Triple Science case study
Biology

Name of centre
Cape Cornwall School

Name of teacher
Jane Wynter

Subject

Biology

Specification

OCR Twenty First Century Science

Brief description of case study
Students investigate core body temperature under varying conditions.

Disclaimer
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Signed: J Wynter

Date: 1 October 2008

Topic

Range and content

Control of body temperature

How Science Works

1.2 Practical and enquiry skills

Pupils should be taught to:

a plan to test a scientific idea, answer a scientific question, or solve a scientific problem

c work accurately and safely, individually and with others, when collecting first-hand data

d evaluate methods of collection of data and consider their validity and reliability as evidence

Extract from Key stage 4 programme of study: http://curriculum.qca.org.uk/key-stages-3-and-4/subjects/science/keystage4/index.aspx

Context of the lesson within scheme of learning

Module B4

In previous lessons students have been introduced to the concept of homeostasis and the need for control systems in the human body. They have also tried keeping a beaker of water at a constant temperature using a Bunsen burner. In subsequent lessons students will encounter the homeostatic mechanism for controlling blood sugar.

Learning objectives

- Make predictions about and then observe how body temperature responds to exercise.
- Explain how the body controls its temperature.

Learning outcomes

Students will be able to:

- monitor body temperature when exercising
- consider the control systems involved in maintaining body temperature, and use their knowledge of the interplay between these systems in explaining their observations.

Key concepts/knowledge/skills/understanding addressed by this lesson

Body core temperature maintenance.

Heat loss via vasodilation and evaporation.

Curriculum opportunities	
X	**a** Research, experiment, discuss and develop arguments.
	b Pursue an independent enquiry into an aspect of science of personal interest.
X	**c** Use real-life examples as a basis for finding out about science.
	d Study science in local, national and global contexts, and appreciate the connections between these.
	e Experience science outside the school environment, including in the workplace, where possible.
	f Use creativity and innovation in science, and appreciate their importance in enterprise.
	g Recognise the importance of sustainability in scientific and technological developments.
	h Explore contemporary and historical scientific developments and how they have been communicated.
	Other curriculum opportunity from specification (give details):

Extract from Key stage 3 programme of study: http://curriculum.qca.org.uk/key-stages-3-and-4/subjects/science/keystage3/index.aspx?return=/key-stages-3-and-4/subjects/science/index.aspx

How Science Works progression in this lesson

The aspect of How Science Works being developed is:

- Practical and enquiry skills; working critically with primary evidence

How are students making progress?

- Students are asked to plan an experiment and subsequently to evaluate the planning and implementation of their practical work, and account for errors or anomalies.

Assessment opportunities in this lesson

The starter activity provides an opportunity to check current understanding and to deliver the lesson at an appropriate level.

The main activity provides a chance to assess students' ability to work safely in groups and to plan a fair test.

A short written report of results and explanation provides an opportunity to assess the learning.

How ICT is used to support learning

ICT is used to show images that support the learning:

- video clip 'Man versus car in sub zero temperatures'
- diagram of skin structure (see Resources).

It would also be possible to carry out the experiment using a data logger, with a probe taped to the skin of the face or hand and one under the tongue measuring core temperature.

Overview of lesson

Lesson title: Keeping cool

Approximate length of lesson: 60 minutes

Starter	*Top Gear* video clip 'Man versus car in sub zero temperatures'
Main	1 How to measure body core temperature
	2 Discuss what could happen to your core temperature as you exercise
	3 Test your hypothesis
	4 Discuss findings
Plenary	Look at skin structure diagram to explain findings

Lesson in detail	
Lesson title Keeping cool	
Lesson structure	
Learning episode and timing	**Detail**
Starter (15 minutes)	Share the learning objectives with the class. Show the video clip from *Top Gear* entitled 'Man versus car at sub zero temperatures' (see Resources) www.metacafe.com/watch/607965/how_cold_a_car_can_handle/ Ask students to discuss in small groups how Hammond won. Feed back ideas to the whole class and ask them to consider whether he would have won if it had been hot rather than cold.
Main 1 (10 minutes) **Main 2** (5 minutes) **Main 3** (15 minutes) **Main 4** (5 minutes)	What is normal body core temperature? Show students how to use a clinical thermometer and/or a digital thermometer (under arm). They then all find their core temperature. Ask students to discuss in groups what they think will happen to their core temperature as they exercise for longer and longer times, and why. (Most think it will go up and up as they are used to being told they have got hot and use skin temperature and appearance to judge this.) Students work in small groups to design and carry out a fair test to see whether the evidence supports their predictions. Students report back any trends and offer explanations. They are asked to identify any anomalies or errors in their data and evaluate the method in the light of this.
Plenary (10 minutes)	Show skin section diagram on screen. Ask students to look for things in the picture that might be involved in helping you to lose heat and so control core body temperature. Hopefully, they will identify blood vessels and sweat glands. Discuss the mechanisms involved and introduce the words *vasoconstriction* and *vasodilation*. Students write a brief explanation describing how the interplay between body systems results in the maintenance of core body temperature.

Reflection and evaluation

Starter

There were many *Top Gear* fans in the class – this engaged the students from the word go and it was great for starting discussion.

Main

Main 1: Few students knew how to use a glass clinical or digital thermometer and several needed help. It took longer than expected! I had only four digital thermometers of two types. A class set of these would be ideal. It would also be possible to carry out the experiment using a data logger, with a probe taped to the skin of the face or hand and one under the tongue measuring core temperature.

Main 2: Many thought that core temperature would continue to increase because skin feels hot and you look red. This worked well because students made predictions to support their beliefs, which had to be revised later. This fits in with the 'constructing meaning' approach, as the students had to restructure their understanding to fit with the evidence they found.

Main 3: A fair test provided problems for some (eg deciding how to exercise at a steady rate). There was much amusement watching them and there were some lovely comments from students – for example, 'But it's not going up! What's wrong with me? I'd better do it again harder.'

All students engaged. They could have done this for much longer.

Main 4: General finding among the group 'It does not go up' finally sank in. Some discussion on validity of data and variation in results was needed. Students had to change their view based on the evidence they had gathered. Typical comments from students included questions such as 'But why does your skin get hot?' This led to an understanding that this was part of the mechanism to control body temperature.

Plenary

Students needed some help in identifying how the blood could be re-routed. Many had thought that blood vessels could move up and down in the skin. Many found the concept of sweat *evaporating* to cool the body difficult. (In the following lesson a warm, wet hand in front of a fan compared to a warm, dry hand helped them to understand.)

Risk assessment		
Main hazards identified	**Who would be affected?**	**Control measures to reduce risk**
Clinical thermometer breakage	Students and staff	Demonstrate correct use Ensure space when shaking Only to be used under arm Mercury spill kit available Ideally use digital thermometers instead
Hygienic use of thermometers	Students	Clean clinical thermometers in alcohol Plastic disposable covers for digital thermometers
Exercise in laboratory	Students	Exercise to be done on the spot (eg jogging) Make sure students exercising have enough space around them and do not overexert themselves Ensure suitable footwear is worn

Opportunities to take this further

In following lessons the class looked at the control of the mechanisms via the brain and what happens when the control fails as in hypothermia and heat stroke. It could also be taken further by asking students to make predictions about core and peripheral temperature and to use a data logger to collect data on this.

Resources

Top Gear video clip of 'Man versus car at sub zero temperatures'
www.metacafe.com/watch/607965/how_cold_a_car_can_handle/

Clinical thermometers and/or digital thermometers – enough for one between two students ideally
Picture of section through the skin showing superficial blood vessels and sweat glands. A good example can be found at http://vrc.belfastinstitute.ac.uk/resources/skin/skin.htm

Bibliography

National Strategies Framework for Teaching Secondary Science: Overview and Learning Objectives (2008) www.standards.dcsf.gov.uk/secondary/frameworks

Science Programme of Study for KS3 (Extract from National Curriculum) (QCA 2008) http://curriculum.qca.org.uk/key-stages-3-and-4/subjects/science/keystage3/index.aspx?return=/key-stages-3-and-4/subjects/science/index.aspx

Science Programme of Study for KS4 (QCA 2008) http://curriculum.qca.org.uk/key-stages-3-and-4/subjects/science/keystage4/index.aspx