SOLAR BUG LAB

Elementary Lesson Plan

KEY LEARNING OUTCOMES

Learners will be able to improve observation skills.
Learners will be able to apply the scientific method to answer a question.

TIME REQUIRED

2-3 class periods (about 2 hours)

MATERIALS

- Student Lab Page
- Pen / pencil
- Stopwatch
- 2V solar cell
- vibrating motor
- 2 chenille stems
- wood bodies for insects
- 2 O-rings

STANDARDS

CROSSCUTTING CONCEPTS EMPHASIZED

1. Patterns
2. Cause and Effect: Mechanism and Explanation
7. Stability and Change

SCIENTIFIC AND ENGINEERING PRACTICES

1. Asking questions (for science) and defining problems (for engineering)
3. Planning and carrying out investigations
4. Analyzing and interpreting data
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

DISCIPLINARY CORE IDEAS

Kindergarten-Grade 2 - ETS1 Engineering Design
Students who demonstrate understanding can:

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 a new or improved object or tool.
K-2-ETS1-2. Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function
as needed to solve a given problem.

K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same problem to compare the strengths and
weaknesses of how each performs.

3-PS2 Motion and Stability: Forces and Interactions
Students who demonstrate understanding can:

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to
predict future motion.

4-PS3 Energy
Students who demonstrate understanding can:

4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

College and Career Readiness Anchor Standards for Reading (K-5)

Integration of Knowledge and Ideas

7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

College and Career Readiness Anchor Standards for Writing (K-5)

Text Types and Purposes

1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

Production and Distribution of Writing

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Range of Writing

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a
single sitting or a day or two) for a range of tasks, purposes, and audiences.

COMMON CORE MATH STANDARDS

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

ENGAGEMENT

1. Solar Bug Demo

Introduce students to the Solar Bugs via a demonstration. Some ideas for discussion questions:

What do you think propels the Solar Bug?
What do you notice about the movements?
What is the difference between movements that are random or part of a pattern?
Are these movements random?

2. Introduce Inquiry Question

Pass out the Activity Page
Read the Research Question together as a class:
How do the leg positions of the Solar Bug change its movement?

3. Cause/Effect and Solar Energy Mini-lesson

Complete the 'Background Information' section of the Student Page.
Discuss the idea of cause and effect.
Example questions:

What is an example of a cause and effect?
If we change one thing, can we measure the impact?
What is an example of a cause and effect we can measure?

A mini-lesson regarding the basics of solar power and PV might be appropriate as background knowledge for your class here, if that is a topic that you have not studied this year. You can find some good resources for building background knowledge at *browndoggadgets.com*.

4. Write a Hypothesis using an 'If __, then__' statement.

Include a mini-lesson on the idea of a Hypothesis, depending on students' previous background and exposure to the scientific method.
If the leg positions are changed, then the movement of the Solar Bug (will / won't) change.

EXPLORATION

5. Groups construct Solar Bugs using the Instructions provided at Brown Dog Gadgets.

6. Read the Procedure and explain the data collection process. There are six variations between a leg being pointed down, folded flat on the surface or bent off the ground.

7. Groups should sketch the Solar Bug leg positions as well as the movement it undertakes in 10 seconds.

EXPLANATION

8. After sketching the leg positions and Solar Bug motions, students should attempt to answer the Conclusion section questions.

ELABORATION

9. Students who complete can advance on to the Elaboration Page. Students should use their observation sketches to be able to predict the movement of the Solar Bugs.

EVALUATION

10. Come back together as a class and share out answers to the following:

Was your hypothesis correct about how the leg positions would impact movement?

What potential errors did you make?

How would you potentially change this lab to test something slightly different?

Which leg position did you choose for the target assignment?

Why did you choose that one?

12. You could also expand the Target Page into a competition of which group can most consistently hit the targets on a variety of different pages. Using a document camera at the front of the room would greatly aid successful buy-in for a competition.