Materials You'll Need:

- Clear glass or plastic cups (at least 3)
- Water
- Vegetable oil (or any cooking oil)
- Food coloring (optional, but helpful)
- Dropper or pipette
- Wax paper
- Sand
- Cocoa powder
- Spoon
- Tray or plate (to contain any spills)
- Optional: Magic Sand (hydrophobic sand)
- Optional (with Adult Supervision!): Waterproofing spray (like Scotchgard)
- Safety goggles

Lesson: Exploring the World of Hydrophobic Substances!

Hey there, future chemist! Ever wondered why oil and water just don't seem to get along? Or how ducks stay dry even when swimming? It all comes down to a property called 'hydrophobicity'. Let's dive in (or maybe not, if you're hydrophobic!) and explore!

What Does Hydrophobic Mean?

'Hydro' means water, and 'phobic' means fearing. So, **hydrophobic** literally means "water-fearing". Hydrophobic substances do not mix with, dissolve in, or get 'wet' by water. Think of oil floating on water.

The opposite is **hydrophilic**, which means "water-loving". Substances like salt or sugar dissolve easily in water – they are hydrophilic.

Why the difference? It's mostly about the electrical charges on the molecules. Water molecules are 'polar' – they have a slight positive charge on one end and a slight negative charge on the other, like tiny magnets. They love sticking to other polar molecules (hydrophilic). Hydrophobic molecules are usually 'nonpolar' – they don't have these separated charges, so water molecules aren't attracted to them and prefer to stick to each other instead, pushing the nonpolar molecules away.

Experiment 1: Oil vs. Water

1. Put on your safety goggles!
2. Fill a clear cup about halfway with water.
3. Add a few drops of food coloring to the water and stir (this helps see the separation better).
4. Carefully pour about 1/4 cup of vegetable oil into the cup.
5. Observe! What happens immediately? Does the oil mix with the water? Where does the oil end up?
6. Try stirring the mixture vigorously with a spoon. What happens when you stop stirring?
7. **Observation:** You should see the oil and water separate, with the less dense oil floating on top. Even after stirring, they separate again. This is because oil is hydrophobic (nonpolar) and water is polar.

Experiment 2: Water Droplets on Wax Paper

1. Place a sheet of wax paper on your tray.

2. Using a dropper, place a few drops of water onto the wax paper.
3. Observe the shape of the water droplets. Do they spread out flat or stay beaded up?
4. Try tilting the wax paper slightly. What happens to the droplets?
5. Now, place a drop of water on a regular piece of paper (not wax paper). How does it behave differently?
6. **Observation:** Water beads up on wax paper because wax is hydrophobic. The water molecules are more attracted to each other than to the wax surface. On regular paper (which is more hydrophilic), the water spreads out more as it's absorbed.

Experiment 3: Hydrophobic Powders

Let's see if we can make everyday powders behave hydrophobically!

Part A: Cocoa Powder / Sand

1. Fill a cup about halfway with water.
2. Gently sprinkle some cocoa powder or sand onto the surface of the water. Observe immediate reaction.
3. Try to gently push the powder down into the water with a dry spoon. What happens? Does it get wet easily?
4. Now, stir the powder into the water. Does it mix well, or does it clump?
5. **Observation:** Natural cocoa powder contains fats (lipids), which are hydrophobic, so it might resist mixing initially. Sand is mostly silica, which is somewhat polar but can resist wetting initially due to surface tension. Compare their behavior.

Part B: Magic Sand (Optional)

1. If you have magic sand, fill a cup with water.
2. Pour some magic sand into the water. Observe its behavior.
3. Try scooping the sand out with a spoon. Is it wet or dry?
4. **Observation:** Magic sand is sand coated with a hydrophobic substance. It clumps together in water and comes out completely dry!

Part C: DIY Hydrophobic Powder (Optional - Adult Supervision Required!)

1. **Ask an adult for help and do this in a well-ventilated area or outside.**
2. Spread a thin layer of regular sand on a tray.
3. Following the product instructions, have an adult spray the sand lightly with waterproofing spray. Let it dry completely (this might take a while).
4. Once dry, carefully try adding this treated sand to a cup of water. How does it behave compared to the untreated sand?
5. **Safety Note:** Waterproofing sprays are chemicals and should only be handled by an adult according to the manufacturer's instructions.

Wrapping Up & Real-World Connections

Today you saw hydrophobic substances in action! Oil, wax, and specially treated sand all repel water because their molecules are nonpolar, unlike polar water molecules.

Where do we see this in real life?

- **Waterproof Jackets/Tents:** Coated with hydrophobic materials.
- **Duck Feathers:** Ducks produce oil that coats their feathers, making them hydrophobic so water rolls off.
- **Car Wax:** Makes water bead up and roll off your car.
- **Cell Membranes:** Parts of the membranes surrounding cells in our bodies are hydrophobic,

controlling what goes in and out.

Great job experimenting today! You've explored a fundamental concept in chemistry by observing how substances interact (or don't interact!) with water.