

## Newton's Boat

### Conventions used in this document:

Blue: Questions from facilitator to children

Maroon: Children's anticipated response

Black: Comments, notes, and plan for the facilitator

### Session flow

Sr. No.	Activity	Talking points	Time allotted
1	Introduction	<ul style="list-style-type: none"> <li>We are going to make Newton's boat</li> <li>How do you think the boat works</li> </ul>	15 mins
2	Group formation and worksheet distribution	Assuming you have already explained to them how to use the worksheet. If not please refer ' <a href="#">General instructions for the facilitator</a> '	15 mins
3	Ideation and Material gathering	Students will come up with the design of the project and list of the material required for the completion of the challenge. Here children should have filled the worksheet till the material list.	15 mins
4	Project making	During this time, children will build the project.	45 mins
5	Worksheet completion	It will be difficult for children to complete the worksheet while making the project. So give them extra time to complete the worksheet once the project is completed.	15 mins
6	Final Discussion	Ask the children what they have observed. How do they think the boat is moving? At this point, you can discuss the working in detail and mention Newton's law of motion.	15 mins



The above mentioned is the minimum time you need to give children. Feel free to change the time allotted as per the requirement of the class. This is typically a 2 hr project. You can extend it up to 3 hrs.

## **Introduction**

You can give them the instruction sheet and tell them to read the challenge for the day. They will be reading the following,

### **Challenge 1**

*Design a boat using a motor, battery, and a propeller (fan). The propeller must either be completely submerged in the water or should be completely above the water.*

What are we going to make today?

A boat.

How will this boat work?

On a battery and fan/ propeller.

So now let us make Newton's boat.

## **How to help children when they are stuck using the Inquiry driven approach:**

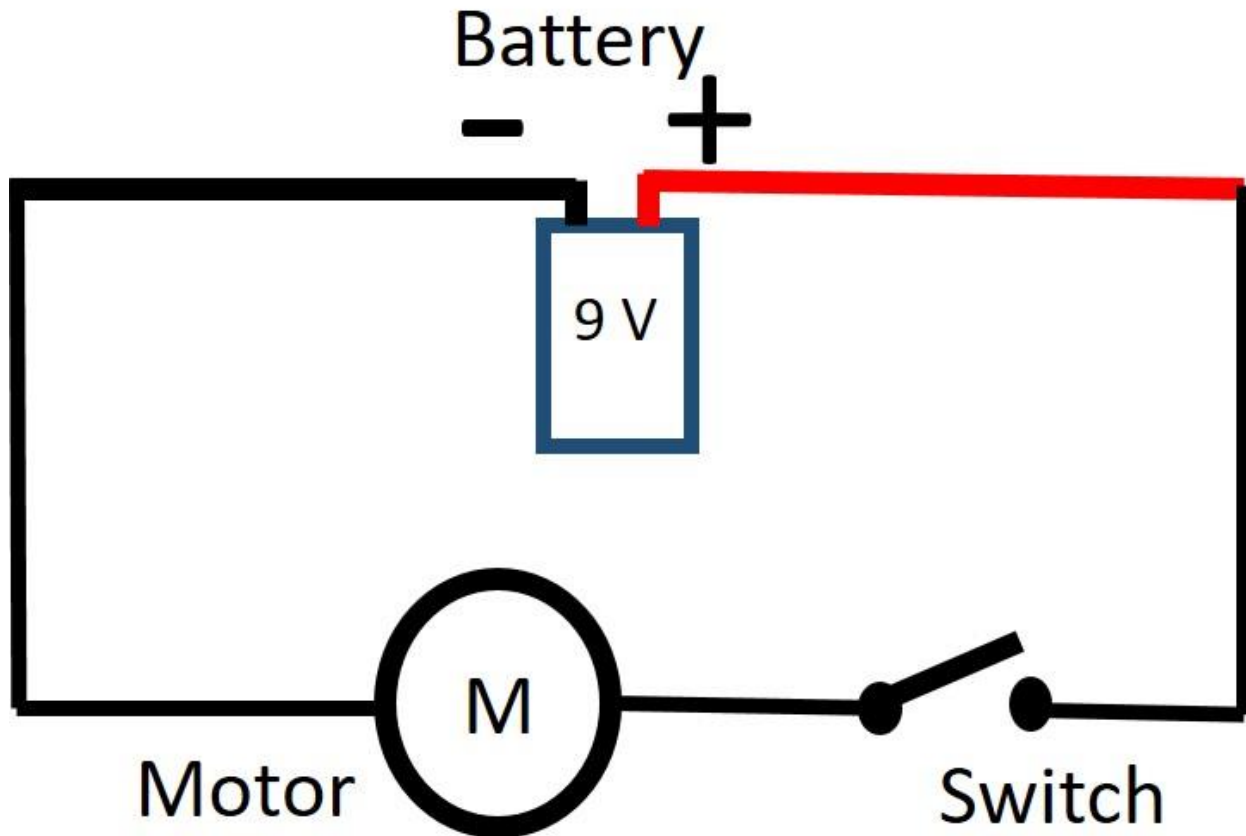
### 1. Balancing

It will be difficult for children to balance the boat since motor and battery are heavy components. This will be visible if the boat is sinking on one side.

Ask them to figure out ways in which they will be able to balance it. They may add some extra weight to balance it. They can use anything from the available material to balance it.

### 2. Connections for your reference

- Positive of a battery to one terminal of the switch
- Another terminal of the switch to one terminal of the motor
- Negative of a battery to the other terminal of the motor



### 3. Making a fan

Ask them [how does a fan look?](#) Once they give you a few examples, tell them to use the material available to make a fan. It is okay if it looks different than what you had envisioned as long as it is serving the purpose. They can use plastic bottles, cardboard, paper cup, wood, etc. Anything to design a fan. They will have to figure out how to attach the fan to the shaft of the motor.

If the hole is big for the shaft, they can use, mseal, hot glue or attach more cardboard. If the hole is small then they can increase the size of the hole using scissors or divider/ compass. In case they have never used a motor you can give them the motor, wires, and battery. They will tinker and figure it out on their own.

Once the basic structure of the fan is ready, ask them to test it with a battery.



### **Why the project may not work:**

1. If the boat is not properly balanced, it will sink.
2. Check if the motor is working and the wiring is proper.
3. Check if the battery is working.
4. Change the direction of the rotation of the fan if the boat is moving in the opposite direction to the expected direction. You can do this by changing the polarity.

### **Working**

#### **Working of Newton's Boat:**

Newton's law of motion talks about the forces acting on the body and the motion of the body.

#### **First law of motion:**

Newton's first law of motion or the law of inertia states that every object will remain at rest or in uniform motion in a straight line unless made to change its state by the action of an external force.

This means that any object which is in some kind of motion will continue to be in motion unless some external force is applied to it.

#### **In the context of the Newton's Boat:**

When the boat is floating on the water surface it is met with drag if it is moving in the opposite direction to the current. If it is moving in the same direction as the current then it moves faster.

#### **Second law of motion:**

Force is equal to the change in momentum (mass x velocity) per change in time. For a constant mass, Force = mass x acceleration.

This means that the acceleration of an object depends on two things, Mass and Force.



Acceleration is directly proportional to force, ie. if force increases then the acceleration will also increase. And acceleration is inversely proportional to mass, ie. if the mass is increased then the acceleration will go down.

In the context of the Newton's Boat:

If you increase the weight on the boat, the boat will move slowly and if you reduce the weight the boat will move faster. Make sure no other changes are made to the boat.

**Third law of Motion:**

“For every action, there is an equal and opposite reaction”. Putting it simply, consider you have two interacting objects, Object A and Object B. If Object A exerts the force on Object B, then Object B will exert an equal and opposite force on Object A as well.

In the context of the Newton's Boat:

When the air from the propeller is thrown in one direction, an equal force is applied to the body of the boat in the exact opposite direction propelling the boat forward.

**Final Discussion:**

What did you observe?

When the fan is turned on the boat starts moving.

Which direction did the propeller push air/ water and which direction did the boat move

They will point out the direction and you can inform them about Newton's third law of motion.

What will happen if you add more weight to the boat?

The boat will become slow.

What happens if you add a more powerful motor to the boat?

The boat will move fast. Why? Because of more force.

Good! so if more weight means the boat will slow down and more force means the boat will speed up. This is Newton's second law of motion.



Here you can state Newton's second law and explain it to them.

What will happen if you put your hand in front of the boat?

It will stop moving. Why? Because my hand will stop it. We are applying force with the hands.

So if you apply external force the boat will stop moving. Let us look at what Newton's first law says.

Here you can state Newton's first law and explain it to them.