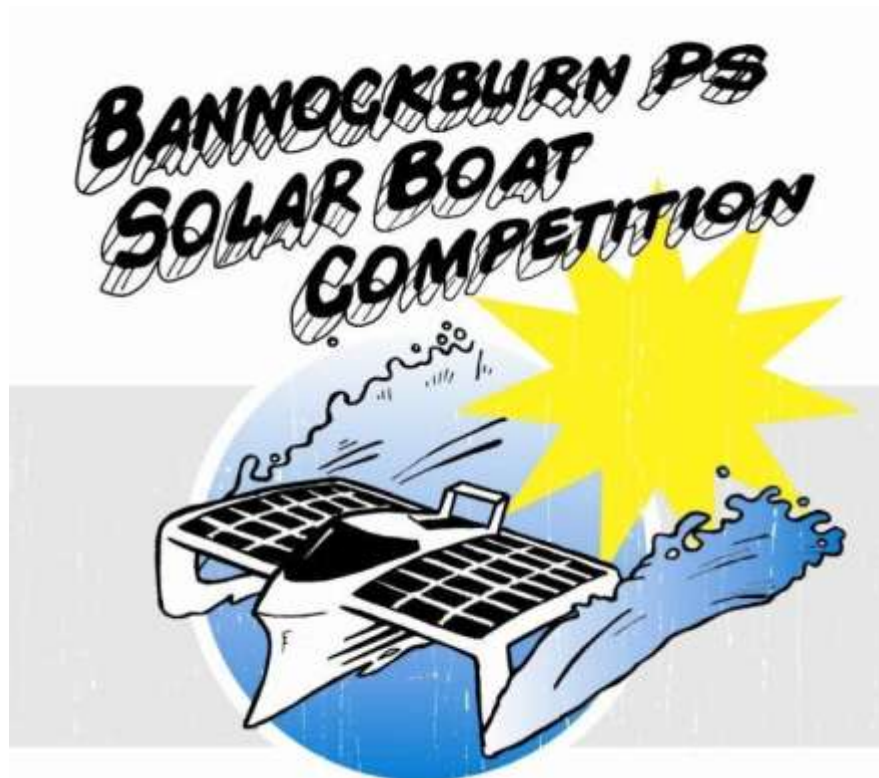


# HOW TO ... A GUIDE TO BUILDING A SOLAR BOAT



What will you find throughout this booklet?

- Details of what you need to build a model solar boat
- Starting with a hull
- Creating a hull
- Making it smooth
- Filling and touch-ups to the hull
- Props, Solar Panels and Motors
- Wiring and assembling your Solar Boat
- Testing and improving
- And a few helpful hints along the way!

## MATERIALS

These are available from Scorpio Technology or other educational / technology suppliers

- A solar panel
- A 3V motor
- A propeller
- A propeller shaft
- A simple on/off switch
- Electrical Wire
- Material for a hull (polystyrene, balsa, recycled materials etc)
- Silicone rubber tube (to attach the prop shaft to the motor shaft)
- Other materials for guide lines etc

This is the very basic list. You need to look at how you can build the best boat – experiment.

Through the process of building a boat children are encouraged to ask questions like: –

- What is the best material for a boat hull?
- What is the fastest shape?
- Which solar panel – voltage or amps?(Do you know the difference?)
- What kinds of propellers are best?
- How well will our boat work if it's sunny or overcast?

You will also need access to the following tools and resources as you start to experiment

- A sharp knife
- General tools such as a hammer and a drill
- Sandpaper or various grades
- A soldering iron and some solder would be helpful—to solder electrical

collections

- A filler such as Pollyfilla Skim Coat
- Paints of various colours to finish the hull
- Wire for the guides

# CREATING THE HULL

Step One

## STARTING

Every boat starts with a hull and every hull starts with a decision as to the best materials

- High density polystyrene foam
- Balsa
- Plastic
- Recycled materials (i.e. coke bottles)

\*Remember, we have a recycled materials competition

Polystyrene is great because you can shape it by hand. You can cut it with a knife or sand it down with sandpaper.

You also need to think about flotation and water proofing.

**Do you want a single hull or a multi-hull?**

**How will you join the hulls of a catamaran or trimaran?**

Step Two

## DESIGNING

Decide on a design for your boat hull. Ask children to look at boat hulls (check the internet).

- What is a good shape?
- Include in your design where you will put the motor, the solar cell, the guides etc.
- We want as little water resistance as possible.

Step Three

## FORMING

Use (very carefully) craft knives, handsaws, rasps, files and sandpaper to shape the hull/s.

A little

### USEFUL HINT

When you're working with foam, you must be careful about what you put on it. We suggest you think carefully about it—certain chemicals will dissolve the foam.

# Making it SMOOTH

Step Four

## TRIM & SAND

The smoother and more aerodynamic the hull, the more quickly it moves through the water. There are other variables of course—but it's certainly good to start with a slick hull.



So after trimming off any extra bits, grab some medium grit abrasive paper and start sanding. You must be gentle or you'll create more problems with the foam. We found a circular motion worked well.

While foam is cheap and easy to work with, sanding doesn't create a perfect surface.

Be very careful with the dust. A breathing mask is useful to have.

A little

### USEFUL HINT

It's also worth mentioning that there are different grades and colours of foam. Higher grades will give a better finish, although they can be quite expensive.

# The Finishing TOUCHES

Step Five

## FILLING

Now apply a layer of filler to cover the pits. You could use PollyFilla Skim Coat, which is a cream like paste that is easy to apply. Put it on by hand—fingers not spatulas. It's also inexpensive and freely available at hardware stores.

You can also use filler to repair holes and dings made during construction or racing.

The filler takes about half an hour to dry, then you can sand it back to a glossy finish using wet and dry paper. I found a 400 grade about right.

Step Six

## PAINTING

You may want to take a moment to think about the graphic design of your hull.

- Are you going to use adhesive stickers to add detail to a painted base?
- Are you going to use a heat-shrink material to wrap your hull? Ask at a model shop.

Then pick a colour. Think carefully about the paint.

- Is it water based?
- Is it solvent based?
- Which one is going to dissolve the foam?

Once you're done, you've got a glossy boat that will slide through the water like a dream.

## The STEERING

Step Seven

## PROPELLER

The propeller is the next most important element of your boat. You can experiment later with 2 blade or 3 blade props, the pitch and size. (maximum size 35mm).

You need to look very carefully as to how you are going to mount the motor and the propeller. It must spin freely, but not 'cavitate'. How long from the stern will it be (remember there are regulations governing boat size). Getting the energy from the solar cells into the water to move the boat is the next most important step after hull design.

Carefully push the prop tube into the hull at a gentle incline. Then push the propeller through the tube ready to connect to the motor.

This is an area you can experiment with.

- What is the best angle for the propeller?  
⇒ Below the boat or behind the boat?
- What about cavitation?
- Does the prop spin freely?
- How far behind the stern?
- etc

# Electronic BITS & PIECES

Step Eight

## SOLAR PANELS

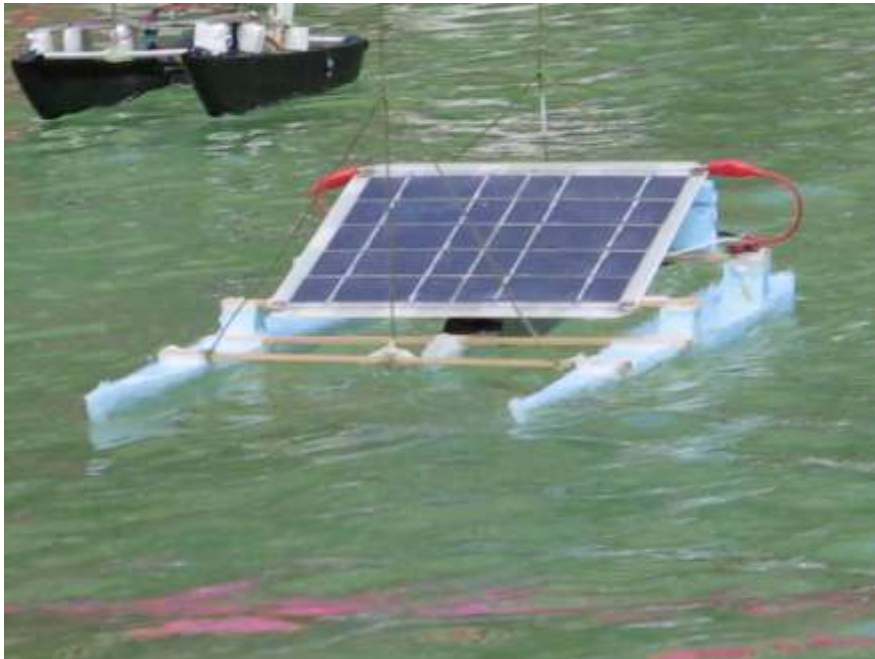
The first thing to say about solar panels is that they are absolutely critical. They're at the heart of this challenge since it's all about alternative energy sources. You can wire these cells up in both parallel and series. Which is best for different conditions? Make sure wiring connections are strong.

Step Nine

## MOTORS

You're going to need to connect the motor to the solar panel.

Take the whole thing out into the sun, without connecting it to the boat, and check that it works! If nothing is moving, then have another look. Also, be careful how you wire to the motor, so that the propeller spins in the correct way.



A little

### USEFUL HINT

Motors come in many shapes and sizes. There are various efficiencies, voltages and speeds. You don't need a very expensive

one.

## Hitting the DECKS

Step Ten

### DESIGNING

While foam is an excellent floatation device, it is a little hard to attach things (Solar cells, wire, guides, switches etc) to it securely. So you may need to attach a deck. This is also necessary for multi-hulls.

You will need to use something solid so that you have something secure to attach the various components to - motors, guides, solar cells.

Step Eleven

### WIRING

You need to attach the solar panel to the hull, Velcro dots are useful, as you can easily remove the cell to work on your boat. You also need a spot for the on/off switch.

Once these components are in place, it's time to get onto some wiring.

You can draw circuit diagrams and have a think about wiring in series and parallel.

## Putting it all TOGETHER

Step Twelve

### ASSEMBLY

Now it's time for everything to come together. You should have the solar panel all hooked up and check the motor spins.

The last task is to connect the motor to the propeller shaft using the link tubing.

If you have assembled it all correctly, you should be able to walk out into the sunshine, flick your on/off switch to on and the propeller will turn. Your propeller should be whizzing around like crazy.

You also need to add wire guides to make sure your boat runs straight down the



course.

Step Thirteen

## TESTING

You can now test your boat. We use a local dam or swimming pool - this must be done with an adult.

Try it on a clear and sunny day, and also on an overcast day. .

Either way, now you get to see your boat in action. You'll start to see how it moves, whether it's stable, how fast it is and so on. Experiment where you can.

A little

### USEFUL HINT

Be very careful around water

Step Fourteen

## IMPROVING

- going back to the start.

Once you've seen how it works, you're going to want to make improvements.

- Build a better hull / or modify your hull
- Buy a better motor
- Re-wire
- Shift the weight by moving components
- Re-position the prop
- And so on...

Experimenting like this is where the fun starts—so get to it!

We look forward to seeing you at the  
Rural Solar Boat Challenge.

# A few more HINTS...

A hint about...

## Hull Design

Which is faster, a speedboat or a yacht ?

Is one hull (mono-hull) the best? Have you thought about catamarans and trimarans?

A hint about...

## Prop Location

Most people locate their propeller fairly randomly. It's worth experimenting with multiple prop locations.

Should it be under the hull or behind it?

Should it be completely immersed or partially out of water?

A hint about...

## Prop Size

When it comes to propellers, don't imagine that one size fits all.

You must match your prop to your engine and panel—which prop works best for you? Also, is can be handy to be able to swap props according to the weather on the day.

A hint about...

## The Web

Of course if you're ever confused or stuck, the first place you should look is online.

There are thousands of sites about boats, models , solar energy etc—just “Google” it.