

PEPPER SCATTER

Objectives

To educate students on surface tension of water and how surfactants (used in everyday and agricultural products) can break the surface tension of water.

Duration

30 minutes

Group Size

20-30 students

Materials

- Petri dish x 15
- Tooth pick x15
- Jugs x15
- Plastic pipette X15
- Detergent (1 bottle—to share among pairs)
- Pepper X 2 (to share among pairs)
- Handout—MDBA Basin Kids, 'Surface Tension'

Background

Surface tension is the result of the strong attraction between molecules in a liquid. Water has an unusually high surface tension because water molecules are very strongly attracted to each other and stick together.

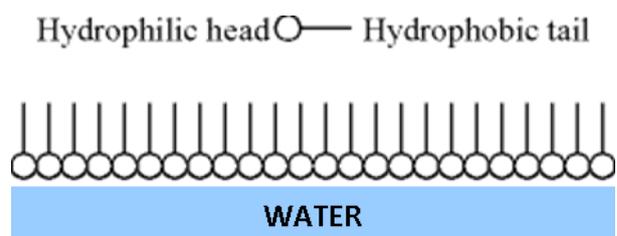
The high surface tension of water (strong attraction) allows insects (eg. water strider) to walk on water, rain to form droplets and beads of water to form on leaves.

Surfactants (surface active agents) are chemicals that reduce the surface tension of the water. Surfactants include detergents and agricultural wetting agents (in agricultural sprays).

They work by allowing oil and water to mix, lowering the surface tension of the water and therefore making it wetter (spreading it out further).

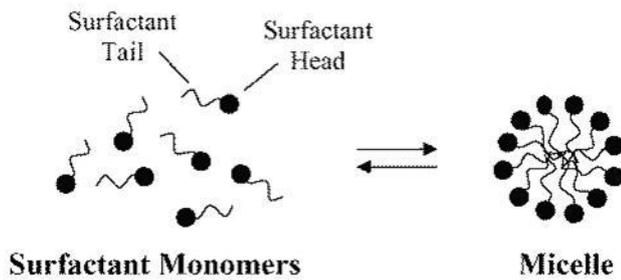
Every detergent molecule has two distinct ends which chemists call the head and the tail. The tail is hydrophobic (water hating) which strongly repels water. The head is hydrophilic (water loving) which is strongly attracted to water. As a result, detergent molecules prefer being on the surface of water with their water repelling tails sticking up and out into the air.

Figure 1: Detergent molecules on water



When you first add detergent to water, the molecules scurry across the surface with their heads down and tails sticking up. Once the surface is full, the remaining detergent molecules begin forming small droplets (called micelles) by joining their tails. This hides the hydrophobic tails from the surrounding water.

Figure 2: Remaining detergent molecules forming micelles



Detergent heads are attracted to water, but not nearly as strongly as water molecules are attracted to each other. This means that where you add detergent, the water molecules on the surface pull away, therefore reducing the surface tension of water.

In this experiment the reduction in surface tension (water pulling away from the detergent) can be seen by the pepper scattering.

LESSON PLAN

Introduction (10 minutes)

Introduce students to the words— surface tension and surfactants. See if they can answer what they are and what they do. Briefly explain these terms to provide students with a basic understanding.

Eg: water molecules have a high surface tension (strong attraction) which allows insects to walk on water, rain to form droplets and beads of water to form on leaves. Surfactants (including detergents and wetting agents in agricultural sprays) are chemicals that reduce the surface tension of the water.

Setting the Scene (3 minutes)

Explain to students that in this experiment they will be sprinkling pepper over water and poking a toothpick into water. They will then add detergent and poke the toothpick in again.

Ask the students what they think will happen when:

- The pepper is sprinkled onto the water?
- The tooth pick is poked into the water?

- Once the detergent is added?

Activity (10-15 minutes)

Explain the experiment to the students, divide them into pairs (or small groups) and ask them to conduct the following steps:

1. Half fill a petri dish with water using the cup and plastic pipette (allows more accurate pouring and less spillage)
2. Use food colouring if wish
3. Sprinkle pepper over the water
4. Take a tooth pick and poke it into the water to the bottom of the petri dish (nothing will happen)
5. Dip the tooth pick into detergent so a small drop is on the end
6. Poke the tooth pick into the water and watch what happens (the pepper will scatter)

Conclusion (5 minutes)

- The motion results from the reduction in the water's surface tension when detergent is added.
- This only works once because the detergent molecules that cover the surface of water stay there.

Explain the terms surface tension and surfactants as of the background information (with the use of diagrams), to help students understand what happened in the experiment.

More information

Contact Sandy Dellwo, Land Services Officer – Education on 03 5880 1415.

Acknowledgments

This activity has been adapted from an activity provided by the Riverina Environmental Education Centre. For more information visit:

www.reec.nsw.edu.au