Introduction to Engineering

Materials used in boat construction

Boats can be made of a vast range of materials. The Vikings used the most common material available to them that would float: wood! Therefore, they made boats from local timber. On the other hand, modern boats or ships are made from multiple materials that suit the purpose of the vessel. Examples of modern materials are given below.

A boat, like a racing speed boat, needs to be constructed of materials that are light, but also strong and flexible. This type of vessel will usually use plastic or carbon composite materials for the structure, which are specially designed to meet these needs when travelling through the water at high speeds. Although these are excellent materials for this type of boat, they can be expensive and hard to maintain.

Bigger boats and vessels, such as large military aircraft carrier vessels or cruise liners, travel at much slower speeds compared to a speed boat. These boats need to be strong but not flexible. Therefore, they are typically made of metal or heavier materials as they are durable and cheap to maintain.

Wood is still used in making boats, but this has mostly been phased out. It is a difficult material to work with and does not offer the same durability or performance as the materials above. Wooden boats are mainly small personal ones that do not require much maintenance or travel shorter distances at a slower pace.

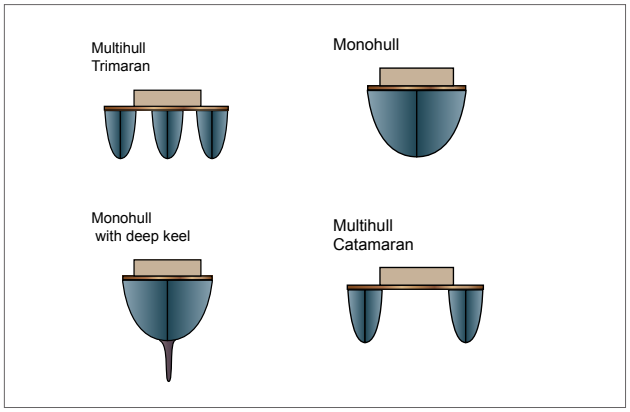
The shape of a boat

The most common shapes of boats are shown below. The hull (the bottom of the ship) is

typically V- or U-shaped. However, the depth and width of the hull varies across ships and depends on how fast or slow it needs to travel. The deeper a ship's hull goes into the water, the more stable it will be as it displaces more water, but this makes it harder to steer.

A ship with a narrow V-shaped hull will displace less water and so can travel faster. However, it is not as stable because it's centre of gravity is higher than larger ships which tend to be weighed down by heavier engines. The overall design of the vessel needs to be a compromise between stability and manoeuvrability - that is why there are so many different types!

To allow the boat to move through the water, the front of the ship needs to displace the water that it is travelling through. To be more efficient and to allow more water to move, the front of the ship is shaped like a knife or a sharp point as this enables the ship to "slice" through the water.



Source: https://en.m.wikipedia.org/wiki/File:Monohull.svg

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Boat Design Challenge

You are going to make three boats out of different materials and test to see which ones float, then try to explain why!

Preparation:

Gather boat-making materials e.g.

- Sponges
- Styrofoam (Large Pieces or Cups, Bowls, Or Small Plates)
- Wood Scraps
- Cardboard Scraps or Small Boxes and Lids
- Egg Cartons
- Paper Tubes and Straws
- Foil Wrap
- Plastic Containers
- Variety of Paper
- Child Safety Scissors
- Glue and Tape
- Water Table or Large Basin
- Coins/Counters

Prediction:

Out of all the materials you've collected, which do you think will make the best boat?

I think _____

will float best because _____

_____

_____

Materials:

Which materials did you use?

_____

_____

_____

_____

_____

_____

Method:

What method did you use?

For example: We collected all the materials we needed to make a boat.

_____

_____

_____

_____

_____

_____

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Boat Design Challenge

Results:

Fill in the table

Material	Did it float?	How many counters did it hold?

Analysis:

What did the results show? Why?

Conclusion:

What happened in your experiment? What could you do differently next time?

Learn about: How surface area affects hydrodynamics

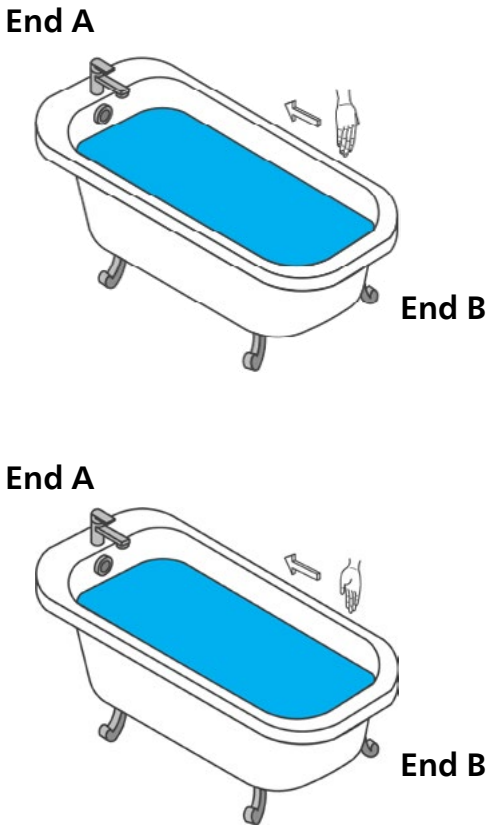
Splash Challenge

You will need:

- 1x bath or bucket
- 1x human hand
- 1x adult to supervise (and to splash)

What to do:

1. Place your open and flat hand in the water with the palm facing the opposite end. Stand the adult at the opposite end of the bath.
2. As fast as you can, keeping your hand open, palm towards the other end and fingers together, move your hand to the other end of the bath (towards the adult). Make sure your hand stays in the water when moving from one end to the other.
3. Allow the Adult to dry off if they have been splashed.
4. Place your hand in the water with your first finger facing the opposite end. Stand the now dry adult at the opposite end of the bath.
5. As fast as you can, keeping your hand open, the first finger towards the other end and fingers together, move your hand to the other end of the bath (towards the adult). Make sure your hand stays in the water when moving from one end to the other.
6. Allow the Adult to dry off if they have been splashed.



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Learn about: how surface area affects hydrodynamics

Splash Challenge
Conclusion

When you carried out steps 1 to 3, you were creating a wide surface area that displaced more water, which would have caused a bigger splash, meaning it was not hydrodynamic. There was a large splash because there was a large amount of water being displaced by your hand, and most of it couldn't move away fast enough. In this case, more energy was needed to move through the water as there was a larger surface area, which meant more water had to be displaced.

When you carried out steps 4 to 6, you were creating a narrow surface area that displaced less water, which would have caused a small splash, meaning it was hydrodynamic. There was a small splash because there was a small amount of water being displaced by your hand, and most of it could move away fast enough. In this case, less energy was needed to move through the water as there was a small surface area, which meant less water had to be displaced.

Using this principle, boats have a thin front (like a knife-edge) to reduce surface area, which means there is less water to displace and less water resistance. This lessens the splash at the front of the ship, which makes them more hydrodynamic. Overall, this means that a sharp front bow allows boats to travel at faster speeds through the water.

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