babcock™

1 HOUR

Rubber band powered submarine

Materials

- 2x plastic bottle
- 1x rubber band
- Lollipop stick
- Scissors
- String or a paper clip
- Water
- Tub of water

Activity Overview

The challenge of this activity is to build a functioning submarine powered by a rubber band that can cross a tub of water in the fastest way possible.

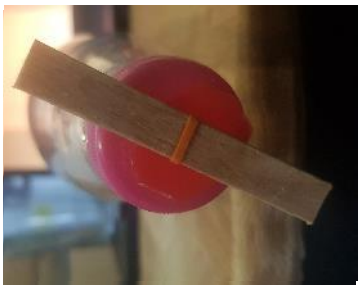
The key elements are:

- The submarine must be self-starting from a standing start and only the rubber band is allowed to provide drive (no external forces allowed)
- The submarine must be made from completely recycled materials, where possible
- The submarine must be as watertight as possible; small leaks may be difficult to avoid

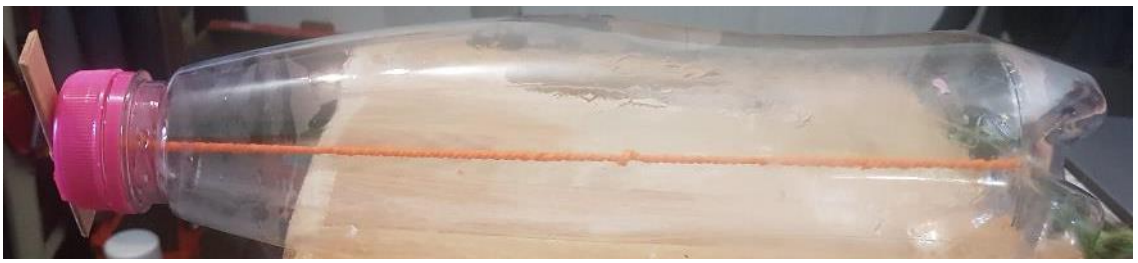
Activity Plan

Build Phase – Body:

- Start by cutting a small hole in the centre of the cap. Cut a similar hole in the centre of the bottom of one of the bottles (just wide enough to fit the rubber band through)
- Tie a length of string, which is approximately the same length as the bottle, around the rubber band and feed the band through the bottom of the bottle whilst keeping a hold of the string (an unfolded paperclip could also work)



- Remove the cap from the bottle before feeding the rubber band through the lid of the bottle. Secure on the top of the lid using a lollipop
- Screw the lid back on
- Now pull the string back out the bottom of the bottle until the elastic band is stretched across the length of the bottle
- Tie a secure knot in the string and cut off any excess string. You should have something like this:



- The sub can be tested in this condition or you can build a propeller using the second bottle

Build Phase – Propeller

- → Using the second bottle, carefully cut the bottle about ¼ of its length down from the lid
- → Keep the section with the lid and recycle the rest of the bottle
- → Similar to before, cut a small hole in the lid big enough to fit the rubber band through
- → Cut a series of lines along the length of the bottom of this section, at even distances (about 4 or 5 should do)
- → Peel back these sections while slightly twisting them in one direction to create your propeller
- → Take hold of the rubber band on the body of the sub and remove the lollipop stick before feeding the rubber band through the lid of the propeller (upside down to the lid of the body), and secure on the other side using more string
- → Screw on the rest of the propeller to the lid
- → The build phase is now complete

Testing Phase

- → To charge the propeller of the submarine, simply hold the body and twist the propeller to create tension in the rubber band
- → Keep twisting until you feel like there is enough resistance coming from the band (careful not to twist too much, as you may snap the rubber band)
- → When ready, place the submarine in one side of your tub of water and release. Remember - the propellers on submarines are at the back!
    - How quickly/slowly did your sub manage to cross the surface of the water?
    - What happens when we charge the propeller more or less?
    - Can your sub go in a straight line when it is moving fast?
- → Now fill your sub up with some water and retest
    - What happens to its performance?
    - Does it look more or less stable than when it was on the surface?

Remember: Your submarine may leak more water into the body, so test this part quickly

- → Now completely fill your sub up with water and retest
    - What happens this time?
    - Is there too much water in the body for the sub to function properly?

Learning Objective

- → Gain a basic understanding on how propellers can be used to generate thrust
- → Gain a basic understanding of buoyancy forces

Reflection Questions

→ What forces act on the submarine when it is travelling through the water?

→ Why does the submarine sink when we fill it with too much water?

→ How could we better balance the submarine, so it can go in straight lines more effectively?

→ How could we make the submarine more/less buoyant?

Final Product Examples

These examples from the web have progressed one step further, with the use of additional materials to balance the buoyancy forces