Environmental Influence on Plant Growth

Middle School 6th-8th Grade

LESSON OVERVIEW

Summary: Students will learn how the environment effects plant growth by conduction and experiment and using the Scimodo system to collect data.

Lesson Length: 3-6 weeks; 3, 45-60 Minute Lab & 4, 15-20 Minute Labs

Part 1: Brainstorm, Question & Hypothesis

Students will learn about the Growth & Development of Plants, formulate a testable question and set up a hypothesis.

PowerPoint: Growth & Development of Plants
Teacher will go over the "Growth & Development of Plants" Power Point

Part 2: Procedure & Experiment Set Up

Students will create a procedure and set up an experiment to test their environmental plant growth variables.

Part 3: Data Collection

Students will review and record collected data.

Part 4: Data Analysis & Conclusion

Students will process collected data and come up with a conclusion to their experiment.

MATERIALS

Part 1: Brainstorm, Question & Hypothesis

Consumable Materials:
- o Environmental Influence on Plant Growth Worksheet #1 (1 per student)
- o 2, 3" or 4" plant per 4 students (suggested varieties pansy, petunia, mum)

Reusable Materials:
- o Magnifying Glass (1 per student)
- o Ruler (1 per 4 students)

Part 2: Procedure & Experimental Set Up

Consumable Materials:

- o Environmental Influence on Plant Growth Worksheet #2 (1 per student)

Reusable Materials:

- o Scimodo Kit (1 per 4-8 students)
- o Computer (1 per 4-8 students)
- o Magnifying Glass (1 per student)
- o Ruler (1 per 4 students)
- o 2, 3" or 4" plant per 4 students (From Lab 1)

Parts 3: Data Collection

Consumable Materials:

- o Environmental Influence on Plant Growth Worksheet #3 (1 per student)

Reusable Materials:

- o Magnifying Glass (1 per student)
- o Ruler (1 per 4 students)
- o Computer (1 per 2 students)

Part 4: Data Analysis & Conclusion

Consumable Materials:

- o Environmental Influence on Plant Growth Worksheet #4 (1 per student)

Reusable Materials:

- o Magnifying Glass (1 per student)
- o Ruler (1 per 4 students)
- o Computer (1 per 2 students)

PROCEDURE

Part 1: Brainstorm, Question & Hypothesis (Designing the Experiment)
1. Go over the "Growth & Development of Plants" PowerPoint
2. Discuss the components of Scimodo and how the following sensors work: temperature/humidity, soil hydration sensor, ambient photo sensor and ambient sound sensor.
3. Use the worksheet as a guide, brainstorm on how Scimodo can be used to design an experiment to test environmental influence on a plants growth. Some examples of things to test are
    a) How temperature effects plant growth.
    b) How soil moisture effects plant growth.
    c) How humidity effects plant growth.
    d) How sound effects plant growth.
    e) How light effects plant growth.

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4. Pass out 2 plants, ruler and magnifying glass to each 4 students. Have students works in teams to discuss and refine their experiment ideas. They make observations about their plants and discuss what they know about plants to help them hash out possible experiment ideas. Consider the following questions.
   a) What environmental influence will you test?
   b) How will you use Scimodo to gather data on this test?
   c) What will be your control?
   d) What will be your independent variable?
   e) How will you gather observations on plant growth?
5. Have each group quickly present experiment ideas to the class. Determine their viability based on the supplies you have and the ability to create a controlled experiment.
6. Make a quick list of experiment ideas and choose 2 to do with your class. Choice can be via teacher selection or classroom vote.
7. Come up with hypotheses for each experiment.
8. Review objectives and clean up.

Part 2: Procedure & Experiment Set Up

Prep: Use same plants from part one.

1. Review the outcome of Part 1.
2. Use Worksheet #2 as a guideline to set up the procedure.
3. Guide the students into setting up their experiments.

Part 3: Data Collection

1. Collect data using Scimodo and Worksheet #3.
2. Scimodo's sensors will collect data from the sensor/s you selected for your experiment. View the data in your dashboard or import the data as needed. See Figure 1.
3. Worksheet #3 is a suggested spreadsheet for collecting additional plant growth data and observational data. You can use it as is or modify it to better suite your needs. There are sample observation data, plant growth and plant growth chart sheets to help you see how data can be collected.

Figure 1. Sample of what Scimodo data displays look like.

Part 4: Data Analysis & Conclusion

1. Use worksheet #4 as a guideline to analyze data and generate a conclusion.

NEXT GENERATION SCIENCE STANDARDS

MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. (Clarification statement: Examples of local environmental conditions could include availability of food, light space, and water.)

Disciplinary Core Ideas
LS1.B Growth and Development of Organisms
Genetic factors as well as local conditions affect the growth of the adult plant.

LS4.C Adaptation
Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more and more common; those that do not become less common. Thus, the distribution of traits in a population changes.

Science and Engineering Practices
Constructing Explanations and Designing Solutions
Construct a scientific explanation bases on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

Crosscutting Concept
Cause and Effect
Phenomena may have more than one cause and some cause and effect relationships in systems can only be describes using probability.

VOCABULARY

- Plant Variety & Diversity
- Adaptation, Genetics
- DNA
- Heredity
- Environmental Influence
- Survive
- Extinct
- Humidity/Temperature Sensor
- Soil Hydration Sensor (hygrometer)
- Ambient Noise Sensor
- Ambient Photo (Light) Sensor

BACKGROUND INFORMATION

Plant Variety & Diversity

Plant diversity refers to the number of different plants that exist in a specific area. On planet Earth, there are approximately 391,000 plants species. Plants are broken down into the following categories mosses, ferns and allies, gymnosperms (types of trees), dicotyledons, monocotyledons, green algae and red algae. Scientists believe there are many more that have not been discovered yet. Most plant species are well adapted to the environment and habitat they live in.

Adaptations
An adaptation is a process of change where an organism becomes better suited for its environment.
For example, rainforest plants can have the following adaptations:

Bark
In drier, temperate deciduous forests a thick bark helps to limit moisture evaporation from the tree's trunk. Since this is not a concern in the high humidity of tropical rainforests, most trees have a thin, smooth bark. The smoothness of the bark may also make it difficult for other plants to grow on their surface.

Drip Tips
The leaves of forest trees have adapted to cope with exceptionally high rainfall. Many tropical rainforest leaves have a drip tip. It is thought that these drip tips enable rain drops to run off quickly. Plants need to shed water to avoid growth of fungus and bacteria in the warm, wet tropical rainforest.

Prop and Stilt Roots
Prop and stilt roots help give support and are characteristic of tropical palms growing in shallow, wet soils. Although the tree grows slowly, these above-ground roots can grow 28 inches a month.

Genetics, DNA & Heredity
Genetics is the study of how characteristics of living things are transmitted from one generation to the next. Plant genetics is the passing of genetic factors of inherited characteristics from one generation of plants to the next. Examples of inherited plant characteristic could include but are not limited to: vascular vs. non-vascular plants, water loving vs. drought tolerant plants, leaf shape and stem structure. These traits are expressed in the DNA. The DNA is in each plant cell and contains the instructions the plant needs to develop reproduce and live.

Plants & The Environment
Unlike animals, plants cannot move when the environment changes. They are at the mercy of environmental influences like climate and human alteration of the environment. Although it may appear that many plants are quite tolerant to change, many studies have shown a variety adverse effects due to change. For example, tree roots are often damaged or killed during floods or building projects. The environment can play a pivotal role in whether a plant survives and becomes extinct.

Sensors & Scientific Investigation
Scimodo provides a variety of sensors that can aid in scientific investigation. The sensors provided in your kit will help monitor and collect data such as humidity, temperature, soil, hydration, ambient noise and ambient photo (light) 24 hours, 7 days a week. You can use these sensors to help identify an independent variable for your experiment.

Vocabulary Definitions
Plant Variety & Diversity: The number of different kinds of plants is the variety. The number of different kinds of plants in an area determines the diversity. The more variety in each area, the more diverse it is.

Adaptation: An alteration in the structure or function of an organism or any of its parts that results from natural selection by which the organism becomes better fitted to survive and multiply in its environment.

Genetics: The study of hos characteristics of living things are transmitted from one generation to the next.

DNA: A molecule inside each cell that contains the instructions an organism needs to develop, reproduce and live.

Heredity: The passing of genetic factors from one generation to the next (parent to offspring).

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Environmental Influence: How the environment plays a part in the growth and development of an organism.

Survive: The ability to live.

Extinct: To no longer exist.

Humidity/Temperature Sensor: A device that detects and measures humidity (in percentage) and temperature (in Fahrenheit). The temperature may read higher than the ambient temperature which is likely due to its proximity to the Arduino board.

Soil Hydration Sensor (hygrometer): A device that detects and measures the amount of water in the soil. The device works by using the exposed pads as probes for the sensor. The more water the soil contains, the better the conductivity is between the pads. The sensor has its own scale for detecting moisture which is 0=100% wet and 1023= 100% dry. Please use the chart below to decipher your moisture content.

Sensor Reading	Percent Wet
1023	0
922-1022	9-1
819-921	19-10
717-818	29-20
615-716.	39-30
513-614	49-40
411-512	59-50
307-410	69-60
105-306	79-70
103-104	89-80
1-102	99-90
0	100

Ambient Noise Sensor: A device that detects and measures the amount of noise in the area.
This device can detect the intensity of the sound environment, according to the principle of vibration. 0 is quiet and the number will increase as it picks up more intense vibrations.

Ambient Photo (Light Sensor): A device that detects and measures the amount of light in the area.
This sensor measures the resistance of the photoresistor. When the ambient light intensity increases the photoresistor will decrease. So, the output signal from this will be HIGH in bright light, and LOW in the dark.

Microcontroler (Arduino MRK 1000)
Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read an input and turn it into an output. You can tell your board what to do by sending a set of instructions to the microcontroller on the board.

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