SOLAR BUG LAB
HIGH SCHOOL LESSON PLAN

KEY LEARNING OUTCOMES

Learners will be able to distinguish between variables.
Learners will be able to apply the scientific method to answer a question.
Learners will be able design a solution to a scientific and engineering problem.

TIME REQUIRED

2 hours (plus additional time for a formal lap report)

STANDARDS

NEXT GENERATION SCIENCE

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

HS-PS3 Energy

Students who demonstrate understanding can:

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

READING

College and Career Readiness Anchor Standards for Reading (6-12)

7. Integrate and evaluate content presented in diverse formats and media, 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.

WRITING

College and Career Readiness Anchor Standards for Writing (6-12)

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

MATH

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.

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?
Are the movements random or similar?

2. Background Knowledge

Review the differences between Dependent and Independent.
What is a controlled variable?

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*.

3. Question Introduction

Introduce the Testable Question together as a class:

How do the positions of the Solar Bug legs impact its movement?

4. Study Design

In lab groups, have students discuss methods of answering the research question, brainstorming at least 3 different ideas for study design.

Invite groups to share-out their ideas.

After hearing the ideas of other group members, the lab group should write out the design of their lab.

a. Hypothesis using an 'If __, then__, because ___' statement.
b. List out the materials necessary in addition to the Solar Bug materials
c. Write out the Procedure steps very accurately and precisely

EXPLORATION

5. Groups construct Solar Bugs using the Instruction provided here.

6. Groups should follow their 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 collecting data and recording their observations, students should answer the questions in a full paragraph of a conclusion section. If required, students can/should complete a formal lab report.

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. Have students use the Lab Checklist and Self-Evaluation to reflect on how well they did on the lab activity.

11. Come back together as a class and discuss the following aspects of the Conclusion section:

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?

In what way did your group work well together?

In what way does your group need to improve?

12. Potential expansion: 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.