# Attachment Issues

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## Basic Knowledge:

Do you ever wonder why vinegar and oil don't mix? It's because oil is nonpolar and vinegar is polar, meaning that polar molecules have a slightly negative charge at one end and a slightly positive charge on the other end. It's like magnets, so polar molecules are attracted to other polar molecules. Which explains why oil repels vinegar because oil doesn't have a positive nor negative charge, it's neutral. Also, oil is hydrophobic meaning it fears water, or in this case vinegar. Another thing is, oil is less dense, so that's why it always floats to the top. So, how are we able to make things such as salad dressings and mayonnaise? We use emulsifiers. Emulsifiers make nonpolar and polar molecules attract to each other for a long periods of time or forever. This type of mixture is called an emulsion. In this experiment, I will be using three different types of emulsifiers; lecithin, xanthan gum, and mustard powder to see which one is the most effective.

## Materials Needed:

- 5 Tablespoons of Vegetable Oil
- 5 Tablespoons of Vinegar
- 1 Teaspoon of Lecithin
- 1 Teaspoon of Xanthan Gum
- 1 Teaspoon of Mustard Powder
- 4 Clear Glasses
- Magnet Mixer
- Heat Pad
- A Stopwatch

## Instructions:

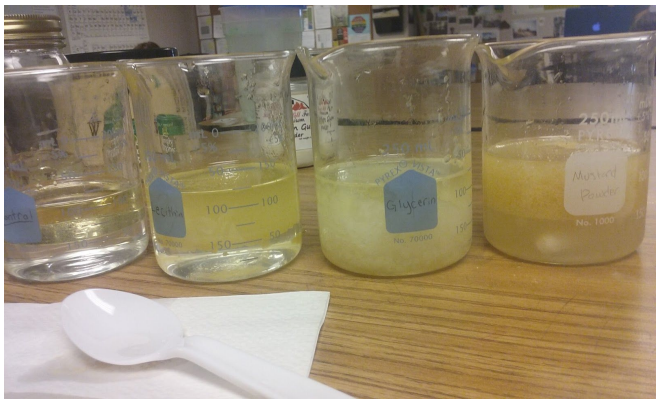
1. Get four clear glasses.
2. Add 5 tablespoons of vinegar to each glass.
3. Add 5 tablespoons of oil to each glass.
4. Put 1 teaspoon of lecithin in one glass, 1 teaspoon of xanthan gum in another glass, and 1 teaspoon of mustard powder in another glass. The fourth glass will not have an emulfiser because it's the control.
5. Place one of the glasses with an emulfiser on a hot pad and put a magnetic stir bar mixture in the glass.
6. Set the magnetic stir bar to 340 and let it stir for 30 seconds.
7. Start the stopwatch and observe the separation process.
8. Repeat steps 5-7 for each glass.
9. Record the data for how long it takes for the oil and vinegar to separate, if it ever does.

**Results:**

Figure 1: Oil and vinegar before adding the emulsifiers.


Figure 2: Oil, vinegar, and emulsifiers before mixing. Left to right; lecithin, xanthan gum, mustard powder.


Figure 3: The emulsion process after 5 minutes. Left to right; control, lecithin, xanthan gum, and mustard powder.



**Discussion/Analysis:**

After mixing the control for thirty seconds, the oil and vinegar separated after five seconds and settled down. For the lecithin, the vinegar and oil mixture lasted for two minutes, but even then the oil and vinegar did not fully mix. This result was the same for the mustard powder. The xanthan gum was the only variable where the oil and vinegar fully mixed and lasted about seven minutes before it slowly started to separate. So really, if you wanted to make a salad dressing, xanthan gum would be the only emulsifier that would work for a longer period of time compared to the mustard powder and lecithin.

The reason I chose lecithin, xanthan gum, and mustard powder for the emulsifiers is because they all have qualities about them that helps oil and vinegar mix. In xanthan gum, it has a thick consisty, which helps prevent the ingredients from separating and it stabilizes the emulsion. In the molecular structure for lecithin, it has one end that is hydrophobic that dissolves in the oil, and the other end is hydrophilic which dissolves in the vinegar, so they stay connected. Mustard powder is a good emulsifier because it has a wide range of chemicals in the mucilage (thick gooey substance in plants) that act as an emulsifier.

In my experiment, the mustard powder and lecithin did not act properly as described. That's why I am surprised that the xanthan gum was the only variable that worked. Maybe if I had added more of the substance it would have created a more effective emulsion.