Hydrogel Outreach Activity

Total activity duration: 30 mins

This activity aims to introduce the concept of hydrogels, with experiments to demonstrate what a hydrogel is, how they are formed, what they could be used for, and how hydrogel formation and collapse occurs.

Equipment needed:

- one nappy (per student or pair of students)
- scissors
- mixing bowl or waterproof container (e.g. see through cup)
- water
- table salt
- hair gel
- stirring implement
- food dye
- use of plastic gloves and eye goggles recommended

Introduction (5 minutes):

- Briefly introduce what hydrogels are and some common examples of hydrogels (e.g. jelly, contact lenses) as well as introducing further uses such as drug delivery devices.

Figure 1. Some common hydrogel examples.

- Explain the practical activities we will be carrying out in the session to demonstrate hydrogel materials.

Experiments (15 minutes):

Experiment 1 – Hydrogel collapse using hair gel

Instruct the students to squirt some hair gel in a container and cover it in table salt. Allow this to rest while Experiment 2 is carried out.

Figure 2. Set-up for the hair gel collapse by salt addition.

Experiment 2 – Making nappy gel

- Instruct the students to cut open the central part of a nappy using scissors. Under the fluffy absorbent layer, they should find a layer of dried hydrogel as a powder. Tell the students to collect as much of this hydrogel powder as possible in a container, removing any bits of fluff.

- The students should weigh how much hydrogel powder they have collected, having weighed the empty container beforehand.

- Next, the students should try to saturate the hydrogel powder with water, by adding water slowly until no more water can be observed. The students should then weigh the saturated gel. They should observe that the volume of the gel has greatly increased.

- The students should calculate how much water has been added, and could calculate the percentage of water content of the gel from the measured weights.

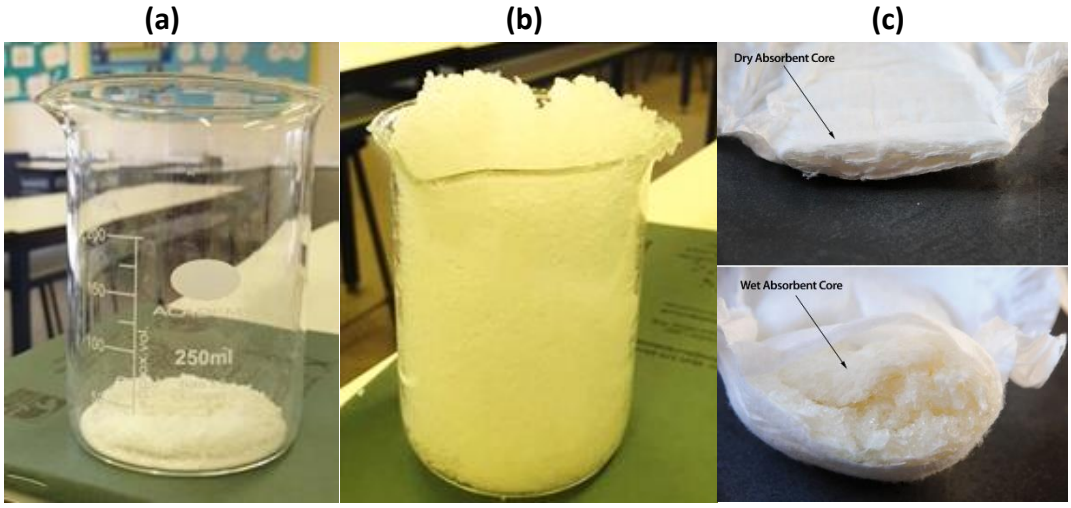

Figure 3. Nappy hydrogel. (a) Dry nappy hydrogel powder, (b) hydrogel formed after water is added to the nappy powder, (c) how this water absorption occurs in a nappy.

After Experiment 2, the students should go back to Experiment 1. They should observe that the hair gel has separated into a solid and free water as the hair gel collapses.

Extensions:

Extension 1: Tell the students to add salt to the nappy gel and observe what happens.
Extension 2: Try using food died water to inflate the hydrogel powder instead of regular water. What difference does this make?
Extension 3: What happens if you add a tiny bit of hydrogel to an excess of water? Can you still see the gel?

Clear up (5 minutes):

Experiments should be carried out in plastic containers to minimise the clear up needed. Newspaper or plastic bin liners could be laid out to cover the working area.

Conclusion (5 minutes):

- Ask the students to reflect on the activities. What did they observed in the experiments and how much water could the hydrogel hold?

- Summarise the key points covered in the session. Explain how the hydrogel is formed by water uptake, and explain how collapse occurs as salt ions interrupt the hydrogel structure.

- Offer an opportunity for students to ask any additional questions they may have.

Health and safety

The most common hydrogel inside nappies is sodium polyacrylate. Sodium polyacrylate is non-toxic and non-carcinogenic. However, it can cause serious eye irritation. Protective gloves and eye/face protection is recommended and hands must be carefully washed after working with the chemical. Work spaces should also be carefully cleaned. If the chemical gets into eyes, eyes should be rinsed thoroughly with water. If accidentally swallowed, mouth should be rinsed with water. Most serious side effects include minor irritation, headaches, nausea and shortness of breath.

The most common hair gel is Blue styling gel. There are no known effects or critical health hazards. No special protective equipment is needed to handle the gel. If gel comes into contact with eyes or accidentally ingested then eyes/mouth should be thoroughly rinsed with water.

Students should also be careful when using scissors.