

Unit 6.1

“Water on the Move”: The Water Cycle

Unit Overview

Unit Summary

In this unit, students explore the water cycle (hydrologic cycle) and how human activity can alter this cycle but not stop it. Students work to describe why a local community is having flooding problems and evaluate proposed solutions to address this problem.

To help students discover why flooding is occurring, they investigate the multiple pathways water can take when moving through the water cycle and particularly how the cycle is a natural system which is driven by energy from the sun and gravity (MS-ESS2-4). Students investigate this as well as how the particle motion and spacing is related to the state of water using models (MS-PS1-4). As students learn about the water cycle, they work to accurately define the criteria and constraints of a successful solution (MS-ETS1-1) based on the needs and wants of the local community members.

Prerequisite Notes:

- It is expected that students have been introduced to systems and system modeling before this unit. If necessary, use the Off-the-Shelf Lesson Plan: Systems and System Models to introduce your students to this crosscutting concept before starting this unit.

Unit Challenge Question

- How does human development affect how water moves through our community?

Unit Big Ideas

- Water is continuously cycling from one earth reservoir to another through multiple pathways and changes in state, due to the effects of gravity and energy from the sun on water particles.

- Solutions to water quantity related issues should take into account the scientific phenomenon dictating the water cycle and how human activity affects the pathway water particles take.

Connection to 21st Century Issues

As the human population on Earth grows, societies have developed more and more of Earth's surface to fit our needs. Prairies are turned into farms, forests into suburbs, and swamps into shopping centers. This development can affect how water moves over and through our communities, sometimes causing problems. On local scales, roofs and parking lots can create impervious surfaces which cause excessive runoff and flooded roads. Land use on larger scales, like farming in the American West can have more dramatic impacts like the failure of the Colorado River to reach its mouth. In this unit, students work to evaluate different development scenarios in their community, and identify scenarios that will reduce the likelihood of flooding.

Unit Challenge

Unit Challenge Summary

Students work to explain if and how well different solutions to address a flooding problem meet the chosen criteria and constraints. The students are asked to present to the planning committee several products: 1) a revised list of criteria and constraints that must be taken into account when addressing a problem, 2) a brief presentation explaining how well a specific solution from a list of proposed development solutions meets the criteria and constraints.

In order to accomplish this goal, the class and student Unit Challenge teams develop a model of the water cycle of the lot in the past when it was in a more natural state throughout the first 6 lessons. During lesson 6, students apply what they have learned to model how water moves through the water cycle on the underutilized present day lot. Students use their models to evaluate the proposed development options (e.g. skate park, rain garden, soccer field) and determine what effects each option has on runoff and

infiltration. Finally, students create an informational presentation that describes how well a given development option meets the criteria and constraints.

Unit Challenge Scenario

At the edge of our community used to be a forested park with a stream that was home to all kinds of wildlife. Locals and tourists would visit the park to enjoy all the trails throughout the forest and along the stream.

After a day of hiking, people would visit our downtown area where the stream that flowed through the park also flowed through downtown. This benefited the community because our downtown brought in a lot of money from tourism.

Then the forested park was replaced with a factory with a parking lot. The factory eventually shut down and was torn down. Now a concrete parking lot and an empty field is all that is left.

Along with losing the forested park, the community started having a problem with the stream sometime after the factory was built. After rainstorms the stream would flood the downtown area! Even after the factory was torn down, the flooding continued. It is so bad that flooding happens after almost every storm. The only time downtown does not flood is during winter.

The flooding is bad for the community because it has reduced the number of people who spend time downtown and shop at the local businesses. For example, the flooding forced a popular bike path in downtown to close. The local businesses are worried because fewer people are coming to shop, and a local environmental group is concerned about all the damage that the flooding is causing in the downtown area.

Unfortunately, the planning committee does not know what causes the stream to flood downtown. There have not been changes in the amount of rain and snow over the years. Since the flooding started after the factory was built, the planning committee thinks that this problem has something to do with how the land changed. The owner of the land where the factory used to be is willing to donate the land to the town, but only if the town's planning committee can convince the owner that the town will make changes to the empty land to help people, businesses, and the environment thrive.

The planning committee is so excited about building on the empty land that they already came up with a large list of ideas. Their list includes ideas like a rain garden, skate park, or even an indoor waterpark! They need you to identify which solutions on the list could improve community well-being and which ones will not. They will take your improved list of ideas and use it to help convince the owner to donate the land!

Lesson Sequencing Table

Lesson #	Lesson Questions	What students do...	# days
1 (opener)	How does human development affect how water moves through our community?	Students identify and communicate prior knowledge about the location of water within their community and how water moves through the system.	1.5-2
2	What causes water to go into a stream?	Students investigate how gravity and the shape of a landscape affects the movement of water.	2.5
3	What happens to water that doesn't make it into the stream?	Students investigate how sunlight affects the movement of water through evaporation and transpiration.	3-4
4	What causes a liquid, solid, or gas to behave differently?	Students explore water at the microscopic scale when it is a solid, liquid, and gas.	2
5	How does water change state in a system?	Students investigate how matter, particularly water, changes state.	2-3
6	How does human development affect how water moves?	Students consider how water moves as part of the global water cycle and how human development can influence the pathways that water takes.	3
7	How can we make sure we have a good solution to a problem?	Students investigate the importance of clearly defining criteria and constraints in order to choose a successful solution to a problem.	1.5-2
8 (closer)	How does human development affect how water moves through our community?	Students use their models and revised criteria and constraints to make recommendations about the solutions proposed by the planning committee. Finally, students present their findings to the class, critique each other's arguments, and reach a group consensus on how to address the problem of streamflow in their community.	2-3