Separating Mixtures

Author: Ms Pam Burt

This resource was developed as a result of participation in CSIRO's teacher professional learning program, Teacher Researcher in Partnership Program.

UNIT PLAN: Year 7, Science unit, 2019

<table>
<tr><td colspan="2">TRiPP Project Overview</td><td colspan="2">Compositional analysis of apple and grape pomace, and soil and river water samples with researcher Dr Avinash Karpe (Jan 2019)
- Dr Karpe's work focuses on deriving useful products from winery biomass using fungi. The aim is to reduce the amount of biomass that goes to landfill and instead convert it to useful products. The project experience involved processing and GC-MS analysis of apple, grape and soil samples.</td></tr>
<tr><td colspan="2">Nature of problem</td><td colspan="2">Winery waste (pomace) is being disposed of in landfill. Alternative solutions for this issue are being investigated.</td></tr>
<tr><td colspan="2">Links to Unit</td><td colspan="2">Students will learn about separation techniques and be introduced in a very basic way to gas chromatography- mass spectroscopy as a way to separate and identify components of a mixture. They will mathematically analyse some of the data collected from my TRiPP experience. They will identify the benefits to society of applying scientific and technological understanding to solve an environmental issue.</td></tr>
<tr><td>Year Level:</td><td>Subject:</td><td>Unit Title: Separating mixtures</td><td>Term: -</td></tr>
<tr><td>7</td><td>Science
Mathematics
Technology</td><td colspan="2">Achievement Standard
Science
By the end of Year 7, students
- describe techniques to separate pure substances from mixtures
- analyse how the sustainable use of resources depends on the way they are formed and cycle through Earth systems
- describe situations where scientific knowledge from different science disciplines and diverse cultures has been used to solve a real-world problem
- communicate their ideas, methods and findings using scientific language and appropriate representations.
Mathematics
By the end of Year 7, students
- identify issues involving the collection of continuous data
- calculate mean for data sets
Technology
By the end of Year 8, students explain how social, ethical, technical and sustainability considerations influence the design of innovative and enterprising solutions to meet a range of present and future needs.</td></tr>
<tr><td colspan="4">Learning Objective
• To apply understanding of mixtures and separation techniques to the context of biomass waste reduction and process and interpret secondary data using statistical techniques.
•
Learning Outcomes
• Students will be able to distinguish between elements, compounds and mixtures as well as homogenous and heterogenous mixtures. They will be able to choose and perform separation techniques appropriate to a mixture provided. Students will be able to understand how chromatography can be used to separate solutions and that GC-MS is an advanced technique that extends on their understanding of paper chromatography. They will be able to calculate percentages and mean from data.</td></tr>
</table>

General Capabilities

- Literacy
- Numeracy
- Information and communication technology capability
- Critical and creative thinking
- Personal and social capability
- Ethical understanding
- Intercultural understanding

ICT Capability	Personal & Social Capability	Ethical Understanding	Intercultural Understanding
In the Australian Curriculum: Recognise intellectual property Define and plan information searches Locate, generate and access data and information Select and valuate data and information Generate solutions to challenges and learning area tasks	In the Australian Curriculum: Develop reflective practice Develop self-discipline and set goals Work independently and show initiative Appreciate diverse perspectives Contribute to civil society Communicate effectively Work collaboratively Make decisions		

Cross Curriculum Priorities related to Humanitarian Engineering		
ABTI Histories & Culture	**Asia & Australia's Engagement with Asia**	**Sustainability**
		1. The interdependent and dynamic nature of systems that support all life on Earth and our collective wellbeing. 2. A diversity of world views on ecosystems, values and social justice 3. Building capacities for thinking and acting in ways that are necessary to create a more sustainable future.

General Capabilities related to Humanitarian Engineering			
Literacy	• use a wide range of new specialist and topic vocabulary to contribute to the specificity, authority and abstraction of texts	**Critical and Creative Thinking**	• Inquiring: identifying, exploring and organising information and ideas, Reflecting on thinking and processes, Analysing and evaluating reasoning and procedures
Numeracy	• compare, interpret and assess the effectiveness of different data displays of the same information		

Australian Curriculum content descriptors and elaborations

AC Content Descriptors	Elaborations
Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques (ACSSU113)	-recognising the differences between pure substances and mixtures and identifying examples of each -identifying the solvent and solute in solutions -investigating and using a range of physical separation techniques such as filtration, decantation, evaporation, crystallisation, chromatography and distillation
Identify and investigate issues involving numerical data collected from primary and secondary sources (ACMSP169)	-using authentic problems to express quantities as percentages of other amounts
Calculate mean, median, mode and range for sets of data. Interpret these statistics in the context of data (ACMSP171)	-understanding that summarising data by calculating measures of centre and spread can help make sense of the data

DIMENSION 2 – VOCABULARY

EXPLICITLY TAUGHT COGNITIVE VERBS	ESSENTIAL VOCABULARY
Retrieval and Comprehension	Pure substance, Mixture, Solution, Dissolve, Solute, Solvent, Soluble, Insoluble, Homogenous, Heterogenous, Separate, Paper chromatography, Gas chromatography, Stationary phase, Mobile phase, Solvent front, Retention factor, Mass spectrometry,
Calculate, Describe, Explain,	
Analysis	
Analyse, Interpret, Compare	
Knowledge Utilisation	
Experiment, Justify	

DIMENSIONS OF LEARNING		
Dimension 3 (Extend & Refine Knowledge)	**Dimension 4 (Use Knowledge Meaningfully)**	**Dimension 5 (Habits of Mind)**
☒ **Comparing** ☐ **Classifying** ☐ **Abstracting** ☐ **Inductive reasoning** ☒ **Deductive reasoning** ☐ **Constructing support** ☐ **Analysing errors** ☐ **Analysing perspectives**	☐ **Decision making** ☒ **Problem solving** ☐ **Invention** ☒ **Experimental inquiry** ☐ **Investigation** ☐ **Systems analysis**	☐**Critical thinking** • Questioning and problem solving: Adopt a questioning and inquisitive mindset. Nothing is taken for granted and questions are the key to a better understanding. • Thinking flexibly: Be flexible with your thoughts and be ready to try different alternatives and options. • Applying past knowledge to new situations: Draw on your prior knowledge to enhance your present learning experiences. Maintain a connection between your past knowledge and your actual learning. ☐**Creative thinking** • Responding with wonderment and awe: Enjoy your learning and have fun learning more. • Taking responsible risks: Be adventuresome and try new things constantly. • Choose an item. ☐**Self-regulated thinking** • Persisting: Persevere in you what you do and keep focused. • Thinking interdependently: Develop team work skills and know how to work collaboratively with others. • Managing impulsivity: Take your time and think before you act. Keep thoughtful and deliberative

LESSON	LEARNING GOALS	LESSON CONTENT	RESOURCES	DIFFERENTIATION STRATEGIES
1	Elements, compounds and mixtures	1. Types of mixtures	Mixture ppt Source : www.northallegheny.org Accessed: 5/2/20	Extra scaffolding Break activities into manageable chunks Specific grouping Monitor work output in increments Encourage involvement Minimise choices
2	Separating mixtures	2. Separation techniques 3. Separating mixtures prac	Separation techniques ppt Source: bgreyson.weebly.com Accessed: 5/2/20 Separating mixtures worksheet	
3	Chromatography	1. Principles of chromatography 2. Paper chromatography prac	Principles of chromatography ppt Source: seaver-faculty.pepperdine.edu Accessed: 5/2/20 Paper chromatography worksheet	
4	Applications of chromatography	1. Winery biomass waste 2. Using chromatography to work a solution	Use of biomass ppt	

Station 1 – Centrifugation

Materials:

Benchtop manual centrifuge and tubes

Calcium hydroxide

Vegetable oil

Method:

1. Add a small amount of calcium hydroxide powder to a centrifuge tube. Add water until approx. 2cm from the top. Cap and shake until fully mixed.
2. Place the tube in the centrifuge.
3. Add equal amounts of oil and water to the second tube. Cap and shake until fully mixed.
4. Place the tube in the centrifuge opposite to the calcium hydroxide tube. This will keep the apparatus balanced.
5. Turn the handle gently and spin the samples for a few minutes.
6. Carefully remove the tubes and observe.
7. When finished leave the filled tubes for the next group.

Questions:

1. What physical property does centrifugation use to separate mixtures?

2. Which substances were pulled to the bottom of the centrifuge tubes?

3. What does this tell you about them?

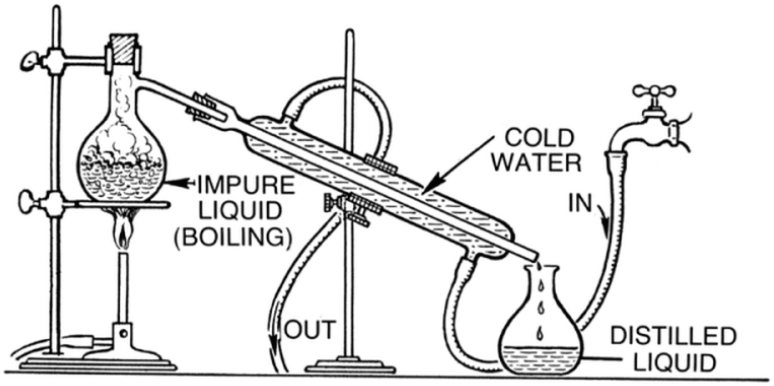
4. What type of mixture can be separated using centrifugation? Homogenous/Heterogenous?

Station 2 – Distillation

Materials:

Distillation apparatus
Coloured water

This is a demonstration only station. Do not touch the equipment. Observe what is happening and answer the questions below. If the amount of impure liquid is getting low, tell your teacher.



Questions

1. What physical property does distillation use to separate mixtures?

2. Where does evaporation take place?

3. Where does condensation take place?

4. Which component of the mixture (dye or water) is the distilled liquid?

5. What does this suggest about it compared to the other component?

6. What type of mixture can be separated using distillation? Homogenous/Heterogenous

Station 3 – Stacked sieving

Materials:

6 disposable cups

Hole poking tools (5 sizes)

Rock mixture

Method:

1. Using the tools provided, poke holes (from the inside to outside) in the cup in 5 different sizes. Don't put holes in the 6th cup.
2. Stack the cups so that the largest holes are on the top, decreasing in size to the smallest holes and then the cup with no holes.
3. Pour a sample of the rock mixture into the top cup.
4. Lift the first cup slightly and shake it so the rocks that can fit through the holes will move into the cup below. When only the largest rocks remain, take the cup out and put it to the side.
5. Repeat the process with each cup in turn.
6. At the end you should hopefully have 6 cups with particles of different sizes in them.
7. Tip the rock sample back into the original container and mix well. Leave the setup for the next group.

Questions

1. What physical property does stacked sieving use to separate mixtures?

2. Why must the cups be stacked in this order? What would happen if they weren't?

3. Were all of the rocks in each layer of a similar size? If they weren't, how could you modify the design to make this happen?

4. What type of mixture can be separated using stacked sieving? Homogenous/Heterogenous

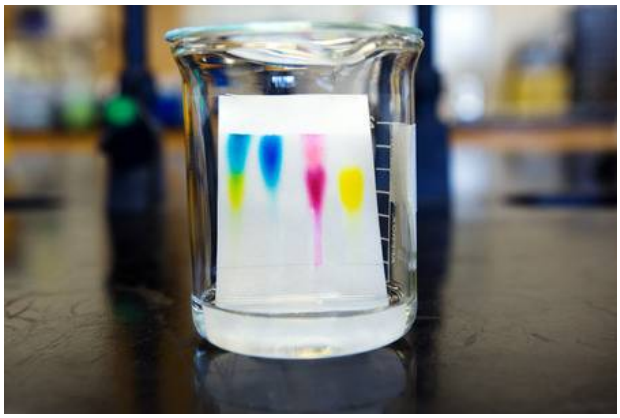
Paper Chromatography Lab
Student worksheet

Learning objectives:

- To use paper chromatography to separate the components of a mixture.
- To calculate the retention factor (Rf) for each component.
- To interpret the Rf values and compare the solubility of the components.
- To compare paper chromatography with gas chromatography.

Safety:

- Wear safety googles at all times during the experiment.



Materials:

- Beaker or similar container
- Pencil
- Ruler
- Sticky tape
- Strip of filter paper 5cm wide
- Water
- Water soluble marker (black works well)

Method:

1. Add 1cm of water to the beaker.
2. Rule a straight line with the pencil across the strip of paper about 1cm from the bottom.
3. Draw a spot with the marker on the ruler line.
4. Tape the top of the strip of paper to a pencil so that the end of the paper hangs touches the water but the spot is not submerged.
5. Let sit until the component colours have travelled up the paper approximately 2/3 of the way.
6. Remove from the cup, mark the solvent front in pencil immediately and leave to dry.

Analysis:

1. Measure the distance from the pencil line to the centre of each band of colour.
2. Measure the distance from the pencil line to the solvent front.
3. Use the formula below to calculate the retention factor for each component.

$$\text{Rf} = \frac{\text{distance from baseline to component}}{\text{distance from baseline to solvent front}}$$

Band colour				
Distance travelled				
Solvent front				
Retention factor				

Questions:

1. Which component was the most soluble in water? How do you know?

2. Which component was the least soluble in water? How do you know?

3. What is the relationship between retention factor and solubility?