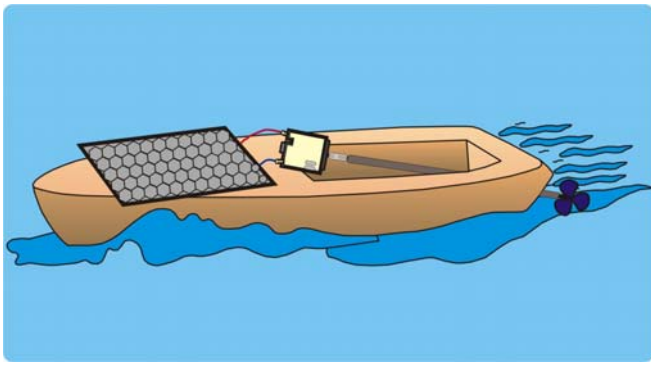
Constructing solar boats moving with a photovoltaic cell, a motor and a propeller

The construction of solar boats out of plastic toys and/or dense Styrofoam can be rather amusing, but a bit more difficult than the construction of solar catamarans with floaters. That is because they have to come in one piece and the construction must also be balanced to float and travel smoothly on the water (cf. CAT, 2001). Furthermore, the suitable kind of solar cells should be used for each construction to be functional (Komp, 2001).

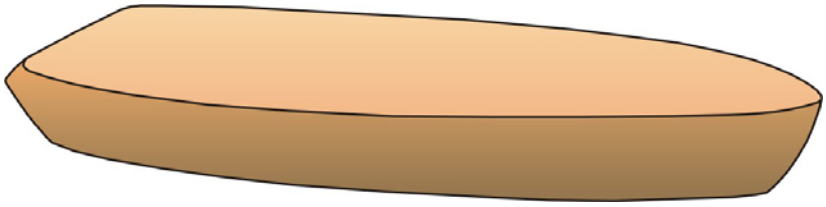
Materials



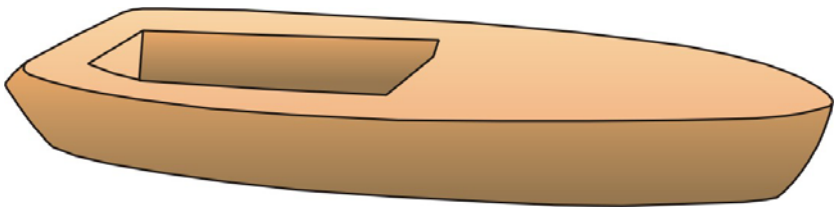
- ✓ a toy boat to be converted to a solar boat and/or a piece of dense Styrofoam (polystyrene) to be shaped with sandpaper to a boat
- ✓ alternatively a piece of plywood or balsa for the construction of the boat hull
- ✓ a piece of paper foam board, 4-5 mm thick
- ✓ a low friction solar motor
- ✓ a toy boat propeller with two or three fins
- ✓ a small connecting piece of thin silicone tube
- ✓ one or two proper photovoltaic cells, even a couple of low efficiency ones of 0,5 Volt will work fine
- ✓ a couple of pieces of wire with crocodile clips
- ✓ silicone glue and glue gun, sandpaper
- ✓ scissors, cutter, or a small saw
- ✓ ruler, pen or pencil, flat screwdriver

Let's put it together

1 Either find a plastic toy boat you can convert to a solar boat or cut out a piece of dense Styrofoam (polystyrene) to the shape depicted in the drawing and sandpaper its sides to construct a hydrodynamic boat hull, which will move smoothly, that is with less friction in the water.



2 If you are using the piece of dense Styrofoam as a construction option for the boat hull, then a small hollow has to be carefully sculptured somehow, perhaps with the aid of an adult and a flat screwdriver (*see drawing aside*).

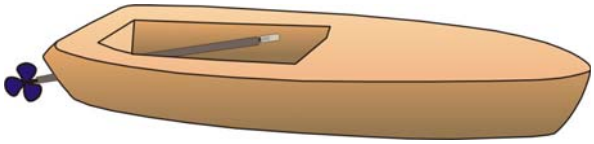


3 A toy boat propeller can be purchased from a toy shop or a technology store, although it can also be constructed with an adult help.

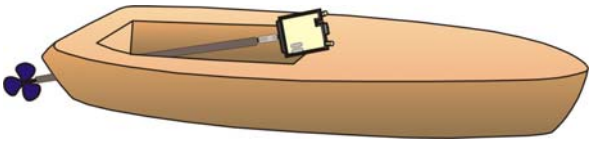
In the second case, you will need a thin metal tube and a metal axis of 2-3 mm diameter, to fit inside the tube and be able to rotate with little friction inside the tube (lubrication may also be added). Then a plastic propeller has to be purchased to fit the metal axis. Alternatively a propeller can be used from another toy.

Notice the small connecting piece of silicone tube, which has to be attached to the other end of the axis in order to be fixed to the motor shaft (*see drawing aside*).

4 With the aid of an adult, a small hole has to be drilled trough the boat hull, at the centre of its back part, and the propeller, actually its outer tube, has to be inserted through there. Some silicone may be spread around the hole for water proofing (*see drawing aside*).

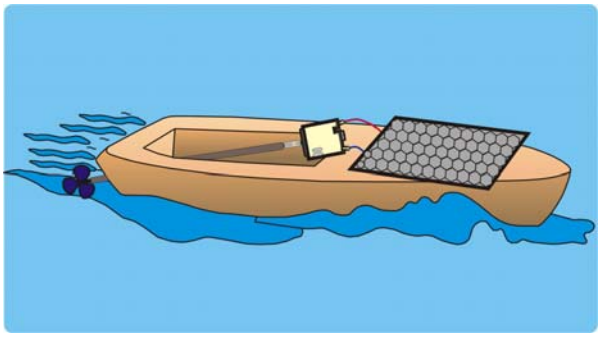


5 You have to obtain the low friction solar motor and adjust its shaft to the metal axis of the propeller with the aid of the small piece of silicone tube. This way they will rotate together simultaneously and turn the propeller around in the water (*see drawing*).



6 All that is now needed is to connect the photovoltaic cell with the motor using the two pieces of wire with the crocodile clips. Put the solar boat in the water and have fun!

Alternatively, you can use a piece of light plywood and/or balsa for the basis of the boat hull and pieces of paper foam board for the sides, back and top parts of the boat to construct it differently (*follow phases a-g below*).



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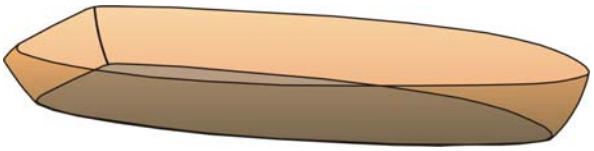
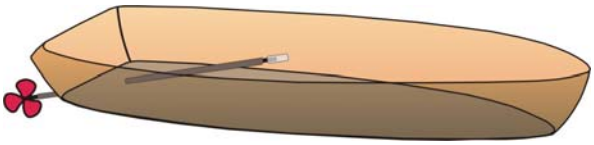
a Seek for adult help and cut a piece of light plywood and/or balsa 4-5 mm thick, in the shape of the drawing aside, to construct the basis of the boat hull.

b Cut along a piece of paper foam board to fit one of the sides of the basis of the boat hull and glue carefully with a glue gun or silicone.

c Do the same for the opposite side and the back. Now you have the body of the boat hull ready (*see drawing aside*).

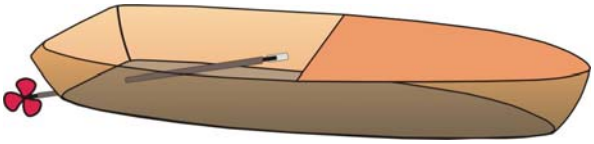


d Make a hole in the middle at the back part of the boat hull to insert the propeller tube. Make sure you put some silicone around the hole for water proofing (*see drawing aside*).

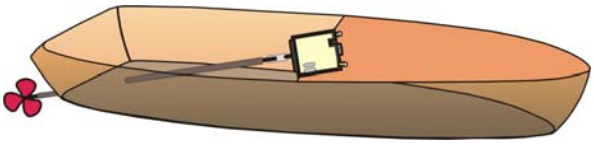


e Cut another piece of paper foam board to cover the front top part of the boat and at the same time to create a basis for the motor (*see side drawing*).

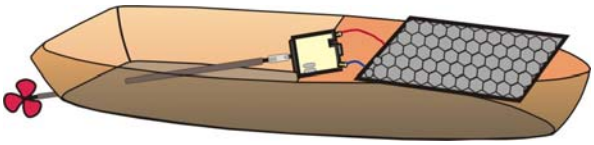
Alternatively, you can cover most of the top part of the boat creating a deck, but carefully leaving an opening for placing the motor and allowing the axis of the propeller to move freely.



f Fix the motor firmly on the deck of the boat and connect its shaft with the axis of the propeller using a thin silicone tube, in order to synchronize their movement.



g Connect the photovoltaic cell with the motor using the two pieces of wire with the crocodile clips and the solar boat is now ready to travel in the nearest pond or swimming pool!



Some photographs from the construction of solar boats …

Most of the solar boats constructed with children for a school science fair on solar energy were made out of balsa wood, for the basis of the boat hull, whereas paper foam board was used for the sides, back and deck (*see photos 1-10 below*). The boats where put in a small water pool and school children had fun during science fairs (*see photos 11-12 below*).

Photo 1: Pieces of paper foam board have been glued around the basis of the boat hull made out of balsa wood. Some extra white glue is added from the inner part of the construction for better fixing.

Photo 2: Two more boats being constructed in the same way.

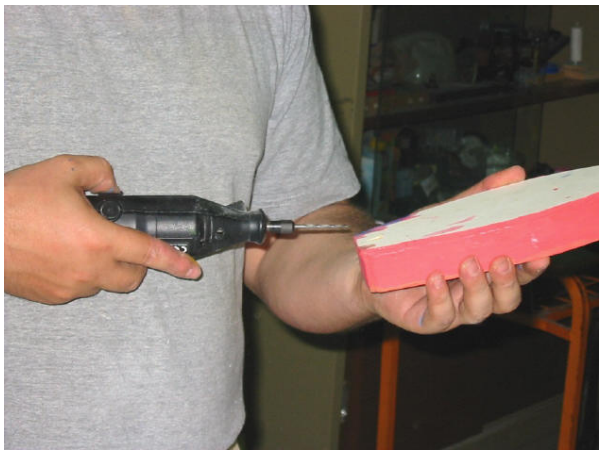


Photo 3: A hole is carefully drilled at the bottom of the boat hull by an adult (teacher).

Photo 4: Children are adding extra glue to the constructions.

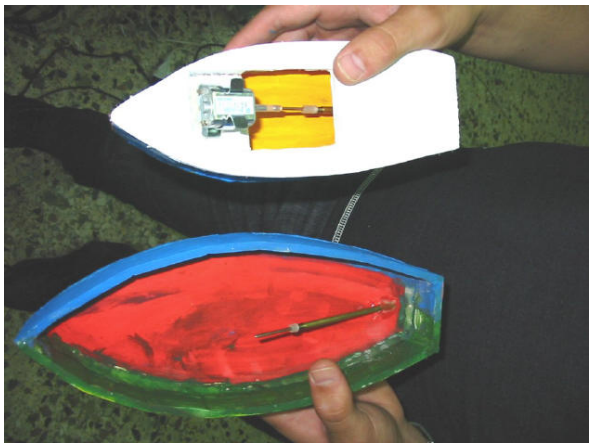


Photo 5: Details of the propeller being fixed to the boat (below) and the motor being fixed on the deck attached to the propeller with the silicone tube (above).

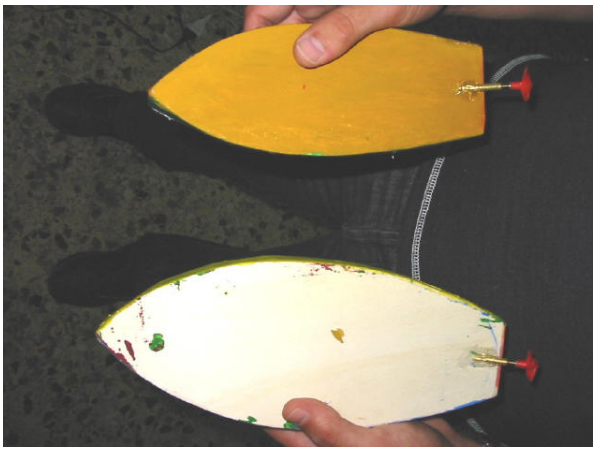


Photo 6: The same boats upside down with the end parts of their propellers in vision.

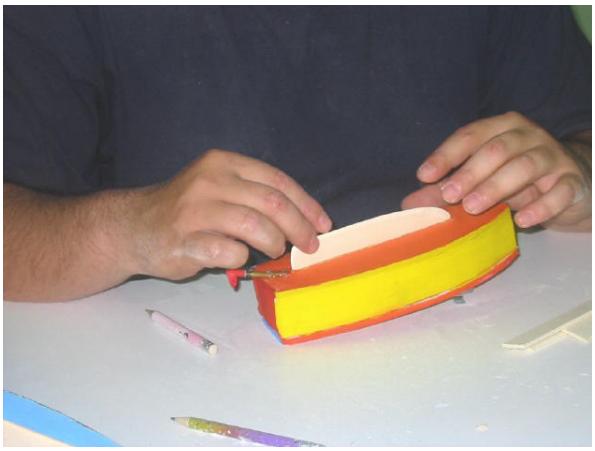


Photo 7: Gluing an extra piece of balsa as a centreboard (keel) for better balance and floatation.

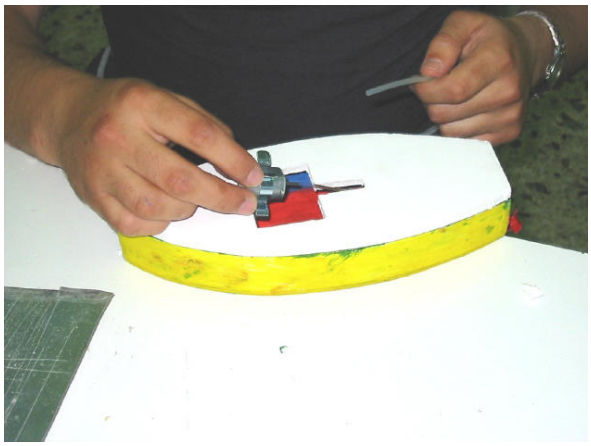


Photo 8: Connecting the motor shaft with the axis of the propeller using a piece of the silicone tube, depicted on the right.

Photo 9: Painting the solar boats, many colours to choose from and mix ...

Photo 10: Painting the solar boats appears to be a dedicated, but rather fascinating task.

Photo 11: Having fun with the solar boats in the pool in a school science fair.

Photo 12: Younger children appear to have more fun with the solar toy-boats ...

References & Resources

Centre for Alternative Technology (CAT) (2001) *Teacher's Guide to Solar Electricity Projects*, Devon: Southgate Publishers Ltd.

Komp, R. (2001) (3rd Edition) *Practical Photovoltaics: Electricity from Solar Cells*, Michingan: AATEC publications.

Solar powered electric boats, Available at URL: < http://www.sunboat.com/history/history.html >.