

Soap-Powered Boat

Equipment:

(coated) cardboard such as a notecard or
a thin sheet of PVC plastic or Styrofoam
scissors
wide container such as a bowl, a trough
or a tray
cotton swab or toothpick

Chemicals:

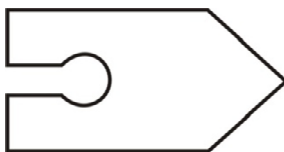
tap water
dishwashing liquid

Safety:

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Procedure:

Preparation: The cardboard is cut into the shape of a boat with a small notch in the back (like in the example below).



The container is filled with water.

Procedure: The “boat” is gently placed on the water. The cotton swab (or tooth pick) is used to collect a small amount of dishwashing liquid. Subsequently, the end of the cotton swab is dipped into the water in the notch in the back of the boat.

Observation:

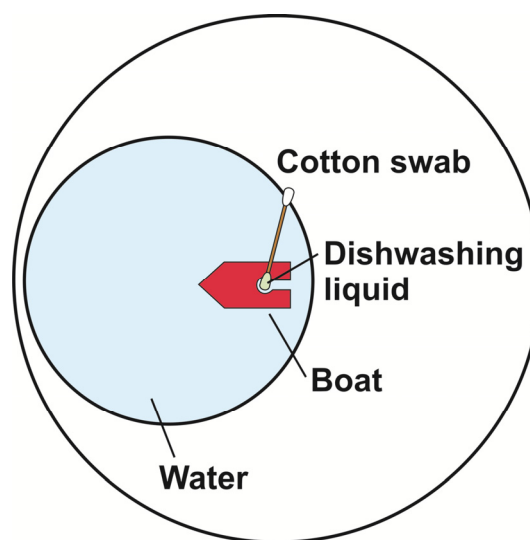
The boat zooms forward in the water.

Explanation:

The soap boat experiment makes use of the “Marangoni effect,” the tendency of molecules to migrate from a region of low surface tension to a region of high surface tension. Since the surface molecules in a liquid with a high surface tension pull more strongly on the surrounding molecules than in one with a low surface tension, the presence of a gradient in surface tension will naturally cause the molecules to move away from regions of low surface tension.

When dishwashing liquid is placed in the notch, the surface tension of the water in that small area is reduced. A soapy film spreads out on the water surface from the back of the boat, thereby “pushing” the boat forward. This is similar to a rocket where the gases flowing out of the tank at the bottom force the rocket in the opposite direction, meaning upwards into the air.

Once the soapy film has covered the whole surface of the water in the container, the boat stops moving.



Disposal:

The liquid can be flushed down the drain. The solid waste such as the boat and the cotton swab (or tooth stick) can be disposed of together with the household garbage.