MOR and FWP Summer Reading Trunk!

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The 2022 Summer Reading Trunk explores aquatic life from Montana's past and present.

While fly fishing in the rivers today, it's hard to imagine that Montana was once covered by an ocean! During the time of the dinosaurs, mosasaurs, plesiosaurs, and giant, toothy fish once swam Montana's warm, inland sea. Over time, the land changed, the Rocky Mountains formed, most sea life and non-avian dinosaurs went extinct, and the sea disappeared. Now, where ocean life once was, we find fossils; and freshwater rivers, lakes, ponds, and streams are teeming with life. Let's explore Montana's modern and ancient fish through some fun activities!

Activity 1: Montana Gyotaku Fish Imprints

Overview:

Before the invention of photography, how could fisherman prove to others that they had *really* caught a big fish? Gyotaku fish prints were a way that Japanese fishermen were able to provide proof of their big catches, by using rice paper and ink to create an imprint of their fresh catch to show to people back on shore. Dating back over 100 years, gyotaku is a great way to capture realistic imprints of a fish using simple materials, which we will be doing today!

Supplies Needed:

- Paint
    - Fabric paint if you are printing on cloth
    - Regular paint will work if you are just using paper
- Paper/Fabric/Printing Surface
- Rubber fish, or other textured items that could be fun to print!
- Scrub brush, cleaning trays, water

Activity Outline

1. Introduce gyotaku and its history – you could show some examples of gyotaku and see if people recognize the fish in the print!
2. Show the different rubber fish examples that participants can choose from today. You can go over each kind of fish, or see if they recognize it. You could also point out the general parts of a fish (https://www.fs.usda.gov/detail/r6/learning/kids/?cid=fsbdev2_027478)
3. You can then demonstrate how to make a print, with all of paint/colors. Participants can make it all one color, or use multiple colors. Let them know that they should work fairly quickly, so that the paint doesn't dry out in the middle. Also, it's better to use a thin coat of paint, rather than thicker blobs, as the transfer won't be as clear with thick layers of paint.
4. Whether you are using paper, or fabric, make sure you remind participants to press firmly all over the fish, but do not rub/move the paper or fabric, as that will smear the image. It's often best to use fingertips to smooth and press things.
5. Further activities:
    a. Have participants make a profile for their fish, with information on the type of fish, where it's found, etc. You could put out books/resources for them to find their fish, and do research to add to their fish print!

Supplemental Videos:

1. Montana FWP Video on Gyotaku: https://www.youtube.com/watch?v=sddH53ty5Kw
2. History of Gyotaku (3:30) https://www.youtube.com/watch?v=k_mG-Ka4mv8
3. How to make a gyotaku print with a real fish (3:42) https://www.youtube.com/watch?v=InpLfs4rasw

Activity 2: Fish Obstacle Course

Overview:

Fish face many challenges in their daily lives, and there are many obstacles they need to overcome in order to survive and thrive in their environments! This Fish Game Obstacle Course is a great way for participants to learn about those challenges, both manmade and natural, and try to make their way successfully through the game.

Supplies Needed:

- Colored paper
- Dice (multiple pairs for different groups of people playing)
- A large space to set up the obstacle course

Activity Outline:

1. Read through the Fish Game Obstacle Course PowerPoint, and decide how long you want to make your obstacle course. You can decide to add activities or missions to each slide to lengthen the game if you like as well.
2. Once you have decided which slides you want to use, you can then decide where in the library you would like to place the obstacle course. Place a printed PowerPoint slide around your designated space, and try to make each station obvious (ex: taping them to brightly colored posterboard) so that people aren't hunting for each station.
3. Before you start the game, make sure to go over safety, especially if you have mini-missions at some of the stations. You can give each participant a pair of dice (or just one die) that they roll to work through the obstacle course.
4. At the end of the game, you can ask people what they learned, or what obstacles they encountered.
5. Further activities:
    a. You could combine the obstacle course with a scavenger hunt! You could place clues/riddles/questions on the stations and give participants bonus spaces if they find out the answer.
    b. You could spend some time talking about obstacles that fish face before starting the game and asking participants to brainstorm first.
    c. This could also work as a summer-long passive activity, similar to a StoryWalk. You could have an accompanying book display that you switch out with various fish-related books and information.

Activity 3: Water of the World

Overview:

This activity demonstrates the different types of water in the world, how it is distributed between the types, and how water supply affects other parts of the world and environment. You can take out pieces of this activity, or do it in its entirety, depending on time and audience. To see a walkthrough video of how to lead this lesson, please refer to the FWP YouTube Video on Water of the World.

Supplies Needed:

- Board or paper to write on
    - Marker/pencil, etc.
- 7-9 1-liter containers
- Blue food coloring (optional, but better visual)
- 1 liter of water
- 1 globe – (blow-up/throwable if you want to do estimates)
- Paper jars worksheet (if you want kids to predict water distribution individually)
    - Blue colored pencils/crayons
    - Scissors
    - Glue or tape
- 1/3 c measuring cup, 1 Tablespoon, ½ teaspoon, ¼ teaspoon, dropper

Educator Prep:

Prepare one liter of colored water (color makes it easier to see). You can pre-label the rest of the containers and keep them out of sight or label them after the brainstorming activity. Have the globe handy and ready to reference. If you aren't able to use water, you can prepare the paper worksheet with jars on them, and colored pencils/markers for attendees to use.

Introduction:

- Discuss water: where does it come from, does it observe state/country boundaries, etc.
    - You may want to review the water cycle (precipitation as rain/snow, evaporation, condensation, back to precipitation)
- What is water used for/why is it important? Drinking, growing food (plants and animals), cooling off, washing, etc.
- Brainstorm the 6 categories where water is "held" or exists in the world
    - You can write all the ideas on the board, then sort them into the 6 main groupings, in no particular order:
        - Oceans
        - Rivers (streams, creeks, flowing water)
        - Lakes (ponds, reservoirs)
        - Ice (ice caps, glaciers)
        - Ground water (geysers, aquifers, well-water)
        - Air (clouds, atmospheric, this room)

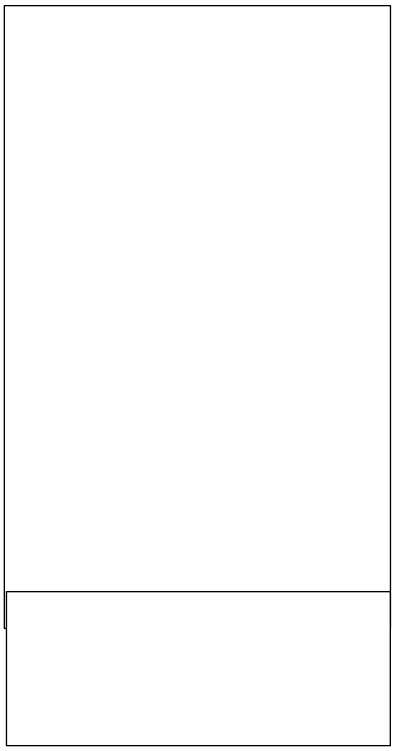
- Label containers. If kids are using own paper jars, have them label their jars as well.
- At this point, you can talk about scientific estimates- we can't measure everything exactly, so we estimate…
    - If you want to play an estimate game, you can toss the globe and record where the pointer fingers catch (land or water). That will give us an estimate of the ratio of land to water. The more samples, the better the estimate. Calculate the percentage of water.
    - Once that is done, you can tell them that about 71% of the earth is covered in water.
- You can discuss thoughts on what order the containers go in.
    - Eventually, they will be ordered from most to least:
        1. Oceans
        2. Ice
        3. Ground water
        4. Lakes
        5. Air
        6. Rivers/streams
    - You may opt to tell the students that the water is not equally graduated from one "container" to the next. If all that water was represented by this 1 liter of water (they can color 1 paper jar full to represent water) and have them guess how much goes into each of the 6 categories. (If they use the paper jars, have them cut the paper horizontally so they can better see a consistent representation in the jars as they "distribute the water")
- Then begin to distribute the water. Usually, the teacher pours 1/3 to ½ into Oceans to start (usually everyone thinks half is a good guess), then distribute to the rest
    - Oceans (start with 1/3-1/2)
    - Glaciers (~1/3 cup)
    - Ground water (~2 Tablespoons)
    - Lakes (~1/2 teaspoon)
    - Air (~10 drops)
    - Rivers/streams (less than 1 drop! But usually represent it as a drop
        1. Can talk about MT having the tiniest fraction of a drop now (would have been more when dinosaurs were here- can tie in with other lessons and look at old maps of oceans/lakes that would have been here)
- How did they do? It's okay to be wrong! That's how we learn
- Can re-sort water into "useable" and "unusable"

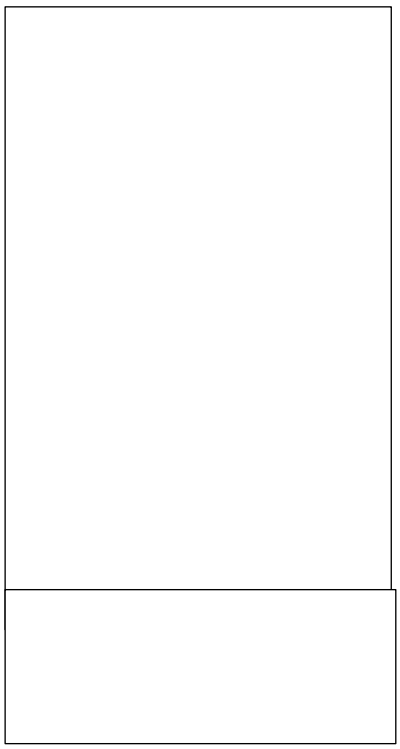
Usable- we can use it for living: hydration, growing food, etc)	Unusable- does not support our life
Groundwater (wells for houses, top of pass…)	Oceans (salt, desalination is VERY costly)

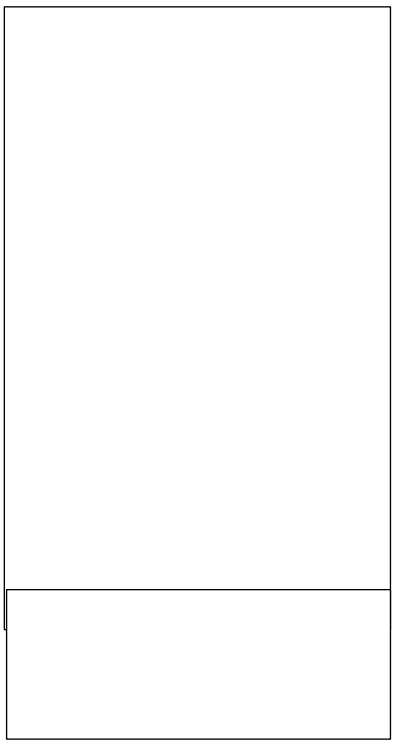
Lakes	Ice (inaccessible)
Rivers/streams	Air (inaccessible until in moves into different category (lake, river, etc)

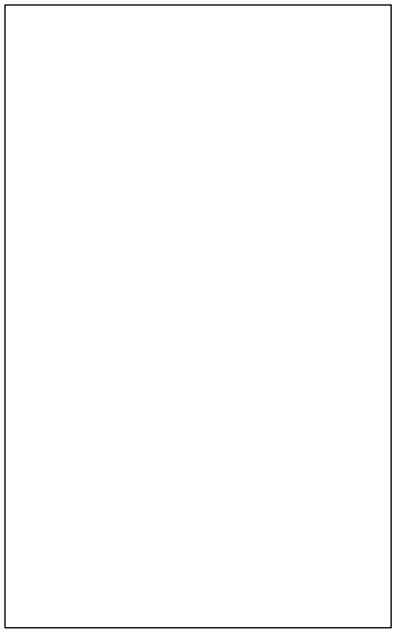
    - Usable ends up being 3.5%, and unusable 96.7%
- Re-visit the water cycle and connect that we don't gain water. We could be bathing in water that dinosaurs and marine reptiles swam in!
- Can we lose water? Sort of… it can get polluted so we can no longer use it, more people means less water available to each individual,
    - This can go in to more on the importance of keeping our waters clean and usable
- Wrap up in a way that makes sense for you

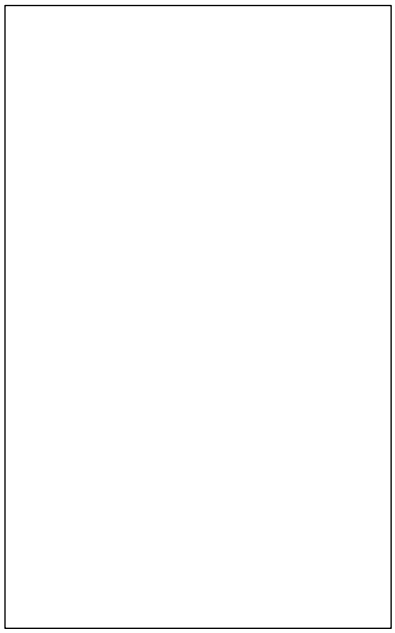
Paper “Jars” that you can use to color in the water, instead of actual water

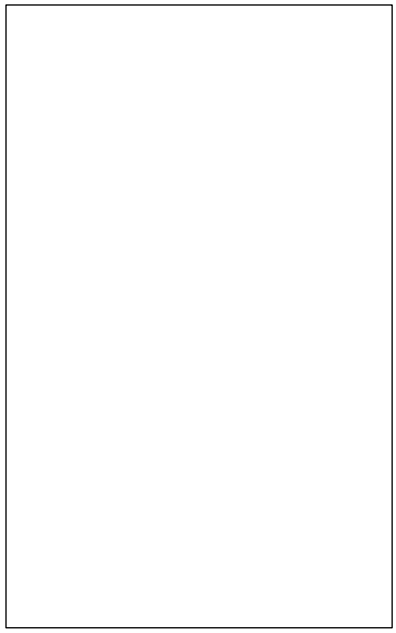












Activity 4: Extant or Extinct?

Overview:

Montana has changed SO MUCH over millions of years! Where your neighborhood is was once a warm, shallow sea TEEMING with giant mosasaurs like *Tylosaurus*, giant, toothy fish like *Xiphactinus*, and ammonites the size of a small car! Over millions of years, the seaway has formed, regressed, and then disappeared forever. From ancient ocean to the Rocky Mountains - enormous marine reptiles to bison - Montana has seen millions of years of change in its geology, environment, and wildlife. Many animals that used to swim in the Western Interior Seaway are now extinct (no longer in existence on Earth), but some animals are extant (still living)! Let's learn about Montana's past and present aquatic animals.

Defining Terms

- **The Western Interior Seaway** was an inland sea that existed from 100 million years ago during the Late Cretaceous to the end of the age of dinosaurs, 66 million years ago. This sea split North America into two landmasses, Laramidia to the west and Appalachia to the east and stretched from the Gulf of Mexico through the middle of the United States and Canada, meeting with the Arctic Ocean to the north. At its largest, it was 2,500 feet (760 m) deep, 600 miles (970 km) wide and over 2,000 miles (3,200 km) long!
- **Extant**: still in existence.
- **Extinct**: having no living members; no longer in existence.
- **Adaptation**: an adaptation is a feature or behavior that arose and was favored by natural selection for its current function. Adaptations help an organism survive and/or reproduce in its current environment.
- **K/Pg Extinction**: a sudden mass extinction of three-quarters of species on Earth approximately 66 million years ago. Many groups of animals went extinct, and very few animals larger than 25 kilograms (55 pounds) survived. This extinction marked the end of the Cretaceous period 66 million years ago, and with it the Mesozoic Era. In the geologic record, the K/Pg extinction event is marked by a thin layer of a rare Earth element called iridium, which can be found throughout the world at this time in marine and terrestrial rocks.

Fish Adaptations

Gar

- **Swim bladder:** Gar gulp air in response to low oxygen conditions that often occur in sluggish waters. The air is delivered to their swim bladder, which acts as a lung and allows for gas exchange within the body when times are tough.
- **Bony scales:** Gar scales are covered in enamel-like substance called ganoin, the thickness provides excellent protection.

Sturgeon

- **Large size:** Sturgeon can grow to be 20 ft. long and weigh over 1000lbs, which allows them to stay safe from natural predators.

Paddlefish

- **Large size:** Paddlefish can grow as large as 2.5 meters (8 feet long) and weigh 164 pounds.
- **Filter feeders:** Paddlefish have gill rakers for feeding on mass amounts of zooplankton at once.
- **Cartilaginous skeleton:** Paddlefish have a cartilaginous skeleton like sharks and rays.

Research these fish for yourself to try to understand more about these incredible survivors!

Supplies Needed

- Extinct or Extant? cards
- Laminated map of Western Interior Seaway
- Extant or Extinct? Extant Fish Maps
- Ocean Fossils Kit: Ammonites and baculites
- 6 toy models:
    1. Ammonite
    2. *Xiphactinus*
    3. *Elasmosaurus*
    4. *Tylosaurus*
    5. Gar
    6. Sturgeon

Activity Outline

1. Lay the models and laminated map of the Western Interior Seaway on a table.
2. Show each **Extant or Extinct card** and have participants guess which animals have gone **extinct**: no longer exist, and which are **extant**: still living today.
3. Discuss the **adaptations** of each animal. An adaptation is a feature or behavior that arose and was favored by natural selection for its current function. Adaptations help an organism survive and/or reproduce in its current environment.
4. Which of these animals are **extant**?
5. Which of these animals are **extinct**?
6. Of the fish that have survived until modern day and are **extant**, what about their adaptations have made it possible for them to stick around until now?
7. Where can you find them in Montana?
8. Of the animals that are **extinct**, why do you think they were not able to survive?
9. Where can you find their fossils?

10. Take out the **Ocean Fossils Kit** and pass around the real ammonite and baculites fossils. These fossils can be handled with care. Have participants gently hold and feel the fossils. Younger children may need assistance.

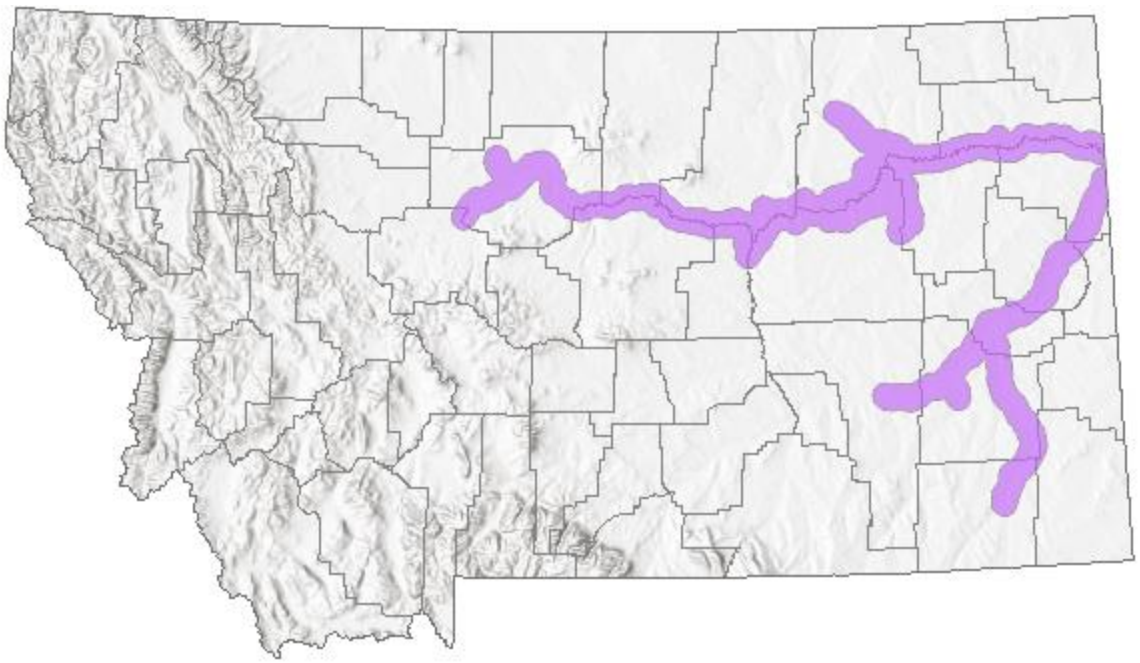
Where can you find different species of gar, paddlefish, and sturgeon today? Look at the modern fish range maps and do your own investigation! Pick up a book or visit the following websites:

- Gar:
  - https://fieldguide.mt.gov/speciesDetail.aspx?elcode=AFCBA01030
  - https://animaldiversity.org/accounts/Lepisosteus_platostomus
- Sturgeon:
  - https://fieldguide.mt.gov/displaySpecies.aspx?family=Acipenseridae
  - https://animaldiversity.org/accounts/Scaphirhynchus_platorynchus
- Paddlefish:
  - https://fieldguide.mt.gov/speciesDetail.aspx?elcode=AFCAB01010
  - https://animaldiversity.org/accounts/Polyodon_spathula

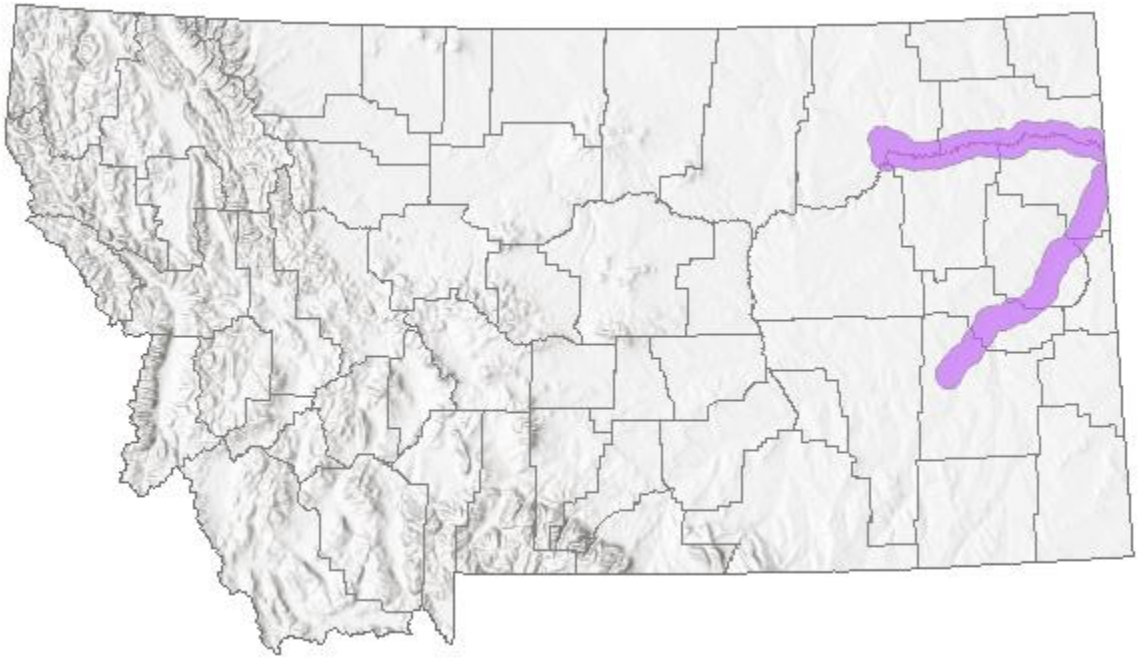
Additional Resources:

- Digital Atlas of Ancient Life – Ancient Fish and their Adaptations
- Kidadl – Everything You've Wanted to Know about Ancient Fish and their Lives
- Sturgeon – Living Fossil Fish
- FWP Fish Consumption Guide

Sturgeon Map:



Gar Map:



Paddlefish Map: