

Separating Salt & Pepper

Section PROPERTIES OF MATTER *Topic* SEPARATION TECHNIQUES

Estimated Time ⌚ Setup: 10 minutes; Procedure: 15 minutes

OVERVIEW

Explore the ways that a mixture with very small pieces can be separated through understanding physical properties of matter.

In this activity, students are tasked with separating a mixture of salt and pepper into its components using everyday objects. By understanding the different physical properties of salt and pepper particles, students can find endless ways to do the separation – some of which are more effective or efficient than others.

INQUIRY QUESTIONS

Getting Started:

- 🔍 How can materials be separated from a mixture? What are physical properties of matter?

Learning More:

- 🔍 Which physical properties are used in each separation technique? Are some separation techniques more effective than others, and why?

Diving Deeper:

- 🔍 How can the concepts of solubility, electric charge, and density be applied in separation techniques? How do physical properties differ from chemical properties?

CONTENT TOPICS

This activity covers the following content topics: physical properties of matter, separation techniques (i.e. filtration, crystallization), density, solubility, electric charge

This activity can be extended to discuss: forces, physical vs. chemical properties

NGSS CONNECTIONS

This activity can be used to achieve the following Performance Expectations of the Next Generation Science Standards:

- 🔗 **2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 🔗 **5-PS1-3:** Make observations and measurements to identify materials based on their properties.
- 🔗 **MS-PS1-2:** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MATERIALS

For one setup:

- ✔ Salt
- ✔ Pepper
- ✔ Hand lens
- ✔ Paper plate
- ✔ Plastic spoon
- ✔ Bounty® paper towels
- ✔ Tweezer or forceps
- ✔ Straw
- ✔ Balloon
- ✔ 2 plastic cups, one filled halfway with water

ACTIVITY NOTES

This activity is good for:

- ✔ Individuals
- ✔ Pairs
- ✔ Small groups

Safety Tips and Reminders:

- ⚠ There is no eating in the laboratory, even when using products normally found in the kitchen!
- ⚠ Pepper can burn or sting the eyes, so be sure students conduct their separations with protective eyewear on and that they keep their face a safe distance away from the mixture during the exploration.
- ⚠ If students test the technique of blowing to separate the mixture, they must do it away from other students.
- ⚠ Review the Safety First section in the Resource Guide for additional information.

ENGAGE

Use the following ideas to engage your students in learning about separation techniques:

- Present your students with a challenge! You had a bag of salt and pepper packets, but it looks like the packets ripped and the salt and pepper were mixed. Can they help you find a way to separate out the salt from the pepper?
- Examples of separation techniques are everywhere! Ask your students to think of some different examples where we try to separate items from a mixture. Some may be easy to see, such as picking out only the chocolate pieces from trail mix, while others are more complex, such as separating pure water through distillation.

See more ideas for engagement in the Separation Techniques Background section! You can also look at the Elaborate section of this activity for other ideas to engage your students.

EXPLORE

Procedure:

1. Provide students with a mixture of salt and pepper on a plate.
2. Ask them to examine the mixture using a hand lens and to write their observations of the physical properties of the salt and the pepper. What are the colors, sizes, shapes, states of matter, smells, textures? Are they similar or different?
3. Ask students to make a prediction of whether the salt can be separated from the pepper and, if so, how.
4. Provide the remaining tools to students and encourage them to try to separate the salt from the pepper using any tool and technique they want, while keeping notes of what they tried, how well it worked, and what physical property of matter was used.

DATA COLLECTION & ANALYSIS

Analyze and discuss the results of this activity using the following questions:

- What are the physical properties of the salt? Pepper?
- Make a chart to document your work: What tools were used to do a separation? How were they used and what happened in the separation? Which tools and techniques were most effective? Which were most efficient? What physical properties were used in these separations?

Notes

[illegible]

EXPLAIN continued

object or two negatively charged objects will push one another away, but a positive and a negative will be attractive and stick together. The balloon picks up extra electrons and becomes negatively charged, so when it is brought near a neutral object, this charge pushes the mobile electrons away in each atom. The positively charged nucleus is not as mobile and stays in place, which is then attracted to the balloon. Small, lightweight objects like pepper can jump up to the balloon and will stick to it. The electrons in a heavier object – like salt – will respond in a similar way, but have too much mass to be removed from the mixture. Therefore, **electric charge** and **mass** are used in this separation.

Differentiation for Younger or More Advanced Students

You can differentiate this activity for students of different grade levels by focusing on the concepts outlined below.

GETTING STARTED

For younger students, emphasize the following concepts:

- Matter can be classified and identified by its physical properties.
- The combination of different substances where they retain their original properties is a mixture.
- In a mixture, a new substance is not formed.
- Different techniques and tools can be used to separate components of a mixture.

DIVING DEEPER

For more advanced students, emphasize the following concepts:

- With knowledge of physical properties of matter, we can find efficient and effective separation techniques.
- Each separation technique directly relates to a physical property of matter.
- Understanding the effects of electric charge can be helpful in separation processes.

ELABORATE

Elaborate on your students' new ideas and encourage them to apply them to different situations. The section below provides some alternative methods, modifications, and extensions for this activity.

- Add to the challenge: put magnetic sand in the mixture and provide a magnet as another tool for separation.
- For more complex separations, try different varieties of salt and pepper. Does fine ground salt separate in the same ways that rock salt does? What about peppercorns versus coarse or fine ground pepper? What differences and similarities do students see?
- Learn about conservation of matter: have students weigh the salt and the pepper before mixing. Who can recover the most salt and pepper from the mixture? Can anyone do a perfect separation? What percent of the salt and pepper were separated? If it was less than 100 percent, where did the rest of it go?
- Add another component to the mixture, like rocks or sand. Do the same separation techniques work? Why or why not?
- Challenge students to find another tool in the learning space that can be used to separate salt and pepper. How can this tool be used and why?
- If your classroom has a microscope, try looking at salt and pepper under greater magnification! Are there new features you notice? Then look up pictures of salt and pepper under an electron microscope.

Notes

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CHEMISTRY IN ACTION

Share the following real-world connections with your students to demonstrate how chemistry is all around us.

Real-World Applications

A coffee machine uses hot water as a solvent to remove the soluble parts of the coffee. As a result, the insoluble parts of the coffee grounds are left behind. This form of extraction is often called solid-liquid extraction.

Recycling in the process of converting used materials into new product. This allows us to reuse instead of generating waste, which reduces pollution and the depletion of natural resources. Each type of material is recycled in a different way based on its physical properties in order to clean, break down, and reform it into a new product. You might have noticed that many plastic materials have a number printed inside the recycle symbol: that tells you what type of plastic it is and how it is recycled! For example, the number 1 means the material is polyethylene terephthalate, which is a material often used for bottles and food packaging. The number 6 is for polystyrene, commonly known as Styrofoam. In some places residents are asked to separate their recycling by the type of material (i.e. plastic versus paper products) or by the plastic type. In other places, residents put all their recycling in one bin for single-stream recycling, and the separation of materials is done at the recycling plant using magnets, sieves, and many other techniques very similar to the ones used in this experiment!

Careers in Chemistry

- Medical lab technicians are able to analyze and test blood samples using separation techniques. Lab technicians use a technique known as centrifuging to separate out the different components of blood. Centrifugation separates a mixture based on the different densities of its components. Centrifugation causes the dense red blood cells to collect at the bottom of a test tube. The white blood cells and platelets form the next layer, and the lighter plasma rests on top.
- A separation technique known as chromatography is often used in law enforcement, specifically in forensic science. Chromatography techniques are used to test for drugs, poisonous substances, and traces of explosives because it is used to separate out the unique components in each substance.

EVALUATE

- Describe how one of the techniques or tools used to separate the salt and pepper is used in the real world. Draw and label a picture that shows how the technique or tool was used in this experiment, and how it is used in everyday life.
- For a take home assignment, ask students to imagine that instead of a small pile of salt and pepper getting mixed up, it was thousands of pounds of salt and pepper that needed to be sorted, packaged, and sold. They have been asked to find a solution to this problem and present their ideas to the salt and pepper factory owners. What technique would work best on a large scale, or are there multiple techniques that could be used together? Students should defend their decision and write a proposal detailing why their company and technique should be chosen for this project.
- Provide examples of additional mixtures in stations around the room. Students can rotate to each station in pairs or groups and follow the same process as in this activity to first observe, describe, and then experiment to test out what separation techniques work and why. Mixtures can include solid-solid (i.e. sand and sugar), solid-liquid (i.e. sugar and water), and liquid-liquid (i.e. oil and water) examples. Students can hand in their work as exit slips at the end of class.