AP Environmental Science- Urban Runoff Simulation Kathleen McCloskey – APES FB

Objective- to evaluate and quantify different types of surfaces used in cities, and the rate/volume of runoff into storm drainage systems.

Supplies:

Plastic Bin with lid - drill a hole in the plastic bin to allow water to run into beaker.
2 beakers 1000ml and 500ml
4 small sponges
Sample of mosaic tile
Clear plastic bin lid
1 cotton towel
Sample of gravel
Potted plant
Styrofoam cup and skewer (to poke holes in the cup)
Wood block

Setup :

1. Using a wood skewer, poke several holes in the bottom of a Styrofoam cup. You will use this to simulate rainfall.
2. Place grey bin lid on edge of lab table, and position the wood block under one end so the lid is at an angle.
3. Wet the 4 sponges, and squeeze out as much of the excess water as you can.
4. Place sponges side by side on plastic lid. This is your simulated soil profile.
5. You will need to hold the plastic bin AND the 500 ml beaker under the edge of the lab table to collect the runoff. Discuss with you team who will pour the water, who will hold the collecting vessels, and who will record the timing of runoff collection.

Procedure 1- Simulating concrete and asphalt.

1.a- place the clear plastic lid over the sponges. This simulates a solid paved surface.
1.b- put 500ml of water into your large beaker.
1.c- Slowly pour the 500ml of water into your Styrofoam cup, holding the “raincloud” over the hard paved surface and begin timing. Be sure to hold the plastic bin and the 500ml beaker under the edge to collect the runoff.
1.d- record the time it takes for 100ml to runoff into the beaker, then again for 200ml, 300ml, 400ml, and 500ml (if you get to 500) .when runoff ceases, record the total volume of water collected.
1.e- pour water back into large beaker for the next experiment.
1.f - Remove clear plastic lid and set aside.

Procedure 2- Simulating permeable surfaces (such as pavers or permeable concrete)

2.a- make sure setup steps 1-5 above are complete

2.b- place mosaic tiles directly on top of the four damp sponges to simulate pavers or permeable concrete.

2.c- make sure you have 500ml of water in your large beaker, and repeat steps 1.c-1.e, timing and recording your data.

2.d- When your data collection if complete, squeeze excess water (if any) from your four sponges before moving on to part 3.

Procedure 3- Gravel roads and pathways

3.a- make sure you have wrung out your sponges and reset steps 1-5

3.b- place a folded shop towel on top of the sponges (this simulates a sand base for the gravel path) and spread a layer of gravel on top of the towel.

3.c- repeat steps 1.c-1.e, timing and recording your data.

3.d – carefully refold the gravel into the towel and place the gravel back into the bowl.

3.e- squeeze out any excess water from the four sponges before moving on to part 4.

Procedure 4- Green spaces and green roofs

4.a- make sure you have wrung out your sponges from part 3 and reset according to steps 1-5

4.b- place a potted plant on the top sponge on your plastic ramp, this will simulate a garden, green space, or green roof.

4.c- repeat steps 1.c-1.e, timing and recording your data.

4.d- when you finish, pour out all water and place all supplies back in your lab bin. Move on to follow up questions and graphs.

Data: Report all times in seconds

	100ml	200ml	300ml	400ml	500ml
Concrete					
Pavers					
Gravel					
Green space					

Total volume of runoff collected:

Concrete- Gravel-

Pavers- Green space-

Analysis:

1. Graph the results of your water collection times on separate paper and attach to this lab sheet. Make a separate line for each type of surface. Label your axes!

2. What was the total volume of storm water runoff for each surface?
    a. Concrete

    b. Pavers

    c. Gravel path

    d. Green space

3. a. Which surface produced the **greatest volume** of runoff?

    b. Did it also have the fastest rate of water runoff?

    c. How might this affect the way water enters gutters, storm drains and rivers?

    d. What would this do to the flow rate of the receiving rivers? How might this affect the organisms in the river? How might groundwater recharge be affected?

4. a. Which surface produced the **lowest volume** of water runoff?

    b. Did it also have the slowest rate of runoff?

c. How might this affect the way water enters gutters, storm drains and rivers?

d. What would this do to the flow rate of the receiving rivers? How might this affect the organisms in the river? How might groundwater recharge be affected?

5. Why would reducing urban runoff be beneficial to a city?

6. Identify TWO ways that cities could reduce urban runoff. Describe how each strategy could reduce stormwater runoff.

Teacher notes- this takes longer to set up than to do! You don't need the exact list of things I used, the clear plastic bin lid (to simulate impermeable surfaces) was just something I had. You could use a piece of vinyl or even foil.

Pro tip- have the containers that the water runs into be wide enough to catch any water that runs off the sides, so you can capture as much of the water as possible (less cleanup! More accurate!)

I used individual pansy plants for the green roof/rain garden bc they are in season, but you could use any plants that have some soil with them, or even some sod if you have access. Just make sure it is well drained so you do get some water running through it.