

Solar Boat Instructions

Items included:

| Quantity | Item | Item Label | Included Yes/No |
|----------|----------------------|------------|-----------------|
| 1 | Boat Base | A | |
| 2 | 3-Hole Rod | B | |
| 2 | Square Frame | C | |
| 2 | Curved Elbow Rod | D | |
| 1 | Small Axle | E | |
| 1 | Medium Axle | F | |
| 1 | Large Axle | G | |
| 1 | Small Wheel | H | |
| 2 | Large Gear Wheel | I | |
| 2 | Small Gear Wheel | J | |
| 3 | Axle Lock | K | |
| 2 | Washer | L | |
| 2 | Paddle Blades | M | |
| 1 | Steering Rudder | N | |
| 2 | Solar Panel | O | |
| 1 | Red Wire Connector | P | |
| 2 | Black Wire Connector | Q | |
| 8 | Red Anchor Pin | R | |

Procedure:

Use Figure 1 for steps 1-4.

1. With boat upside down place 2 red anchor pins at the front of the boat.
2. Attach 3-hole rod to the ends of the anchor pins. (Rods should be in a vertical position).
3. Slide the small wheel and axle lock onto the medium axle and place axle between through the top hole of the rods so that it is secured between them.
4. Slide axle lock to the right until it touches the rod and turn boat to the front.

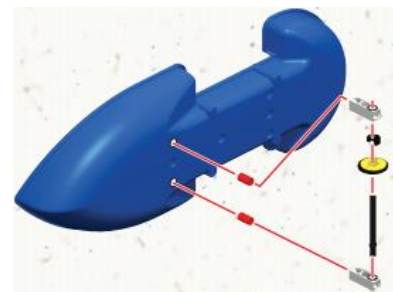


Figure 1: Boat

Use Figure 2 for steps 5-11.

5. Place anchor pin at the back of the boat and attach steering rudder to the end of the anchor pin.
6. Connect the two elbow rods with using a red anchor pin. (Make a half circle).
7. Attach the half circle rod to the steering rudder through the two available holes on the rudder.
8. Attach the solar panels the front of the boat paying attention to the direction of the battery holder.

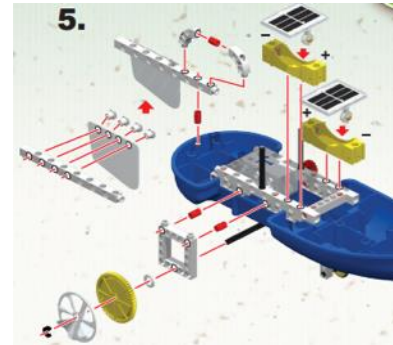


Figure 2: Boat Assembly

Right side:

9. Place anchor pins on the red holes at middle of the boat. Attach top corners of square frame to the ends of the anchor pins.
10. Slide large axle through center hole at the bottom of the frame. Place axle so that is as even as possible on both sides of the boat.
11. Slip washer, large gear, paddle blades and axle lock onto the axle respectively. (Axle lock should be placed close enough to lock wheel into place but allow the axle to spin easily).

Use Figure 3 for steps 12 & 13.

Left side:

12. Repeat steps 9 and 11 to the left side of the boat. To step 11 add a small gear before the large gear.
13. Slide small axle through center hole at the top of the frame and attach small gear at the end of axle.

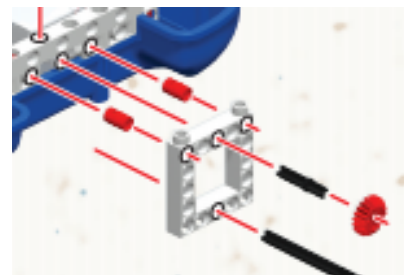


Figure 3: Right Side Assembly

Use Figure 5 for steps 11-14.

14. Place ends of black wire connector in the sockets at the front of the battery holder.
15. Place one end of red wire connector to the socket on the left battery holder and the other end of wire connector to the socket labeled negative.
16. Place one end of black wire connector to the socket on the right battery holder and the other end of wire connector to the socket labeled positive.

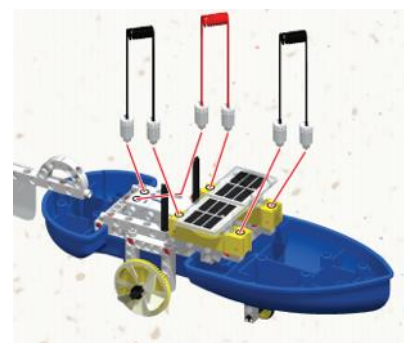


Figure 4: Wire Connection

Solar Boat Exercise



You will build a boat that will be powered by the sun. You will learn how to calculate the energy going into the boat through the solar panel and the efficiency of the system.

Remember to answer all the questions.

- ❖ What type of energy goes into the Boat?

- ❖ What is the energy entering the boat converted to?

- ❖ What is the area of each solar panel? Remember the area is Length x Width. Convert your answer to m^2 (100 cm = 1 m and 2.54 cm = 1 inch):

- ❖ If the energy from the sun is 1350 W/m^2 , calculate the energy going into the system. Use this formula: $\text{Power In} = 1350 \times \text{Area of Solar Panels in m}^2$

- ❖ Measure the current and voltage produced by the solar panel using the voltmeter.

- ❖ Calculate the power output using our values from the voltmeter. Remember $\text{Power} = \text{Voltage} \times \text{Current}$.

- ❖ Find the efficiency of the system ($\text{power output/power input}$)

Formula Sheet

KINETIC ENERGY:

$$KE = \frac{1}{2} \dot{m} v^2$$

POTENTIAL ENERGY:

$$PE = \dot{m} g z$$

EFFICIENCY:

$$n = \frac{\text{Energy Output}}{\text{Energy Input}}$$

POWER:

$$P = I * V$$

$$P = A_s * P_{sun}$$

WORK:

$$W = F * d$$

FORCE:

$$F = m * a$$

ACCELERATION:

$$a = \frac{v}{t}$$

VELOCITY:

$$v = \frac{d}{t}$$

COMPONENTS

v = velocity

\dot{m} = mass flow rate

g = gravity

z = height

n = efficiency

I = current

V = voltage

A_s = solar panel area

P_{sun} = power produced by the sun

ρ = density

\dot{V} = volumetric flow rate

A_c = cross-sectional area

d = distance

a = acceleration

m = mass