Substances & Mixtures: Separations

Materials:

- Permanent Markers
- Plastic Cups
- Ethanol
- Water
- Coffee Filter Paper Strips
- Tape
- Clear Soap
- Stir Sticks
- Isopropyl Alcohol
- Blue food dye.
- Salt

Introduction:

1. What do scientists do?
2. Where do you find scientists?
3. What is a biologist? What is an ecologist?
4. How does this type of science affect your life? What about other types?

Why Do We Care?

1. What's a pure substance? *A substance made up of only one type of particle.*
2. What's a mixture? *A substance made up of two or more types of particle.*
3. How do we turn everyday things into mixtures? *Put them together in a container and stir together, melting metals together to make alloys, chemical reactions…*
4. How do we undo this action? *Trickier question… depends on the substances we want to separate!*

What's A Separation:

1. What are some of our options for separating a mixture? *Sieve, filters, magnets…*
2. How about the bagged mixture?
    a. Here we had a bag of shredded paper, plastic bits, rubber, and some paperclips.
    b. Students should think to use a magnet, so you can talk about how some properties of substances are helpful in allowing us to separate them.
    c. We then dumped the pile onto the desk and have two student volunteers (one with a magnet, one without) race to see who can get all the

paperclips separated first. Have students predict what will happen beforehand.

Why A Magnet?

1. Why did you choose a magnet to get out the metal bits? *Because metals often have the property of being magnetic.*
2. Did it work well? *We've had both wins and losses depending on the students and pile… Just a heads up.*
3. Are there any other properties we could use to separate things? *You may get answers such as "size" for filters, but try to prompt the idea of separating liquids through evaporation for the next slide.*

What About Liquids?

1. How can we separate two liquids, or something that has been dissolved in a liquid (ie. saltwater)? *Take advantage of different melting or boiling points!*
2. In a mixture of water (boiling point of 100 degrees Celsius) and vinegar (118 degrees Celsius)

Distillation:

1. Distillation is a way of purifying water; separating pure water from the dissolved minerals inside it.
2. We showed a quick Youtube video demonstrating distillation since we did not have an apparatus with us to explore with.
3. Ask students if they know what it means for a substance to be volatile – how readily it evaporate.

Water and Oil:

1. This slide talks about using **polarity** to separate objects. Discuss that water is polar because of its bonds between particles and that oil is non-polar.
2. Introduce the rule of thumb: "like dissolves like". Since oil and water are not similar in polarity, they do not dissolve one another.
3. We wrote on a plastic cup with permanent marker, and asked the class if a wet napkin would take off the marker. Most understood that it would not based on their experiences trying to wash permanent marker. Explain that water is polar, and the permanent marker is not as polar as water is.
4. Ethanol is more non-polar than water… Could ethanol separate the permanent marker from the plastic? In the end, it should. It may take some scrubbing depending on the marker and amount of time it's been dry for.

Chromatography:

1. In advance, we prepared coffee filter paper strips (about 1 inch by 2 inches) with four coloured dots in a row along the bottom of the strip (one of the 1 inch ends).
2. Group students into pairs or threes, and circulate to give them each a clear plastic cup and pipette.
3. Circulate with a glass of ethanol and have students pipette about 1cm of liquid into their cup.
4. Have students tap their coffee strips inside the cup so that the end with the dots on it is just grazing the top of the liquid. The ethanol will run up it using **capillary action**. All 2 or 3 students in a group can tape their strip in the same cup. Have them observe which colours separate the most.
5. Discuss that for all chromatography separations, there is a **stationary phase** (the paper) and the **mobile phase** (the ethanol which makes the colours separate).
6. Show the neon lights chromatography video for a more dramatic example.

Solubility Separation:

1. When separating liquids, what if two liquids are close in their boiling point? Or if they are just too hard to separate that way?
2. Explain that a **precipitate** is just the solid that forms when two different things are mixed together. In the NaCl/AgCl example, a **double displacement** reaction happens between our reactants (which are both aqueous) to form a solid precipitate as a product. This solid can be filtered out or the liquid can be carefully boiled off.

Biological Separation:

1. We are going to separate your DNA from your cheek cells.
2. Instructions:
    a. Mix 500 mL drinking water with 1 tbsp of salt. Give about 3 tbsp of mixture to each student
    b. Have them gargle the 3 tbsp salt water. Time for 1 minute. Spit back into cup.
    c. Stir with 1 drop of soap. We went around with mixing sticks with a dab of clear soap on them for them to slowly mix in. Try not to make bubbles. The soap breaks down the cell membranes.
    d. Mix 100mL isopropyl alcohol and 3 drops of food dye. Again we went around with this and added it for them. Tilt salt cup

and gently poor a 2cm layer on top. This shortens and condenses the DNA, making it visible.

e. Wait 2.5 mins! Gently stir and you should see the white clumps of DNA start to form.

Separations:

1. Review the 5 main ways to separate mixtures:
   a. Manual means (magnets)
   b. Distillation
   c. Chromatography
   d. Solubility
   e. Biological

Relevant Fields:

1. If you have time, discuss some jobs that use these sorts of separations in their everyday duties.