

PLANT WITH A PURPOSE POLLUTION & FLOODING PREVENTION

Instruction Sheet

April showers bring May flowers, but they also bring flooding—especially in Chicago and the surrounding suburbs! Flooding is a major risk to health and safety. Not only does flooding cause water damage to homes and businesses, but it also results in sewage backup and pollution runoff. But that is where reintroducing plants can help. In this activity, create models to experiment with how we can reduce flooding and pollution through the help of plants and soil.

MATERIALS

Ask a parent or guardian before getting started.

- 3 (with caps) 2-liter bottles
- 48 ounces (6 cups) Plaster of Paris (can be purchased at craft and home improvement stores or online)
- Ruler
- 6 clear plastic cups
- Hole puncher
- Soil
- Rope or string
- Water
- Teaspoon
- Utility knife – To avoid safety risks, please have your parent or guardian handle the knife for you.**
- Oil
- Liquid food coloring
- Cereal or beads
- A timer
- Grass or fibrous rooted plant seeds (see table for examples)
- Optional: taproot plants (see table for examples)



Agronomist Cristina Negri collects poplar samples to measure the pollutants sucked from the earth.

Photo by George Joch, courtesy of Argonne National Laboratory.

ACTIVITY HIGHLIGHTS

- Create models of rain gardens!
- Observe how soil and plant roots impact flooding and runoff!
- Design your own city block using what you learned!

Fibrous Plants (A)	Taproot Plants (B)
Grass	Dandelion
Basil	Carrots
Mint	Beets
Pansy	Parsley

Image by KaitlinLiu from [WikiCommons](#)

INTRODUCTION

Has your family been impacted by flooding? Chances are if they live in Chicago or the suburbs, they have! One of the reasons flooding is common in cities is because there is less soil to absorb rainwater. Extra water that overflows from drains or isn't absorbed by soil is called runoff. Runoff is a primary cause of urban flooding and poses a big threat to clean water. This is because runoff picks up pollutants, contaminants, and toxins like fertilizers, pesticides, and oil, and then releases it into streams, rivers, and lakes. It can also seep into drinking water or harm aquatic wildlife. Further, these pollutants, contaminants, and sewage water can flood into our yards and homes, bringing biohazards (like bacteria and viruses that can make us sick) to where we live and play.

One way to prevent flooding and pollution is through [rain gardens](#). Rain gardens are depressed (lower/dipped) landscaped areas that use plants and soil to help absorb and filter stormwater runoff. Not only can plants, especially the right kind, slow down runoff water, but their roots can filter out pollutants as well. Plants with long fibrous roots also hold the soil in place to prevent erosion (the wearing away of land by water, wind, and ice). The more soil, the more water can be absorbed, meaning less runoff.

In the activity you do today, you will explore what can impact runoff water. You will create models of just pavement, a soil rain garden, and a rain garden made of both soil and plants. Through these models, you will explore both soil erosion and filtration and see how different aspects of the ground can impact runoff water.



Image by Chris "CJ" Johnson from [Pixabay](#)



Rain gardens are used at the Green bungalows and in parkways around the City of Chicago. The photo depicts a rain garden using native plants.

Image Source: [City of Chicago Water Management](#).

PROCEDURE STEPS

You will prep 3 bottles: clay only; clay and soil; and clay, soil, and plants.

Prep Bottles:

1. **Ask a parent or adult to do this step for you.** Have them cut off the top third of all three bottles the long way. The base and the spout of the bottles should be intact, like the image to the right. **Suggestion: Tape the raw edges so you don't accidentally get cut.**
2. **Prep Plaster of Paris:** Mix 48 ounces (3-16oz cups) of Plaster of Paris powder with 24 ounces (3-8 oz cups) of cold water. Stir until smooth (no lumps).
3. **Bottle 1 (control):** The first bottle will be your control to represent areas that do not have any soil or plant growth. Cover the length of the bottle with Plaster of Paris mix. Make sure to leave some space between the top of the plaster and the edge of the bottle (~2-3 cm). Dry for ~30 min.
4. **Bottle 2:** Fill approximately 2/3 of the bottle closest to the base with Plaster of Paris mix. You will need to tilt it so the plaster doesn't spread across the entire bottle (see bottom photo). Dry for ~30 min. Once completely dry, fill in the rest of the space with soil, still only going up the same amount.
5. **Bottle 3:** Fill approximately 2/3 of the bottle closest to the base with Plaster of Paris mix. You will need to tilt it so the plaster doesn't spread across the entire bottle (see bottom photo). Dry for ~30 min. Once completely dry, fill in the rest of the space with soil and plants.
6. The bottles are ready. Each of the 3 bottles represents a different ground situation: one with only a paved surface, one with a soil-only rain garden, and the other with a soil and plant rain garden.



Prepare Runoff Water:

7. First, punch two holes near the rims of 4 cups, directly across from one another.
8. Create a handle by tying your string or rope into the two holes.
9. In your other 3 cups, create your polluted rain water. In each cup, pour tap water (the clean rain water), then add a few drops of food coloring (bacteria and chemicals). Add a teaspoon or two of soil (dirt) and a teaspoon of oil (leaks from cars). Finally, add a few pieces of your cereal or popcorn to represent trash. These cups should be almost identical.

**Experiment Set-up:**

10. Set up all 3 of your bottles near the edge of a table, using a bottlecap or small object under the base of each to tilt the spout down.
11. On each of the spouts, hang the 3 cups with handles.
12. Test each bottle one at a time. Start your timer when you pour. Pour one cup of your homemade polluted water onto the base of the bottle with just clay. Time how long it takes for water to stop running into the cup under the spout of the bottle. Write down the time it took and the characteristics of the water into the data sheet provided. Preserve that cup so you can compare with the rest of the runoff cups of the other bottles.
13. Next, do the same for the rest of the bottles.
14. Repeat two more times (trials) for each bottle.
15. Compare the cups of runoff water:
 - *How fast did the runoff flow into the cup?*
 - *“How long did it take for the cup to fill?”*
 - *Which cup was the most “polluted”?*
 - *Which cup had the least amount of water?*
 - *Why do you think these differences occurred?*

**Extension**

16. How does the type of plants/roots impact runoff? For example, fibrous roots are thin, stringy and net-like, whereas taproots (like carrots or dandelions) have a thick central root.
17. How does the ratio of “concrete” to “rain garden” impact runoff?
18. Share your results and your explanations with Argonne Education! We will share submissions on @Argonne_Education on Instagram.

BONUS- Design a City Block

Chicago, other big cities, and their surrounding suburbs often have issues with flooding because of how much concrete has taken over space for native plants. Apply what you learned from this experiment and the extension activities. Draw or use your computer to design a city block. Add details like measurements, alleys, sidewalks, drains, and of course, gardens! You can also make a model of your block using a new bottle, plaster, soil and plants.

Share your design and the reasoning behind it with Argonne Education! We will share submissions on @Argonne_Education on Instagram.

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Data Sheet

ACTIVITY TABLE

Here is where you can write how long it took for each cup to finish filling as well as the characteristics of that cup, including what pollutants are in there and how much water is in there.

Bottles	Time Elapsed	Characteristics of Runoff
Plaster bottle		
Plaster and soil bottle		
Plaster, soil, and plant bottle		

This activity was adapted from Sabine De Brabandere, PhD, Science Buddies activity: [“Fight Flooding and Pollution with a Garden?!”](#)