



Water flows through the Red River during flooding

NATURE Sunday Academy

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Project Description:

In this project, we would like to introduce the concepts of riverine systems and flooding to K-12 students such as tributary, snowpack, filtration, watershed/catchment/basin, flow discharge, peak flood, inundation map.

The half-day long active learning STEM modules will include three lessons but not limited to:

Lesson 1: Water cycle – Game and Quizzes

Lesson 2: How water moves through the Red River watershed – Exploratory Games

Lesson 3: Measuring flow discharge and the sediment motion - Experiments

Project Objectives:

In this project, we will demonstrate how students can identify the components of a watershed and a riverine system. Students will learn the concepts by posing hypothesis and interacting with models of riverine systems.

Session Organization:

11:00-11:30 Cultural connection/brief introduction

*11:30-12:00 Activity I – **The water cycle – Blookey game***

12:00-12:45 Lunch

*1:00-1:45 Activity II – **Simulate the movement of water through the Red River watershed.***

*1:45-2:30 Activity III – **Streams and sediment***

2:30-3:00 Wrap up

ND State Science Standards:

Science K-12 Standards - 2019, MS-ET1-4

Materials and Equipment:

The author will bring most of basic materials. However, the supports of computer, project, and Wi-Fi, and other facility supports are needed to be provided by the lesson facilitating sites. The required materials are listed below:

LESSON 1: - WATER CYCLE

Computer and project to facilitate the presentation and educational videos about background of water cycle on earth. Games on Blooket.com to engage students with the contents

Materials by the author: *a glass/ceramic bowl, a small bowl.*

Materials provided by the host institution: *Hot (boiling) water, two ice bags*

LESSON 2: MOVEMENT OF WATER THROUGH A WATERSHED

Materials by the author: *1 small submersible pump; 2) A fish tank; 3) two PVC pipes; 4) 3 empty buckets; 5) Ping-Pong balls*

Materials provided by the host institution: *1) A sand box (3 feet x 5 feet x 1 feet – Plastic/Wooden); 2) 2 x 25-pound bags of sand (Home Depot)*

LESSON 3: STREAMS AND SEDIMENTS

Materials by the author:*1) 3 empty plastic bottles (large); 2) soil; 3) grass; 4) a small submersible pump; 5) a small flowmeter; 6) organic soil;*

Materials provided by the host institution: *A large plastic box, which will be used to host all materials while doing the experiments. The size of the box is roughly (2 feet x 4 feet x 1 feet – Plastic)*

While the author plans to bring as many components as possible. However, the host institution is expected to provide the listed materials in the above section.

Activity I: The water cycle

Concepts:

Evaporation (and transpiration) – When water changes from a liquid to a vapor

Condensation – The opposite of evaporation – process where vapor becomes liquid

Precipitation – water falling, in liquid or solid state, from the atmosphere to the earth (rain, hail, snow)

Collection – when water falls back to earth as precipitation, it may fall back in the oceans, lakes or rivers or it may end up on land; when it ends up on land it will either soak into the earth and become part of the 'ground water' that plants and animals use to drink or it may run over the soil and collect in the oceans, lakes or rivers where the cycle starts.

Questions in Blooket.com – GAME PLAN:

- *What is it called when surface water changes and adds vapor to the atmosphere? (evaporation)*
- *What is water in the form of a gas called? (vapor)*
- *Rain, sleet, snow, hail are examples of what? (precipitation)*
- *When vapor is changed into liquid, the process is called what? (condensation)*
- *What is water stored in an aquifer called? (groundwater)*
- *Name one example of flowing surface waters. (brooks, creeks, streams, rivers, canals)*
- *Give one example of standing surface water. (lakes, ponds, swamps, bogs, marshes)*
- *What three forms does water occur in? (Liquid, solid, gas)*
- *What is the only substance found on earth naturally in three forms? (water)*
- *At what temperature does water freeze? (32 degrees F)*

Games:

The above questions will be entered into the game of Blooket and ask students to play. After the game, there will be a prize for the winner.

Activities (Demonstration):

Divide the class into smaller groups (2-6 kids). In each group, a small glass bowl will be used to simulate the ocean. Hot water will be poured into the bowl. A smaller bowl will be put at the center of the big one. A thin film will cover the top surface of the bowl as the lid. Ice will be applied on the top lid. Students will be asked what will happen next. As the moisture inside the bowl starts to condensate, students will be asked to observe what will be happening inside the bowl. Students will explain the processes that affect the condensation.

Safety rules: In this lesson, hot water will be used. Please following the safety rules of these materials for burning. Use only a small amount with the use of hand cover. please also avoid direct contact with eyes and mouth.

Activity II: Simulate the movement of water through the Red River watershed.

Concepts:

Tributary – a river flowing into a larger river

Snowpack – a mass of snow on the ground that is compressed and hardened by its weight

Watershed/drainage/catchment basin – the land surface that water flows across or under on its way to a stream, river or lake

Stream flow – volume of water that moves over a specific point over a fixed period of time

Questions (Blooket game)

- When a river overflows its banks, the natural disaster is called what? (flood)
- What is the land surface that water flows across or under on its way to a stream, river or lake called? (watershed)
- What's the movement of surface water in horizontal direction called? (current)
- What is a smaller river that flows into a larger river called? (tributary)

Game (Concept of flow discharge – Volume/ time):

Team of 4 – 6 students will be given a bucket of Ping-Pong balls and two empty ones. The students will line up in a row. The students need to pass the ball from one person to a neighbor until the ball reaches the last person in the row. The last person has two options: (i) drop the ball in the empty bucket; (ii) return the ball to the previous person. No person is allowed to have two balls at the same time. All balls need to travel from the beginning person and return back. Team with the least amount of time needed for all balls to travel will win.

Activities (Experiments):

Dividing into teams with four members per team (2-6 teams) and deciding the Team name (each team needs a team name). The sand boxes will be used to simulate the formation of rivers. Students will be asked to make channels from the sand. They will learn and adjust the channel slope. Water will be poured into the inlet of the channel so that the sand will be moved. A small pump will be connected to the inlet to provide a continuous flow to the channel creating a flooding condition. Students will be asked to estimate the inundation area. The following features will be added to the channel and banks:

- Houses
- tree logs
- Slope measurement from banks

Safety rules: In this lesson, electricity will be used to power the pump. Please following the safety rules of these materials for electrical current. Avoid a direct contact between water and the electrical outlet.

Activity III: Learn how sediment, plants, and flowing water interact to form stream/river channels and help form our topography.

Concepts:

Watershed – the land surface that water flows across or under on its way to a stream, river or lake

Riparian – the land on either side of river/stream including the river banks

Meander – a winding curve or bend in river

Inside bend – the inside bend of river where flow is slower and sediment accumulates

Outside bend – the outside bend of a river where flow is faster and sediment erodes

Riverbed – the bottom of a river, typically made of sand and rocks

Floodplain – land adjacent to river or stream that is naturally subject to flooding

Headwaters – where a river/stream begins, typically high in the mountains or a body of water

Erosion – the process of wearing away by water, wind or other natural agents

Mouth – the end of a river/stream, typically opens into a body of water

Questions:

- What is the land surface that water flows across or under on its way to a stream, river or lake called? (watershed)
- What's the movement of surface water in horizontal direction called? (current)

Activities:

Using the sand box, students will create a river bend. The concepts of inner and outer banks will be explained. The flow pattern in a bend will be explored using a submersible pump to drive the flow in the bend. Students will use a stop watch (a smart phone) to calculate the flow velocity in the channel by dropping confetti to flow on the channel surface. The concept of erosion will be introduced by comparing three types of seepage. Three plastic bottles will contain soil samples (sand) with different settings: a) sand only; b) with vegetation roots (onions); c) organic soil with roots. The amount of seepage will be measured by dropping the same amount of water into each plastic bottle. This lesson will help students in understanding the role of soil conservation in protecting river bank erosion.

Safety rules: In this lesson, electricity will be used to power the pump. Please following the safety rules of these materials for electrical current. Avoid a direct contact between water and the electrical outlet.

Wrap-Up & Discussion:

Lesson 1: After this lesson, students are expected to have basic knowledge on water cycle.

Small prizes will be given to students who participate question answers in class, and a fun fact sheet with all the most important points about water phases will be given to the students.

Lesson 2: With this lesson, students are expected to know that water flows shape rivers and streams.

Lesson 3: In this lesson, the students are expected to understand how soil conservation will lead to an improve in flood control and water quality.