the CEED

THE CENTER FOR ENERGY EFFICIENT DESIGN

The Effect of UV Light vs. Other Light Sources on Plants in Greenhouses

Grade Level	2	**Subject**	Science- Plant Resources/Weather

Objective(s): The student will design a greenhouse to investigate the effects of solar light and other light sources on the growth of plants over a 3 week period . The student will also compare and contrast the differences in light by measuring growth. The students will collect data and graph growth, temperature, and oxygen levels in each greenhouse. He/she will compare the temperatures in their greenhouse to the temperature measured on the CEED Dashboard.

SOL Addressed: Science- 2.1 a,c,d,e,h,l,j,k,l- The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting experiments in which:

- Observations and predications are made and questions are formed
- Observations are repeated to ensure accuracy
- Two are more characteristics or properties are used to classify items
- Length and temperature are measured using proper tools (**Math SOL 2.11a and SOL 2.14)**
- Data are collected and recorded, and bar graphs are constructed (**Math SOL 2.19)**
- Data are analyzed
- Conclusions are drawn
- Observations about data are communicated
- Simple physical models are designed and constructed to clarify explanations and show relationships

2.4 b: The student will investigate and understand that plants undergo a series of orderly changes as they grow and mature.

2.5 a: The student will investigate and understand that living things are part of a system a) living organisms are interdependent with their living and nonliving surroundings

2.6 b: The student will investigate and understand basic types, changes, and patterns of weather that include b) the uses and importance of measuring, recording, and interpreting weather data

Common Core Standards: K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of new objects

K-2-ETS1-2. Develop a physical model to illustrate how the shape of an object helps it function as needed to solve a given problem

2-LS2-1. Plan and construct an investigation to determine if plants need sunlight and water to grow.

<table>
<tr><td>Materials Needed Per Class of 30

and

Prior Knowledge</td><td colspan="2">

Materials for greenhouses: plastic containers, plastic wrap, clear trash bags, straws, dowel rods, cardboard, tape, glue, etc.
Bean plant seeds
Potting soil
Cardboard planters
Notebooks/ pencils for recording
Rulers
Measuring cups for water
Thermometers
Oxygen detector

Prior Knowledge: What do all living things need to survive?

The students must know the terms: length and temperature as well as how to collect and read a ruler and thermometer.
The students need to know how to make a bar graph and record data.

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<tr><td>Ways to differentiate this lesson plan</td><td colspan="2">

EXTENSION for Higher Level Learner

Students can convert the ºF temperature to ºC temperature by using the following formula (they may use calculators for the multiplication and division part of the formula) :
ºF temperature -32=y
5 x y= z
z/9=ºC

MODIFICATIONS
Students will be placed in heterogeneous groups no bigger than 4 people, making sure all academic strengths are present.

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<tr><td>Introduction/ Anticipatory Set</td><td>Anticipatory Set: The teacher will review the water cycle and what makes the water cycle run (The Sun). The teacher will also review the parts of a plant.

The teacher will read: Out and About at the Greenhouse by Bitsy Kemper to give students a better understanding of greenhouses.
Questions to ask students:

What do plants need to survive?
How can we provide all these things for plants?
How does each part of a plant help it survive?

</td><td>Introduction:
The class will discuss what the sun provides for plants and other living things.

The discussion will continue to other light sources we use in place of the Sun.

Asking: How are we able to see when there is no Sun? What kinds of light do we use?

The class will also discuss what happens to plants we want to keep alive in the winter.

Asking: How would you keep a plant alive in the winter? Where are some places we could keep them?

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Guided Practice	• Students need to be broken into groups of no more than 4 people.
	• As a group students will:
	  ▪ design and then use any of the provided materials to build 2 identical greenhouses.
	  ▪ plant four plants using the same seed type, same planters and same amount of potting soil.
	  ▪ Choose a source of lighting other than natural light (ex: flashlight, incandescent light, fluorescent lighting, etc.)
	  ▪ place one plant in each greenhouse
	• One of the teams' greenhouses will be placed outside (but will be brought in at the end of the school day) and one of the greenhouses will be placed under the lighting source the team has chosen.
	• Students will also place their other two control plants outside in the same area as their greenhouses
	
	The following predications need to made and the answers need to be recorded:
	1. Which type of lighting do you think will grow the tallest plant? Explain.
	2. What time of day do you think the temperature will be highest? Lowest?
	3. Which greenhouse do you think will have the highest temperature? Oxygen level?

Independent Practice	• At three times throughout the day (morning, noon, and before students go home) students will measure and record temperature and oxygen level for both greenhouses. • Students will measure length (cm) at the end of each day. • At the end of each week, students will discuss their data and possible reasons for the results. • Students will also make a bar graph of their data at the end of each week. • As students are measuring and graphing the teacher should be monitoring and asking questions about the students' findings.
Closure (Summary of Lesson)	• At the end of three weeks, students need to graph all of their data into one graph and discuss their findings. • **Students will analyze and answer the following questions:** 1. What light source produced the tallest plant? 2. Why do you think this light source produced the tallest plant? 3. Do you think using different materials for your greenhouse would have changed your plant growth? • Students will then be placed in groups with different children to compare their findings and answer the same questions as above.
CEED Building Application/ Sensor Data	2nd Grade students will look at the CEED dashboard each day to compare temperatures outside to the temperatures of their greenhouse. Students will look at the graphs and see which time of the day has the highest temperature.
Assessment	Student completed data charts and graphs can be assessed. Students should write an explanation of their conclusions about the best possible lighting for growing plants.

INQUIRY LEARNING RESEARCH PROCESS GUIDELINES

The following table is just one guideline to use for developing your own inquiry materials. The seven steps in the Learning Research Process include not only how people learn but also how research is conducted. The heart of the design, the three-stage learning cycle of exploration, concept invention or formation, and application is embedded in the middle. In addition to these three stages, this design takes into account that learners need to be motivated to spend the time required for understanding complex subjects and that learners need to build this new knowledge onto prior knowledge. These are similar to the 5E and 7E learning models.

The Learning-Research Process

Steps in the Learning-Research Process	7E Equivalent	Component of the Activity
1. Identify a need to learn.	Engage	An issue that excites and interests is presented. An answer to the question *Why?* is given. Learning objectives and success criteria are defined.
2. Connect to prior understandings.	Elicit	A question or issue is raised, and student explanations or predictions are sought. Prerequisite material and understanding is identified.
3. Explore	Explore	A model or task is provided, and resource material is identified. Students explore the model or task in response to critical-thinking questions.
4. Concept invention, introduction, and formation	Explain	Critical-thinking questions lead to the identification of concepts, and understanding is developed.
5. Practice applying knowledge.		Skill exercises involved straightforward application of the knowledge.
6. Apply knowledge in new contexts.	Elaborate and Extend	Problems and extended problems require synthesis and transference of concepts.
7. Reflect on the process	Evaluate	Problem solutions and answers to questions are validated and integrated with concepts. Learning and performance are assess

Greenhouse Team Data Collection Sheet:

Monday

Morning:
Mid-Day:
End of Day:

Tuesday

Morning:
Mid-Day:
End of Day:

Wednesday

Morning:
Mid-Day:
End of Day:

Thursday

Morning:
Mid-Day:
End of Day:

Friday

Morning:
Mid-Day:
End of Day: