MODEL SOLAR ELECTRIC POWER BOAT

PLUGGING *into the* SUN®

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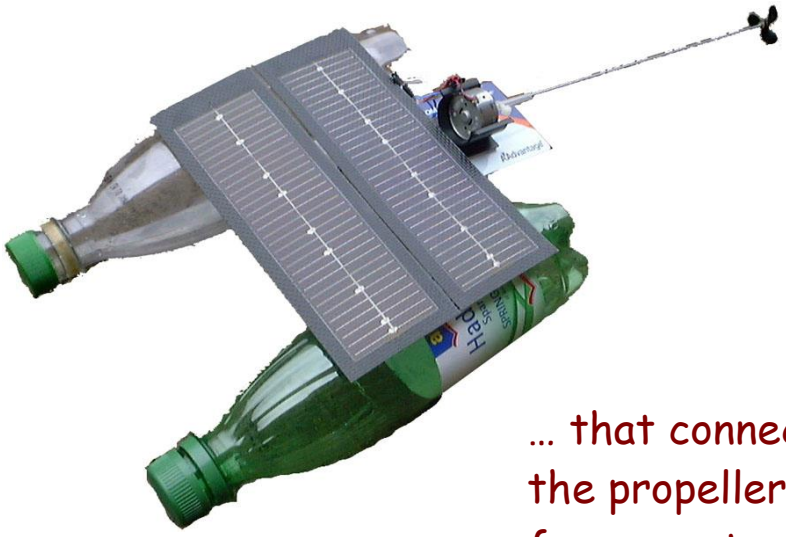
# ASSEMBLY GUIDE

Two flexible solar cells turn sunlight into electricity …

… that flows through the solar motor making it spin …



… that connects to the propeller which forces water backwards …

… resulting in a forwards force on the boat allowing it to move through the water.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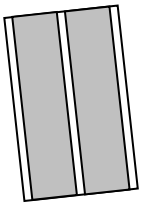
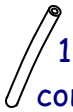
# PARTS LIST:

2 flexible PV cells

Velcro hook & loop



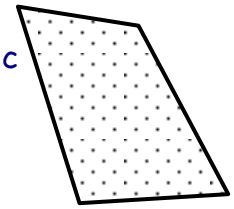
1 propeller

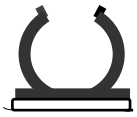


1 shaft connector tube

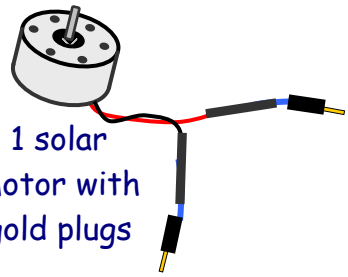
1 balloon

1 plastic card



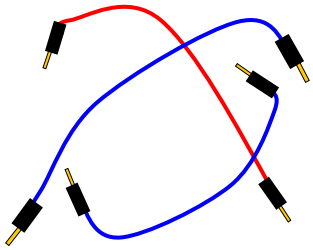


1 self-adhesive motor mount

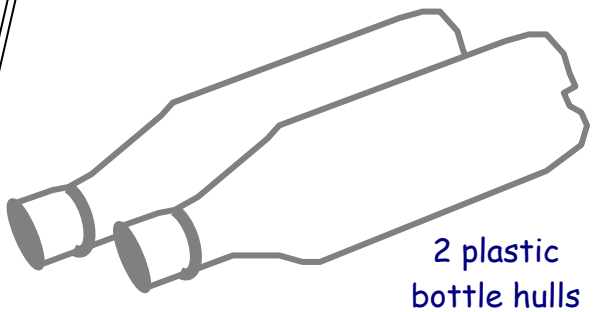


1 solar motor with gold plugs

1 steel propeller shaft



3 connection wires with gold plugs



2 plastic bottle hulls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**How does a boat float and propel itself through the water?**

**Find out from the science and component notes extracted from our website to the appendix of this guide. >>>**

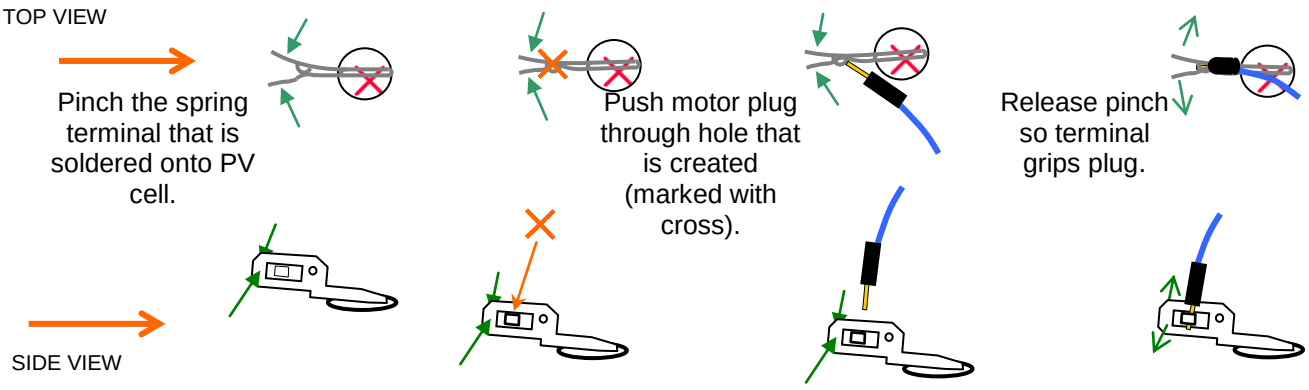
# SOLAR CELLS & ELECTRIC MOTOR

**PV cells, motor, connection wires**

**Connecting solar cells together & to motor (& testing)**

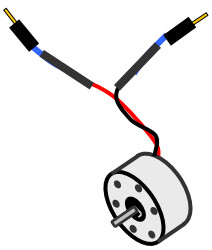
Each solar cell has a positive terminal (marked by a red dot) and a negative terminal.

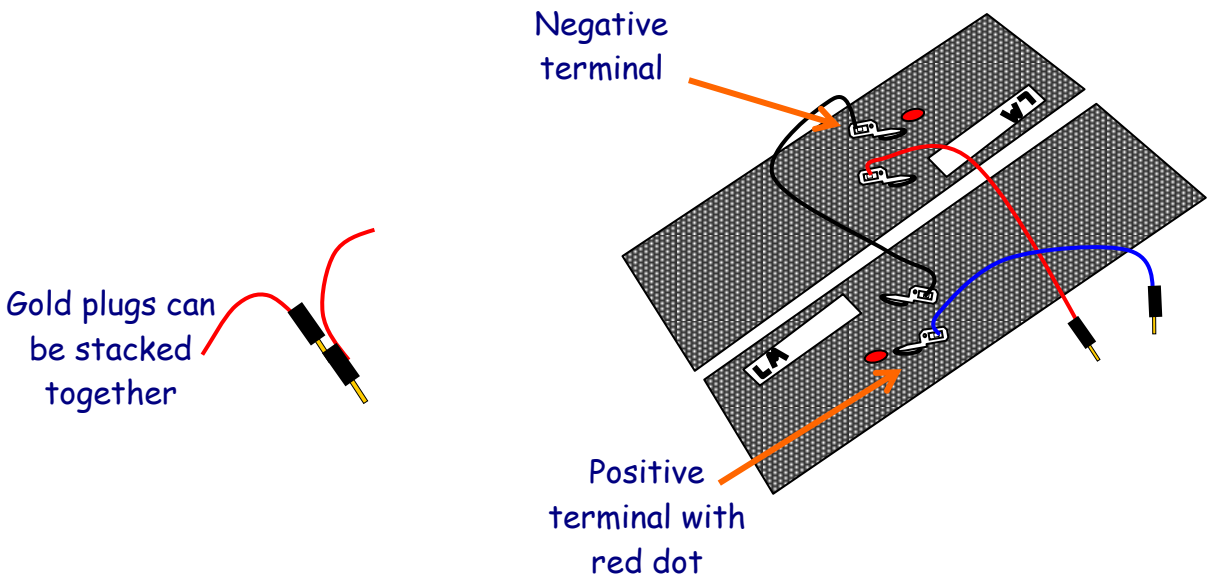
Electrical Connections with Pinch Terminals




Connect the positive terminal of one cell to the negative terminal of the other.
Connect the motor to the two remaining terminals.

Solar motor with gold plug connectors






Testing Solar Cell & Motor

**SAFETY: *Risk of electric shock*. If an electric lamp is used to illuminate the solar cell then take great care to avoid splashing the lamp with water.**
***DO NOT HOLD ELECTRIC LAMPS OVER WATER*.**

TIP: If you connect red motor wire to a positive terminal & black motor wire to a negative terminal, then motor shaft will spin clockwise. Swap motor plugs between terminals to change direction in which motor runs.

TIP: How much light does the solar cell need?
Given suitable lighting conditions the solar cells supply more than enough electricity to spin the motor. A 100W bulb held closely to (but not touching) the collector side of the cells will spin the motor. Maximum power is produced under natural lighting conditions when the cells can 'see' as much of the sky as possible (motor speeds attained outside will be higher than speeds on a window sill for instance). Diffuse sunlight from a cloudy sky will normally provide enough energy for the motor to spin. Remember the solar cells are designed for daylight wavelengths (including light scattered by cloud cover), not the wavelengths given off by artificial light sources so the motor is slower under artificial light.

⊙ Direct collector side of solar cells towards a bright light source and check that the motor spins.
⊙ Disconnect the motor and solar cells from each other.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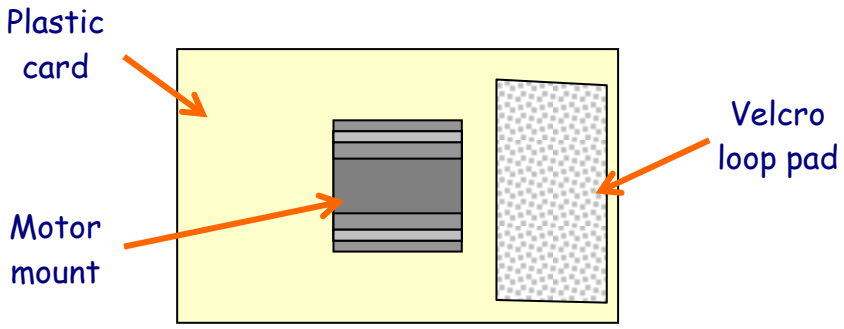
# PROPULSION SUB-ASSEMBLY

**motor, connection tube, shaft, propeller, motor mount, plastic card**

**Preparing motor mount.**
The motor will sit in a self-adhesive mount.
Stick mount in centre of card noting orientation in picture.

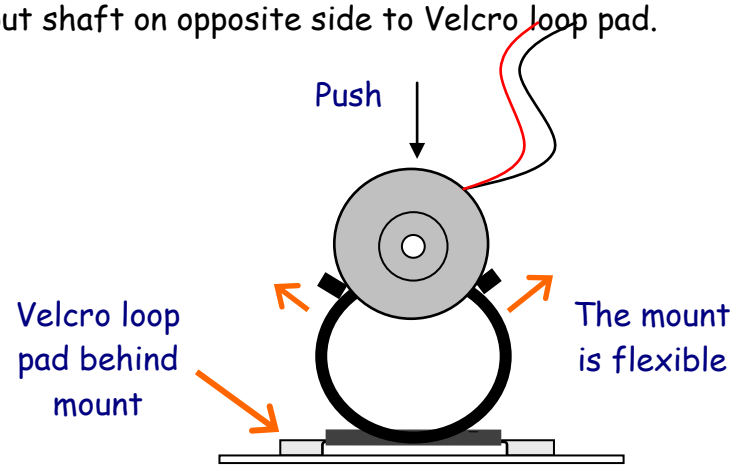



TIP: Velcro has two different halves that grip each other when pressed together. One half is covered in tiny hooks that feel rough to the touch. The other half is covered in fine loops that feel soft to the touch. When Velcro is pulled apart you can hear the distinctive ripping sound as the hooks loose grip of the loops.

Stick Velcro loop pad across one end of card as in the picture.

**Fitting motor to mount**

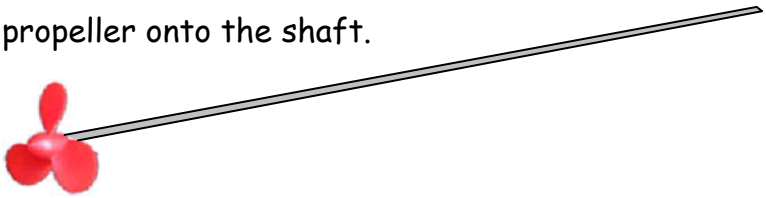
Push motor into mount with output shaft on opposite side to Velcro loop pad.



**Connecting propeller to propeller shaft**

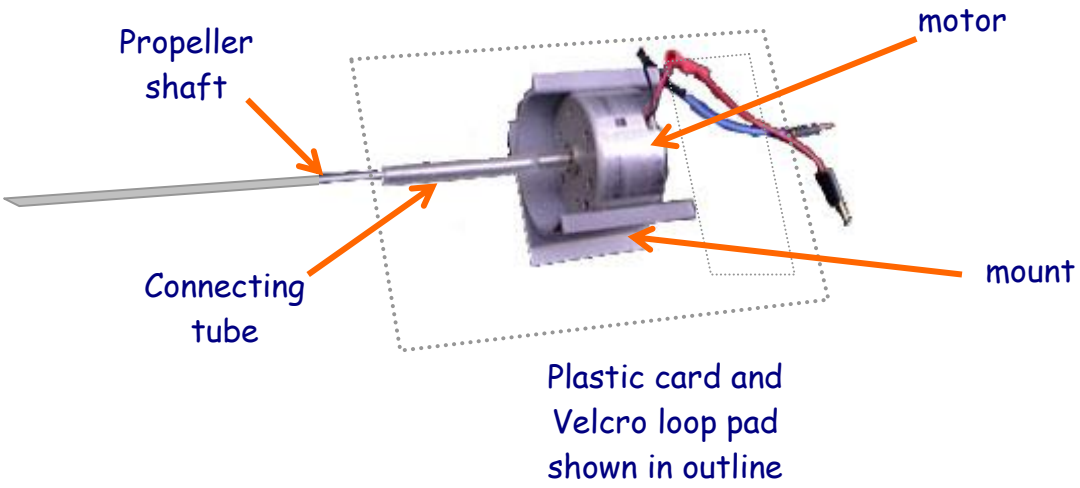
Safety: The steel propeller shaft is thin (diameter only 2mm), and could potentially pierce the skin. Do not push shaft towards the palm of your hand at any time.

Push the propeller onto the shaft.



**Connecting motor to propeller shaft**

A piece of plastic tubing connects the propeller shaft to the motor shaft.
Push the tube onto the motor output shaft.
Push the propeller shaft into the tube.




The propeller will spin at the same rate as the motor.
TIP: To test the sub-assembly connect a 1.5 volt battery to the motor wires and make sure the mechanism runs smoothly.

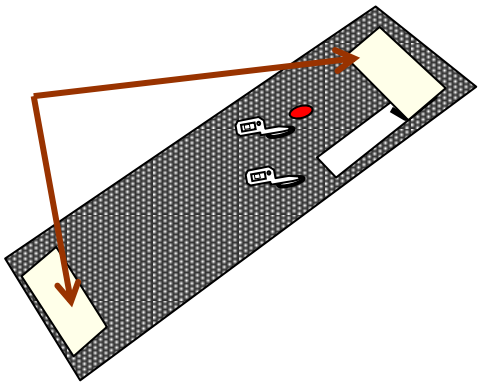
# BOAT STRUCTURE

**Plastic bottles, Velcro hook & loop, PV cells**

The solar cells connect the two hulls of the boat
Stick 2 Velcro hook pads onto each solar cell in positions shown.

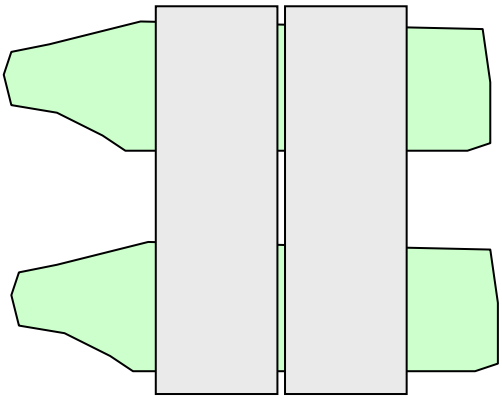
Press a Velcro loop pad & hook pad together so they grip each other.
Remove backing paper from the hook pad and stick it to a solar cell in one of the positions shown in picture.
Repeat this for the other position on the cell and the two positions on the other cell.

Velcro pads




**Joining hulls and flexible solar cells**

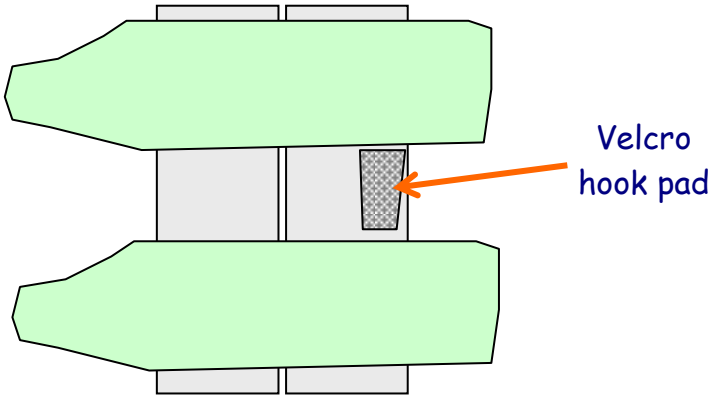
Remove backing tape from the two Velcro pads on each cell and stick to bottles as in picture.



# FIXING PROPULSION PARTS TO BOAT

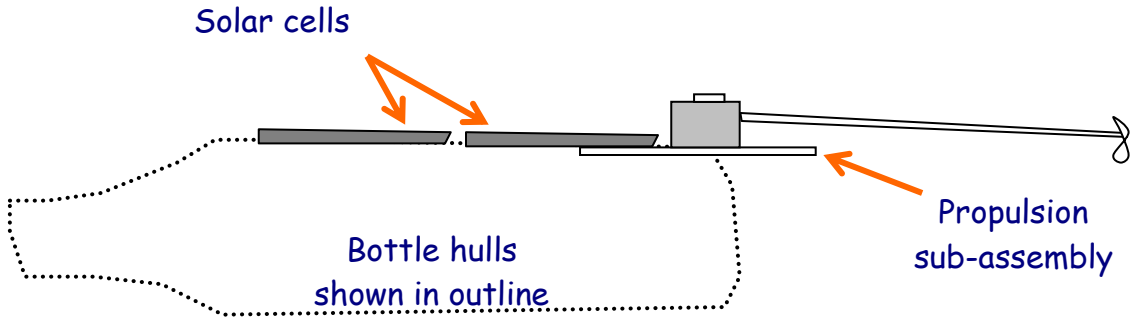
**Velcro hook & loop, propulsion sub-assembly, boat structure**

Stick a Velcro hook pad onto the cell near the base of the bottles in position shown in picture.




Join the Velcro loop pad on the propulsion sub-assembly to the hook pad on the rear solar cell.

The propeller shaft should extend away from the boat at the opposite end to the bottle tops.




**Electrical connections.**
Reconnect the solar cells and motor as described at the beginning of this guide.

# LAUNCHING & SAILING THE BOAT

**Safe body of water, model solar boat**

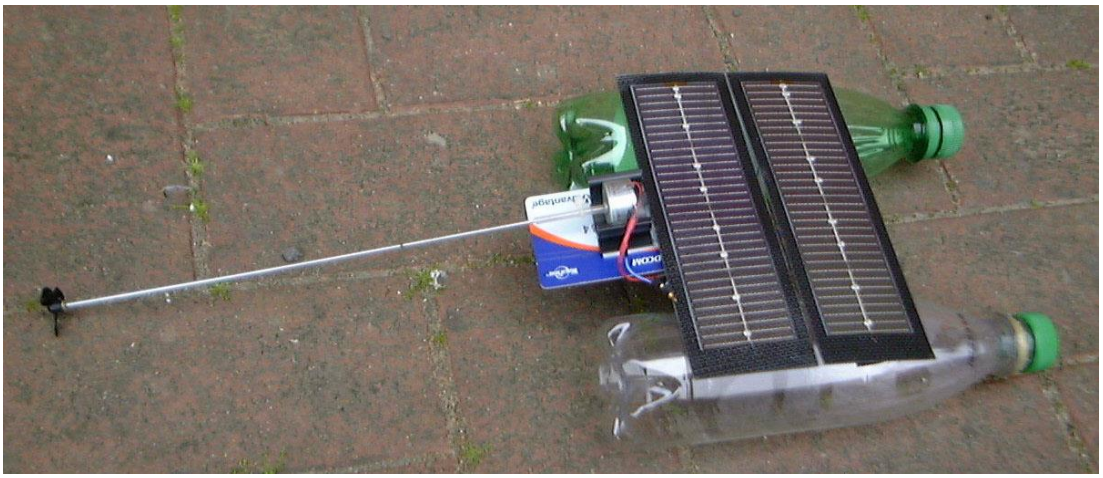
**Safety near water: Find a safe place to sail your solar boat. It needs only a few centimetres depth of water to float. Beware of unstable banking and unsafe bodies of water.**

TIP: How much light does the solar boat need?

In a correctly assembled kit given suitable lighting conditions the solar cell supplies more than enough electricity to spin the propeller and propel the boat. Optimum performance is always achieved under natural lighting conditions when the cell can 'see' as much of the sky as possible. Diffuse sunlight from a cloudy sky will normally provide enough energy for the boat to run. Remember the PV cell is designed for daylight wavelengths (including light scattered by cloud cover), not the wavelengths given off by artificial light sources.

Tip: The motor must be kept dry at all times; cover it with the balloon or a small plastic bag.

**SAFETY: Never use an electric lamp to illuminate the solar cells when the boat is in water. There is a danger of electric shock if water and mains electricity come into contact. There is no risk of electric shock from the solar cells.**



Complete boat - just needs water!

# PROBLEM SOLVING GUIDE

| Problem | Check Items ⇒ Solution |
|---|---|
| | |
| boat goes backwards | polarity reversed ⇒ reverse terminal connections |
| Propeller does not turn or boat goes very slowly | insufficient light intensity at solar cell ⇒ read 'How much light…' above<br>high electrical resistance ⇒ check soundness of connections between motor plugs and solar terminals ⇒ check for broken motor wires<br>bent propeller shaft ⇒ remove propeller and check it by rolling on a smooth surface |

# FURTHER INFORMATION

Use the password 'morephotons' on the front page of our website to download solar notes and advise on running your model solar boat.
Tel/Fax 0114 249 9459.
Email: enquiries@pluggingintothesun.org.uk
Website: www.pluggingintothesun.org.uk