Lesson Extension

Chemistry 4: Separation of Substances

In class, we learned about mixtures and how to separate them. For our activity, we separated a mixture of iron, sand, and rice into the three different components by using their different physical properties using filters and magnets.

More Separations

Let's try using what we learned in class to separate different mixtures. Remember, all of the separation techniques will be based on physical properties and not chemical changes.

Materials:

- Rocks/pebbles of different sizes
- Gravel
- Sand
- Salt
- Dirt
- Water
- Toilet paper
- Aluminum foil cut into 4-inch square sheets
- Empty 2-liter soda bottles with the top cut off
- Large mixing bowls (It will get dirty! Check with your parents!)
- Measuring cups
- Kitchen scale
- Ruler
- Funnels
- Sieves
- Coffee filters
- Paper plates
- Tweezers
- Other tools you find helpful!

Procedure:

Consider the following mixtures and then come up with plans to separate them into their pure components. An ideal separation method would recover all of the pure materials (Recovered Fraction = 1) and would be fast and easy! But as we learned in class, it is very difficult to get back everything once it has been mixed. Sometimes the best method is one that takes a long time. Of course, the best way to see if a separation method is a good one is to try it out. So choose one or two of your ideas and test them!

Remember the formula for the recovered fraction is:

$$Recovered\ Fraction = \frac{Final\ Mass}{Initial\ Mass}$$

Mixture 1: Different-sized rocks

1. Weigh a handful of rocks of different sizes, a scoop of gravel, and a scoop of sand. Record the initial mass of each material.
2. Mix the rocks, gravel, and sand together in the big mixing bowl. Stir or shake them up so they are as well-mixed as possible.
3. Separate the rocks into groups by size. Try to recover all of the sand and gravel and weigh the amounts you get back after the separation. Determine the recovered fraction. For the different sized rocks, measure the size of the largest and smallest rock in each group you separate and record the range of sizes.

Mixture 2: Salt and sand

1. Weigh equal volumes of salt and sand. Record the initial mass of each.
2. Mix the salt and sand together.
3. Separate them, and weigh the amounts you get back after the separation. Determine the recovered fraction.

Mixture 3: Paper and aluminum

1. Weigh a stack of toilet paper and a stack of aluminum foil sheets. Record the initial mass of each.
2. Mix the sheets up as best you can so that they are shuffled together.
3. Devise a separation method that you could scale up to separate the massive amounts of paper and aluminum that gets sent to a recycling plant. While it might be simple to flip through a handful of sheets and pull the aluminum out by hand, this would not work in a plant designed to separate tons of recyclables per day.
4. Test your method on the small number of sheets you have and determine the recovered fraction.

Discussion Questions

- How long did the separations take?
- Were you able to recover all of your material (get a recovered fraction of 1)?
- Do you think you could have recovered more if you took more time or would it have made no difference?
- What else could you have done to increase the percent recovery?
- What physical properties are you using in each separation technique?

Additional Resources:

- Reading Rainbow – How Trash is Recycled with LeVar Burton (6:23) - https://www.youtube.com/watch?v=FX55cKJvg-g
- Waste Management – How Recycling Works - Single Stream (2:40) - https://www.youtube.com/watch?v=hdGjiKJsgRk