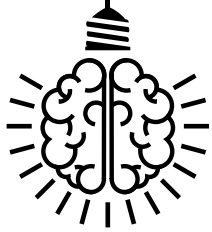
Teachers' notes

- bringing Catalyst to life in the classroom



Discover ideas and resources to build on the issues covered in edition 33 of Catalyst.

Contents

Quantum Technologies

1

By Dave Gibbs, STEM Computing and Technology Specialist, STEM Learning

Matching article:
Teleportation is real

Useful resource:
www.stem.org.uk/quantum-technologies

Quantum Physics features in post-16 qualifications, and 14-16-year-olds also explore the sub-atomic scale, usually without reference to quantum effects.

This article provides enrichment to the curriculum, bringing a sense of wonder to the topic by making science fiction less… fictional!

Discussions and further research tasks resulting from the article would cover the atomic theory of gases, as well as photons and sensitivity of photon detectors. Links to the double-slit experiment would further explore the wave-particle duality of photons.

The topic of entanglement leaps beyond the curriculum, but is explained in 'classical' terms that are mystical yet comprehensible (if your students can suspend their disbelief).

Students of computer science might consider secure communications – current encryption algorithms such as RSA haven't been shown to be unbreakable, although they serve current needs adequately. The 'race' between quantum encryption and quantum computers, which make cracking of classical encryption a trivial task, is a fascinating idea which will directly impact in future careers.

All these ideas and more can be explored in our Quantum Technologies resources.

The urban gold mine

2

By Mark Langley, Science CPD Lead, STEM Learning

Matching article:
The urban gold mine

Useful resource:
Dr Euan Doidge, WEEE are golden
www.youtube.com/watch?v=5GZ7frF4nw0

Solvent extraction is a key process in purification of many products, often in organic chemistry. Dr Euan Doidge is researching ways of selectively extracting gold from aqueous solutions and suspensions of metals as explained excellently in his YouTube video.

Demonstrating solvent extraction of metals can be difficult but the principle can be demonstrated quite colourfully using simpler, cheaper reagents. A solution of iodine in potassium iodide (around 0.1 mol dm-3) as used for starch testing, is added to a test tube, and an organic non-polar solvent (such as cyclohexane or hexane) is added to the tube by gently trickling it from a pipette down the inside of the tube. The colourless organic layer sits on top of the dark brown aqueous solution. A bung is added and the tube shaken. The iodine from the aqueous solution dissolves into the organic layer, giving it a bright purple colour.

The organic layer can be removed and the solvent recovered, and the process repeated until virtually all the iodine is removed from the aqueous solution. However, for demonstration purposes, unless the organic solution is evaporated off in a fume cupboard (to leave iodine crystals) it is better just to collect the organic layer and store with halogenated organic waste for disposal. For more details on this procedure see the video on our STEM Learning website.

Extreme survival: from the Sahara to the summit of Everest

By Mary Howell, Biology Subject Specialist, STEM Learning

Matching article:
Extreme survival: from the Sahara to the summit of Everest

Useful resources:

- ABPI interactives – The skin and temperature Control **www.stem.org.uk/cx4rd**
- Institute of Physics Pulse Oximeters **www.stem.org.uk/rxz4n**
- The Physiological Society 'Lessons from Everest's Sherpas could aid intensive care treatment' **www.physoc.org**

Learning about the complex systems involved in homeostasis can be tricky, so this article provides a useful and engaging starting point. This context of extreme sports, pushing the human body to its limits, provides discussion prompts about temperature control, dehydration and blood oxygen levels.

In England at GCSE combined and single science students need to understand 'the importance of maintaining a constant internal environment in response to internal and external change,' although it is only in single science biology that temperature control and water levels are specifically required. Feedback ideas in homeostasis can be difficult, so a simple challenge asking students to keep a beaker of water over a Bunsen at a constant 37 degrees Celsius - using only adjustments to the Bunsen and a little cold water or ice - models the role of feedback, may help some students.

In post-16 biology, understanding percentage oxygen saturation of blood and interpreting oxygen dissociation curves is challenging. Many students will find it helpful to discuss what is happening to Ricky Munday during the acclimatisation process as he builds up haemoglobin, and what goes wrong during his climb, before embarking on more abstract ideas. Fingertip pulse oximeters detect the absorption of red and infra-red light by the blood, giving a measure of the oxygen saturation of the blood. They can be bought for under £20 and can be used to measure students' blood oxygen content, before moving on to more abstract ideas. In addition this could be used to link to biophysics.

Insight into changing blood oxygen levels in extreme situations can support our understanding of anaesthesia and help us probe what might happen as we develop space exploration. The Physiological Society produce accessible summaries of research papers on their Understanding Life site, for those who want to take this further.

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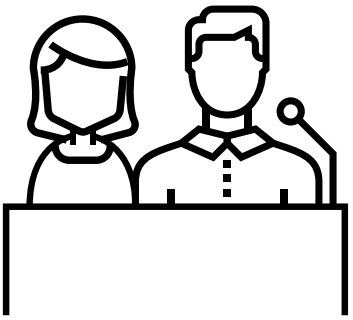

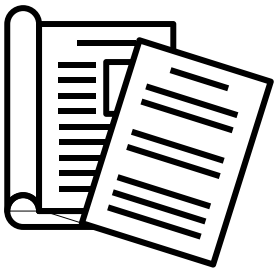

Thank you

We hope you enjoyed Catalyst, and matching teachers' notes. If you have any feedback, or ideas for topics you'd like to see covered in future editions, please email:

catalyst@stem.org.uk

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