An tSraith Shóisearach do Mhúinteoirí

Junior CYCLE for teachers

Learning Outcomes in Action: Chemistry Across the Strands

JCT Science Team

Chem Ed Conference 2018
Trinity College Dublin

Introduction and Teacher background

Learning Intention

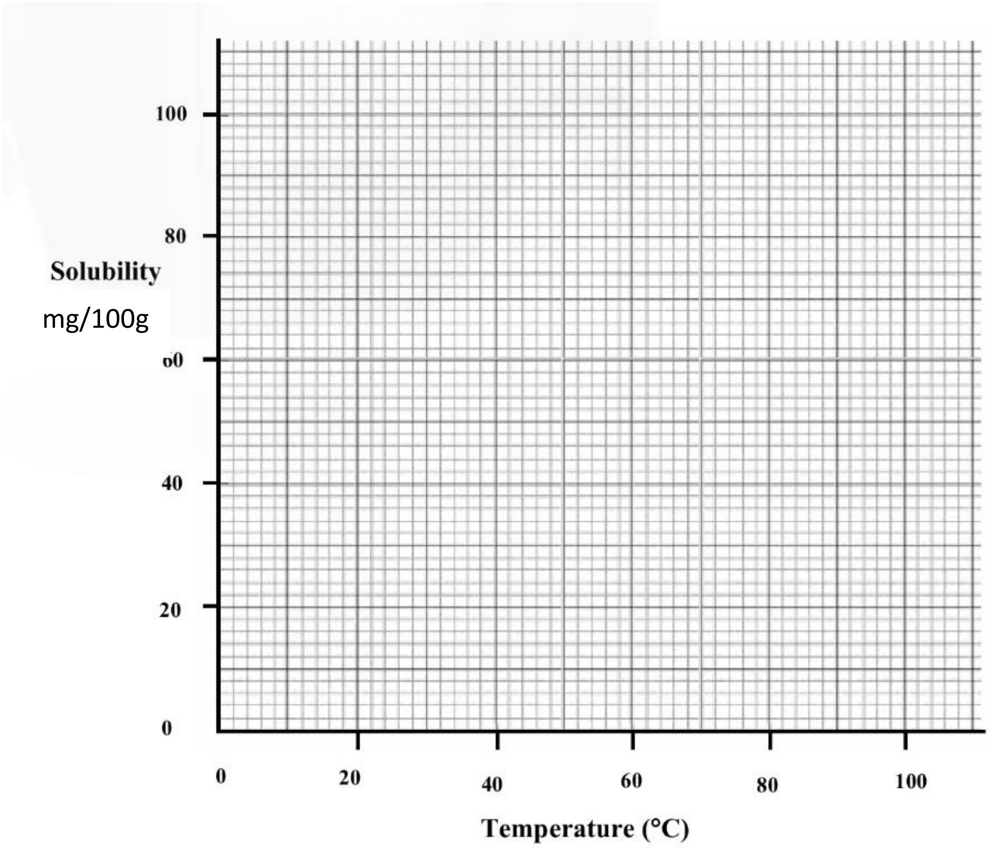
- Recognise the opportunities across the specification for developing a deeper understanding of cross-cutting chemistry concepts.

In this workshop, we use a series of activities to show how learning outcomes translate into classroom practice. In particular, we wish to highlight how flexibility within the specification allows opportunities for teachers and students to engage with chemistry concepts across the Nature of Science and contextual strands.

Prior Learning

Water is an excellent solvent for many substances. Previously, students learned the amount of solute which will dissolve increases with increasing temperature. However, when gases dissolve in water, the amount of the gas which dissolves decreases as the temperature of the water increases. The higher kinetic energy causes more motion in the gas molecules which break intermolecular bonds and escape from solution.

Activity A



Graph the experimental results shown below and discuss what you notice about the solubility of a solid, a liquid and a gas

Temperature (°C)	0	25	50	75
Solubility of a solid (mg/100g water)	14	29	55	75
Solubility of a liquid (mg/100g water)	11	24	48	67
Solubility of a gas (mg/100g water)	7.0	3.0	1.4	0

Activity B

1. Three bottles of sparkling water are placed into containers at different temperatures: iced water, room temperature water and warm water.

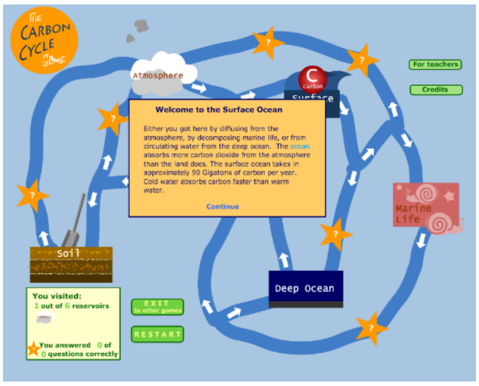
2. Open all three bottles and pour equal volumes of water into the plastic cups provided.
3. Count the number of bubbles leaving each cup for 30 seconds and record your observations in the results table below.
4. One person in the group take a sip of each water sample and record the sensation on your tongue in the results table.

	Cold	**Room temp**	**Warm**
No. of bubbles after 30s			
Sip test			

Activity C

Simulation Game on The Carbon Cycle

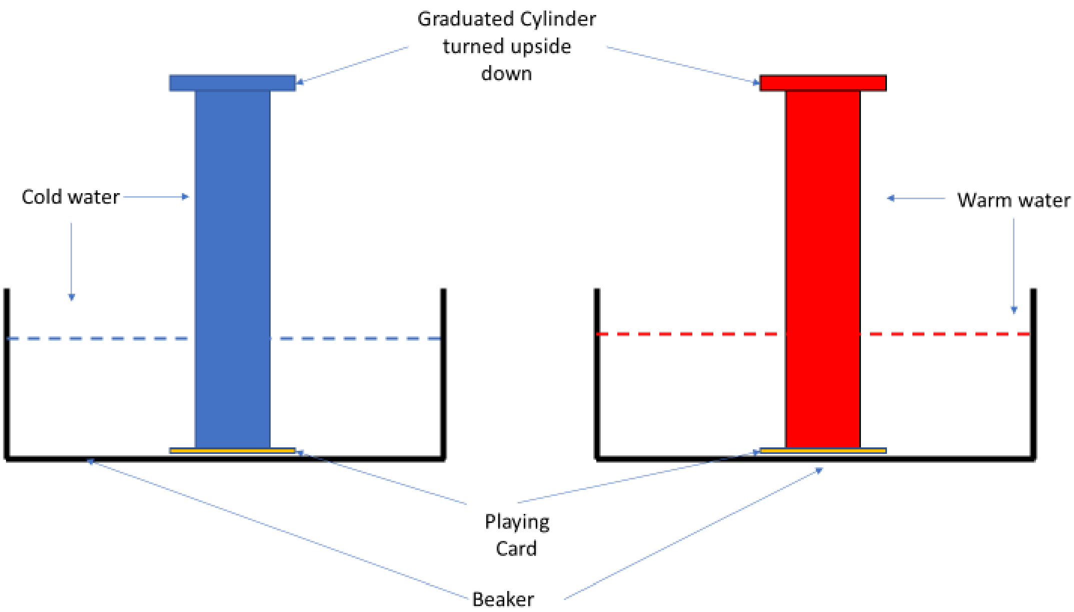
Using the computer device, enter the URL below to locate a simulation on the carbon cycle. Engage with the right hand side of the simulation entitled marine life.



(If you click the "for teachers" button on the page it will bring you to many other resources that could be used when teaching about the carbon cycle.)

https://www.windows2universe.org/earth/climate/carbon_cycle.html

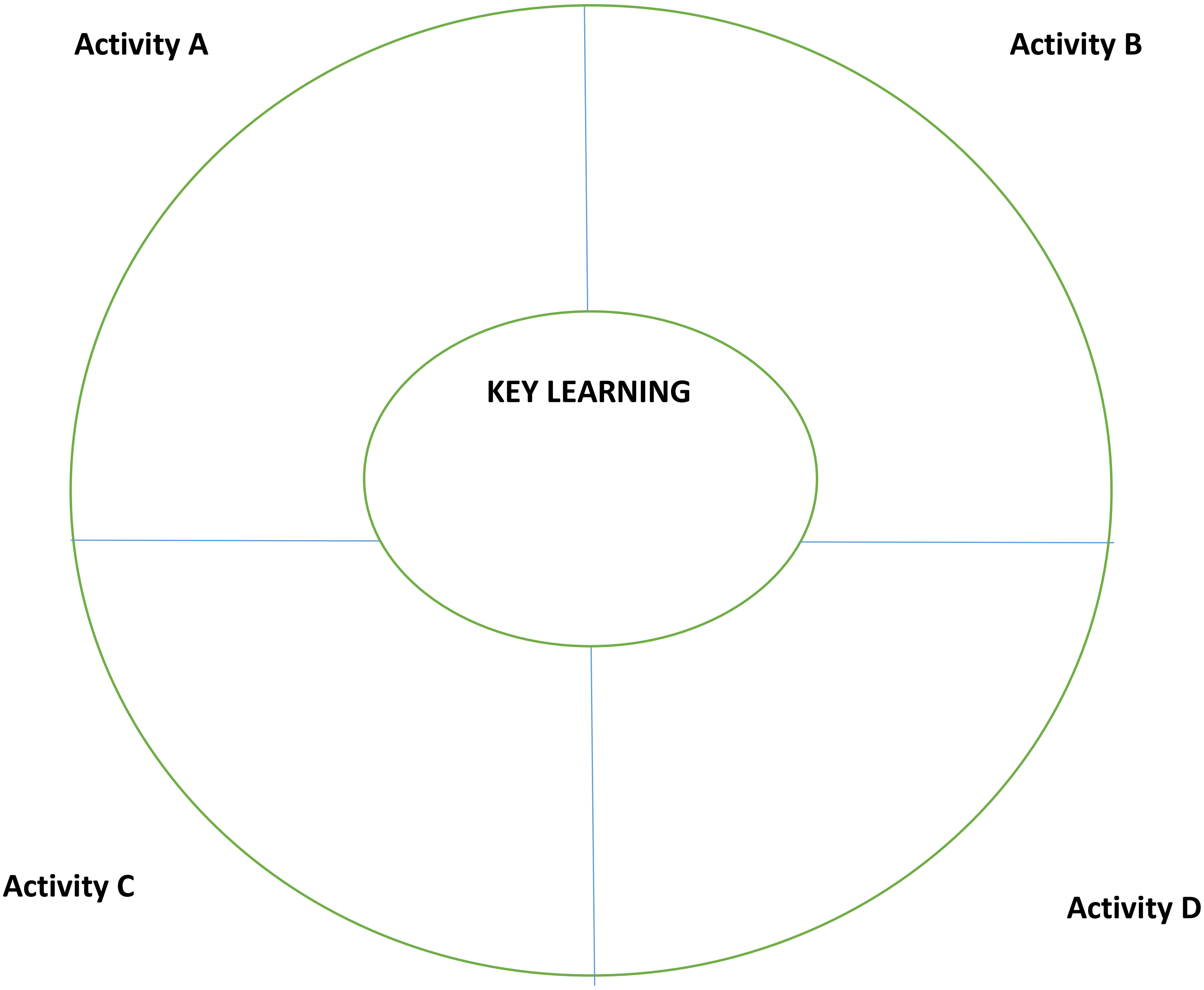
Activity D



1. Set up 2 beakers, one with hot water and the second with cold water.
2. Fill 2 graduated cylinders to the top, one with hot water and the second with cold water.
3. Use a playing card to hold the water in place at the top of each graduated cylinder and place it into the beaker upside down as show in the diagram above.
4. Carefully place an Alka-Seltzer tablet under the opening and observe the CO_2 gas being produced in both graduated cylinders. Record your observations.

	Cold water sample	Warm water sample
Observations		

Comments and Observations from the Activities:



Additional Resources

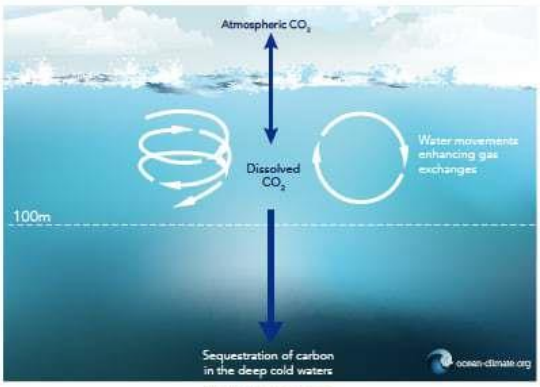
Ocean & Climate platform

A healthy ocean, a protected climate

The ocean, a carbon sink

A carbon sink is a natural or artificial reservoir that absorbs and stores the atmosphere's carbon with physical and biological mechanisms. Coal, oil, natural gases, methane hydrate and limestone are all examples of carbon sinks. After long processes and under certain conditions, these sinks have stored carbon for millennia. On the contrary, the use of these resources, considered as fossil, re-injects the carbon they hold into the atmosphere. Nowadays, other carbon sinks come into play: humus storing soils (such as peatlands), some vegetalizing environments (such as forming forests) and of course some biological and physical processes which take place in a marine environment.

These processes form the well-known « ocean carbon pump ». It is composed of two compartments: a biological pump* which transfers surface carbon towards the seabed via the food web (it is stored there in the long term), and the physical pump* which results from ocean circulation. In the Polar Regions, more dense water flows towards the Deep Sea dragging down dissolved carbon. Actually, in high latitudes water stores CO2 more easily because low temperatures facilitate atmospheric CO2 dissolution (hence the importance of Polar Regions in the carbon cycle). It is difficult to determine the quantity of carbon stored by these mechanisms, but it is estimated that the ocean concentrates 50 times more carbon than the atmosphere. For some scientists, the Deep Sea and its water column may be the largest carbon sink on Earth, but its large-scale future is still

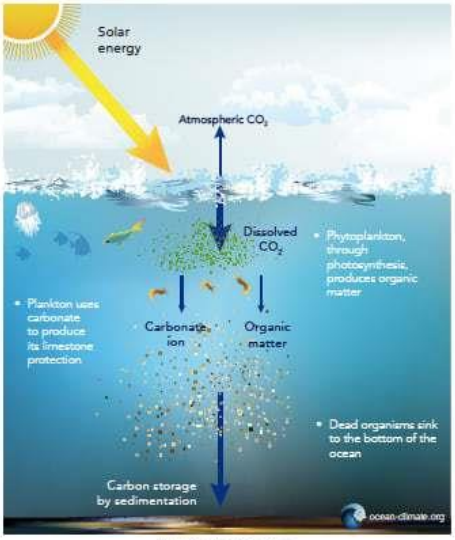


Physical carbon pump

unknown. Also, with ocean acidification, this process could become less efficient because of a lack of available carbonates*.

When talking about carbon storage, the notion of time is crucial. The biological pump is sensitive to disturbances. Consequently, it can be destabilized and re-emit carbon into the atmosphere.

The physical pump acts on another time-scale. It is less sensitive to disturbances, but it is affected on a long-term basis. Once the machine is activated, it will be difficult to stop it. The carbon, transferred to the Deep Sea due to ocean circulation, is temporarily removed from the surface cycle but this process is rather poorly quantified. Also, after a journey of several hundred years, what will this carbon become when these waters resurface?



Biological carbon pump

The biological pump is actually easier to assess. It relies on ecosystems' good health. In the high seas for instance, the planktonic ecosystem is a major player. All organic materials that reach the bottom participate in the biological pump and when conditions permit it, they also participate in oil formation. Calcium-containing materials such as coccolithophore, a microscopic one-celled alga, participate in subtracting carbon from the natural cycle. When they die, they generate a vertical net flux of carbon. This carbon can then be stored in the Deep Sea for long geological periods. These processes can leave traces. For instance, chalk cliffs are an accumulation of coccolithophores (micro algae covered with plating made of limestone) on the ocean seabed, which have later resurfaced to the continent due to geological movement.

Healthy coastal ecosystems play a mitigation* role against climate change, especially by capturing carbon for their development. For instance, mangroves, seagrass beds and salt marshes are significant carbon sinks. These last three examples, store at least ten times more carbon than continental forests when they develop by capturing carbon in their calcium skeleton. However, these coastal ecosystems cover little surface on a global planet scale. Also, these ecosystems are weakened by coastal urbanization and coastal economic activities. Ecosystem restoration remains a priority to improve storage of carbon excessively released into the atmosphere and requires ambitious policies.

In order to combat climate change, geoengineering* techniques to store CO2 artificially in the ocean carbon sink are under consideration. The scientific community is rather concerned because negative consequences of potential disequilibrium have not been explored yet. However, the concept of carbon sink is very controversial. The carbon cycle is rather complex as it is associated with other cycles which favour global warming. Consequently, storing CO2 also releases steam water, which plays an important part in the greenhouse effect. In addition, because of the increase in greenhouse gas concentration, the water temperature and its acidity are changing. This modifies physical, chemical and biological equilibriums and may affect the ocean pump. All of this data should encourage us to think about the future of marine ecosystems. This uncertainty should encourage us to be more careful and to preserve marine ecosystems.

https://ocean-climate.org/?p=3896&lang=en

Ted Talk

https://www.ted.com/talks/triona_mcgrath_how_pollution_is_changing_the_ocean_s_chemistry?language=en

Thank you for participating in this workshop. We hope you enjoyed it!

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Contact Details

For any queries, please contact us on one of the following:

Email: info@jct.ie

Phone number: 047 74008

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