

Climate change outreach project

Flash Floods and our Changing Climate

Overview

- Our climate is changing, and as it does, it is altering the global hydrologic cycle, sometimes in ways that we're not adequately prepared to handle.
- The frequency of heavy rain events has increased in some parts of the country. To find how our changing climate is affecting your state, refer to the Environmental Protection Agency's Climate Change Indicators (which compiled a summary of changes by state). To learn about the history of floods in your state, refer to USGS-NWIS (links are below).
- Floods can be a hazard, particularly in locations with aging or inadequate infrastructure, where surface materials allow little to no infiltration, and where rainfall patterns are being altered by our changing climate. In these locations, heavy rainfall may not infiltrate into soils, but rather end up as runoff to local streams and rivers, increasing the chance of floods and flash floods.
- This activity shows how different amounts of rainfall impacts different types of surface materials.

Learning Goals

- Understand how slow, steady rain affects different types of land surface materials
- Understand how heavy precipitation events affect different types of land surface materials
- Understand infiltration and runoff and how they differ depending on the type of land surface materials they encounter
- Understand that flash floods from heavy precipitation events impact the land surface

Data sources:

Environmental Protection Agency (EPA) Climate Change Indicators:

<https://www.epa.gov/climate-indicators> (available for all states)

National Oceanic and Atmospheric Administration (NOAA) Climate Data Online (precipitation data): <https://www.ncdc.noaa.gov/cdo-web/>

United States Geological Survey National Water Information System (USGS-NWIS):

<https://waterdata.usgs.gov/nwis/rt>

Supplies:

- 4 plastic spice jars (any jars or bottles will do as long as they are all the same size)
- Gravel (aquarium gravel from the pet store)
- Sand (play sand from the hardware store)
- Organic matter (orchid soil from the hardware store)

- Regular soil (potting soil from the hardware store)
- Vermiculite (from the hardware or gardening store)
- Cups or bottles to act as runoff-baskets
- String to attach the baskets to the jars
- Scrubber to remove labels from jars
- Hairspray and lighter – to scorch soil
- Spray bottle
- Water
- Box cutter to cut openings in the jars

Set-up:

- Scrub labels off bottles, air dry
- Use box cutter to cut section from side of bottle or jar
- Put different geologic materials in each bottle
 - My bottles are deep enough to build a representation of our local, unconfined sand and gravel aquifers as the base material for all jars
 - Plain soil in one bottle
 - In the next one, I used soil whose surface was scorched to represent local wildfires (this was done using hairspray and a lighter – if you don't want to do that, use a sheet or paper or other mostly impervious material on top of the soil to represent that the soil is hydrophobic)
 - In the next bottle, I used orchid soil (contains tree bark and other large particles of organic matter)
 - In the last bottle, I used vermiculite to represent the clay soils we have in some parts of our local area
 - Surface and aquifer materials may differ in your local area; represent these differences if you can. If you are not familiar with local materials, feel free to use mine, which represents an unconfined aquifer in the Great Plains region, with a semi-arid climate and few trees.
- Cut bottoms off water bottles or use cups to make baskets
- Poke holes near top edges of baskets
- Thread string through the holes, tie knots to secure

Procedure:

- Set up the bottles of geologic materials side-by-side with the open side facing up
- Explain to the visitor they can spray the surface of each jar to see if regular rain affects the material inside
- Discuss how precipitation has changed or increased in recent years, and how that can lead to surface changes and flash flooding
- Ask the visitor to dump some water on the surface of each jar to see how larger rain events can impact material
- Discuss their observations





Further Challenges

Modifications

Longer programs:

- Present this activity in conjunction with the Rising Tides activity to discuss engineering design approaches to mitigating the impacts to humans and structures of increasing flooding and flash flooding.

Mixed-age groups:

- Discuss observations of our changing climate, past floods and flash flooding.
- Present the hydrologic cycle, particularly the components that directly impact surface water and groundwater resources and discuss potential impacts of increased precipitation on those resources.
- Discuss potential impacts of a changing global hydrologic cycle on human populations and Earth's surface.
- Discuss potential human responses to the changing global hydrologic cycle.

NGSS Standards

K-ESS3-3 Earth and Human Activity. Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

2-ESS2-1 Earth's Systems Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.

MS-ESS3-3 Earth and Human Activity Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

HS-ESS3-4 Earth and Human Activity Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

2-ESS2-2 Earth's Systems Develop a model to represent the shapes and kinds of land and bodies of water in an area.

HS-ESS2-2 Earth's Systems Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

HS-ESS2-5 Earth's Systems Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS3-1 Earth and Human Activity Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-ETS1-1 Engineering Design Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.