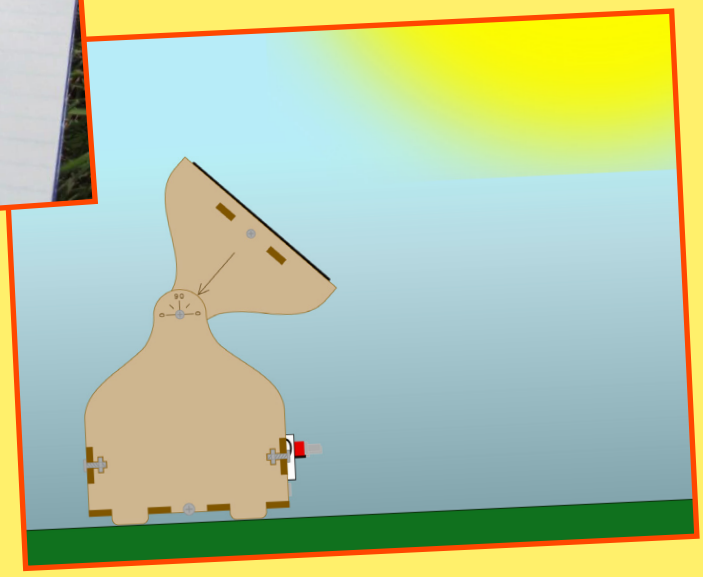
Solar Science Station

Experiment eBook



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Studying Solar Energy using the Solar Science Station

Solar energy is all around us. Plants use it to create food via photosynthesis, our planet gets its warmth from it, and people use the sun to generate increasing amounts of electricity from solar panels. While generating electricity may seem complicated, people have been doing it for almost 130 years! We've gotten much better at harnessing it but the same basic principles are used in modern day solar cells. The key to success is using them the right way.

This guide will walk you through the process of using a Solar Science Station to run an experiment that measures solar energy while collecting data, and presenting it in a way that enables you to answer some important questions. This guide is intended to be 100% student led and is appropriate for use by a single student at home, in a classroom, or as a science fair project.

What You'll Need:

To do this project you'll need a few simple items:

- A built Solar Science Station from Brown Dog Gadgets.
- A notebook and pencil.
- A smart phone with built in compass (most have this) or a hand-held compass and a watch.
- Sun. It helps to do this activity over several sunny days.

Check out our online resources for the Solar Science Station!

Just scan this QR Code or visit:
browndoggadgets.dozuki.com/c/Solar_Science_Station

How to create a quality experiment

Use the Scientific Method

Start with the Scientific Method (Question, Hypothesis, Experiment, Data Collection/Analysis and Conclusion). Each part is important and this is your chance to use the very same process that cutting-edge scientists still use to find answers to the things they wonder about.

A Good Question to Answer

You must develop an appropriate question that allows for data collection and experimentation. This should never be a question with a simple "yes" or "no" answer or a question that already has answers that can be found by researching what is already widely known.

A question such as "Will this device charge my cell phone?" is a poor question for a science fair project because answering it will only yield a "yes" or a "no". A good question would be one that allows you to gather information and form your own conclusions. If you're having trouble thinking of one on your own, we've given you a few examples that can be used.

What is a Hypothesis?

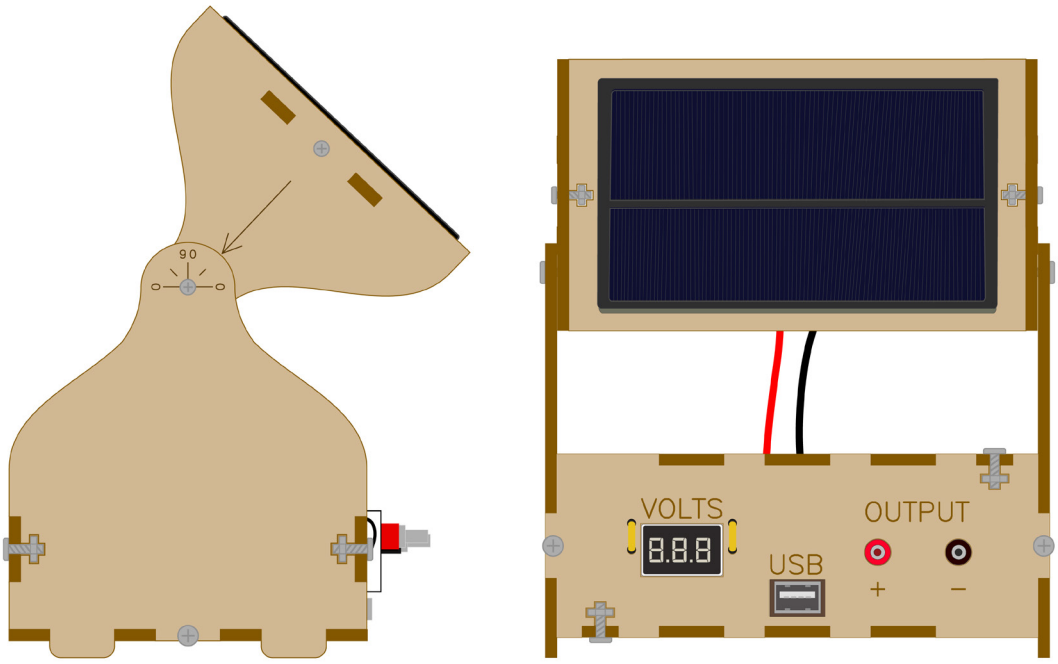
Think of your hypothesis as what you THINK/SUSPECT may be the answer to your question based on what you already know. It is a reasonable answer to your question based on your own knowledge and experiences.

Setting up your experiment and documenting its procedure

Simply put, a good experiment is one that will give you factual information that is **related to the question you are investigating**. This is why recording and communicating HOW your experiment was set up is important. It lets other people know that they can trust how you got the information you analyze in the end. The goal is to design your experiment and describe it well enough that someone else could do it on their own.

Controls and Variables

In any experiment, there are elements that are kept the same and element(s) that are allowed to change. The things that COULD change but are kept the same instead are called **controls/constants**. They are KEPT constant so that your results cannot be blamed on/attributed to them. The elements in an experiment that are allowed to change are called variables. Typically, **variables** are related to the thing you wish to test for.



Example Questions and Experiments

Below you will find some example questions that could be investigated with the help of your Solar Science Station along with the variable and control elements that are related to them.

What is the best SINGLE Cardinal Direction for a solar panel to face in order to generate electricity throughout a given day?

Variable: Your Solar Science Station is completely portable and, for that reason, is easy to move and position to face different Cardinal Directions. An experiment involving the sample question above is all about DIRECTION of the panel in relation to the light source. For this reason, DIRECTION should be the variable element in your experiment. The simplest way to test this would be to go outside with your Solar Science Station and run trials with the panel itself, held at a constant angle while facing a variety of Cardinal Directions (North, South, East and West). Use a compass to help you position your Solar Science Station's panel accurately (cell phone . North, South, East, and West are a good start but we also recommend trials for North East, South East, South West, and North West if you can make the time for it.

Controls: In order to collect useful data, you are going to need to control three main things: Panel Angle, Time and Weather.

Angle: There is a built-in protractor on your device and we recommend using it to help you keep the panel locked at 45 degrees for any and all trials.

Time: Because the sun changes position throughout the day in relation to your Solar Science Station, you will need to take voltage readings at each Cardinal Direction you test several times a day over several days to collect the data you need. To control the element of time in your trials, you'll just need a watch and a predetermined schedule that you keep to for all trials of each direction. The difficult part will be taking readings at regular intervals. So, make sure that you create a schedule that you can keep to throughout your day. Don't choose a testing schedule that you can't keep to because missing trials/data points may give you results that are skewed and hard to trust when comparing one direction's data to another. PLAN AHEAD so that you have time to do all the trials you need to in order to move on to later steps of the Scientific Method.

Weather: Because the weather is also likely to be different from one day to the next and you do not want your daily results of directional changes to be attributed to weather changes, it is also necessary to control THAT aspect of the experiment. The simple way this is done is to make sure that you test and record Voltage at each time slot in your daily schedule from all of the directions you are investigating. That way, each reading is taken under the same weather conditions, even though those weather conditions may be different from day-to-day.

2) What is the best panel angle in relation to light source for generating electricity?

Variable: Your Solar Science Station is designed to allow for the user to adjust the angle that the panel itself is positioned at in relation to a given light source. An experiment designed to investigate the sample question above is all about the ANGLE of the panel. For this reason, the panel angle should be the variable element in your experiment and therefore changed from trial to trial while all other elements are held constant as controls.

Controls: The easiest way to do this means that you should make efforts in your experiment design to take data readings at the same time of day, while the device faces a constant Cardinal Direction (such as South).

3) What is the best panel angle and direction combination for a solar panel to be placed on the roof of your school?

A local energy company has donated several larger solar panels to your school. The roof of your school is very large and you have many options as to where to place these panels. Your principal wants you to investigate what angle and direction to place these panels in order to generate the most electricity for your school.

Procedure: Instead of taking voltage readings with the panel at different angles while facing ONE common direction, you would be taking voltage readings at those different angles; repeated while facing EACH direction. In this experiment even though you are testing voltage output for a certain angle while facing **different** directions, DIRECTION is still held constant because EACH direction would be used to investigate a single ANGLE.

Presenting your data

When you collect your data, consider creating an organized table ahead of time based on the pieces of information that you intend to collect. Simple lines drawn across a piece of paper with a ruler work just fine. Clearly label all rows and columns and record your data neatly so it's legible afterward.

Below are some SIMPLE examples of tables collect your data. Do NOT trust that the EXAMPLE numbers we plugged in are accurate. YOU need to conduct your OWN trials and use your OWN data.

Direction, Time of day, and Voltage Example

Cardinal Direction Tested	North	South	East	West
10 AM Voltage	0.6V	2.0V	1.5V	0.5V
11 AM Voltage	0.75V	2.1V	1.75V	0.6V
12 PM Voltage	1.0V	2.5V	2.1V	2.0V
1 PM Voltage	1.1V	3.0V	2.5V	2.5V
...and so on				

3) Panel Angle, Time of day, Cardinal Direction, and Voltage

For data with all of THESE characteristics, you'll probably need to make several charts for each of your Cardinal Direction Sets. The one below is our example "South" facing chart for a single day. DO NOT trust that our EXAMPLE data is actual trustworthy data. Acquire and use your own instead!

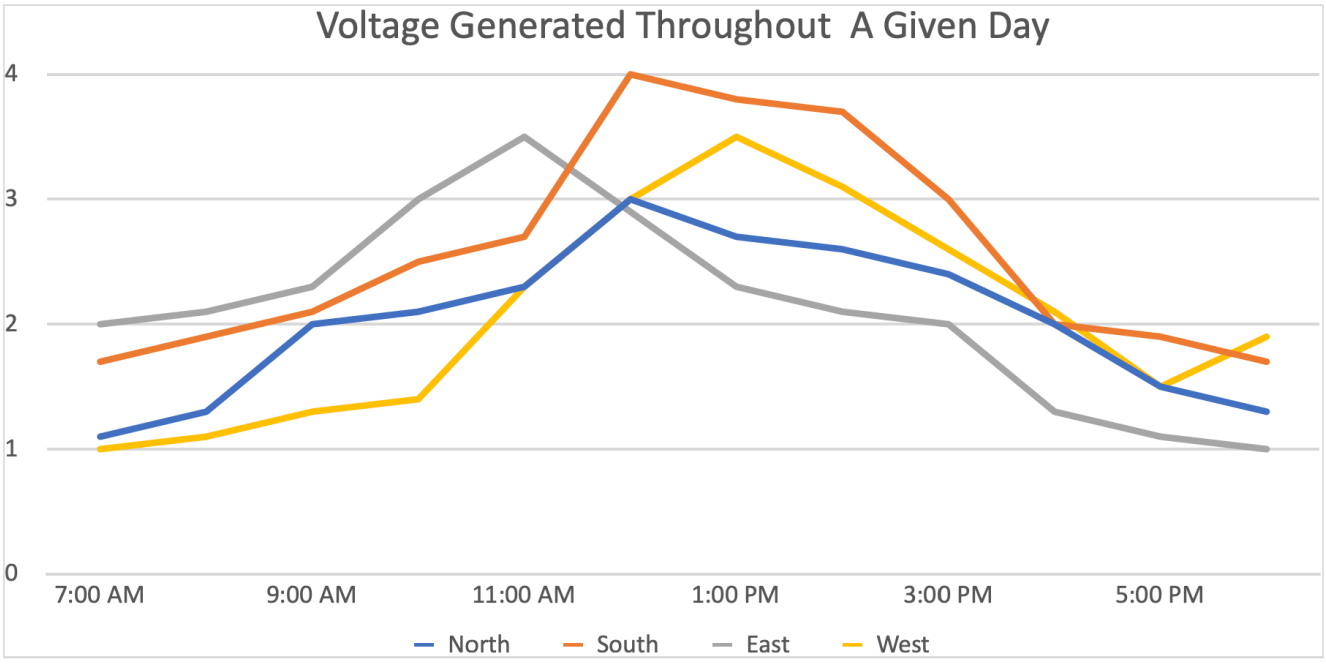
Day 1 (date), South-Facing Data

Panel Angle Tested	0 Degrees	45 Degrees	90 Degrees	135 Degrees
9 am Voltage	3.2V	5.2V	1.0V	3.0V
9:30 am Voltage	3.7V	5.5V	1.2V	3.1V
10 am Voltage	3.8V	5.8V	1.5V	3.3V
11 am Voltage	4.0V	6.0V	4.0V	3.7V
...and so on				

After Experimentation and Data Collection

Charts and Graphs

Graphing and charting your data afterward benefits you first AND everyone else after. Not only will graphs and charts help YOU to see relationships and trends in your data, it is also an effective easy way to present those bigger ideas to others. Below is an example of a simple line graph showing voltage over a given day for each of 4 Cardinal Directions.



Graphing your data for North, South, East and West all on the same line graph allows you to compare their daily trends side by side and see how one compares to the next. It also helps others see your data relationships the same way!

Conclusion

After all your data collection and graphical analysis, it's time to answer your question and revisit your hypothesis. Was your original hypothesis supported by the data you collected or did you find some new information out? What else did you learn while running your experiment? Did you have any problems? Use the conclusion section of your project to explain your findings and describe your experience. Use complete sentences and details from your experiment.

Below are some example questions you could answer in your conclusion to help you describe the things you found out from your experiment. Use them to get you started on the final portion of your science fair project.

1) Was my original hypothesis supported by my data?

2) What were things I observed during the trials of my experiment?

3) What happened as expected throughout the trials of my experiment?

4) Were there any unexpected results from my experiment? If so, what were they?

5) What is the best way to position solar panels?

6) If I were to run this experiment again, what would I keep the same and what would I change?

7) Do you think changes in weather may have affected your data?

8) Do you have any NEW questions about Solar Energy after completing your project?

9) What trends and relationships did your graphs show?

10) What was the most challenging aspect of your project?

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Learn, Create, and Inspire–Even on a Budget

Creating a project from scratch can be difficult for the casual builder. Finding the right directions, the right parts, and the right tools—all at the right price—can be a major hurdle.

At Brown Dog Gadgets, we've created kits and projects for creators of all ages and budgets. Follow our step-by-step project directions and learn more with our classroom resources or find individual parts to dream up your own creations. No matter how or what you create, our products can help you learn the basics of electronics, circuitry, and solar energy.

Find additional eBooks, crafting guides, videos, directions, and educational resources at BrownDogGadgets.com. Contact us for educational discounts and free professional development classes.

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