



**STEM SKILL:  
BRILLIANT BOAT BUILDING  
ACTIVITY**

# BRILLIANT BOAT BUILDING

## Purpose of Activity:

To understand how to use your knowledge of density to build a boat that can carry large amounts of cargo.

## Equipment:

- Aluminium foil
- 1 x A3 card (2 x A4 card)
- Tape (masking)
- Pencil, rubber, ruler
- Container of water (e.g. bucket, sink)
- Colander
- Cargo (e.g. marbles, coins, Lego®)
- Scales

## Introduction:

The world is reliant on ships to transport goods, people medical supplies and fuel. The largest supertanker ever build was Knock Nevis at 458 meters, with a beam of 68 meters, approximately the width of a football field! When fully loaded, Knock Nevis only 24.6 meters is out of the water! Learn more about Knock Nevis at [https://www.dailymail.co.uk/travel/travel\\_news/article-4779070/History-Seawise-Giant-world-s-largest-ship.html](https://www.dailymail.co.uk/travel/travel_news/article-4779070/History-Seawise-Giant-world-s-largest-ship.html). The largest container ship ever build is Emma Maersk measuring 397 meters long, with a beam (width) of 56 m, and reaches a depth of 30 m. Learn more about Emma Maersk at [www.dailymail.co.uk/news/article-2351510/Emma-Maersk-Revealing-photos-gigantic-proportions-worlds-largest-shipping-containers.html](http://www.dailymail.co.uk/news/article-2351510/Emma-Maersk-Revealing-photos-gigantic-proportions-worlds-largest-shipping-containers.html)

Ships can carry huge amounts because their density is lower than the fluid they are immersed in. Density is the amount of matter (mass) that can fit in a given volume. The more items (or mass) that can fit into a fixed space (volume), like a box, the DENSER the box becomes. Steel is MORE DENSE than cotton balls because the same mass of steel, for example, 1kg, takes up less space than 1kg of cotton balls. To find an object's density you divide the mass (e.g. grams, g) by the volume (e.g. centimeters cubed,  $\text{cm}^3$ ).



## Instructions:

*Build a boat that can carry as much cargo as it can. You are restricted on your resources:*

- 1 sheet of A3 (or 2 sheets of A4) and a 60cm length of foil.*
  - Tape is not waterproof; use no more than 1 meter to minimize waste.*
  - **Width** is not wider than **10 cm**, **length** is not longer than **20 cm** but height is up to you.*
1. Fill up your container with water to a 15-20 cm depth.
  2. Plan the size, shape and design of your boat on paper.
    - a. Think about how you are going to make it into a 3D shape - e.g. panels, mathematical nets.
    - b. Depending on the 'cargo', you will also need to consider how to stop the cargo from moving / rolling around and making your boat unstable. Think about baffle plates (walls / barriers).
    - c. As your boat is made from light card, you will need to strengthen the hull top to prevent it from being crushed by the weight of the water.
  3. Transpose (draw) your design onto the card using pencil and a ruler, measuring twice to keep within the size limit. Remembering scissor safety, carefully cut and constructing your boats.



4. Tear off a sheets of aluminium, no longer than 60cm length and wrap-up your boats, like a present, so that there are no gaps for water to get in.

☆ **Challenge Task:** find the density of your boat by finding the mass (by weighing on scales) and dividing this by the volume (width x length x height). Workout how much in grams your boat can carry (for help: <https://www.bbc.co.uk/bitesize/guides/zt6p34j/revision/5>).

5. Place your boats on the water, stand back to make sure it can float for 5 seconds. Count in your cargo, keeping a record of how many. You might want to put in 10 at a time in the beginning (do not put more than this in one go) then one-by-one until it sinks.

- Aim to get 500g, anything over 1kg is just fantastic and few boats can get over 2kg! Can yours?

**Extension:** Build another boat that can fit more cargo / mass - name your boats and record your findings – what was different?

**Conclusion Question:**

**Which part of the density equation do you need to increase to carry more cargo?**

