

Magic Sand Experiment

Safety and First Aid

This section will only deal with the specific safety issues regarding the chemicals involved in the video; there are likely to be other safety issues that will need to be addressed outside the scope of this section. A full risk assessment should be performed prior to undertaking the experiment.

- Students should not ingest any of the experiment; good lab practice starts young!
- Read the MSDS and safety documents for your specific brand of waterproofing spray. Common hazards are flammable aerosol and toxic chemicals with repeated exposure; we recommend the spray not be used by the students.
- *First Aid* – for the water proof spray, this will be detailed in the safety documents provided with the product.

Glossary

- *Hydrophobic* – a physical property of a material that results in the apparent repelling of water from its surface
- *Hydrophilic* – a physical property of a material that results in the attraction of water molecules to its surface

Suggested Teaching Points

- *Hydrophobic materials* – this experiment works as a result of the hydrophobic nature of the waterproof spray
- *Commercial application of chemistry* – this experiment highlights the use of chemistry in everyday life
- *Interactions between different states of matter* – this experiment will highlight how different materials react with different states of matter

What to Expect

Please see the video for a detailed depiction of the experiment.

This experiment will demonstrate the commercial application of chemistry by utilising waterproofing spray to coat sand, followed by investigating its interaction with water. The surface of normal sand is typically very hydrophilic and so attracts water molecules to its surface. Since grains of sand are

attracted to the water molecules bound to the surface of another grain of sand, this has the effect that wet sand clumps together. When the sand is sprayed with the waterproof spray, this coats the individual grains of sand with an oily-material that is hydrophobic in nature. As a result, when the coated sand is poured into water, the water molecules no longer stick to the surface of the sand grains attracting them to each other. Thus, the coated sand does not clump together but rather forms piles with trapped air inside. Since the water is not able to stick to the surface of the sand grain, when the coated sand is removed from the water, it is completely dry.

Equipment and Chemicals

- Sand – coloured sand will also work
- Water proof spray – any brand will work
- A tall glass of water
- A shallow container

Supplementary Instructions

- We recommend that students not be allowed to use the waterproof spray for safety reason; this is, however, the teacher's decision.
- Try not use excessive amounts of waterproof spray as it will take longer to dry.
- The sand needs to have completely dried before continuing with the experiment; overnight should be long sufficient.
- The Magic Sand can be removed from the water and stored for future use. If the waterproofing effect deteriorates, simply recoat the sand with an additional layer of waterproof spray.

Suggested Questions for Students

- *What use could waterproof sprays have?* – commercial waterproof sprays have a wide range of applications from applying to shoes, tents, coats, cloths and many more.
- *What makes a material hydrophobic or hydrophilic?* – there are a huge number of factors that affect the ability of a surface to either repel or attract water. A simplified explanation can be thought of as a measure of how strong the bonds are between individual water molecules and between water molecules and the surface. If the bonds between individual water molecules are stronger than the bonds between water molecules and the material, the material will be hydrophobic because the water molecules will prefer to be bound to

themselves. If, however, the bonds between individual water molecules are weaker than that the bonds between water molecules and the material, then the material will be hydrophilic because the water molecules will prefer to bind to the material than each other.

- *Why doesn't sand dissolve in water?* – for a substance to dissolve in a solvent, the bonds that are made between the solute and solvent molecules must be stronger than those between the solute molecules themselves. In the case of sand, the bonds between the molecules of sand are much stronger than the bonds between the sand molecules and water. As a result, sand does not dissolve in water.

Suggested Improvements / Student Challenge

- *Change the brand of waterproof spray* – students could investigate if different brands of waterproof spray work better. This could be a measure of how efficient different commercially available waterproofing sprays are.
- *Can you prevent sugar from dissolving* – students could be challenged to see if this water proofing technique could be applied to sugar and prevent it from dissolving in water.
- *Use a selection of coloured sand* – students could use a selection of various different coloured sands to construct colourful underwater sculptures.

Clean up and Waste Disposal

No specific waste protocols are required for this experiment; all the waste can be disposed of in a bin.

Spillages can be cleaned with soapy water and paper towel.