POLLUTION AND PLANTS

Keep Omaha Beautiful

Description:

Conduct three experiments to determine how pollutants can affect plants... and how plants can help to reduce pollution.

Objective:

- Participants will comprehend how communities contribute to water pollution and actions individuals can take to reduce their impact.
- Participants will observe how pollution can harm plants and how plants can help reduce pollution.

Standards:

All Grades

- LA X.2.2 Writing Modes: Students will write in multiple modes for a variety of purposes and audiences across disciplines
- SS X.3.3 Explain relationships between humans and the physical environment.

2nd Grade

- SC.2.13.3.B Compare multiple solutions designed to slow or prevent wind or water from changing the shape of the land.
- SC.2.7.2.A Plan and conduct an investigation to determine if plants need sunlight and water to grow.

4th Grade

- SC.4.13.4.D Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

Materials:

- Plastic zip top bags
- 6 Beakers
- Salt
- Food coloring
- Vinegar
- Celery with leaves (NOTE: this item is NOT included in your checkout kit)
- Tablespoon measure

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Background Info:

Plants play a fascinating role in our environment when it comes to pollution. Some pollution is damaging to plants and can cause delayed flowering, root damage, leaf damage, and other issues. But some plants are tolerant of pollutants and can even help remove pollution from our atmosphere and soil.

Cities all over the world are turning to the benefits of trees as an opportunity to improve their air quality. In China's Hebei Province, which includes Beijing, city officials are planting a "green necklace" of plants to reduce pollution form factories that surround the capital. In Paris, officials are planting an urban forest that will encompass it's most iconic landmarks in an effort to adapt to climate change and improve the city's air quality. In Chicago, trees remove more than 18,000 tons of air pollution each year. And In 1997, New York City spent $1.5 billion to preserve the forested watershed that supplies New York City's drinking water by purchasing thousands of upstate acres of forested watershed. A filtration plant large enough to clean New York City's water supply would have cost more than $6 billion dollars.

The urban canopy helps to reduce water pollution as well. Trees help slow the flow of water by intercepting precipitation and by consuming water in the ground – a mature oak, for example, can consume over 40,000 gallons of water in a single year!

Trees help reduce stormwater runoff, which is the leading cause of water pollution in Nebraska.

- Trees intercept and store runoff and transfer water back to the atmosphere through evapotranspiration, reducing the volume of runoff.
- The shade and tree litter beneath the canopy help promote infiltration of precipitation that reaches the ground beneath the tree, providing moisture to the tree roots (ultimately to become transpiration) and reducing the volume of runoff.
- Roots, tree litter, and vegetative groundcover beneath the trees can slow the travel of runoff, resulting in lower times of concentration than associated with bare earth or impervious surfaces, and thus lowering peak runoff rates.
- Tree roots, leaf litter, and vegetative cover stabilize the soil surface, preventing erosion and associated impacts.
- Trees, associated ground litter, and groundcover provide filtration and vegetative uptake of contaminants, enhancing water quality.

But not all trees and plants are created equal when it comes to removing pollutants from the air and water – some are more effective than others. And some are more susceptible to harm from pollutants.

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Background Info Cont:

Most ecosystems work best when there is a lot of biodiversity - this allows the ecosystem to survive and thrive despite disease and pests. Additionally, scientists now recognize that there are many benefits to native plants, which are adapted to survive in an environment with little intervention from people. Native Nebraska prairie plants, for example, are adapted to survive in our area with little watering and other maintenance but might require more attention/maintenance in another part of the country.

Rain gardens are a form of green infrastructure that take advantage of the benefits of plants. A rain garden is a garden of native shrubs, perennials, and flowers planted in a small depression. It is designed to temporarily hold and soak in rain water runoff that flows from roofs, driveways, patios or lawns. Rain gardens are effective in removing up to 90% of nutrients and chemicals and up to 80% of sediments from the rainwater runoff. Compared to a conventional lawn, rain gardens allow for 30% more water to soak into the ground.

Activity:

1. Determine if you will do this activity as a single class demonstration or in small groups. This activity consists of 3 experiments, which can all be done at the same time.
2. Set up the experiments and have students complete the prediction section of their student data sheet.
3. Observe the results.
4. Direct students to complete the rest of their data sheets, including the final question.
5. Discuss the results of the experiments. Discuss new questions that students developed (the final question on their data sheet). Note: students may pose questions that you do not know the answers to. Help them to understand that good science is a continuous process – as scientist's complete experiments, they usually have new questions that emerge and lead them to additional work.

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Experiments:

Experiment #1: How does water travel from the roots of a plant to the leaves?

- Fill 3 beakers or cups halfway with water
- Add 10 drops of red food coloring to one beaker/cup
- Add 10 drops of blue food coloring to the second beaker/cup
- Do not add anything to the water in the final beaker/cup (this is your control)
- Cut the bottom inch off 3 stalks of celery
- Place one stalk of celery in each beaker
- Leave the beakers overnight
- Observe the differences in the celery stems and leaves
- Use a sharp knife to cut the celery stalk horizontally in the middle of the stem to observe it internally

Experiment #2: How do pollutants affect some plants?

- Fill 3 beakers or cups halfway with water
- Add 2 tablespoons of salt to one beaker/cup
- Add 2 tablespoons of vinegar to the second beaker/cup
- Do not add anything to the water in the final beaker/cup (this is your control)
- Cut the bottom inch off 3 stalks of celery
- Place one stalk of celery in each beaker
- Leave the beakers overnight
- Observe the differences in the celery stems and leaves
- Use a sharp knife to cut the celery stalk horizontally in the middle of the stem to observe it internally
- NOTE: you can extend this activity with variations. Try the following:
    - Just a few drops of vinegar or a pinch of salt to one beaker; compare this to the 2 tablespoons of vinegar/salt
    - One tablespoon of all purpose cleaner
    - One tablespoon of dish soap or laundry soap

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Experiments:

Experiment #3: How does water leave plants?

- Take 4 zip top bags outside.
- Select four leaves or small branches of deciduous leaves that are within reach. Select some in different locations and from different types of plants. Try putting some bags in sunny spots and some in shady spots. This activity works best on trees but can also be done on shrubs and other herbaceous plants.
- Explain to students that evapotranspiration is the process through which water evaporates out of plant leaves through tiny holes in the leaves called stomata. This is experiment is not to determine if that happens – it does. This experiment is to see which of these bags will have the most water – which plant transpires the most water? This helps us to understand which of these plants might help us clean the most pollution – the plant absorbs potentially polluted water through its roots and releases cleaner water through the leaves.
- Place the zip top bag on the branch, encasing a few leaves, and zip it closed.
- Leave the zip top bag overnight or at least for a few hours.
- Return to observe how much liquid is in the bags. NOTE: a basic observation is all that is required for this activity. However, some students may want to carefully remove the bags and weigh them to determine the exact amount of water in each bag.

Assessment:

Completed student data sheets