

Western Engineering Outreach

Waterproof Clothes

Grades 6-8

Meet Today's ENG HERO!



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Dr. Gillies obtained her PhD from University of California, Berkeley in 2004. She leads a research program in smart materials and biomaterials with a focus on polymer chemistry and the design and synthesis of materials with new properties and functions. She works with other research groups to apply her materials to drug delivery, regenerative medicine, and agriculture.

If you want to learn more about Dr. Gillies, visit <http://publish.uwo.ca/~egillie/>

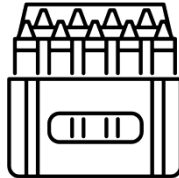
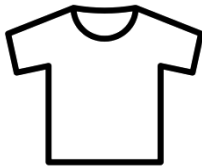
Learning Goal:

- Students will learn about hydrophobicity and investigate ways to make material repel fluids
- Students will be introduced to the idea of nanotechnology
- Curriculum Connections: Grade 8 - Fluids, Grade 7 - pure substances and mixtures

Materials Needed:

- 8" X 8" pieces of plain grey cotton fabric and/or other (water absorbent) materials
- 4" x 4" pieces of nano tshirts <https://www.hanes.com/shop/hanes/hanes-mens-nano-t-t-shirt-h4980>
 - optional
- waterproofing materials
 - wax
 - crayons
 - flax seed
 - clay
 - glue
 - lanolin / oils
- spoons / sticks for smoothing

- cup of water to test waterproofing
- hair dryer to melt wax / crayons
- Plastic bags
- soap (for the removal trials), green scrubbers



Engineering and Science Connections:

Today we will be talking about solubility and hydrophobicity.

Where have you noticed solubility and hydrophobicity in everyday life?

Solubility

Solubility refers to the ability of a substance (**solute**) to dissolve into a **solvent**. Often, we will think about solids such as salt or sugar dissolving in water as examples of solubility. However, solutes can be in solid, liquid, or even gaseous form.

When a solute is fully dissolved in another, the resulting substance is a solution of the two pure substances. The two pure substances are not easily separated. However, if it does not completely dissolve and the substances remain in their pure form and are easily separated from one another, the result will be a mixture of the two pure substances.

Hydrophobicity

Hydrophobic: from Latin, hydro = water, phobos = fear. These substances are water-hating.

Hydrophilic: These substances are water loving.

Have you ever noticed what happens when you mix oil and water? The oil does not want to mix with water and will not form a solution because it is hydrophobic. Have you also noticed when rain falls the rain beads on the surface of the leaves of plants? This is because the waxy coating on their leaves is also hydrophobic, or they possess tiny hair-like projections on the surface of the leaf that provides an air pocket of sorts that also repels water.

Scientists and engineers have found ways to apply the hydrophobic effects of certain materials to various fabrics to waterproof them.

How Do You Make Something Water Repellant?

There are two major methods:

1. Creating air pockets that separate the water from the fabric fibres
2. Coating the fibres with a substance that water cannot absorb or dissolve in

Nanotechnology has been used by engineers to add tiny “hairs” on cotton fibres (similar to those on certain leaves) to create air buffers. These hairs are added along the cotton fibre and prevent water from soaking into the fibre, which makes the material more breathable and flexible than using waxes.

Video Recommendation: Ultra Ever Dry (cool examples of everyday items being treated with a substance to become hydrophobic)

<https://www.youtube.com/watch?v=BvTkefJHfCQ>

Activity:

Before you start, think about the following questions:

- Which of my materials are hydrophobic and insoluble in water?
- Which method am I using to make this clothing water repellant?

Class Field Trip

Your science class is going on an amazing field trip that you’ve been looking forward to all year long! The weather forecast called for sunny skies all day, but all of a sudden it starts pouring rain. No one brought waterproof clothes but getting soaked will make the field trip much less enjoyable.

Thankfully, this is a class full of future scientists and engineers and you have all the available materials to make your clothing waterproof so you can get back to having a super fun field trip.

Using the materials listed, design a plan to make your fabric waterproof. You may want to try multiple variations and test them against each other. Use water with food colouring to test your materials. If it stains the fabric, you may need to re-think your plan and try something else. If it doesn’t stain, you have successfully engineered a piece of waterproof fabric!



Some Ideas to Get You Started

Looking at the materials list, you can tell which of the materials will be hydrophobic for sure. We know oil and water don't mix, but putting oil directly on the shirt might not be a good solution because it would simply sink into the fibres and create a new problem. To counteract this, we might need a protective layer between the oil and the fabric. We also know that wax resembles the outer coating on plants that repels water, so should do the trick. Crayons are very waxy and can form a wax coating if you melt them down with a hairdryer. Linseed oil, which comes from flax seeds, is often used for waterproofing wood. Flax seeds are extremely absorbent in general, so it may be interesting to investigate if their efficiency as a waterproofing material, perhaps when paired with something else acting as a protective layer.



What Did You Learn?



- Why was your material hydrophobic after the experiment? How did the 'ingredients' you added make the water bead up and not be absorbed into the fabric?
- What is the difference between a mixture and a solution?
- What does it mean for a substance to be hydrophobic? Hydrophilic?
- How is nanotechnology used to create water resistant materials?
- How do chemical engineers use inspiration from nature to create waterproof products?

Future Learning



- How might you remove your waterproof coating?
 - Try various methods like scrubbing, heating, freezing, washing, ironing, etc
- Test the waterproofing methods on other absorbent materials such as paper towels or bread

Share your creations!

We would love to see what you made. Email us at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!