11/20 — Chose the prompt for my science fair experiment:
Oil-water filtration

11/2:
The title of my project will be called: 'Comparing simple ways of oil-water filtrati

11/25 — Picked out 2 research papers that relate to my expenment. They are:

1. "Simple and Low-cost Oil/Water Separation Based on the Underwater Superoleophobic - by of the Existing Materials in Our Life or Nature." by Hao Bian, Jiale Yong, Qing Yang, Xun Hou, and Feng Chen.

2. "Oil-water Seperation: A Gift from the Desert" - Jiale Yong, Feng Chen, Qing Yang, Hao Bian, Guangqing Du, Chao Shan, Jinglan Hou, Yao Fang, and Xun H

At first, I picked it out due to the immense amount of experiments I conduct at school e.g. lava lamps, but soon after I realised oil-water filtration could be essential to eradicating tailing pond water.

12

12/01

Today, I researched all about tailing pond water and its effects on Alberta.

According to NRDC or National Resources Defense Council tailings are poisonous brews of water, sand, silt, and petrochemical waste products that are extracted from oil sands mining operations. These ponds have a huge environmental impact. They sicken local communities, poison wildlife, and contaminate Alberta's water resources.

My experiment is filtering oil out, which directly relates to this issue.

12/05

I prepared the necessary materials for my experiment.

1. Water
2. Oil (Canola)
3. Wire mesh / Metal Mesh
4. Sand (Stanley River Aquarium Sand)
5. Filter paper (Stonylab)
6. Scissors
7. Appropriate beakers / glass containers
8. Food colouring
9. Plastic bottle (Gatorade)
10. Drill
11. Metal Stand
12. Pencil

12/10

The materials have arrived via Amazon

12/15

I thoroughly read through some research papers. Here is what I gathered:

Tailing ponds are extremely problematic due to the hazardous compounds they contain. These include ammonia, mercury, napthemic acids and many more. These toxins can harm animals, and the ponds often leak, contaminating the surrounding land and groundwater. Additionally, they require long-time containment, with over 830 million m^3 needing management. This makes it hard for wildlife to survive, especially birds who are at high risk when coming into contact with tailing ponds.

12/20

Updated CYSF platform on my recent research.

12/30

Added info. to a new google slide

1/05

Preparing everything for the experiment

1/10

My dad has drilled small holes around 1-2 mm in size. To be exact, around 1.6 mm. This is so that when the oil-water mixture is poured into the plastic bottle, the ~~oil~~ mixture will be able to seep out through the holes in the cap.

1/20

Procedure:

1. Drill holes around 1-2 mm into Gatorade bottle cap.
2. Put bottle cap on bottle (cut it in half)
3. Put bottle into the metal stand
4. Cut filter paper to appropriate size (size of the bottle cap) Do this by tracing the bottom of the bottle cap onto the filter paper and cutting carefully.
5. Put the filter paper between the cap and the bottle.
6. Do the same thing w/ the metal mesh and put it between the cap + filter paper.

7. Pre-wet the filter paper
8. Put a beaker onto the metal stand directly under the bottle to catch the dropping water
9. Take out a separate beaker, and pour in a 1:1 ratio of water : oil.
10. Pour it into the beaker

1/25

Results of my first attempt of experimentation

- All of the water rushed out quickly
- At the very end, the oil was very slowly falling out
- It was a half-success
- Next time, I will try to add more layers of filter paper to see if that will stop the oil from dropping out.
- After ~ (4) minutes, the oil has reached the 5 mL mark.
- The oil went much slower than the water, but after ~ 20 minutes, the gatorade bottle was empty

1/28

I figured out a way to solve this problem, and filter the oil + water.

Do the same steps as before, but right as the water comes out and the mixture reaches the 20 mL mark on the beaker, quickly switch it out for a new beaker. The first beaker should be filled w/ water, and the second should be filled with oil. OR when the mixture slows down, switch the beakers.

This is because the water comes out very quickly due to its lower viscosity. All in all, I think this experiment was a success!

1/29
Next Experiment!

This time, I will be testing out sand as a filter.

1. Wash out previously used bottle, beaker, and mesh. You can also cut out a new layer of mesh.

2. Put the mesh into the bottle cap
3. Fill the bottle cap with sand up to the inner circle so that you can still screw on the bottle, without the sand overflowing.
4. Screw on the bottle
5. Put the bottle back onto the stand.
6. Fill a beaker with a 1:1 ratio of oil & water (I'm using 20mL: 20 mL.
7. Pour the mixture into the bottle and make sure to have a container underneath to catch the falling water

Results: This was extremely similar to the filter paper experiment. Once again, the water flowed out very quickly, and once the water was out, the oil flowed out at a much slower pace.

I do think that this time it was a little bit easier to do, and there was a longer pause between the water and the oil, making it easier for me to quickly switch the beakers.

2/01

Filter Paper + Sand Filtration:

1. Wash out bottle + appropriate containers
2. Put in a new metal mesh
3. Put in a piece of filter paper of the same size.
4. Pour in a layer of sand that fills the inner circle up w/o spilling.
5. Screw the cap back on
6. Do the rest as before

Results:

- It was the same result as before
- The water rushed out quicker than the oil
- I still had to change the beakers

2/03

We tried ~~triple~~ double lining the filter paper to see if it would help.

Results (no sand):

- This time it was MUCH slower than before, but it could've also been a side effect of forgetting to prewet the filter paper
- Time between each drop of water is 5.49 s.

This was a success!
The oil has stopped completely.

The mixture was successfully filtered out 20ml of water : 20 ml of oil. I then tried this 2 more times each yielding similar results. I think that this worked because this time instead of cutting the filter into a tiny circle that just barely fits the inner circle, instead you should directly put the filter paper in the lid without cutting it. This way, there is no chance of the oil escaping out through any small ~~cracks~~ gaps between the filter paper and lid.

1/04

Next, we tried sand + metal mesh.

This resulted in another failure. Both the water and the oil poured out non stop. At one point I couldn't tell which was which.

oil spill

We ultimately deduced that the reason for this was because the sand had a very unstable balance, and once it touched the water, it would get washed away to the side, causing the oil to move out freely.

To solve this issue, I decide to put another metal mesh layer on top so that the sand would have nowhere to go.

This didn't work either, and I realized the cause of this was due to the sand making it hard for the cap to screw on completely, making the water and oil capable of seeping out through the sides

To solve this problem, we put on some "raw materials", which was basically something like floss (dental floss) but a bit thicker. I wrapped it around the area where the oil was leaking out.

It failed again since the material was able to let the oil get under it, and the oil & water leaked out once more.

OIL/WATER filteration for both filter paper & sand

results #2:
This time, I decided to double like the filter paper BUT still cut it to see if this would help as well

This just gave us the same results as before. The water and oil still both leaked out.

The water was still faster than the oil, and we still needed 2 beakers!

Next I tried the same thing, but without cutting the filter paper:

This time, the experiment was a success! Even though the sand kept on moving around, the filter paper acted as a solid block and only allowed the water to pass.

From this, I deduced that as long as you don't cut the filter paper, no matter ~~even~~ if it is only filter paper or both filter paper and sand, the experiment will succeed! This is because by not cutting the filter paper, you are preventing the water ~~to~~ or oil from leaking out through any other places, making it a lot more efficient for filtering.

I tried this out a more times, to make sure this experiment wasn't a fluke. The results were all very similar with no notable difference.

2/10

I wrote down / typed out my results on CYSF and continued making my google slide

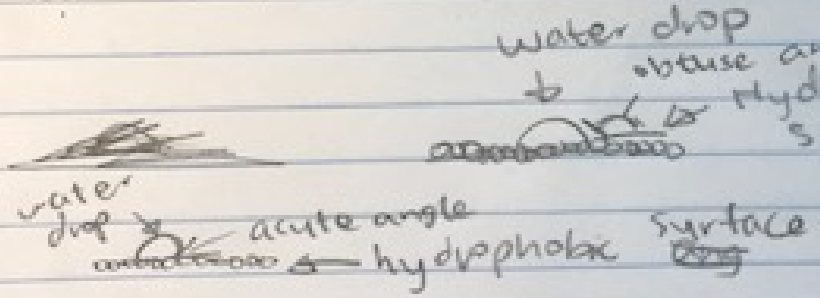
2/13

I realised that my observations were too long for the google slide and made it into a chart instead

2/20

I'm still finding new info and taking pictures of my contact angle.

The contact angle is the angle where the liquid meets the solid and is tangent to it.



The filter paper is hydrophilic & the water droplet coming in contact with it will make a obtuse contact angle. The oil is hydrophobic so the contact angle will be acute.

I uploaded my pictures onto CYSF, and my google slides.

2/25
I continued editing my slides and adding some information. I also started practicing rehearsing my lines for the recording.

3/01
Making final adjustments to the google slide and finalizing my research

3/05
-Started recording attempts + rehearsal
- Uploaded slides to CYSF.

3/06
- Submit logbook on CYSF