior Ranger, I promise to teach others about what I learned today, explore other parks and historic sites, and help preserve and protect these places so future generations can enjoy them!

Park Stamps

Ice Age Floods Trail Stamp

YOUR NAME

PARKS VISITED

RANGER'S NAME

DATE

This Junior Ranger booklet is possible through cooperation with:

- **The Ice Age Floods Institute**
- **Geological Society of America & Geoscientists in the Parks**
- **National Park Service**
- **Lake Roosevelt National Recreation Area**
- **The Student Conservation Association**

Words and research by
Elise Freeman
Intern, Geoscientists in the Parks

Graphics and design by
Callie Ogborn
Digital Media Intern, Lake Roosevelt NRA

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