# Float your Boat

**Aim:** To enable students to become aware of the engineering techniques used throughout the waterways of Ireland.
The float your boat worksheet consists of an introduction into boat building, an activity and a question & answer section. All of which can be carried out within a classroom setting. The worksheet aims to link in with the following curriculum links:

**STEM (Science, Technology, Engineering and Maths)**

**4th Class**

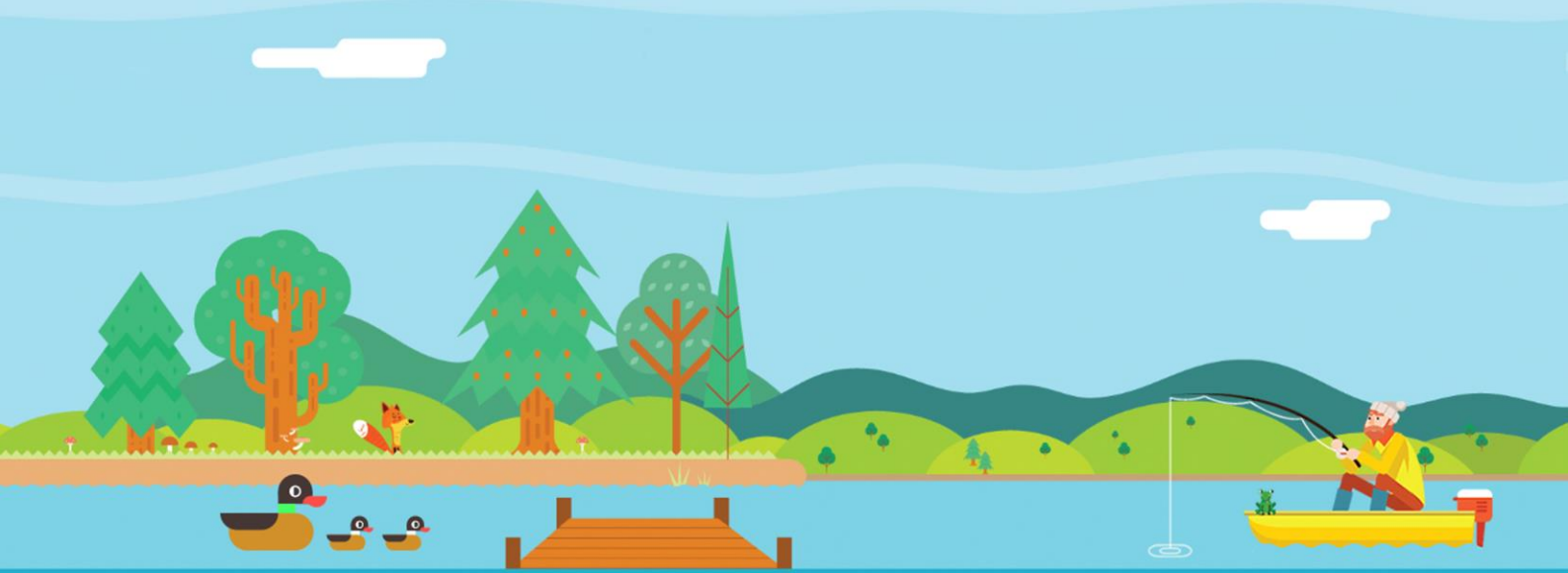
**Strand: Science, Technology, Engineering and Maths**

- Talk and discussion
- Active learning
- Collaborative learning
- Problem solving
- Skills through content
- Free exploration of materials
- Investigative approach
- Using the environment

**KS2**

**Strand:** Thinking Skills and Personal Capabilities (TSPC) Framework

- Managing Information
- Thinking, Problem Solving and Decision Making
- Being Creative
- Working with Others
- Self-Management



# Float Your Boat

## Key concepts

- Water
- Density
- Physics
- Hydrodynamics
- Fluid dynamics

## Introduction

Have you ever wondered how a ship made of steel can float? If you drop a steel bolt into a bucket of water, the bolt quickly sinks to the bottom. Then how can a steel ship float? And better yet, how can a steel ship carry a heavy load without sinking? It has to do with the density of the ship (including its cargo) relative to the density of water.
In this activity, you'll make little "boats" out of aluminium foil to explore how their size and shape affects the amount of weight they carry and how this relates to water density.

## Materials

- Aluminium foil
- Ruler
- Tape
- Calculator
- Scrap piece of paper and pen or pencil
- Bucket, tub, sink or dishpan
- Water
- Pennies. You may need as
- many as 200, depending on the size and shape of the boats you make.
- Rag or paper towels
- Dry rice and measuring cup (optional)

## Preparation

**1)** Cut two squares of aluminium foil, making one square with dimension that are twice that of the other square. For example, you could make one square that is 30 by 30 centimetres (one by one foot), and make the second square 15 by 15 centimetres (six by six inches).

**2)** Fold the two aluminium foil squares into two different boats. Try to make them the same shape. For example, you could make them both have two pointed ends (like canoes) or you could make them square or rectangular with straight edges that come up on the sides (more like a barge).

**3)** Make finishing touches to the boats. Make sure they don't have any leaks. If needed, use a little tape to make them stronger. Flatten the boat bottoms. On each, try to make sure the rim is the same height going all around

the boat edges.

Why do you think this is important?

**4)** Calculate the volume of each boat. If both boats are square or rectangular, you can measure the length, width and height of each and multiply these dimensions together to get its total volume. If parts of the boat have an irregular shape, measure the volume piece-wise and then add these volumes together. Use triangles to approximate any areas of the boat that are curved or angled. What is the volume of each boat?

**5)** Alternatively, you can use dry rice to calculate the volume of each boat. To do this, carefully fill each boat with dry rice so that the rice is level with the top of the boat. Being careful not to damage the boat, transfer the dry rice into a measuring cup. What is the volume of each boat using the rice?

**6)** Count how many pennies the boat could support before sinking (the penny that sank the boat does not count). How many pennies could it support?

**7)** Repeat this process with the other boat. Be sure to only add dry pennies. Why do you think using dry pennies (instead of wet ones) is important?

**8)** Could the larger boat support a lot more pennies than the smaller one?

**9)** Make sure that the volume you calculated for each boat is in cubic centimetres (cm3). Convert it if necessary and write it down. (Cubic centimetres are the same as millilitres, or ml.)

**10)** Convert the number of pennies each boat could support to grams. To do this, multiply the number of pennies by 2.5 grams (the weight of a single penny). How many grams could each boat support? Write this number down for each boat.

**11)** For each boat, divide the number of grams it could support by its volume in cubic centimetres. This roughly gives you the boat's density. What was the density of each boat right before sinking? How do you think this relates to the density of water?

## Background

**Question:** What determines whether an object floats or sinks?

**Answer:** It's the density (mass per unit of volume) of the object compared with the density of the liquid it is in. If the object is denser than the fluid, the object will sink. If the object is less dense, then it will float.

With a steel-boated ship, it is the shape of the boat that determines how well it floats and how much of a load it can handle.

On an empty ship with a steel bottom enclosing a volume of air, the ship's density is equal to the sum of the mass of the steel boat and the mass of the enclosed air, all divided by the boat's volume:

The ship floats because its density is less than the density of water. But when cargo or other weight is added to the ship, its density now becomes the sum of the mass of the steel boat, enclosed air and cargo, all divided by the boat's volume. If too much weight is added, the ship's density becomes greater than that of the water, and it sinks. Excess cargo would need to be thrown overboard in a hurry or it's time to abandon ship!