GO WILD IN NEW YORK CITY

LESSON PLAN/ New York City Rocks! Chapter

Inquiry project: Design your soil

In this lesson students will first examine soil that is locally sampled and brought to class and then design their own soil for planting. Students will use the designed soil to grow their plants in order to understand how different soil compositions affect plant growth. This will take several weeks to complete depending on the kinds of research questions and experimental designs the students develop.

Learning Goals

At the end of this project, students will be able to:

- Describe various soil characteristics.
- Formulate a research question and hypothesis that is testable using a science experiment.
- Design and carry out a science experiment.
- Measure and record data through observation.
- Formulate conclusions about how different compositions of soil affect plant growth.

Background Information

Where does dirt come from and what's it made of? Dirt, or soil as we call it, is made up of different amounts of rock, sand, and humus. The small rocks and pebbles are pieces of larger rocks in the earth's surface that have broken off due to millions of years of rain, snow, wind and ice. Sand comes from rocks that have been broken up by rivers and oceans. Humus, the best part of the soil, comes from decomposing plant matter, decaying organisms and animal waste. Humus is the best part of the soil because it's the richest in nutrients and is the key to growing food for humans and other animals to eat (see Go Wild in New York City, pp.26-27). Soils also have different amounts of air and water in them.

Rocks and sand are relatively easy to come across outside in the city and pretty hard to make ourselves in a classroom with limited time. Humus however, is easy and fun for students to make in their science classes—all you need is a worm compost bin. There are many resources available to help you get your class started on worm composting. Look for Appelhof's timeless classic Worms Eat My Garbage or go to the New York City Compost Project website at www.nyccompost.org for more information.

Development of the Activity

Before Class

Ask students to bring soil samples from their home or neighborhood. Ask them to document their sample collection methods and processes (such as documenting the location from which the sample was taken, the depth of the soil, vegetation in the

location, and storage methods). If this is not realistic, you may suggest places students might find soils to bring in, such as local parks, sandboxes, community gardens or local beaches. You might also ask other teachers in your school to bring in samples and bring some in yourself.

Since humus is an important component of good soil, this activity requires that the class have a supply of it, either from the class compost bin or a local community garden.

Warming-up

Ask students to think about how many different types of soils they find in their neighborhoods and brainstorm soil characteristics that differentiate soil types. They need to use previous experience or knowledge to answer the question.

Part 1. Soil Characterization

1. In the classroom, students in groups will spread out their soil samples and examine them closely. Ask students to record observations.
2. As students examine their soils, provide some questions to guide their observations. Ask them to keep a detailed record of their observations:
    - What properties/characteristics do you notice?
    - Can you identify the components (organic material or humus, rock fragments, sand, clay, etc.) of your soil?
    - Smell: How does the soil smell?
    - Texture: How does the soil feel?
    - Water content: Is your soil wet or dry? How does dry soil (once you dry it) differ from the original soil samples?
    - Color: What colors do you see?
    - How does/did your sampling method and procedure affect the characteristics of your soil?
    - How would you categorize or classify various soil samples in your groups?
3. Then, as a class, brainstorm and discuss the various soil characteristics that students used to describe their soils.
4. Ask students to discuss how their knowledge of the soil characteristics changed based on their investigations. What did they learn?

Part 2. Custom designed soil

1. Review soil characteristics and soil components with students (e.g. clay, sand, and humus, air, water).
2. Explain to the students that they are going to design soil for their plants.
3. Discuss the components of soil in terms of how it relates to the growth of plants.
    - Water is necessary to carry nutrients into the roots and up the stem. It is also necessary for the plants to grow.
    - Air is necessary to allow the roots to "breathe". Also, air spaces in the soil allow a place for water to enter the soil.
    - Organic matter, plant and animal parts, help hold the water in the soil. It also provides nutrients.

    - Rocks and minerals provide nutrients to the plants and structural support to the roots.
4. Students in groups will research about soil and plants that they are interested in using for their project.
5. Students in groups will develop a soil design that will help their plants to grow the best.
6. Students in groups will develop a science experiment to test whether the soil they designed will facilitate plant growth better than the soil that is found in their house or neighborhood. For example, one group might plant several bean seeds in their soil and the same type and numbers of seeds in a pot containing natural soil (that was brought from home or neighborhood).
7. Ask students to develop a detailed and specific research plan including research questions, hypothesis, materials needed, and data collection methods and procedures.
8. Students will carry out their science experiments by monitoring and recording their experiment (This may take several weeks to complete).
9. Once their data collection is over, students in groups will prepare a final research report and presentation. Then the whole class will hold a science conference.

Assessment

This project provides various opportunities to assess students' learning (see Learning Goals) in formative and summative ways. Student's skills and conceptual understanding can be assessed through:

- Performance in class activities and group inquiry project (Formative)
- Students' science journal (Formative)
- Students' participation in class discussions (Formative)
- Students' final reports (Summative)
- Students' presentations on their inquiry projects (Summative)

Extensions

As a follow up to this activity, the class can investigate the differences and similarities between the compost that is produced by earthworms in their compost bin and commercial fertilizers that can be easily found in local nurseries or hardware stores. Although both compost and commercial fertilizers serve similar purposes, their environmental impact would be quite different. Through the investigation students will be able to understand the potentially negative impacts that commercial fertilizers have on our environment and learn about alternative, environmentally friendly, ways of fertilizing our soil.

Connection to New York City Standards

This activity addresses the following NYC Performance Standards for Middle School Science:

S3a and d Earth and Space Sciences Concepts: The student produces evidence that demonstrates understanding of:
a. Structure of the Earth system.
d. Natural resource management.

S4b to e Scientific Connections and Applications: The student produces evidence that demonstrates understanding of:
b. The designed world, such as the reciprocal nature of science and technology, the development of agricultural techniques, and the viability of technological designs.
c. Health, such effects of toxic substances, personal and environmental safety
d. Impact of technology, such as risks, and problems and solutions
e. Impact of science, such as interactions between science and society.

S5a to f Scientific Thinking: The student:
a. Frames questions to distinguish cause and effect; and identifies control variables in experimental and non-experimental research settings
b. Uses concepts from Science Standards 1 to 4 to explain a variety of observations and phenomena
c. Uses evidence from reliable sources to develop descriptions, explanations and models
d. Proposes, recognizes, analyzes, considers, and critiques alternative explanations; and distinguishes between fact and opinion.
e. Identifies problems; proposes and implements solutions, and evaluates the accuracy, design and outcomes of investigations.
f. Works individually and in teams to collect and share information and ideas.

S6a to c: Scientific Tools and Technologies: The student:
a. Uses technology and tools to observe and measure objects,organisms,and phenomena,directly,indirectly,and remotely.
b. Records and stores data using a variety of formats.
c. Collects and analyzes data using concepts and techniques in Mathematics Standard 4.

S7a, b, d and e: Scientific Communication. The student:
a. Represents data and results in multiple ways.
b. Argues from evidence.
d. Explains a scientific concept or procedure to other students.
e. Communicates in a form suited to the purpose and the audience.

S8a to c: Scientific Investigation. The student:
a. Demonstrates scientific competence by completing a controlled experiment.
b. Demonstrates scientific competence by completing fieldwork.
c. Demonstrates scientific competence by completing a design.