# Solar Power

Go to the **SELF BUILD** house. We are using the sun's energy in *three* different ways here. What are they?

Which direction is the side of the house with the conservatory facing?

Sketch the house, writing notes to show how it uses solar energy.

Go to the **SOLAR WATER HEATING** display. First go into the open building with the sinks and try the water. You might need to run the tap for a bit to get rid of the cold water in the pipe.
This water is only heated by the energy from the sun falling on the panels on the roof.
How hot or cold is the water from the hot tap right now?

How sunny has it been today?

Was it sunny yesterday?

How many people do you think have tried the tap before you today?

What time of year is it?

Is it sunny or cloudy right now?

Does the temperature of the water seem high or low, given the weather?

.Draw a diagram to show how the water goes round the system in a house when it is sunny. Include the panels on the roof in your diagram.

Is there a suitable place on your home to put solar water heating panels? If so, where and why?

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Go to the main display of solar electricity (check on your map to see where it is).

Solar cells are called photovoltaic cells (PVs for short).
What do they actually do?
Look for the Solar Pump. This has 5 panels of solar cells. They produce electricity and that runs the pump. In a real situation it would probably be used in a dry area to pump water up from underground for people to use. Here it is just pumping water round and round to show how it works.
Is it pumping water at the moment?

Would you expect it to be, given the weather, time of day and time of year?

If the pump is working, put the clouds over the panels.
What happens and why?

What happens if you only put some of the clouds over the panels?
Look up at the roofs of the buildings around you. One of them is covered with solar cells. These solar cells can produce 13kW of electricity.
13kW is the maximum that they will produce. Sometimes they will produce less than this and sometimes they will produce nothing.
When do you think they will produce the most? (what season of the year and what time of day).

When do you think they will produce nothing?

# Solar heating – water and buildings

Go to the **SOLAR WATER HEATING** display. First go into the open building with the sinks and try the water. You might need to run the tap for a bit to get rid of the cold water in the pipe.
This water is only heated by the energy from the sun falling on the panels on the roof.
How hot or cold is the water from the hot tap right now?

How sunny has it been today?

Was it sunny yesterday?

How many people do you think have tried the tap before you today?

What time of year is it?

Is it sunny or cloudy right now?

Does the temperature of the water seem high or low, given the weather?

Look closely at the panels on display. One has a cut-off corner so that you can see what it is like inside.
Look at the little metal panels that you can feel, with displays above them to show the temperature of each. Look at how they are different from each other.
Write down the temperatures –
*white metal* *black metal* *black & insulated* *black, insulated & glazed*

Why is the colour black important?

What does the insulation at the back do?

What does the glazing on the front do?

Why is there reflective foil behind the pipes on many of the panels?

Draw a diagram to show how the water goes round the system in a house when it is sunny. Include the panels on the roof in your diagram.

What are the good things about using the sun to heat water?

Is there a suitable place on your home to put solar water heating panels? If so, where and why?

Go to the **SELF BUILD** house. Which direction is the side of the house with the conservatory facing?

We are using the sun's energy in *three* different ways here. Sketch the house, writing notes to show how it uses solar energy in these three ways.

# Solar Electricity

## Solar cells – Photovoltaics - PVs

Go to the main display of solar electricity (check on your map to see where it is).
Remember electricity is measured in Watts (W) and 1000W is called a kilowatt (kW).
Solar cells are called photovoltaic cells (PVs for short).
What do they actually do?

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All the solar cells around here are facing the same way.
Which direction do you think they are facing?

Why do they face this way?

Look around at the sky. What sort of weather is it?

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Look for the Solar Pump. This has 5 panels of solar cells. They produce electricity and that runs the pump. In a real situation it would probably be used in a dry area to pump water up from underground for people to use. Here it is just pumping water round and round to show how it works.
Is it pumping water at the moment?

Would you expect it to be, given the weather, time of day and time of year?

If the pump is working, put the clouds over the panels.
What happens?

Why?

What happens if you only put some of the clouds over the panels?

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Find the case with the butterfly model in it.
Where is the solar electricity cell that should make the butterfly move?

Pull down the handle on the right of the display and observe what happens in the case. Explain what's happening (or not).

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Look at the display panels with information about solar electricity. Look for the picture of a house in Oxford which has solar cells on its roof.

How much did those solar cells cost?

That house in Oxford also uses solar energy in other ways. What other ways?

What would these other ways cost?

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Look up at the roofs of the buildings around you. One of them is covered with solar cells. These solar cells can produce 13kW of electricity.
13kW is the maximum that they will produce. Sometimes they will produce less than this and sometimes they will produce nothing.
When do you think they will produce the most? (what season of the year and what time of day).

When do you think they will produce nothing?

Behind the restaurant there is a control room with a large window. Inside there you will see a computer screen which gives all sorts of information about the solar roof. At the bottom of the screen in the middle there is a little box labelled "overall output power (kW)". If, for example, it says 6.50 then the roof is producing half of what it could do.

How much did this roof cost?

What other ways do we use here at CAT to produce electricity?

# WIND POWER

Take a walk round the Centre.....follow the arrows. On your way count how many windmills you can see. Notice whether they are turning or not.

Think about these questions. What three jobs can windmills do? Think of a farming area some hundreds of years ago.....an area short of water....and a place with no electricity.

When it generates electricity a windmill is often called a wind turbine or aerogenerator. Near the restaurant there are steps which lead up the bank to a platform where you can see a 600kW wind turbine. This belongs to the Centre but the electricity goes into the grid. In a very windy position a wind turbine that size would produce enough electricity for 500 homes.

Now go to the wind power display.
In the middle of the wind power display there is a telescope through which you can see the wind turbine up on the hill which produces a lot of the Centre's electricity. This is a 15kW turbine, called a Polenko. Is it turning?

Try the windseat. Can it lift you up today?
Where does the force to lift you on the seat come from?

How would you describe the wind today – very strong, strong, weak, none?

If it's blowing at all, which direction is it coming from?

We have put lots of windmills down here so that people can see them properly and touch them. Look again at the windmills that are turning. Some of them will probably be turning around, changing their direction all the time. This isn't very good for producing power. Look for some which are facing the same way all the time.
What can learn from this about where you should (or should not) put windmills?

Look at the signs in the display.
Draw and label diagram which shows you how a windmill to generate electricity works.

Look at the really big windmill with the blade that looks as though it is buried in the ground. This is just the top of a big wind turbine. We were given these bits but we haven't got the tower. Have a look inside to see what all the different bits are. Do you understand what they all do?

Look at the smaller machines down in the display. There is one with 3 white blades down on your level. On the tail it says it is an Aerogen 5. Have a good look at it and think about what would happen when the wind blows (if it wasn't tied to the railing so that it can't spin round and hurt anyone).
Explain step by step what would happen.
The wind blows……

…….electricity travels through the wires to be used in houses and offices.

Why does the wind turbine have a tail? What does it do?

Could we get much of our electricity from windpower in Britain?

What sort of places could we put them? Where will the strongest winds be?

Is it fairly cheap or expensive to make electricity with the wind?

After about 25 years a big windmill will be worn out and will have to be taken down. What do you think would be left on the site after it has gone?

What do you feel about windmills? Would you like to see more of them in Britain? Why?

# WATER POWER

Go to the **POWER HOUSE** (near the lake).
Make notes and sketches of the large turbine inside. Describe the flow of water from the source (a reservoir up the hill) down to the river in the bottom of the valley.
Use these words to help you -
rain, reservoir, 30 metre fall, pipes, pelton wheel, force of water, generator, electricity

If the turbine is running today, find out how many kilowatts it is generating.

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In the Power house you will also find the model to show how a Pelton wheel works.
Turn on the water jet so that it makes the model Pelton wheel spin.
Make a sketch of it. Note exactly where the water hits the wheel.

Is it the weight of water or the force of the water that is making the wheel spin?

You can feel the force of the wheel turning in its shaft. Hold it and see if you can stop it.

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Here at CAT over half our electricity comes from water power but in Britain about 2% of electricity comes from water power. Find a picture of the sort of large water power system that produces electricity and try to draw it.

Go outside and look at the other turbines and propellors by the lake.
Using the descriptions on the wall inside the power house, draw and label two types other than the Pelton wheel.

Go through the wind display to the **WAVE POWER** machine.
Make some electricity, without wetting yourself and your friends too much.
Describe how the machine uses the energy in the waves to make electricity. (a clue... air pressure is involved somewhere).

In what sort of place would you find an actual wave power system?

What makes waves happen in the sea?

Look at the sign. Where is there a full size wave power system in Britain which provides electricity for people to use?

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There is another type of water power which we could use in Britain – tidal power.
What makes the tides come and go?

Where would tidal systems be put?

# Buildings

Walk all round the Centre looking at buildings.
Various different materials have been used over the years.

For building walls they include slate blocks quarried on this site, wood, bricks, straw, earth
Roofs use Welsh slates, wood, grass and metal
Insulation in walls and roofs is wool, warmcell (shredded up newspapers), straw, (and fibreglass and foam in older buildings).

Look at these buildings and write down the materials that have been used in each:

The shop and information centre

The restaurant

The theatre

The top railway station

The self-build house

Here, when we choose materials to build with, we think about a number of things:

They should be made as near to here as possible so that we don't use too much energy in a lorry moving them

They should use as little energy as possible to make

They should not be unhealthy for the builders or for the people who use the buildings

They should be renewable – not made from something that will run out.

Some of the buildings are 25 years old and ideas about what materials we should use have changed in that time.

Why do you think we have used the following materials?

Wool

Straw

Wood

Earth

Slate

Two of the buildings on the site have been designed so that solar energy can come in through windows to heat the building up (this is called passive solar heating).
Which buildings are they?

Draw a sketch of one of them to show how it does this.

# Changing places

The Centre for Alternative Technology (CAT) opened on this site in 1975.
The site had been empty for about 20 years and before that they quarried slate here.
What does that mean? What happened here?

As you came up to the site you climbed up a slate tip. This was all the bits of slate that they couldn't sell because they didn't come out of the ground in useful shapes or sizes, so it was all tipped into a pile that gradually grew bigger as they tipped more and more off the edge.
We still make use of that slate that was rubbish to them. Look around you for it and describe what we use it for.

Look closely at some pieces of slate. How would you describe it? Why do you think slate was used on roofs?

The slate Quarry opened here in about 1830. In those days they didn't have electricity to use to run equipment. They used one of the sources we use now but they used it directly to turn saws to cut the slate. Which source do you think it was? You can see part of the system out beyond the restaurant, near the solar electricity display.

Two large buildings near here were originally part of the slate workshops.
What is in one of those buildings now?

In the past the slate which was in useful sizes was taken off to be sold on a little railway which went across the site and down the slate tip, near to where our railway is now.
Go and stand on the railway platform and look out. From here you can see where the old railway went. Describe (or draw) where it went.

In those days it was the weight of the slate, not the weight of water which moved the carriages down the hill.
Working in the slate quarry could be dusty, unhealthy and dangerous.
Look at the first picture under the veranda of the station facing the lake. This is what this place was like before CAT was developed. How would you describe it?

What is now the whole flat area of the site had been an uneven valley. As they tipped the waste slate they filled up the hollows so that they would have a convenient flat area to work on.
We have planted lots of trees on the site but some trees and other plants had just started growing here on their own before that. Look around. Which ones do you think grew on their own?

Go to the lawn in the middle of the garden. (When you come out of the molehole it is in front of you). We found that here the slate was quite a thin layer and that underneath there had been a field which was farmed some time before 1830 and perhaps for hundreds of years before that.

Places and landscapes change, partly because of what people do.
How would you like your own place (city, town, village, street, school) to change in the future?

# ORGANIC GROWING

Following the arrows, walk round the whole site.

Then go through the **MOLE-HOLE** (slowly enough to really appreciate it) to the start of the garden.
The problems gardeners have to deal with are dealing with the weeds and pests which eat the plants and feeding the soil.
Why are all the creatures in the soil important?

What happens to these creatures when pesticides are sprayed on the plants and soil?

What do the words ‘organic growing’ mean to you?

Have a look at the **PEST CONTROL** display.
What animals and insects are useful to a gardener? (especially predators)

Did you discover any ways that you can get rid of pests, such as slugs and greenfly, without poisoning them?

Have a look at the **COMPOST BINS** in the display. Choose one and make notes and sketches so that you can make one at home or school.

All the things put into the compost bins will rot. Lots of different organic material is being made into compost....perhaps some things you didn't expect. Make a list of at least *six* things you can recycle into compost.

What things did you find surprising?

What normally happens to these things? (You can find this out by looking at the **Whole Home** display in the house).

Go and look at the displays about gardening and rubbish in the **Whole Home.**

What are the main differences between organic and non-organic growing?

What are the great dangers for the future if we carry on chemical farming?

We have several **PONDS** on site. Find one of them.
Spend some time near it....very quietly.
What do you see? What do you hear?

Finally, how can you plan a garden so that it attracts wildlife?

# ENERGY CONSERVATION

Take a walk round the Centre, following the arrows.
Go to the building with the Shop and Information Centre. This building has been designed to keep heat in and stop it from escaping quickly.
Look at the windows. What type of windows are they and why have they been used?

In the Information Centre you will find a little “window” which lets you see inside the wall.
What is the wall filled with?

This is insulation in the wall. How does insulation work?

Why do you think this material has been used here?

Go to the **SELF-BUILD DISPLAY**, next to the wind/sun phone box and look at the type of insulation that is displayed there.
What is it made from?

Now go into **THE WHOLE HOME** display inside the house nearby.
What is special about the way this house has been built?

Explain how you could insulate your home on the inside. Use drawings to help you.

What other parts of your home could be insulated?

Where might you find draughts in your house?

How can you save electricity at home? What electrical gadgets are left on when they don't need to be?

What electrical gadgets could we live without quite comfortably?

How can you save energy when you are cooking?

What other ways can you save energy in the kitchen?

Name *six* quick things you can do in your home to save energy.

Then think about your school.

How could you save energy in transport? How can you reduce your family's use of the car?