

Recycling by Chemical Separation

Methods of Separating Chemical Components

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for the STEM Education Center at WPI's Summer 2023 Research Experience for Teachers program

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Subject: Chemistry

Grade Level: High School

United Nations Sustainable Development Goal 12: Responsible Production and Consumption

Overview

There are several environmental issues facing our community and our world. How can we use different separation methods like chromatography, distillation, centrifuging, etc... to separate contaminants from critical resources like water, air, or soil? How can we separate and isolate plastics or heavy metals and recover them from chemical compounds to protect our environment?

Standards & Learning Targets

HS-PS 1-11 Design strategies to identify and separate the components of a mixture based on relevant chemical and physical properties. Clarification Statements:

- Emphasis is on compositional and structural features of components of the mixture.
- Strategies can include chromatography, distillation, centrifuging, and precipitation reactions.
- Relevant chemical and physical properties can include melting point, boiling point, conductivity, and density.

Vocabulary	Tier 1 - Everyday	Tier 2 - School	Tier 3 - Classroom
	Separate Mixture Relevant Structural	Design Identify Strategies Components Compositional Filtration	Chemical properties Physical properties Chromatography Distillation Centrifuging Precipitation Conductivity Melting point Boiling point Density
What do students need to KNOW ?	1. Students will use the following vocabulary words in context: 2. Define the vocabulary terms in their own words using an illustration or an everyday example. 3. The tools and techniques that can be used in the process of separating a mixture.		
What do	1. Use a model or an example solution or a mixture (salt water, sugar water,		



students need to DO?	<p>muddy water, vinegar), design strategies to separate the components of the model they choose.</p> <ol style="list-style-type: none"> Write the list of materials needed, procedure, safety requirements. Determine what mathematical calculations are needed- draw up a data table.
What will students CREATE?	<ol style="list-style-type: none"> Carry out the experiment and produce the separate components of the mixture. Prepare a quantitative data table and present it to class.

ELA Standard: Vocabulary Acquisition and Use

Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.

a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy).

c. Consulting general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology.

d. Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).

Vocabulary	Tier 1 - Everyday	Tier 2 - School	Tier 3 - Classroom
	Concentration Density Filtration	Volume Mass	Balance Coefficients Mole
What do students need to KNOW?	<ol style="list-style-type: none"> Refer to a dictionary to understand different meanings for the word. What context the same word is used to reflect different meanings. How are the terms applied to the activity 		
What do students need to DO?	<ol style="list-style-type: none"> Students will use the following vocabulary words in context: Write sentences using the the word in two or more contexts Use illustration/drawing to distinguish the different meanings for the same word. 		
What will students CREATE?	<ol style="list-style-type: none"> A poster depicting the different meanings of one word. Students can illustrate with simple sketches to express their understanding of the terms. 		

Prior Knowledge

Separation methods like filtration, chromatography, distillation, centrifuging
 Vocabulary words - precipitation, conductivity, melting and boiling points



Materials/Resources

Chromatography paper, funnel, filter paper, separating funnel,
<https://www.flinnsci.com/sep-pak-c18-cartridge-ap8917/vpd0149/>
Beaker, graduated cylinder, filter paper, funnel, Balance

Timeline of Activities

Duration	Activity	Instructions	Product
10 min	Warm-up (small group)	Name some pollution problems you come across in your community, in your city and in your world. How and what does such pollution affect?	Students list the problems identified on the board.
10 min	Class discussion	Students share their 'problems'. What are some things we can do to prevent such pollution? What are some steps to be taken to solve the existing pollution? What do you know about the methods used in real world labs to separate components of a mixture?	Each group will share the cause of their pollution problem and their knowledge of possible solutions.
20 min	Research or demo by teacher	Students research different strategies or methods used in labs (the names of the methods introduced on the board for students to choose) online. Then they choose the one that will be appropriate for their 'problem'. Students should also explain the basis or the property used to identify the method.	Using the internet student groups will write a short paragraph on the methods of separation used in labs and identify which of these methods will apply for their 'problem.'
10 min	Lab projects intro	Teacher presents 5 lab projects that will involve the separation of the components of 5 mixtures. Projects could include: <ol style="list-style-type: none">1. Extract heavy metals2. Recycling centers3. Separating different types of plastics4. Separation of water and alcohol5. Separation of muddy water into potable water6. Oil spills7. Household chemical mix-up8. chemical analysis of over the counter drugs9. salt/sugar water mixture Students using the knowledge they gained from the research above, will choose which mixture they will select to use one of the strategies/lab procedures.	



15 min	List materials and procedure	Each group will come up with a list of all the materials, glassware and equipment they will need. The group will also do a rough draft of the procedure to be followed in the separation- mixture. (can be done as Homework)	Pre-activity to familiarize with techniques like distillation or chromatography or other
Next day 10 min	Peer help	Groups review each other's processes and make suggestions or corrections. Teacher goes over the procedures to approve and signal if the group is ready for the experiment.	
30 min	Lab	Student groups will set up their lab and proceed to do the experiment and collect data.	
Next day	Propose solutions	Students review their lab results and propose solutions to the environmental issues they researched.	Presentations

Attending to Equity - Teaching Strategies

Strategy	Explain how the strategy contributes/relates to the lesson/activity
Students track their own progress towards learning vocabulary	The vocabulary poster activity in small groups will help English learners have easy access to understand the term and foster collaboration in learning.
Everyday life connection	The correlation of the topic to solving the problem with everyday materials will help engage all students.
Engage community parents in a lesson /project.	Students can bring in ideas from their interactions from their families on a specific topic to share. Students can bring in a parent or a professional from their community to share their work experience in a STEM field.

Career Connections

The students explore 5 STEM careers on the internet and complete [this document](#). (The student has to fill the 1. URL 2. Job Title (of the Stem career Professional) 3. Education required 4. Salary Range 5. Demand 6. Typical work activity description)

The students complete a [Quiz](#) about their inclinations, work areas, work materials of their choice, locations of their choice etc and at the end of the Quiz it chooses a STEM career that aligns with the responses from the Quiz. I think this is interesting and allows students to retake the Quiz and everytime presents them with an Infographic about a STEM career.



Assessment

[Recycling by Chemical Separation Rubric](#)

