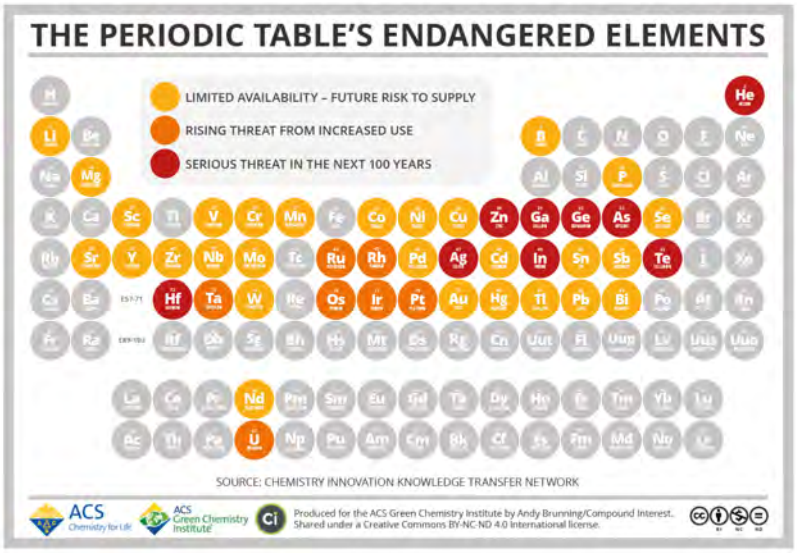
Suggested STICE Activities for the classroom

(not an exhaustive list…)

SSN STICE Symposium

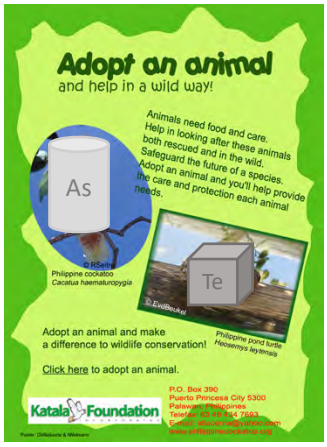
Endangered Elements

- Why are they endangered?
- Where are they sourced from?
- What are they used for?
- What happens if an element becomes scarce?



Endangered Elements

- Adopt an Endangered Element campaign



Endangered Elements

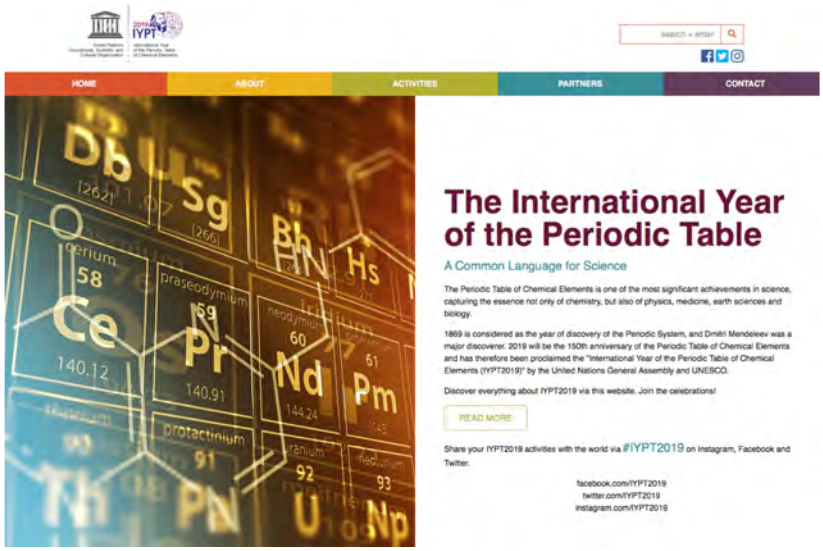
- Periodic Table of Sustainable Elements Chemistry Outreach for Schools
- Australian National Commission for UNESCO 2019 Grant winner

Endangered Elements

- Free activity for regional schools in November, 2019
  - *Still recruiting! If you have a colleague at a school in regional Victoria who might be keen, let us know today!*
- Practical activities highlighting elements
  - Aluminium-Air battery
  - Copper crystals growing on Al sheets in agar gel
  - Zinc plating on copper coins
  - Mini-thermite ☺

International Year of the Periodic Table

iypt2019.org



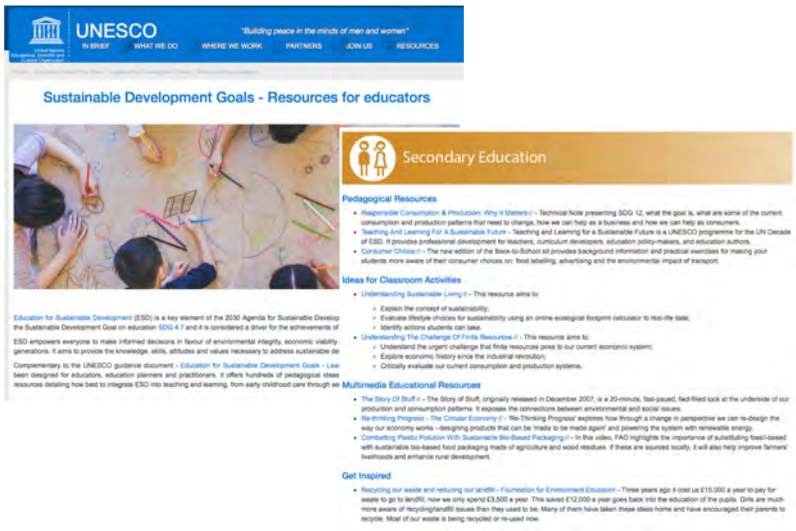
International Year of the Periodic Table

RACI: Stories from the Periodic Table

Connecting chemistry with global issues

Connecting chemistry with global issues

- SDG Resources for Educators – UNESCO
- teachSDGs.org
- Worldslargestlesson.globalgoals.org (UNICEF)
- sdgs.org.au
  - Search for Australian examples

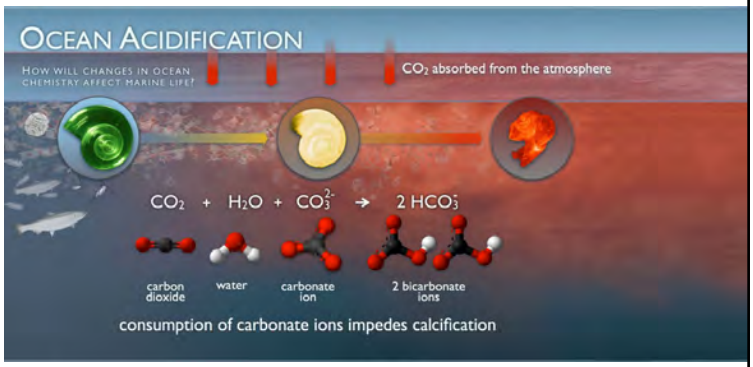


Connecting chemistry with global issues

Context: Ocean acidification

Content: covalent bonding
Lewis structure
formal charges
equilibrium
pH
solubility of $CaCO_3$

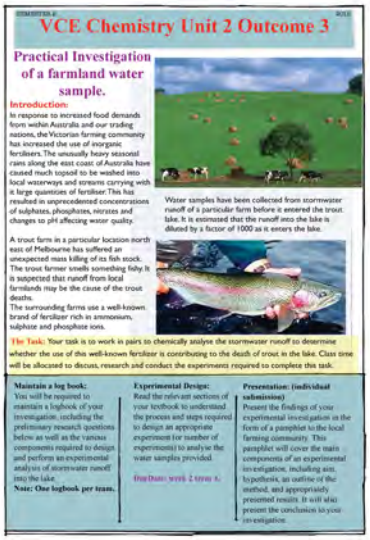
dynamic processes



https://www.noaa.gov/education/resource-collections/ocean-coasts-education-resources/ocean-acidification

Systems thinking / socio-scientific literacy

- Contaminants in water systems
- Unit 2
- Melb High EEI Outcome 3 example



VCE Chemistry Unit 2 Outcome 3

Practical Investigation of a farmland water sample.

Introduction:

In response to increased food demands from within Australia and our trading nations, the Victorian farming community has increased the use of inorganic fertilisers. The unusually heavy seasonal rains along the east coast of Australia have caused much topsoil to be washed into local waterways and streams carrying with it large quantities of fertiliser. This has resulted in unprecedented concentrations of sulphates, phosphates, nitrates and changes to pH affecting water quality.

A trout farm in a particular location north east of Melbourne has suffered an unexpected mass killing of its fish stock. The trout farmer smells something fishy. It is suspected that runoff from local farmlands may be the cause of the trout deaths.

The surrounding farms use a well-known brand of fertiliser rich in ammonium, sulphate and phosphate ions.

Water samples have been collected from stormwater runoff of a particular farm before it entered the trout lake. It is estimated that the runoff into the lake is diluted by a factor of 1000 as it enters the lake.

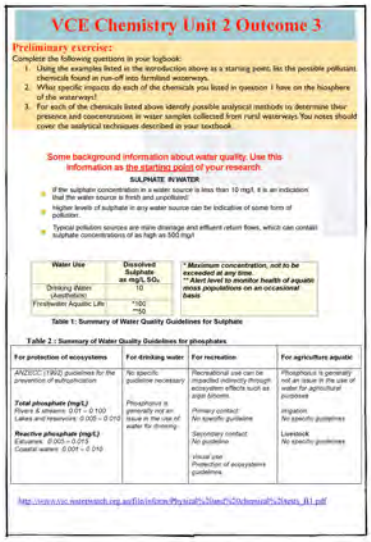
The Task: Your task is to work in pairs to chemically analyse the stormwater runoff to determine whether the use of this well-known fertiliser is contributing to the death of trout in the lake. Class time will be allocated to discuss, research and conduct the experiments required to complete this task.

Maintain a log book:
You will be required to maintain a logbook of your investigation, including the preliminary research questions below as well as the various components required to design and perform an experimental analysis of storm-water runoff into the lake.
Note: One logbook per team.

Experimental Design:
Read the relevant sections of your textbook to understand the process and steps required to design an appropriate experiment for number of experiment(s) to analyse the water samples provided.

Due Date: week 2 term x.

Presentation: (individual submission)
Present the findings of your experimental investigation in the form of a pamphlet to the local farming community. This pamphlet will cover the main components of an experimental investigation, including aim, hypothesis, an outline of the method, and appropriately presented results. It will also present the conclusion to your investigation.



VCE Chemistry Unit 2 Outcome 3

Preliminary exercise:

Complete the following questions in your logbook:

1. Using the examples listed in the introduction above as a starting point, list the possible pollutant chemicals found in run-off into farmland waterways.
2. What specific impacts do each of the chemicals you listed in question 1 have on the biosphere of the waterways?
3. For each of the chemicals listed above identify possible analytical methods to determine their presence and concentrations in water samples collected from rural waterways. You notes should cover the analytical techniques described in your textbook.

Some background information about water quality. Use this information as the starting point of your research.

SULPHATE IN WATER

- If the sulphate concentration in a water source is less than 10 mg/L it is an indication that the water source is fresh and unpolluted.
- Higher levels of sulphate in any water source can be indicative of some form of pollution.
- Typical pollution sources are mine drainage and effluent return flows, which can contain sulphate concentrations of as high as 500 mg/l

Water Use	Dissolved Sulphate as mg/L SO_4
Drinking Water (Aesthetics)	10
Freshwater Aquatic Life	*100 **50

* Maximum concentration, not to be exceeded at any time.
** Alert level to monitor health of aquatic mass populations on an occasional basis

Table 1: Summary of Water Quality Guidelines for Sulphate

Table 2 : Summary of Water Quality Guidelines for phosphates

For protection of ecosystems	For drinking water	For recreation	For agriculture aquatic
ANZECC (1992) guidelines for the prevention of eutrophication Total phosphate (mg/L) Rivers & streams: 0.01 – 0.100 Lakes and reservoirs: 0.005 – 0.010 Reactive phosphate (mg/L) Estuaries: 0.005 – 0.015 Coastal waters: 0.001 – 0.010	No specific guideline necessary Phosphorus is generally not an issue in the use of water for drinking	Recreational use can be impacted indirectly through ecosystem effects such as algal blooms Primary contact: No specific guideline Secondary contact: No guideline Visual use: Protection of ecosystems guidelines.	Phosphorus is generally not an issue in the use of water for agricultural purposes Irrigation: No specific guidelines Livestock: No specific guidelines

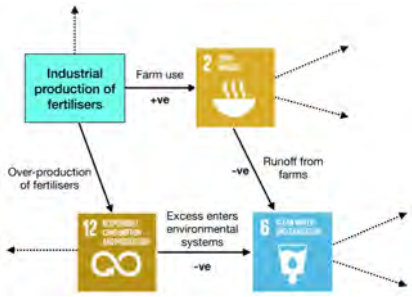
http://www.vic.waterwatch.org.au/file/inform/Physical%20and%20chemical%20tests_fs1.pdf

Systems thinking / socio-scientific literacy

Pre-activity

Consider the context of the use of fertilisers in the local farmland community in this assignment.

- Which SDGs do you think relate to this community (you'll be surprised how many ☺)
- For each of the SDGs you identify, is the farming practice…
  - Contributing positively towards that SDG (intended consequence)?
  - Or… contributing negatively towards that SDGs (unintended consequence)?
- Using arrows, draw a **systems map**, to show how these intended and unintended consequences are *interconnected*. Use the example below to start…



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(Mahaffy, 2019)

Systems thinking / socio-scientific literacy

Mahaffy (2019, p. 367)

- Conventional v. systems thinking approach emphasising circular nature

Loss of fixed nitrogen from fertilizer production to the environment
Not usually discussed
Develop a simple model to trace the loss of N atoms through the food chain, and apply this model to evaluate different strategies based on green chemistry and engineering principles to minimize matter and energy inefficiencies in critical processes along the chain

Systems thinking / socio-scientific literacy

Mahaffy (2019, p. 367)

- Conventional v. systems thinking approach emphasising circular nature

Energy considerations
Energy use in the industrial production not usually discussed
Evaluate the claim that 1.8% of global fossil fuel combustion is directed to the industrial synthesis of ammonia (connection to SDG 7)

Systems thinking / socio-scientific literacy

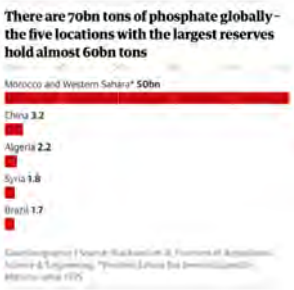
Mahaffy (2019, p. 367)

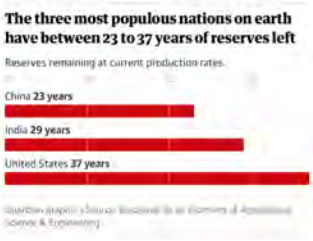
- Conventional v. systems thinking approach emphasising circular nature

Connections between reactive nitrogen production and global climate change
Global climate change usually receives little more than a passing mention in textbooks, and the link to reactive nitrogen is not explored
Inventory the contribution of nitrous oxide (N_2O) gas to the total radiative forcing of greenhouse gases since the industrial revolution, and allocate the main sources from which it enters the environment.

Systems thinking / socio-scientific literacy

- Case study analysis
  - Finite resources
    - Phosphorus





Phosphate fertiliser 'crisis' threatens world food supply

Use of essential rock phosphate has soared, but scientists fear it could run out within a few decades

▲ Untreated phosphate in Western Sahara. Photograph: AFP/Getty Images

The world faces an "imminent crisis" in the supply of phosphate, a critical fertiliser that underpins the world's food supply, scientists have warned.

The Guardian, Sept 6, 2019

Systems thinking / socio-scientific literacy

- Case study analysis
  - Value from waste – the new recycling economy
    - Fabrics from waste and recovered material

https://www.ellenmacarthurfoundation.org/publications/a-new-textiles-economy-redesigning-fashions-future

Life cycle analysis activities

- What does LCA mean?
- Describe the five stages of an LCA
- For one stage, think about alternatives to reduce waste

Examples: mobile phones
leather shoes
nappies

https://www.stem.org.uk/resources/elibrary/resource/447095/life-cycle-analysis
https://www.istc.illinois.edu/UserFiles/Servers/Server_427403/File/99-031.pdf

Redesigning plastics

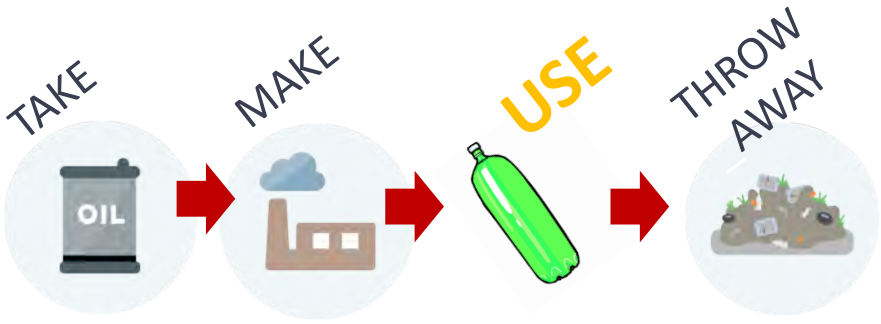
- Video to initiate thinking
  - What is made of plastic?
  - What properties make plastic useful?
  - What properties make plastic problematic?
  - How is plastic made?
  - What happens when we have finished with it?
  - What alternatives are there?

https://www.ellenmacarthurfoundation.org/our-work/activities/new-plastics-economy

HOW ARE PLASTICS PRODUCED?

A linear system

NPEC



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DESIGN CHALLENGE

The potato journey

1  Potatoes were grown, then harvested

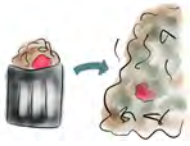
2  They were taken to a factory where they were baked, sliced and processed.

3 

The crisps were baked then put into a bag

4  I bought them at the shop

5  Then I ate them

6  The packet will go to the dump

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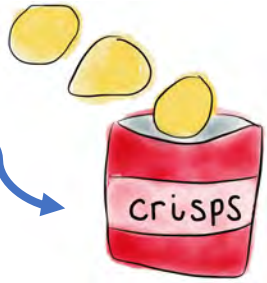
DESIGN CHALLENGE
Small groups, big change

NPEC

How might we re-design packaging?

Packaging



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Source for more resources…. Soon!

www.eschemistry.org

eschemistry@deakin.edu.au
#eschemistry
#sustainableelements

- Content from this symposium
- School activities
- Teacher resources / teacher PD