**Investigative Question:**

* How do human impacts on the land affect the flow of water within a watershed?

**Time Frame:** 50 minutes

**Materials Needed:**

Each student group will need:

* Best Management Practices Cards (PDF handout)
* Storm Water Worksheet for each student (PDF handout)
* 2 aluminum trays (9x13, one with a hole in one end for draining)
* 3 regular size sponges cut into quarters (3x5)
* 2 one-quart size plastic bags
* Liquid measuring cup, with ml graduations, or 100 mL graduated cylinders

**Videos (optional)**

The short stormwater video clips might be a great way to introduce the power of stormwater to your students. There are several clips you can choose from to make the point. After the stormwater activity, the *Stormwater BMPs in Action* video would be a great way to show how BMPs work on our community.

**Short Stormwater Video clips**

<https://arizona.box.com/s/sftw3k55zxrqnzgb077nffj20p07dib9>

**Stormwater BMPs in Action (UA Raingardens)**

<https://arizona.app.box.com/file/713019280953>

**Stormwater Activity Demonstration Video**

<https://arizona.app.box.com/file/722562358809>

**Warm Up:**

Have students discuss what they know about rainwater in the environment:

* What happens when rain falls on different surfaces? What happens when it rains in the city? What happens when it rains on the grass? What happens when it rains in a forest?
* Where does the water go?

**Reference:** adapted from “Storm Water” Parts 1 and 2, *Project WET Curriculum and Activity Guide 2.0*, 2nd edition, 2011, pg. 395-404.

**Lesson Sequence:**

1. Give each student a *Storm Water Worksheet*.
2. Have students define what a **permeable landscape** is and how water behaves on a permeable landscape - water soaks or infiltrates into the soil. Once in the soil, it can go into plants or keep traveling further to reach groundwater. Some water also evaporates. Have students write down examples of permeable landscapes on their worksheet, Step I.
3. Have students define what an impermeable landscape is and how water behaves on an **impermeable landscape** - water stays on the surface or runs off.Water can also evaporate. Have students write down examples of impermeable landscapes on their worksheet, Step I.
4. Look at an aerial view of your school (find on Google maps). Have students identify the permeable and impermeable surfaces on campus. Alternatively, you can take the students on a walk around campus.
5. **What happens to the water when it rains on campus**? Some of the water collects and then disappears. This can be from evaporation or infiltration. Some of the water runs off and Water Managers call this water “storm water”.
6. **Where do you think storm water goes?** Storm water exits the urban environment through storm drains. **Why would storm water be considered a bad thing?** Think of all the activities we do on the land surface (drive cars, fertilize plants, animals go to the bathroom). These things can be picked up in runoff from landscapes, city streets, and sidewalks. As the “storm water” picks up the particles, it is collected in our storm drains.
7. Have students define Best Management Practices - Best Management Practices (BMPs) are techniques that everyone can use to help keep as much storm water as possible out of our storm drains and sewers. Some of these BMPs can be implemented by City Water Managers, but many of these can be done by everyday people living on the land.
8. Tell students they are going to conduct an experiment that deals with permeable and impermeable surfaces and compare landscapes that do and do not have storm water Best Management Practices applied. Distribute the materials to the water festival groups and demonstrate how to set it up. Two aluminum trays should be nested, the inside tray should be placed on one of the short sides of the other tray at a slope with the drain hole on the downward side. Two one quart sized plastic bags, each containing 6 quarters of a sponge, should be placed in the top tray making as flat a surface as possible.

After drawing cards

Before drawing cards

1. Have students look at their model. **What do you think the sponges in the plastic bags represent?** Impermeable layer. **Can you locate the storm drain at the bottom of the land area?** The goal of this investigation is to discover how much water runs off this surface and how much is retained.
2. Pour 250 mL of water on the upper slope of the model with the sponges still in the plastic bags. This represents a rainstorm. Demonstrate this and then allow students to do it. Let the pan drain and collect into the second tray for one minute. Have them measure how much water ran off (the amount in the bottom tray) with a graduated cylinder, recording it on the data table on Step II of their worksheet. Have students calculate the amount of water that was left (retained) in the model by subtracting the amount of runoff from the original amount (250mL) added. Record the result on their data table and any observations they made during the investigation.
3. Each group of students will have a stack of cards and each card describes a different Best Management Practice that can help to manage storm water and reduce runoff. The students will read the entire card and remove whatever number of sponges that is indicated by the card from the bag. If there are sponges remaining in the bag, they should be kept in the bag and be placed back in the tray along with the sponges that were removed. Once a plastic bag is empty, they can take it out of the tray.
4. Set a timer for 10 minutes and have students begin. Students take turns drawing a card from the stack and read the card. They discuss the card and record the Best Management Practice type at the bottom of their worksheet (Step III) checking if they have seen this practice in their school or community. Then, follow the directions on the card for removing sponges. \*\*\*\*\*Students will NOT add water again (another 250 ml) until 10 minutes is up\*\*\*\*\*
5. After 10 minutes, have the students STOP and pour 250 mL of water on the top portion of the tray, Step IV. Let the pan drain and collect into the second tray for one minute. *Measure:* How much water is collected in the tray underneath compared to the amount poured in? *Record:* Record the amount of runoff and calculate how much water was retained by subtracting the amount of runoff from the original amount (250mL). Have students make observations.
6. As a class make a runoff vs retention chart on the board (the data that students recorded in the table in Step V of the worksheet). See example below. Lead a discussion about the relationships between runoff and retention and permeable and impermeable surfaces.

Example data:

|  |  |  |
| --- | --- | --- |
|  | **Impermeable** | **Permeable** |
| **Group** | **Runoff (mL)** | **Retention (mL)** | **Runoff (mL)** | **Retention (mL)** |
| 1 | 240 | 10 | 70 | 180 |
| 2 | 243 | 7 | 37 | 213 |
| (cont.) | … | … | … | … |

**Wrap-Up:**

Have students answer the questions in Step VI:

1. **What claims can you make about impermeable surfaces based on the evidence that you observed?** See example below:

Evidence – more water ran off the impermeable surface (plastic bag).

Claim – more water will run off streets and roofs etc. than off the land areas.

1. **What claims can you make about permeable surfaces based on the evidence that you observed?** See example below:

Evidence – more water ran off the impermeable surface (plastic bag), less water ran off the permeable surface (sponges).

Claim – more water will soak into land areas made up of porous earth materials and areas where best management practices have been applied.

1. Make a Claims/Evidence t-chart on the board and have each group report a claim based on the evidence they saw.
2. **What are Best Management Practices for storm water?** Practices that make areas more permeable. **What are they designed to do?** Get more water to infiltrate into the ground and less to runoff.