COOPERATIVE EXTENSION
Arizona Project WET
Arizona Water Festival

SW-IFL
Southwest Integrated Field Laboratory

Pre-festival Lesson 3.2 Understanding Urban Watersheds Lesson Plan

Investigative Question:

- How does human impact on the land affect water and heat within a watershed?
- How do the parts of an urban watershed interact with the water cycle?

Summary: Students explore urban watershed topics of permeable, impermeable, runoff, urban heat island effect, and pollutants as they complete a scavenger hunt on their school campus and participate in a full-body simulation of a storm drain system. Students also identify temperatures in their immediate environment and make connections between people, water and heat in urban environments.

Reference: adapted from "A-maze-ing Water" Warm Up and Activity Option 1, *Project WET Curriculum and Activity Guide 2.0*, 2nd edition, 2011, pg. 231-238. Worksheet created by staff.

Time Frame: 50 minutes

Cross Cutting Concepts Demonstrated:

- cause and effect
- scale and quantity
- systems and system models
- structure and function

Science and Engineering Practices Integrated:

- ask questions and define problems
- develop and use models
- plan and carry out investigations
- engage in argument from evidence

Materials Needed:

Each water festival group will need:

- Runoff & Heat Scavenger Hunt Worksheets
- Clipboards (one for each group if possible)
- Temperature gun (provided by APW if attended workshop)
- Chalk (for outside) or 10-15 chairs (for inside option)
- Sticky notes or other materials to represent pollutants found in urban runoff
- Can or bottle labeled "chemicals" or "oil" (optional)

Pre-festival Lesson 3.2 Understanding Urban Watersheds Lesson Plan

Warm Up:

- Use the slides provided above to introduce your students to some urban watershed topics.
  - Have students define what a **permeable landscape** is and how water behaves on a permeable surface - 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 in their notebooks.
  - Have students define what an **impermeable landscape** is and how water behaves on an impermeable surface - water stays on the surface or runs off. Water can also evaporate. Have students write down examples of impermeable landscapes.
  - Have students define what the **urban heat island effect** is and how water behaves in this landscape – there may be less rain overall because of the heat dome or if there is rain there is more runoff that can't soak in. Water can also evaporate faster. Have students write down examples of things that might increase heat (pavement, buildings, AC units, cars) or suggest things that might cool down the urban environment (trees).

- Show students a can or bottle labeled "chemicals" or "oil". Tell them that you need to dispose of the chemicals and that you plan to dump them in the street in front of the school. **Ask students if they think this is a good idea**. Have them describe what they think will happen to the waste material.
- Read the paragraph below – *storm water scenario*. Ask students what they think might happen to the runoff.

Storm Water Scenario:

Imagine the parking lot of a large shopping center. Every year, thousands of cars park in the lot, each depositing a small amount of engine oil and grit (loosened road materials). A gentle rain begins to wash the lot. At the parking lot's lowest point oil-and gas-tainted runoff water begins to flow into the street gutter. A few blocks away, an urban river flows, filled with floating debris, sediment and multicolored water from another street, then another and another. The flow now nearly fills a ditch constructed to channel urban runoff. From a distance, the storm water in the drainage system appears dark-colored. Perhaps the road salt used in the winter to melt ice on roads and sidewalks has mixed in. How about the paint a neighbor poured into the gutter? The pet waste near the sidewalk? Woosh more water moves by! What next? What will happen to the nearby stream and the people using water downstream for their water supply?

Pre-festival Lesson 3.2 Understanding Urban Watersheds Lesson Plan

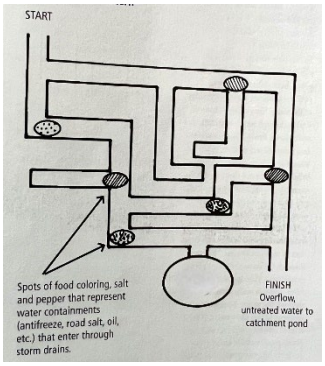
Lesson Sequence:

Activity 1 – Runoff & Heat Scavenger Hunt:

1. Break students into small groups and give each student their own worksheet. (maybe only have one student from each group take their paper outside, and then have the rest of the group record the data when you get back into the classroom). Students in each group can take turns being the recorder.
2. **Explain to the class that you will be going around the school campus looking at different surfaces (permeable and impermeable).** It would be best if they can try to find at least one surface of each and one that is in the sun and the shade so they can make some contrasting observations.
    a) Students also should be **recording the temperature** of the surface with the temperature gun and listing any **possible pollutants** they might find
3. Once back in the classroom, students can share the info they collected so that everyone can record the data on their own sheet. Then have students turn the page over and answer the other questions. You can also facilitate this as a class discussion.
    a) **Which surface was hottest, why? Was it permeable or impermeable? Does this surface add more heat and pollutants to our cities?**
    b) **Which surface was coolest, why? Was it permeable or impermeable? Does this surface help cool down our cities and maybe reduce pollutants?**
    c) **What are things you and your family can do to help keep our cities cooler and to protect our water?**

Activity 2 – Full-body simulation of urban runoff in a storm drain system:

1. **Review how water is used to clean things, such as the surface of a table after a spill. Relate how rainwater "washes" the outdoors.** Explain again that as it flows over plants, soil and sidewalks, water picks up and carries away soil and other materials. Often the water goes down storm drains, runs through pipes and flows to a stream, river or ocean.
2. **Draw a simple but large maze on the school blacktop** (see possible example) **or arrange the chairs in the classroom to form a maze.** The maze represents underground pipes that collect and transport surface water that has flowed down storm drains. Have students go through the maze. Inform them that they are water flowing through the drainage pipes to the river.



3. **Discuss again where the water comes from that runs into the storm drain system.** (Streets, lawns, parking lots and so forth). **What might this water carry?** (Oil from cars, fertilizers, trash).
4. **To simulate surface water transporting pollutants into drainage areas, have several students position themselves along the sides of the maze.** They represent storm drains through which contaminated water flows. Provide them with sticky-notes to use as pollutants. **When students run through the maze, the storm drain students affix sticky-notes to them**; this denotes contaminated water mixing with other water (that may or may not be clean) flowing through the system. Allow students to take turns playing different roles.
5. **After students make several trips through the maze, discuss what happens to this dirty water.** What if it flows into the river? Have students summarize ways to reduce waste and pollutants.

Wrap up:
Discuss the problems associated with untreated urban runoff entering rivers or other bodies of water. **Let students share ideas** they have of ways they can help r**educe the effects of the urban heat island and reduce pollutants** from entering our storm drain systems within our watersheds. Ask: **Who is responsible for taking care of and managing the watersheds we live in?** Each of us are responsible. It is up to all of us! In the coming lessons we will dive deeper into sustainable solutions and actions students can take.

*Students should complete the Lesson 3.2 section of their AWF Water Notes handout to record evidence and construct explanations based on that evidence. Students will also look at the lesson from the perspective of cause and effect. Cause is why something happened. Effect is what happened because of it.

If you would like access to the whole ***A-maze-ing Water*** lesson from 2.0 Guide click TBD.
Here is also the webpage where I got the heat maps and tree cover maps – here.

THE UNIVERSITY OF ARIZONA Cooperative Extension

ARIZONA project WET WATER EDUCATION TODAY

Runoff & Heat Scavenger Hunt

Go explore your school and find different examples of surface materials. List them below and record your observations. How hot are they? Are they impermeable or permeable, and did you find any evidence of pollutants?

Surface Material	Data
1. ☐ Permeable ☐ Impermeable ☐ In shade ☐ In sun	• Temperature of surface: _____ • List any possible Pollutants:
2. ☐ Permeable ☐ Impermeable ☐ In shade ☐ In sun	• Temperature of surface: _____ • List any possible Pollutants:
3. ☐ Permeable ☐ Impermeable ☐ In shade ☐ In sun	• Temperature of surface: _____ • List any possible Pollutants:
4. ☐ Permeable ☐ Impermeable ☐ In shade ☐ In sun	• Temperature of surface: _____ • List any possible Pollutants:
5. ☐ Permeable ☐ Impermeable ☐ In shade ☐ In sun	• Temperature of surface: _____ • List any possible Pollutants:

THE UNIVERSITY OF ARIZONA Cooperative Extension

SW-IFL Southwest Integrated Field Laboratory

ARIZONA project WET WATER EDUCATION TODAY

REDUCING RUNOFF & HEAT

What surface did you find that was the hottest? Why do you think it was so hot? Can water soak down into this surface? Do you think this surface material adds more heat to our cities? Does it add more possible pollution?

What surface did you find that was the coolest? Why do you think it was cooler? Can water soak down into this surface? Do you think this surface material helps cool down our cities?

Now that you better understand how different surface materials affect storm runoff and can add heat to our environment, list some things you can teach your family or that you can do to help keep our cities cooler and to protect our water.