

PRACTICAL EXPERIMENT 4 - SOAP BOAT TEST

This is an alternative to the Soak Test. It requires more planning and time to complete.

Difficulty: Medium/Hard

Time Required: 20 minutes

Equipment Required:

Large bowl or water container filled with water

A flat, level surface

Soap Boat (see stencil outline) made from card

Pipettes

1 bottle of Endotherm solution

Note:

EndoTherm test solution is available as part of the Eco-Schools resource pack please contact EndoTherm to request it. Washing up liquid can also be used as an alternative to mimic the EndoTherm effect in the practical experiments in the classroom. Washing up liquid is not a substitute for EndoTherm and should NOT be dosed into a heating system under any circumstances.

PROCEDURE

1. Fill the container about $\frac{3}{4}$ full with water and lay on flat surface.
2. Assemble the boat using card, cut out a triangle from the bottom of the card and fold up the corners to create a pointed nose shape.



3. Place card soap boat on the surface of the water.
Continued over



PRACTICAL EXPERIMENT 4 - SOAP BOAT TEST

PROCEDURE - continued

4. Touch the water behind the cutout triangle with soap using your preferred method i.e. your finger, a cue tip, a toothpick, or simply dropping soap onto the surface of the water.
5. If you have a large enough container, you could organise boat races where students are only allowed to use the pipettes and EndoTherm Solution to power the boat.

OBSERVATION AND RESULTS

Why does the boat move forward? Liquids with lower surface tension tend to move toward liquids with higher surface tension. You can think of this as a tug of war between different liquids. The one with the higher surface tension pulls harder and wins the war, and the lower surface tension liquid will move toward it. This is called the **Marangoni Effect**. Soap has a lower surface tension than water, so the soap will move toward the water. As the soap moves backwards away from the boat, Newton's law of equal and opposite reactions states that the boat must in turn move forward!

Soap also lowers the surface tension of water. Soap is a long molecule with a hydrophobic end (an end that does not like water) and a hydrophilic end (an end that likes water). When the hydrophilic ends bond to the H₂O molecules, they tend to break the bonds between water molecules and form a layer on the surface. This new arrangement lowers the surface tension. Now imagine the forces on the boat. The surface tension in the back of the boat is lower, but remains the same on all other sides. Therefore, there will be a net force forward, and the boat will move forward!



PRACTICAL EXPERIMENT 4 - SOAP BOAT TEST

SOAP BOAT TEMPLATE

FOR BEST RESULTS TO USE GLOSSY PAPER OR CARD

