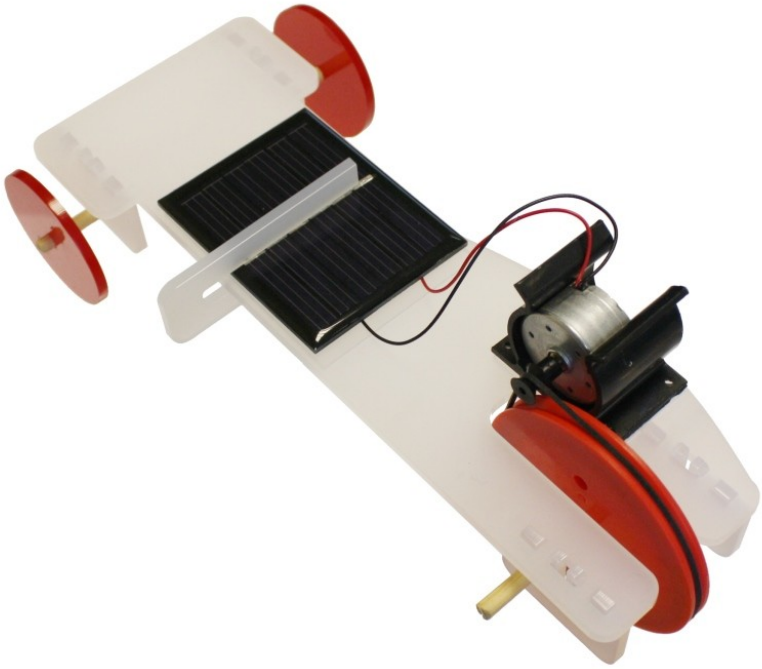
Kitronik

TEACHING RESOURCES

INTRODUCTION TO RENEWABLE ENERGY
UNDERSTANDING SOLAR CELLS
MODIFYING YOUR BUGGY
HOW TO SOLDER GUIDE

EXPLORE SOLAR POWER WITH THIS

SOLAR POWERED BUGGY



Version 2.2

Index of Sheets

Introduction

About the project kit

Both the project kit and the supporting material have been carefully designed for use in KS3 Design and Technology lessons. The project kit has been designed so that even teachers with a limited knowledge of electronics should have no trouble using it as a basis from which they can form a scheme of work.

Using the booklet

The project is designed to be used as a focused practical task that can pull in other aspects such as using solar cells, renewable energy and pulleys. The booklet is designed to be printed out as classroom handouts. In most cases all of the sheets will not be needed, hence there being no page numbers, teachers can pick and choose as they see fit.

Please feel free to print any pages of this booklet to use as student handouts in conjunction with Kitronik project kits.

Support and resources

You can also find additional resources at www.kitronik.co.uk. There are component fact sheets, information on calculating resistor and capacitor values, puzzles and much more.

Kitronik provide a next day response technical assistance service via e-mail. If you have any questions regarding this kit or even suggestions for improvements, please e-mail us at:

support@kitronik.co.uk

Alternatively, phone us on 0845 8380781.

Renewable Energy

Renewable energy is becoming more important as our demand for energy grows, while, at the same time, traditional forms of generating power such as coal, gas and oil are a finite resource. Once these are used up, they will be gone forever. A renewable energy source is something that is naturally occurring and can be replaced.

Types of renewable energy include:

Solar

Solar energy is energy generated from sunlight. Applications of solar energy include generating power by turning the sun's rays into electricity by using a solar cell and by heating water, which can then be used for showers, baths or for heating radiators.

Wind

Wind power is energy generated from the wind. Normally the wind is used to turn a wind turbine. A wind turbine looks like a large windmill, which rotates when the wind blows on it. This is then used to turn a turbine that turns the rotating movement into electricity. Often a number of wind turbines are located near each other in what is known as a 'wind farm' that can generate enough electricity to power a few thousand houses.

Hydroelectricity

Hydroelectricity uses the power of water falling to generate electricity and is one of the most widely used forms of renewable energy. The force of the water is used to turn a turbine, which generates electricity. Most hydroelectric power plants are created by damming a river and then using the force of the dammed water to turn a turbine.

Tidal

Tidal power is another form of hydropower. Instead of using the power of falling water to generate electricity, it uses the movement of water due to the tides to generate energy. There are currently a lot of different designs for tidal energy devices that are coming into use but they all use the force of the water in some way to turn a turbine, which generates electricity.

Geothermal

Geothermal power comes from heat energy that is stored within the ground. Geothermal power plants are often located near tectonic plate boundaries where there can be large sources of geothermal heat created as two tectonic plates meet. Normally, some form of 'heat engine' is used to convert the heat in to electricity. Sometimes the geothermal heat is used to simply heat water, which can then be used to heat homes and businesses.

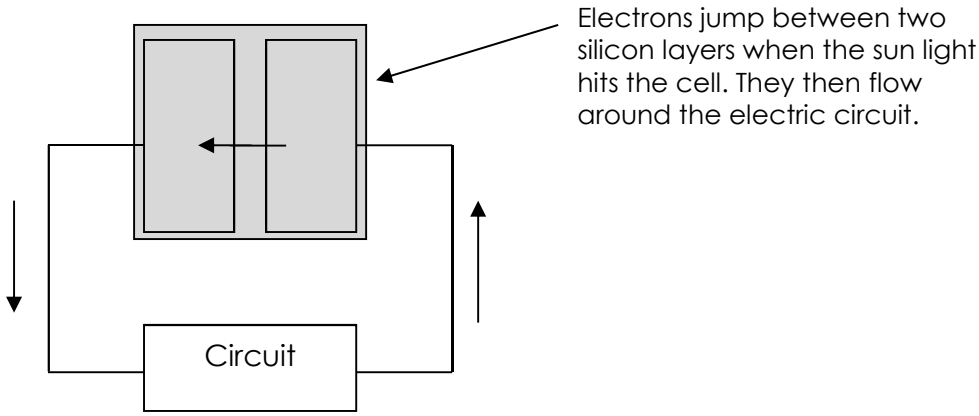
Bio fuels

Bio fuels are fuel sources that are derived from some form of biological mass (plants). They are renewable because the plant from which they are created can be re-grown and replaced. Bio fuels can be used to power cars and other vehicles and can be used to power generators, which can be used to create electricity.

How Does a Solar Cell Work?

A solar cell (sometimes known as photovoltaic cells) is a device that converts light from the sun into electricity that can then be used to power other electronic devices.

Most solar cells are made of silicon. The silicon is separated into two parts and each part has another chemical added to it. This is called 'doping'. When sunlight hits the solar cell it causes electrons to 'jump' between the two doped parts of silicon. The direction the electrons 'jump' is always the same as this is controlled by the way the two parts of silicon are doped. It is this constant flow of electrons that we think of as electricity.



The sun generates a lot of energy but not all of this can be converted into electricity by the solar cell. The amount of the suns energy that can be converted into energy is determined by the efficiency of the solar cell. A typical solar cell may have an efficiency of 12%. This means that if 100 Watts of light energy fell on a solar cell it would generate 12 Watts of electrical energy.

Electrical power (in Watts) is given by:

Power = Volts x Amps

The solar cell in the buggy uses a cell that produces 3V and 100mA. Therefore in perfect conditions it produces:

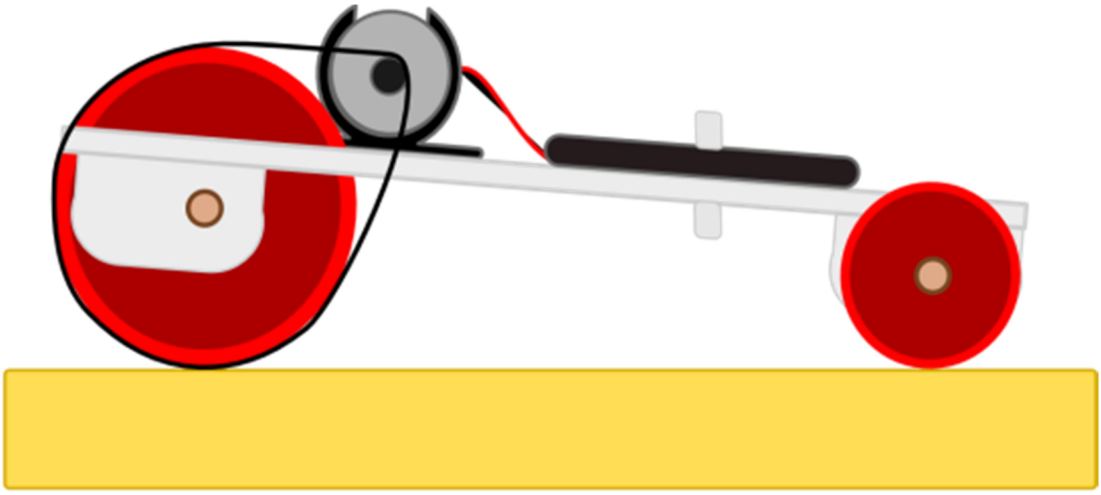
3V x 0.1A = 0.3 Watts.

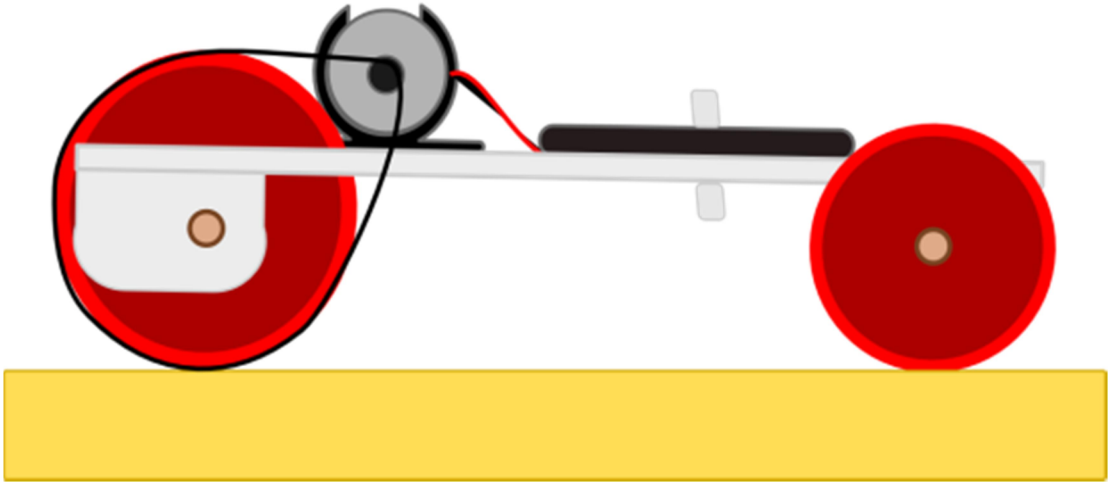
Modifying the Buggy

There are many modifications that you can make to your solar buggy that will impact its performance. Two examples are listed below.

One simple modification wold be to alter the size of the back wheels. You can make different sized back wheels and see how the performance changes. These can be laser cut or made from corrugated card if a laser is unavailable.

What effect does the size of the back wheels have on the angle of the solar cell?
Why are solar cells usually 'tilted' and not flat to the ground?
What impact does it have on the weight of the buggy? By extension what does this mean for the current required to start the buggy?

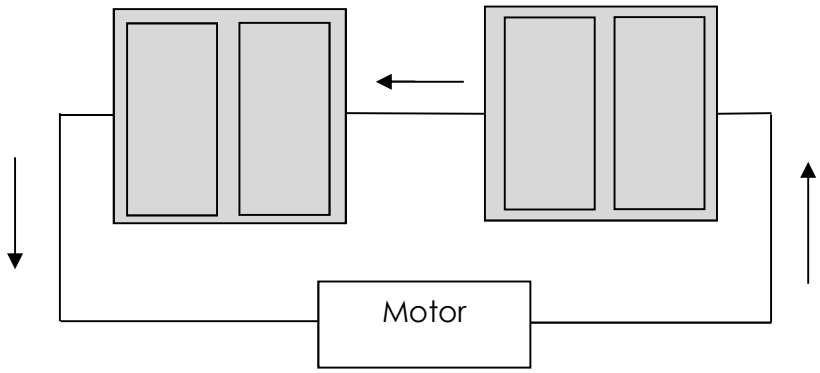




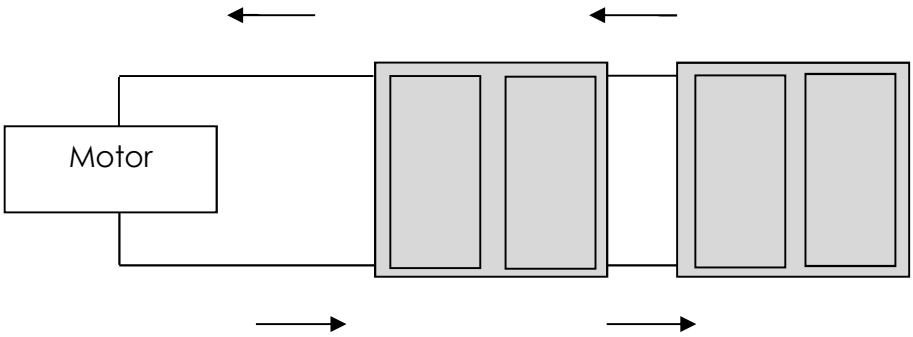
Modifying the Buggy Continued

A second solar cell (purchased separately) can be attached to the buggy with double sided tape or blue tack. This will potentially double the power to the motor. There are two ways to wire the second cell, demonstrated below.

Series



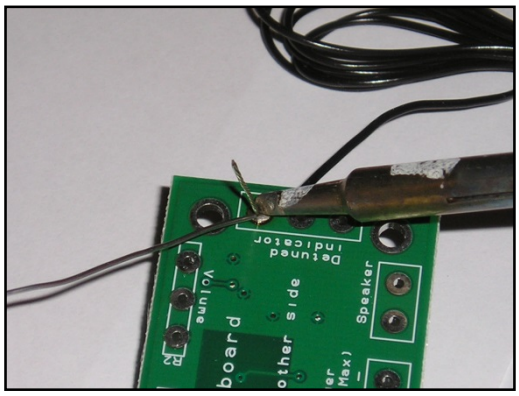
Parallel



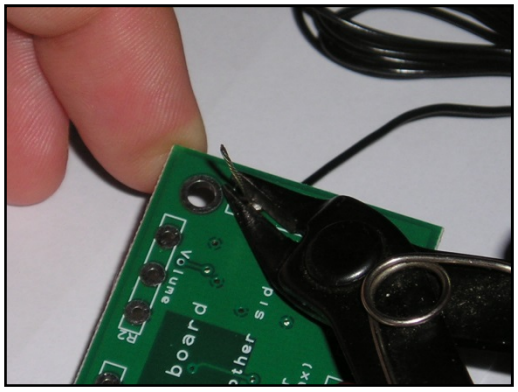
Assuming that the same amount of light is falling on both cells, wiring them in series will double the voltage supplied to motor whereas wiring them in parallel will double the current.

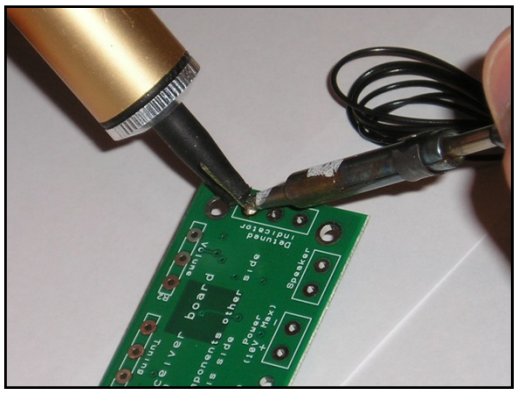
Wiring them in parallel will allow the buggy to work in lower light levels, whereas wiring them in series will increase the maximum speed but only in good lighting conditions.

Soldering in Ten Steps

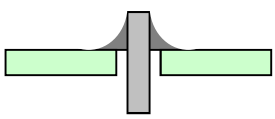


1. Start with the smallest components working up to the taller components, soldering any interconnecting wires last.
2. Place the component into the board, making sure that it goes in the right way around and the part sits flush against the board.
3. Bend the leads slightly to secure the part.
4. Make sure that the soldering iron has warmed up and if necessary, use the damp sponge to clean the tip.
5. Place the soldering iron on the pad.
6. Using your free hand, feed the end of the solder onto the pad (top picture).
7. Remove the solder, then the soldering iron.
8. Leave the joint to cool for a few seconds.
9. Using a pair of cutters, trim the excess component lead (middle picture).
10. If you make a mistake heat up the joint with the soldering iron, whilst the solder is molten, place the tip of your solder extractor by the solder and push the button (bottom picture).

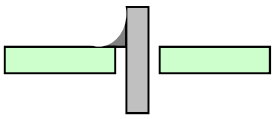




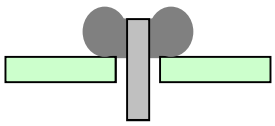
Solder joints



Good solder joint



Too little solder



Too much solder

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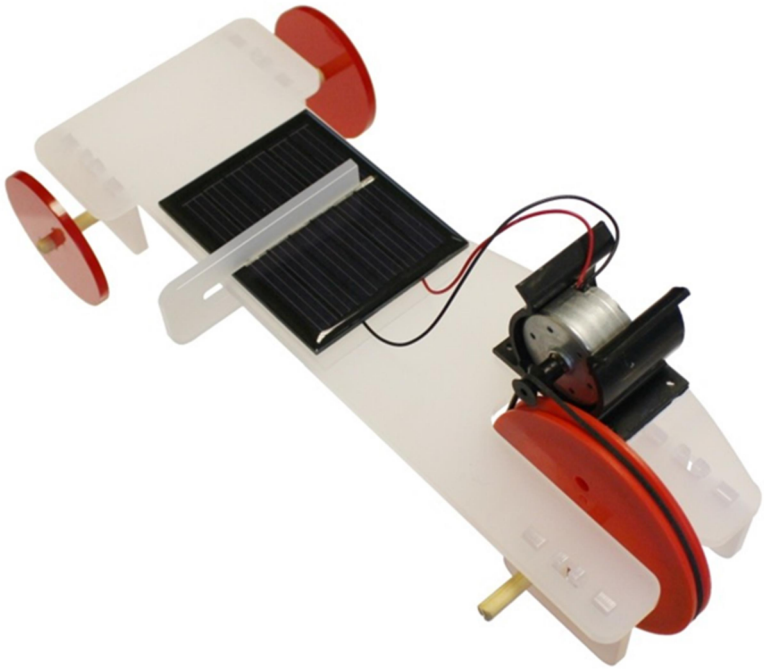
ESSENTIAL INFORMATION

BUILD INSTRUCTIONS
HOW THE BUGGY WORKS

EXPLORE SOLAR POWER WITH THIS

SOLAR POWERED BUGGY



Version 2.2

Solar Powered Buggy Essentials

www.kitronik.co.uk/2153

Build Instructions

1 INSERT REAR CLIPS

Push the rear two clips into the base of the buggy, these have centred holes so can go either way around. They do have to go on the correct face of the buggy, see the image right.

2 ATTACH MOTOR CLIP

Remove the plastic backing from the black motor clip to reveal the adhesive foam. Look for the small rectangular outline etched onto the buggy and stick the clip on.

Make sure that you stick it to the opposite side to the side you pushed the clips through. Look at the picture right if you are unsure.

3 PREPARE THE FRONT WHEEL

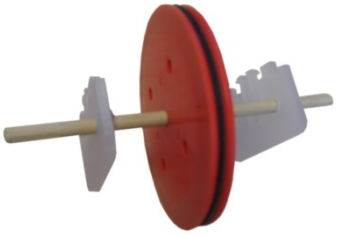
Put the rubber band around the big red wheel, it will fit into the recess in it.

4 PREPARE THE FRONT AXEL

Push one piece of the dowel through the big wheel. If it won't fit you may need to sand it down a little bit. There is some variance in the thickness of the wood so some kits may be stiffer than others.

5 PREPARE THE FRONT CLIPS

Push the two front clips onto the dowel, once on each side of the wheel. The front clips have off-centre holes and both clips need to go on in the same direction, as shown right.

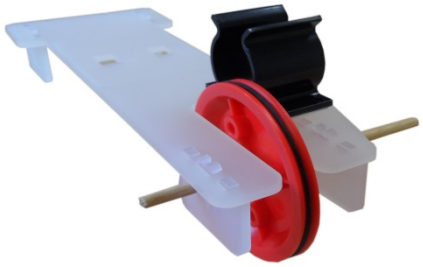


Solar Powered Buggy Essentials

www.kitronik.co.uk/2153

6 INSERT THE FRONT CLIPS

Push the two front clips into place, making sure that the dowel is closer to the middle of the buggy.



7 ATTACH THE MOTOR PULLEY

Push the small black pulley onto the motor shaft.

8 SOLDER THE MOTOR TO THE SOLAR CELL

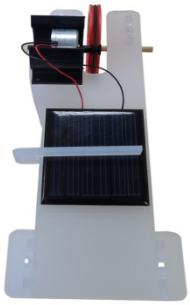
If your solar cell has wires attached already, cut them off. Solder the red and black wires of the motor onto the inner connection points on the solar cell.

The solar cell has markings '+' and '-' for positive and negative. Wire the red wire to '+' positive and the black wire to '-' negative.

9 ATTACH MOTOR AND SOLAR CELL

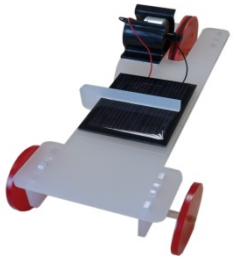
Push the motor into the black clip with the shaft facing inwards. Pull the rubber band that is around the red wheel over the black pulley.

Place the solar cell onto the large etched rectangle on the buggy's base making sure that the soldered connections are through the two holes (this lets the cell lie flat). Then slide the 'U' shaped clip over the solar cell to hold it in place.

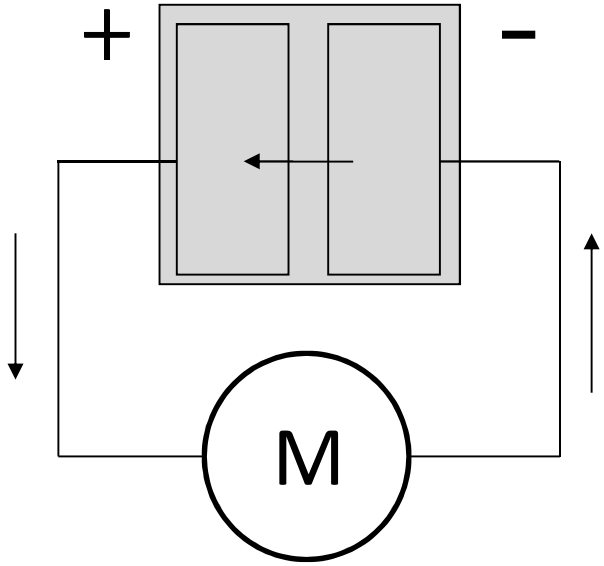


10 ATTACH REAR WHEELS

Put the second piece of dowel through the two holes in the rear clips and push a small red wheel onto each side. Your buggy is now complete!
Take it outside on a sunny day or shine a bright halogen lamp onto the cell to see it go.



How the Solar Buggy Works



The solar cell is wired in series with the motor so that the current generated by the solar cell can cause the motor to spin. The motor used is a low inertia motor; this type of motor tends to spin very quickly but with little torque. The advantage of this type of motor is that it requires very little current, making it suitable for use with low current power supplies like solar cells. This type of motor however cannot provide much pulling power; the motor shaft can be easily stopped by placing your finger on it even at full speed. For this reason a rubber band is used as a gearing pulley to convert some of the speed of the motor into additional torque.

Online Information

Two sets of information can be downloaded from the product page where the kit can also be reordered from. The 'Essential Information' contains all of the information that you need to get started with the kit and the 'Teaching Resources' contains more information on soldering, components used in the kit, educational schemes of work and so on and also includes the essentials. Download from:

www.kitronik.co.uk/2153

This kit is designed and manufactured in the UK by Kitronik

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