BRIGHT HORIZONS™

Year 6 Students

HORIZON POWER

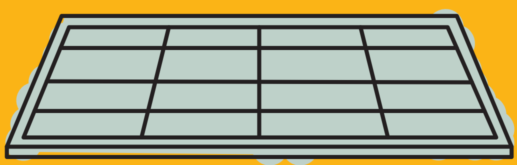
STAWA SCIENCE TEACHERS' ASSOCIATION OF WESTERN AUSTRALIA

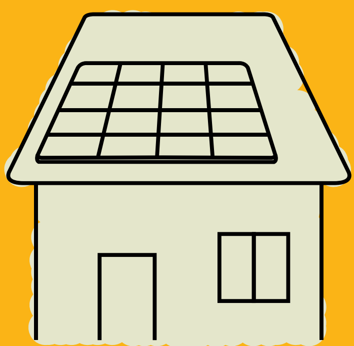
Name ______________________________

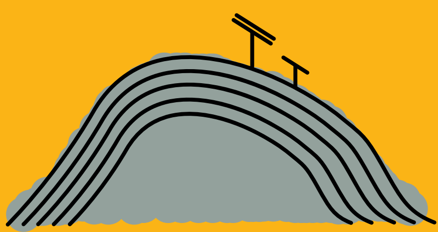
Horizon Power acknowledges the traditional custodians throughout Western Australia and their continuing connection to the land, waters and community. We pay our respects to all members of the Aboriginal communities and their cultures; and to Elders both past, present and emerging.

Acknowledgement

The following teaching and learning materials have been modelled on the STEM Learning Project resources template. The STEM Learning Project resources were produced by a consortium of STAWA, MAWA, ECAWA and Scitech under contract to the Education Department of WA.







Activities

Activity 1 Research

Solar electricity

Research solar panels and battery storage for community electrical energy needs.

Activity 2 Investigate

Investigating factors affecting the power output of solar panels

Conduct investigations into conditions that affect the electrical power output of solar panels.

Activity 3 Imagine & Create

What's the System?

Explore the design process and apply it to designing and building a model house or community with a 2.8 W solar PV system.

Activity 4 Evaluate & Communicate

My Model Solar House

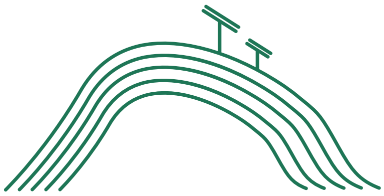
Demonstrate, test and evaluate the model solar PV system and house. Present your model and conclusions to an audience using multimedia.

Activity 1

Research

Solar Electricity

Research solar panels and battery storage for community electrical energy needs.



1. My country

Look around you.

What do you see? Make a list. You can use words and or pictures, paper or on the ground.

Form a yarning circle. One at a time share with others one thing you see. Continue in the circle so everyone gets a chance to add to the discussion. Keep going until you run out of things to add.

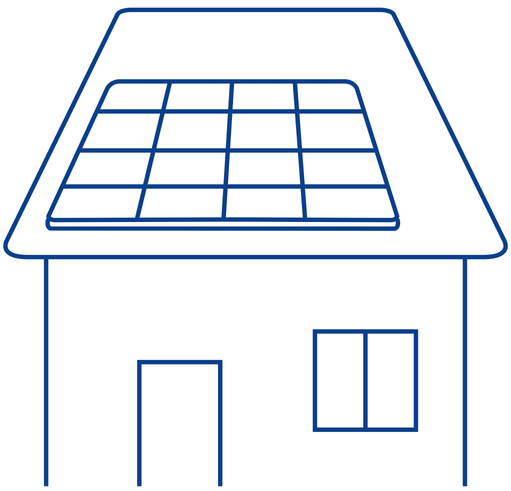
How big is your list?

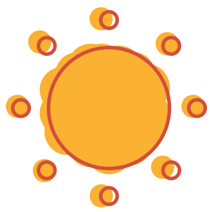
Narrow the list down to the most important 8 things. Create a tournament sheet from your list of 8 things. Each item will compete until we get a winner. The winner is what you think is the most important thing.

Round 1 you compare 1 and 2 and decide which is more important. The more import item wins and moves to round 2. Repeat for 3 and 4; 5 and 6; 7 and 8.

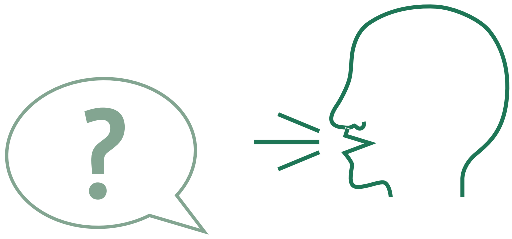
Round 2 you compare the winner of Round 1 [(1 and 2 with 3 and 4) (5 and 6 with 7 and 8)]

Round 3 you compare the winners of Round 2.





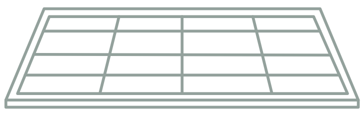
Item Tournament



Step back to Round 3: Which of the choices is the more important as a source of energy.

Tournament 2: Which energy source for electricity would be the best for your community and Country

- ☐ Diesel
- ☐ Solar
- ☐ Hydro electricity
- ☐ Wind
- ☐ Coal
- ☐ Geothermal



Activity 1

Exercises:

1. Energy Flow Diagrams

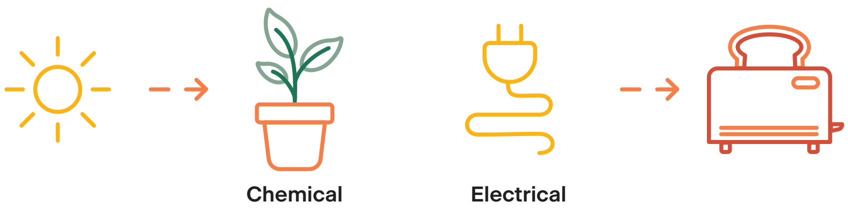
Energy from the sun is called solar energy.

The original source of **energy** on earth is the **sun**.

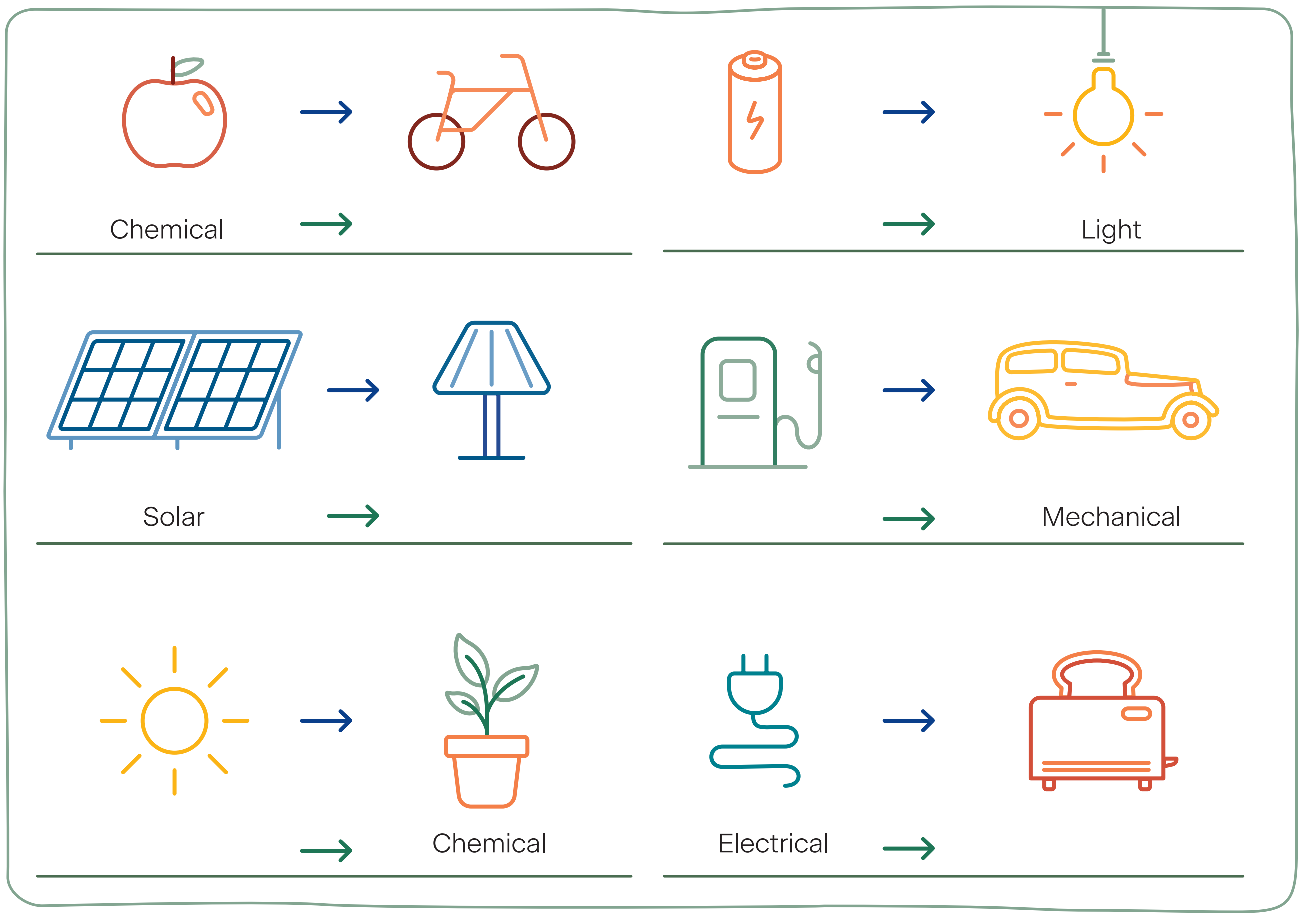
1. Draw an energy flow diagram to show how we get our energy from the sun.

The suns energy is transferred from the sun to the earth as light energy. Plants transform light energy from the sun into chemical energy stored in the food they make. Plants use the food energy they make to grow and reproduce. Animals rely on plants and other animals for their food. Our energy comes from the food we eat.

Diagrams can be used to show how energy is transformed from one form to another. An energy flow diagram uses arrows to show the energy changes. Arrows starts at one energy form and points to the new energy form showing the energy transfer and how it has been transformed. The diagrams below are examples of energy flow diagrams.



2. Complete the diagrams showing how one form of energy can be converted to a different form of energy.



Activity 1

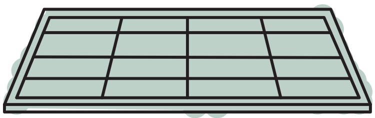
Exercises:

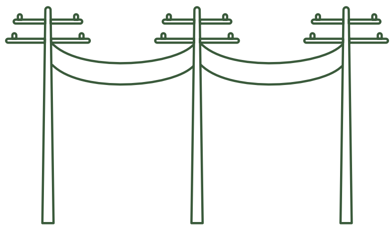
3. Where does your community get their electricity from?

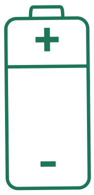
☐ **Take photographs of things related to electricity, such as**

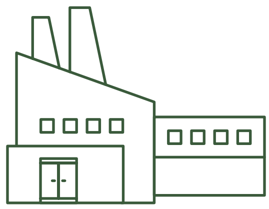
- Things that transfer electricity like power lines,
- Things that make electricity like solar panels, and
- Things that use electricity, like fridges and ovens

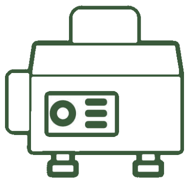
☐ **Tick the energy source or sources that provide your electricity?**

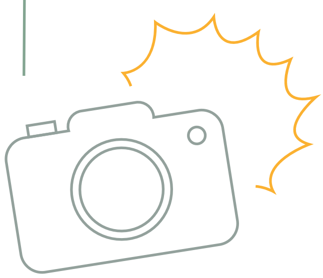
☐ 

☐ 

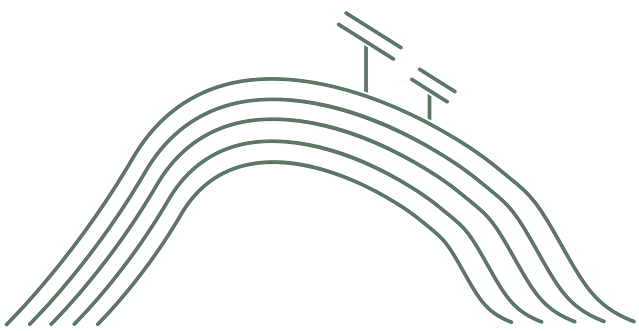
☐ 

☐ 

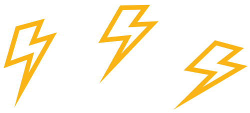
☐ 



Watch a video of how remote communities are powered:
https://bit.ly/3n8gxlA



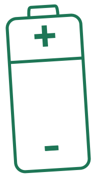
3. Electricity



Your body needs energy so that you can run around. Running is doing work. Where do we get the energy needed so that we can run?

For our body to do work it needs to be supplied with energy. We fuel our body with the energy stored in the food we eat.

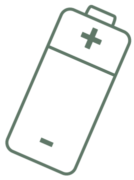
Energy is the ability to do work.



What is power?

Energy and Power are not the same, but they are related.
Power is the amount of energy used in a given amount of time.
Power has the unit's joules per second or watts. 1 J/s = 1 W.

Watch the video: *https://www.youtube.com/watch?v=1_KjuGNzxc*



Electrical energy is needed to do the work of running a fridge or a TV.
The basic unit of energy is the Joule, abbreviated to J.

A Joule is a small amount of energy, so the unit kilojoules (kJ) is used when we talk about larger amounts of energy. 1,000 J = 1 kJ

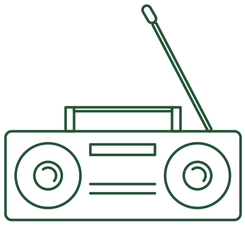
Machines and appliances are labelled with their wattage, how much power it uses in watts (W). For example, an 1,800 W hair dryer or a 10 W LED light bulb.

Question

Match the word with its definition:

Definition	Match the word to its definition by drawing a line between them
The ability to do work	Watt (W)
The amount of energy used in a given amount of time	Energy
The basic unit of energy	Joule (J)
The original source of energy on earth	Power
The unit of power	Sun

Activity 1

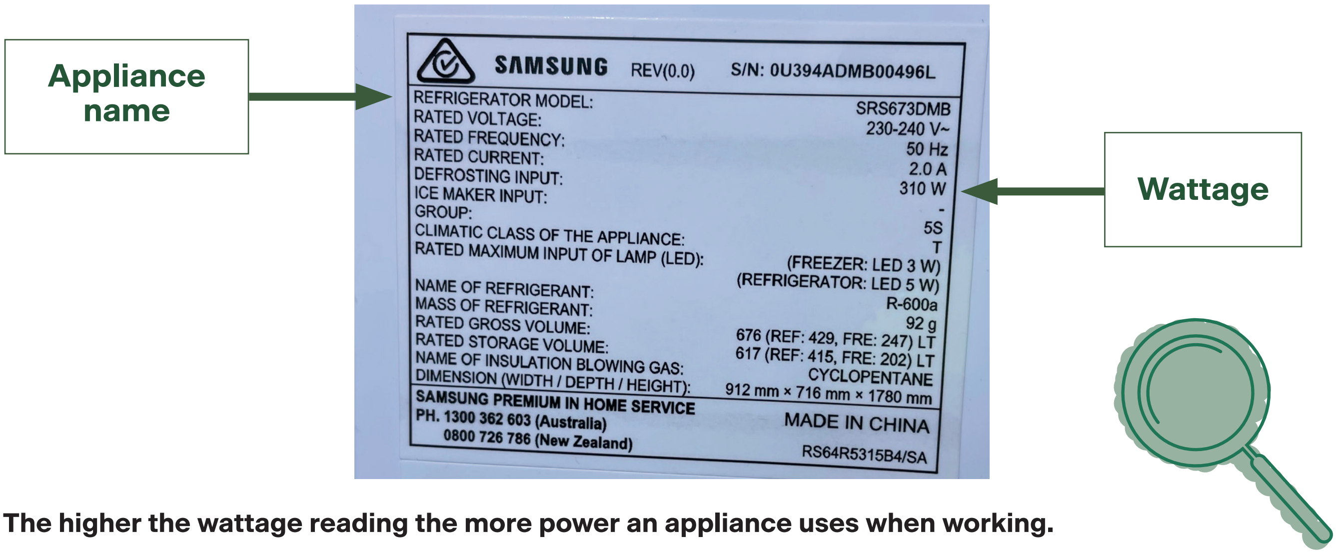


4. Appliance labels

Machines and appliances are labelled with their wattage, how much power it uses in watts (W). For example, an 1,800 W hair dryer or a 10 W LED light bulb.

For most appliances this information will be on a label similar to that in Figure 1.

Figure 1: Room Heater model and electrical label with its name and wattage pointed out



The higher the wattage reading the more power an appliance uses when working.

For example, a 2,000 W hair dryer uses more power than an 1,800 W hair dryer.

In the table below, photos of the Electrical labels of different household appliances are shown.

1. Complete the table by reading the labels and recording the name and wattage of the appliances.

<table>
<tr><th>Appliance</th><th>Appliance Name</th><th>Power</th></tr>
<tr><td>
</td><td></td><td></td></tr>
<tr><td>
</td><td>Television</td><td></td></tr>
</table>

Appliance	Appliance Name	Power
		
	Refrigerator	
		

2. Remember the higher the wattage reading the more power an appliance uses when it is working.

   a) Which appliance in your table uses the most power?

   ____

   b) Which appliance in your table uses the least power?

   ____

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3. Ask your teacher if you can take your own photos of electrical labels of different household appliances that you might have in the classroom.

Remember to be safe. Make sure the appliance is turned off and unplugged.

Activity 2

Investigate

Investigating factors affecting the power output of solar panels

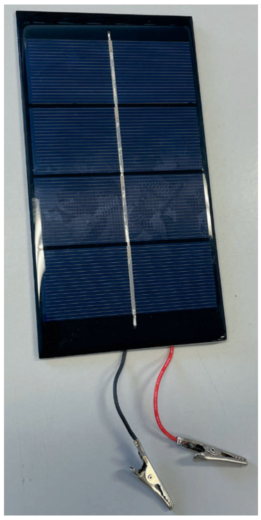
Conduct investigations into conditions that affect the electrical power output of solar panels.

5. Solar Electricity

Electricity from the sun is called solar electricity or solar power.

The sun radiates energy. Solar energy is light energy. We are very familiar with solar energy making us hot. Solar energy can be changed from light energy to heat energy. Plants change the suns energy into chemical energy, store it and use it as food. Solar energy can also be changed to electricity.

Solar PV panels transform solar energy into electrical energy.



Exercise 1: Connecting crocodile clips.

Connect a crocodile clip to each end of the insulated electrical wires coming from the solar panels. The wire can be soldered, or twisted and clamped, onto the crocodile clips. The photo shows a solar panel with crocodile clips attached.

Connect crocodile clips to your battery pack and solar panels.

Exercise 2: How to use a Multimeter

Be safe - only use the multimeter to test DC circuits. Never use them with AC, your home and school electricity.

Testing DC voltage:

- Plug in the red and black leads as shown in the photograph.
- Turn the multimeter on by moving the switch to the left 20 mark. This measures up to 20 volts.

Testing DC Current (Amps):

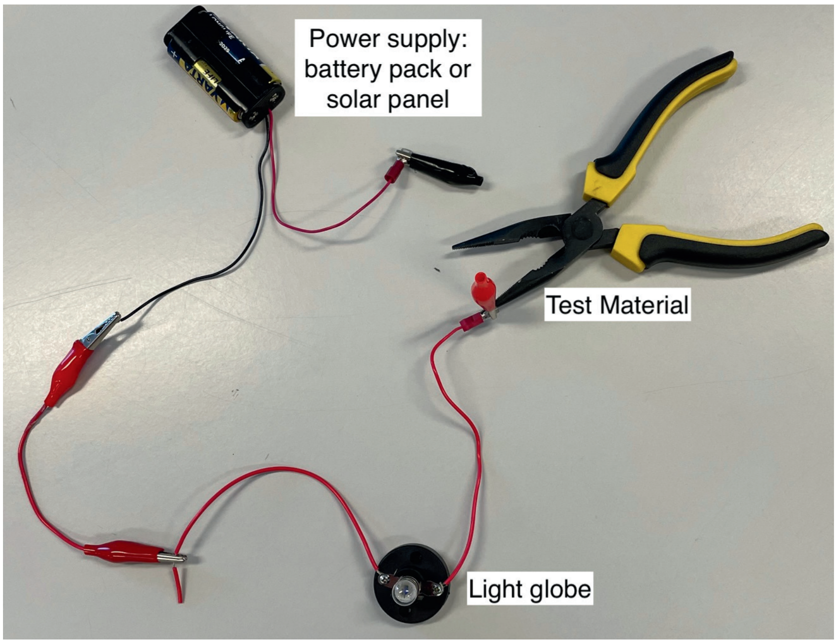
- Move the red lead to the 10 A hole. It is the spare hole above the position of the red lead shown in the photograph.
- Turn the switch to the right to the 10 A setting. This measures up to 10 Amps. For smaller current you can turn the meter dial back to 200 mA, and if your reading is still too small back further to the 20 mA setting.
- Always turn the multimeter off when not being used, especially when measuring current to avoid blowing its fuse.
- Always connect the multimeter in series when measuring current and in parallel when measuring voltage.

Experiment: Conductors and Insulators

Electrical power lines and household wiring and leads are made from a material that can conduct electricity. This is usually a metal like copper. For safety reasons, electrical leads and cables have plastic insulating material covering the conducting wire. An insulator does not allow electricity to flow through it.

Collect and set up the equipment as shown in the photograph.

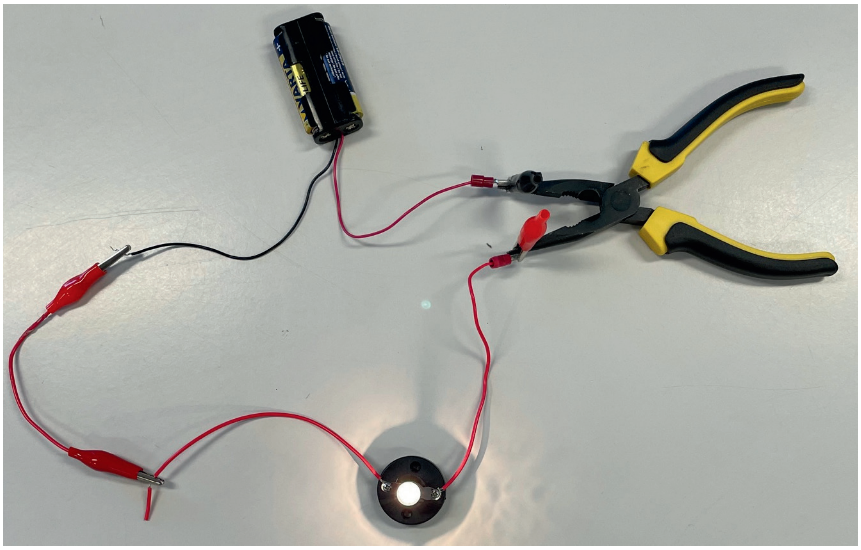
Set up:



Equipment:

- Solar panel as the power supply.
- Multimeter or battery pack to test the conductivity.
- Test materials: such as wood, a plastic rule, a rock, a leaf, charcoal, the different parts of a pen and pencil, plastic chair, metal (table or chair leg, drink can, bottle top, crocodile clip), cotton cloth, the floor tiles, different parts of a stapler, brick wall, white board to see which materials are conductors and insulators.

Activity 2



Use a battery pack or solar panel for power. Use multimeter set to read 20V or a globe as shown in the photograph to show electrical conductivity.

The conductors will allow electricity to flow through them and the multimeter will give a voltage reading or the globe will light up as shown in the second photograph.

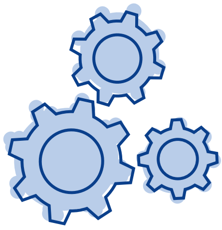
Safety notes:

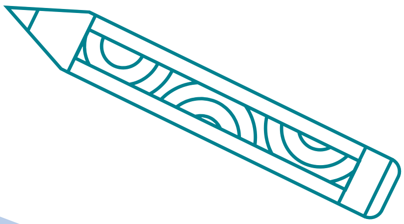
- **When outside in the sun ____________________________.**
- **Don't touch the light bulb as it will get ____________________.**
- **Disconnect the light bulb once you have made your observation, especially if it glows brightly.**
- **Always turn the multimeter off when not being used, especially when measuring current to avoid blowing its fuse.**
- **Always connect the multimeter in series when measuring current and in parallel when measuring voltage.**

Results:

Record your results in a table using the headings Conductors, Insulators.

Test Material	Voltage (V)	Conductor	Insulator
Steel Saw	0.40	YES	



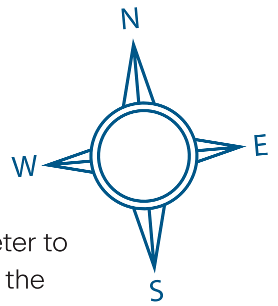


Experiment: Testing your solar panel

Equipment:

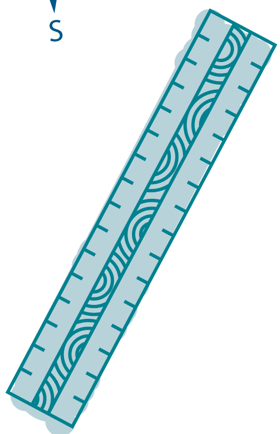
- ▢ Solar panel
- ▢ Multimeter
- ▢ Protractor
- ▢ Compass to measure direction
- ▢ A multimeter connected to solar panels
- ▢ A4 Sheet of card or paper
- ▢ Graph paper

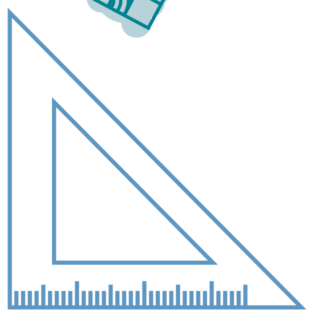
Activity 2

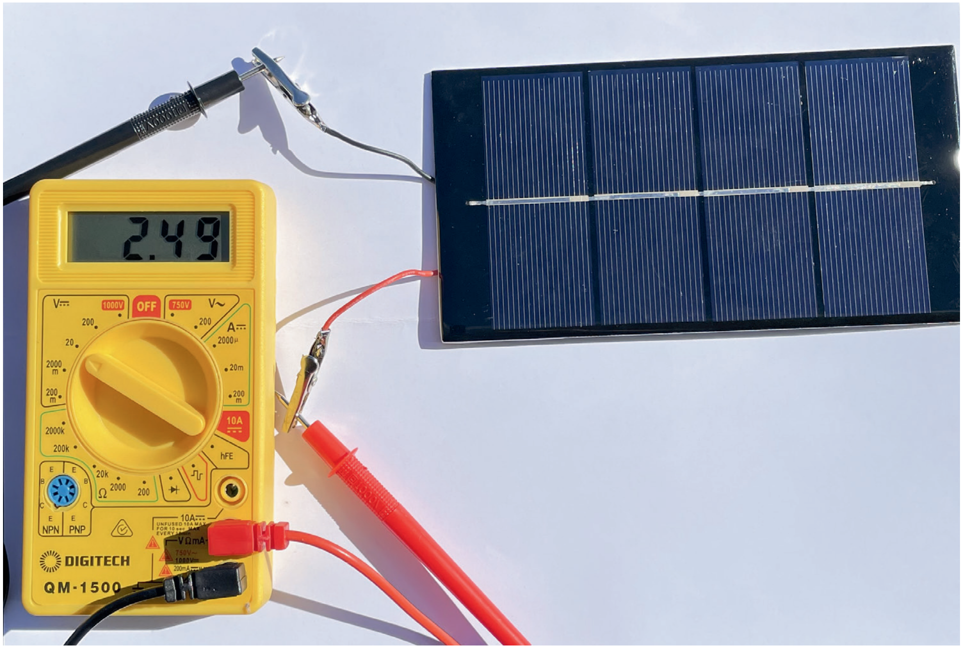


Set up

Set up your electrical circuit as shown in the photo. You will be using the multimeter to measure the voltage output of the panel. Set the multimeter to 20 V as shown in the photo. Record the voltage reading. The voltage reading in the photo is 2.49 V.

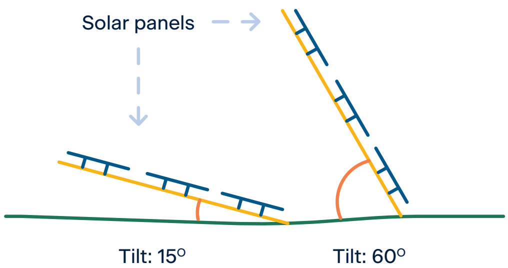






Circuit for testing voltage.

Test 1: Solar Panel Angle



Take your panel outside and set up the circuit. Face the panel towards the sun. Make sure you don't have any shade on the panel. Start with the panel lying flat on the ground. Move the panel by changing its tilt angle to the ground. Observe how the voltage output changes as you increase the panel angle. Describe what happens to the voltage reading.

Repeat your experiment but this time record the measurements of panel angle and voltage in a table.

Panel Angle	Voltage (mV)
0° (lying flat)	

Draw a graph of your results.

Panel angle on the horizontal axis and Voltage on the vertical axis.

Using your graph identify the angle that gave the highest voltage outpu. ______________________

Test 2: Solar Panel Direction

Take your panel outside and set up the circuit. Make sure you don't have any shade on the panel. Keep the panel angle the same for each direction you test. Record the time of Day.

With your teacher mark North, South, East and West using landmarks. For example, North (playground), South (office) etc.

Start with the panel facing North. Measure and record the voltage output. Record the results in a table.

Panel Direction Test Results: Time of Day ______________________

Panel Direction	Voltage (mV)
North	
East	
South	
West	

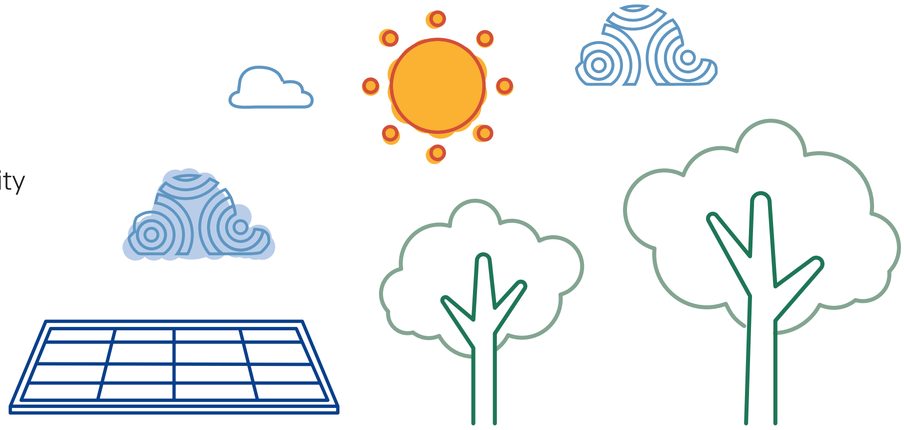
Which panel direction gave the largest voltage output? ______________________

Why do you think this direction gave the largest voltage output?

____

____

Activity 2



If you have solar panels in your community

- Are they on an angle?
- In which direction do they face?

Test 3: Solar Panel and Shade

Take your panel outside and set up the circuit. Make sure you don't have any shade on the panel. Keep the panel angle and the direction you face the panel the same for this experiment.

Use a sheet of paper or card to provide the shade. This is a little like clouds moving across the sky. Move a sheet of paper or card across the solar panel. As you gradually shade the solar panel observe the voltage output. Describe what happens to the voltage output as you increase the amount of shade.

Repeat this experiment. This time measure and record the amount of shade covering the solar panel and voltage output. Record the results in a table.

Solar Panel and Shade Test Results:

Amount of shade as a fraction	Amount of shade as a percentage (%)	Voltage (mV)
No shade	0%	
¼ of the panel in shade		
½ of the panel in shade		
¾ of the panel in shade		
All of the panel in shade		

How does shade effect the voltage output of the solar panel?

Why do you think shade has such a big effect on the amount of electricity produced by the solar panel (voltage output)?

If you have solar panels in your community

- Are there any trees nearby?
- If trees are nearby what time of the day will they shade the solar panels and reduce the amount of electricity being produced?
- If the solar panels get dirty and covered in dust will the dust effect the amount of electricity produced? Explain.

6. Looking after Solar Panels

The top of solar panels facing the sun are made mainly of glass. Glass is fragile and brittle. This means that it can break easily especially if hit.

Write a list of Do's and Don'ts that you need to teach people especially children in your community to protect them and your electricity supply.

Do

Don't

7. Multimedia Presentation

Create a video, power point, wall chart, story book or other multimedia presentation on one of the following:

1. Demonstrate and explain how to use a multimeter to measure DC voltage and current.
2. Demonstrate and explain how the amount of electricity is affected by the installation angle and direction that a solar panel faces.
3. Demonstrate and explain how the amount of electricity is affected by clouds.

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Activity 3

Imagine & Create

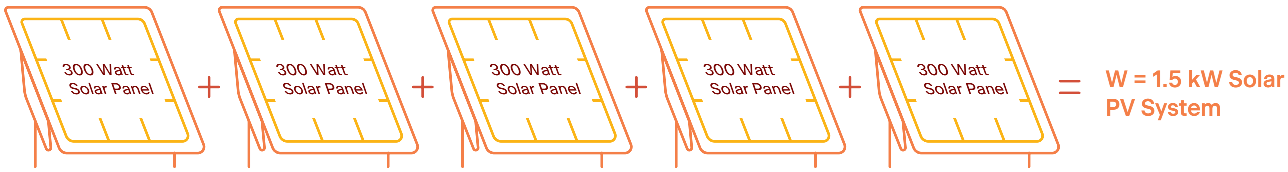
What's the System?

Explore the design process and apply it to designing and building a model house or community with a 2.8 W solar PV system. Use the mini solar panel provided in the Horizon Power school pack.

Background Information

Rooftop solar panels transform light energy from the sun into electrical energy. Solar panels can also be placed on the ground.

The figure below shows that when solar panels are connected in series their voltages add. The system of 5 panels each of 300 W add to give an output of (300 + 300 + 300 + 300 + 300) 1,500 W. This is called a 1.5 kW solar PV system.



Safety notes

- When outside in the sun ______________________________ .
- Don't touch the light bulb as it will get ______________________ .
- Always turn the multimeter off when not being used, especially when measuring current to avoid blowing its fuse.
- Always connect the multimeter in series when measuring current and in parallel when measuring voltage.
- Follow all safety instructions when using cutting tools such as scissors.

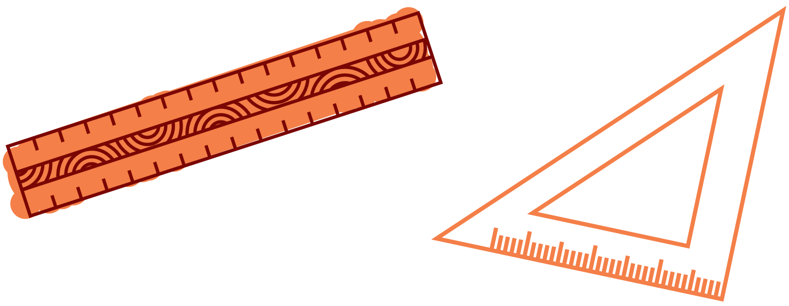
Materials – list the materials that you will use for your model

____

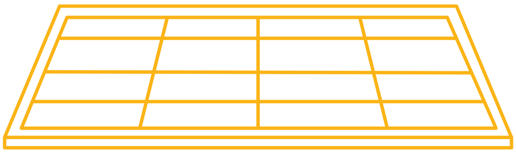
____

____

____



Activity 3



Planning

How many mini-solar panels do you need to create a 2.8 W solar system?

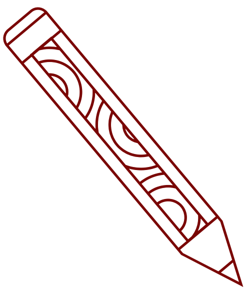
Using the Pm value on the solar panel label, calculate the number of mini-solar panels you need to create a 2.8 W system.

Working out:

I will need ____________ solar panels to build my 2.8 W system.

Construction plan

- the location of the panels
- labels and dimensions
- a circuit diagram for my solar PV system and house/s



Design and build a model solar powered house

Design and build an approximately 2.8 W rooftop or free-standing solar PV system using the mini solar PV panels. You can use the house cut-outs sheets provided or supply your own materials to build your model house.

Your model needs to be wired to your solar system and be able to light up a globe and any other devices that you care to fit into the house.

Checklist of model house inclusions:

Must have Item	Check
2.8 W rooftop or free-standing solar PV system	
Electrical Circuit connecting the solar system to a switch and globe	

Optional Items that I have included	Check

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Activity 4

Evaluate & Communicate

My Model Solar House

Demonstrate, test and evaluate the model 2.8 W solar PV system and house.

Evaluate your results and present your model and conclusions to an audience preferably using multimedia.

Create a video, power point, wall chart, story book or other multimedia presentation to

- demonstrate how the mini solar panels were connected to create a 2.8 W solar PV system,
- explain how the system provides electrical energy to the electrical circuit built into the model house,
- describe any challenges and successes you had in designing and build your model, and
- provide advice that would help other students wanting to create a similar model.

Notes

Sticker Here

Notes

www.horizonpower.com.au/BrightHorizons

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APPROVED ARTWORK SIGN OFF Year 6 Remote Schools Energy from Country_FA

Client	HORIZONS
Job Number	HOPOPW0043
Date	10/08/21
Version	FA

Please check and initial your internal approval:

Engagement Team	Copy	Design/ Art Direction	Producer	Studio
any changes	any changes	any changes	any changes	

WUNDERMAN THOMPSON