



Minnesota State Energy Center of Excellence

Energy Science Trailer

Special notes:

The Solar and Wind kits have many small pieces. We provide some large cookie sheets for you to use on your desks or tables to keep parts from sliding or rolling away. Please use these trays and emphasize to the students to use care and keep all the parts in each kit.

Also available in the trailer are some re-sealable bags in two sizes for keeping track of small parts. Please use these rather than putting many loose parts back in the boxes.

Solar Pathfinders:

The best resource for these is the company website: <http://www.solarpathfinder.com/PF?id=faklqjS7>.

On this web page you will find a video imbedded on the left side or you can go directly to this page for the video: <http://www.solarpathfinder.com/video/2?autostart=1>

A printable pdf that covers each section of instruction on it use can be found at this web page: <http://www.solarpathfinder.com/pdf/pathfinder-how-it-works.pdf> This makes an excellent instructional aid to go through each step of set up and how to read.

I have been told that viewing the video as an overview to start, then going through the steps as noted in the pdf, followed by a second view of the video helps to reinforce the lessons before going out to assess sites. Usually it is best to send students in groups of four to specific sites to do the analysis. An excellent activity is to have each group go through a series of sites, some good and some with shadows, so they can identify the barriers and compare their findings to other groups.

Wind Power 2.0:

This kit offers eight different kits that can be constructed. For our work, we will focus on just two, those being Wind Power with long blades and Wind power with short blades. The instruction booklet provides you with several basic lessons about wind energy starting on page 3 going to page 8. I also recommend viewing the video on our Energy Center webpage that shows building a large wind tower:

<http://energycareersminnesota.com/wind-turbine-construction/> This video shows what goes into constructing and erecting a large commercial grade wind tower.

My recommendation after the front lessons is to go to the construction pages 20-22 to build the windmill with long blades, 23-25 to build the short blade model. Depending on your class structure, you may desire to have half of the class build each model so you can run comparisons in your experiments. The strongest recommendation I can provide here is keep the group doing this step by step. There are many small pieces and it is very important to be sure you are identifying each part accurately as you build.

Once assembled you are now ready to run several different types of experiments. The first I like to talk through is the gear ratio information found on page 10. By shifting (sliding) the colored gears to change the ratio, students are able to see how slow blade speed can provide high generator speed that lights the LED. The reverse will show that high blade speed will not turn the generator fast enough to light the LED.

There are fans available for use in the trailer. Generally speaking, the box fan is best for creating an adequate wind source. Remember to secure the base of your tower before turning on the wind. A heavy book, a brick or some similar device seems to work best.

On page 17 of the manual you will find a table that helps illustrate the output of the various gear ratios using long blades and short blades. When using the short blades, you can also alter how many blades are used and configured to maintain balance.

You may also have interest in using the digital meter from the solar kits if you wish to measure output as you change configurations and wind speed.

Safety note: if using the generator to charge a battery, be certain you are using a rechargeable battery and the green battery holder. I recommend staying with the LED for maximum safety.

Solar Lab 1.0:

The company that created the kits we are using has some excellent resources for teachers on their website. I am specifically suggesting the SOLAR 101 page that has many tabs going to multiple resources. <http://store.sundancesolar.com/solar-101/> One sample lesson on this page is Understanding Energy and Power: <http://store.sundancesolar.com/understanding-energy-and-power-1/> There are many more so take some time to browse.

Another excellent resource is the National Renewable Energy Laboratory (NREL). You can get very deep into the technology through the resources available on their webpage: <https://www.nrel.gov/solar/>

Some basic videos: <https://www.youtube.com/watch?v=xKxrkht7CpY>

<https://energy.gov/eere/energybasics/articles/solar-photovoltaic-technology-basics>

For these solar kits, Scott Randall, faculty at Century College, has provided a short instruction sheet that is included in this package. Also provided is a pdf version of the manual included with the kits. There is

an abundance of possibilities you can explore if you have adequate time. I recommend starting with Scott's guide and build from there.

KEY POINT: The digital meter in this kit can be used for a variety of other lab exercises. Starting with Lab 2 in the manual, you are able to grow in complexity using the meters to test a variety of circuits, learning about polarity, and more.

Horizon Energy Box:

The Horizon Renewable Energy Boxes (FCJJ-40) provide a broad look at multiple areas of renewable energy. There are again multiple resources associated with this material. Some require you to create a login on their web page, others are open access. We also have resource CD with the kits.

<https://www.horizoncurriculum.com/chapter-1/1-1-introduction/> At this page you get the introduction chapter. When you click on to chapter two, you will arrive at a login page where you must create a profile. If you do so, you will have access to a variety of free STEM lessons that can be used with the kits or independently.

Another resource is the Science Education E-book: <http://www.horizeducational.com/wp-content/plugins/email-before-download/download.php?dl=73355ac8d5e86d3a08e322b6bebaa63e>

Horizon provides a User Manual for the Energy Box. I have it available in pdf format and am able to provide it ahead of your use of the trailer. In this box (there are six in the trailer) there are materials to do experiments and lessons on Hydrogen Energy, Wind Energy, Solar Energy, Bio-Energy, Mechanical Energy, Thermal Energy, Salt Water Energy, and Multi Energy Powered Car.

HYDROPOWER 2.0:

This experiment kite familiarizes student with hydropower. The manual and materials in the kit will help students learn how to use hydropower to produce electricity.

KILL A WATT meter:

These simple meters provide an excellent experiment on energy consumption. The meter can be plugged into any standard outlet. Then by connecting the appliance to be measured (i.e. refrigerator), the meter will measure the consumption of that appliance or device over a period of time. It records both the kilowatts used and the time of duration. These are an excellent activity to compare various appliances and devices around the school or home.

KIDWIND kits:

We only have a couple of these kits in the trailer. These offer a great opportunity to create an activity around blade construction, shape and size. This is truly one for students to imagine and get creative. The students can be given the assignment to create a set of blades to install on the turbine. They will need to consider weight of materials, shape, how many blades they wish to use, length of blade surface,

etc. We have seen “blades” made from paper cups, paper plates, tag board, wood, and more. This is quite a creative exercise, but also teaches concepts of “catching” wind to make it useful. Setting up a single turbine with the box fan will allow students to install their blades and test the output. A worksheet for this activity has been created by Melanie Waite-Altringer, biology faculty at Anoka Ramsey Community College.

Trailer mounted solar collector/converter:

This system is designed to function like a small cabin system would. There are eight solar panels (240 watts each) mounted to the trailer. Inside you will find the combiner box which contains six breakers. Only four are used in this system since 2 panels are combined to each circuit. From the combiner, current is directed to the Outback inverter system. This system provides the connection point that charges the storage batteries in the cabinets below. Also through this system we are able to convert the DC from the storage batteries to AC current to power the outlets in the trailer. If you have applications you wish to connect to the trailer, there are two cord reels mounted just inside the back door of the trailer that can be extended out to connect to your devices. All the power in this trailer is generated from solar so it is an excellent demonstration model of how a person could power an off grid home or cabin.

As a bonus, there is a popcorn popper included in the trailer. We recommend as your week is wrapping up with the trailer you take the time to pop some “solar popcorn” for your classes if time permits. Popcorn and bags are provided in the trailer.