Missouri River Detectives
Lesson Plan 3

Lesson Title: Why Does the Missouri River Look Like Chocolate Milk?

Grade: 4th Grade

Theme: Erosion is a Driving Force of Life on the Missouri River

Topic: Observations, Erosion and Sediment

Length: 30 minutes

Overview: In this lesson, students will investigate the processes of Weathering, Erosion and Deposition in relation to rivers. Students will be able to identify these processes and understand how meandering rivers are formed as well as how human-engineered Channelization process can affect these natural processes.

Student Outcomes:

- Understand the cause and effect relationship of erosion on the Missouri River.
- Know how to identify control variable about the cause and effect relationship of erosion on the Missouri River.
- Be able to make observations that can serve as evidence to address the cause and effect relationship of erosion on the Missouri River.

Next Generation Science Standard: 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation.

Getting Ready:

- Materials: Projector, computer, speakers, paper and pens/pencils for students.
- Open the Missouri River Detectives: Lesson 3 video file and have lesson plan available for reference. The video is ***(11:33)*** minutes in length.
    - Be sure that the computer device and projector used to display the Missouri River Detectives: Lesson 3 video has a working audio system.
- Space Requirements: It is best to have the classroom arranged in a way that allows space for students to be able to view the screen and be able to write down any thoughts, questions or answers that come to mind on their sheet of paper.

SCRIPT:

Opening and Slide 1: Welcome

Hello, fellow Missouri River Detectives, and welcome back to a new investigation brought to you by Missouri River Relief. Today, we are exploring why the Missouri River looks like chocolate milk.

Slide 2: How Does Erosion Work?

Have you ever seen a steep riverbank or a sandy beach? That is erosion and its competitor, deposition, in action. Let's find out more about them.

Slide 3: Brief Notes on the History and Appearance of the Missouri River

Take a look at the waters of the Missouri River. It looks almost green in this photo due to the reflection of the trees along the bank.

Slide 4: History and Appearance of the Missouri River cont.

If you were to be looking straight down at the water, it would appear to be a dark, murky brown. Have you ever heard anyone call the Missouri River the Big Muddy? It comes by its name honestly. Some people even say that it looks like chocolate milk!

Slide 5: History and Appearance of the Missouri River cont.

The reason for its appearance is that the Missouri River has a large amount of sand and dirt all mixed up in it like cocoa powder in milk.

Slide 6: History and Appearance of the Missouri River cont.

Here we can see some jars of Missouri River water and a picture of chocolate milk. If you filter out the dirt, many Missourians still use the river for drinking water to this very day. The Missouri River is also used for fun and transportation of goods. Think of it like a water highway where boats travel up and downstream. Today, the Missouri River looks big, but can you imagine that it used to be a whole lot bigger?

Slide 7: History and Appearance of the Missouri River cont.

This is an artist’s interpretation of what the Missouri River used to look like hundreds of years ago. What do you notice? I notice how the river spreads out and snakes around islands and hills. The River is also a lot wider and even though you can’t see this, scientist say that it used to be a whole lot shallower too.

Slide 8: History and Appearance of the Missouri River cont.

In fact, it was so shallow in places that steamboats, like the one pictured here, would crash and sink. It was so difficult to navigate that hundreds of steamboats sank into its

waters. One moment, they would be traveling along and then the next they would get caught on a snag or submerged tree. Most people could swim to shore, but the items onboard would be lost.

Slide 9: What is the Process of Erosion?

But what does this have to do with the Missouri River looking like chocolate milk? Well good question, we are going to explore how erosion is involved with the Missouri River's appearance. Let's find out!

Slide 10: Weathering

Weathering is the process of wearing or breaking down soil, rocks, and other sediments into smaller pieces. An example of this on the Missouri River would be water smoothing sharp rocks along the riverbank as they tumble in the flowing water. Other examples of weathering include, rocks on hiking trails being worn down due to foot traffic or rocks breaking from stress.

Slide 11: Erosion

Erosion is the movement of these smaller pieces to new locations. Erosion happens with agents such as water, wind, or gravity. Erosion is different from weathering because it involves the movement of the weathered materials from one place to another. Along the Missouri River, soil is often eroded from nearby agricultural fields that end up in the waters of the Missouri River and rocks tumble from the face of the bluffs. A common example of erosion would be riverbank erosion, where the flow of the water breaks soil from the bank and carries it downstream.

Slide 12: Deposition

This riverbank erosion can create soil deposits downstream. Scientists call this Deposition, which is the build up of soil or sand that could eventually form into dryland. On the Missouri River soil builds up along the edge of a bank or forms an island around a sunken tree where the water is forced to slow. Slower waterflow means that the water can no longer carry heavier bits of soil, so the soil gets dropped off or "deposited".

Slide 13: Weathering, Erosion and Deposition Process

If we go down to the river and think about how these natural processes fit together, we might notice that some rocks get weathered up on the bank. Rocks might be broken down into smaller pieces or even into soil. Eventually, the soil could get swept away in the river's current and erode downstream. The eroded sandy soil could either end up deposited on the shore of an island where the waterflow is slow or swept further downstream.

Slide 14: Meandering Rivers

In nature, this pattern of erosion and deposition often creates what scientists call meandering rivers. A meandering river looks like a massive snake from above, curving back and forth continuously.

Slide 15: Erosion and Deposition on the River

Once it bumps against the bank, the channel bounces off and crosses over to the other side of the river. Here you can see how it snakes from side to side. The channel gradually erodes these curves over a long period of time, carrying away soil. What do you notice about the sandy deposits in this picture? This deposited sand and soil is from the banks upstream. It piles up in the slow-moving water. When the curves become extreme enough, they can form what is known as an oxbow lake.

Slide 16: Oxbow Lake Formation

Wow! Take a look at that. This oxbow lake is in mid-formation!

Slide 17: Erosion on the Missouri River

"But what about the Missouri River?" you say. I hear you. Why aren't there any cool oxbow lakes nearby? Well, the Missouri River isn't just any old river. To be good detectives, we have to take a look at the timeline. Think back to the picture I showed you earlier. The painting. Does anything look familiar? To me, it looks like there is a lot of meandering going on there. So, why doesn’t the river look like this now? What happened to all of those snakey curves and islands?

Slide 18: Wing Dikes and Levees

It is all due to a process called Channelization. Channelization involves the construction of wing dikes and levees along the banks of a river in order to control its flow. These manmade structures were built with large pieces of wood that had to be driven into the ground.

Slide 19: Wing Dikes and Levees

They were placed into the river by the U.S. Army Corps of Engineers in the 1930s. The Missouri River was dangerous for transportation, and channelization could make it easier for steamboats to travel up and down with less of a fear of sinking.

Slide 20: Indian Cave Bend (How Erosion and Deposition Affect the Missouri River)

Let's take a look at some photos over time from a place called Indian Cave Bend. This is a photo from 1934, before they started construction. Here we can see the wing dikes after they were placed by the U.S. Army Corps of Engineers. This is after some time has passed. The faster part of the river, called the channel, is clearly visible now. Now, even more time has passed. What do you notice at the wing dikes? Land is being built up along the wing dikes. The wing dikes slow the flow of water and cause deposition to occur!

After a decade, trees started to grow on the newly deposited land. And by 1977 the forests had been cut down and turned into farmland.

Slide 21: Channelization Today

Can you see any of the wing dikes or levees? That's right. When the water level is low, you can see the ends of them sticking out to this day.

Slide 22: Channelization Effects

Channelization caused the Missouri River to form a narrower and deeper channel where water can quickly flow through. The river travels in a more condensed path, which lessens the possibility of flooding in nearby towns as well as making it much easier for boats to navigate as mentioned earlier. This also means that the river has become less meandering resulting in less islands and consequently less habitat for native animals, like the Pallid Sturgeon to reproduce and safely raise their young. Recently, scientists have been working to help fix this problem by creating places along the Missouri River that resemble the old habitat.

Slide 23: Channelization Effects on Wildlife

Here is a map of the Big Muddy National Fish and Wildlife Refuge, which is just outside of Columbia, Missouri. Here, scientists have specially designed two such habitats. You can also see the difference in size of the river between 1893 and 2013. The green outline represents old river and the blue outline represents the Missouri River after Channelization. The red lines represent the North Overton Chute and the Tadpole Island Chute. The water in these chutes flows slower than in the main channel, making it easier for small fish to survive.

Slide 24: Channelization Effects on Wildlife

Fish like the Pallid Sturgeon are not the only species of animal helped by these chutes, the protected beaches and slower waters are also important for endangered species of birds like the Interior Least Tern and the Piping Plover. Without these protections, many of these species would go extinct.

Slide 25: Thought Activity (*OPTIONAL PAUSE*)

Now that we have investigated and understand the processes of weathering, erosion and deposition, do you think that you could point them out next time you observe them in action? Could you explain to someone why the Missouri River looks like chocolate milk or how it became known as the Big Muddy?

What helped you learn about how rivers can change over time?

(There is some time built into the video for discussion at this slide, teachers are welcome to pause the video in order to allow students more time.)

Slide 26: Closing

Thank you all for joining Missouri River Relief on this investigation into the processes that shaped the Missouri River. See you on the River!

Slide 27: Credits

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- **Curriculum Sources:**
  - Szydlowski, Mike. "Not so muddy Big Muddy." *Columbia Tribune*, 12 Oct. 2016, https://www.columbiatribune.com/851S36d94-b391-58a3-8a0f-d3be73b8d288.html?fbclid=IwAR2IorRPt8MpUfcv0wcgCJX4ZxDxusRNKVjPGmcDSn-zkFRobOS0z8DZjWg. Accessed 16 Mar. 2021.
  - "Why Do Rivers Curve?" *YouTube*, uploaded by MinuteEarth, 19 Nov. 2014, https://www.youtube.com/watch?v=8a3rcG8Wic&feature=emb_rel_pause .

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