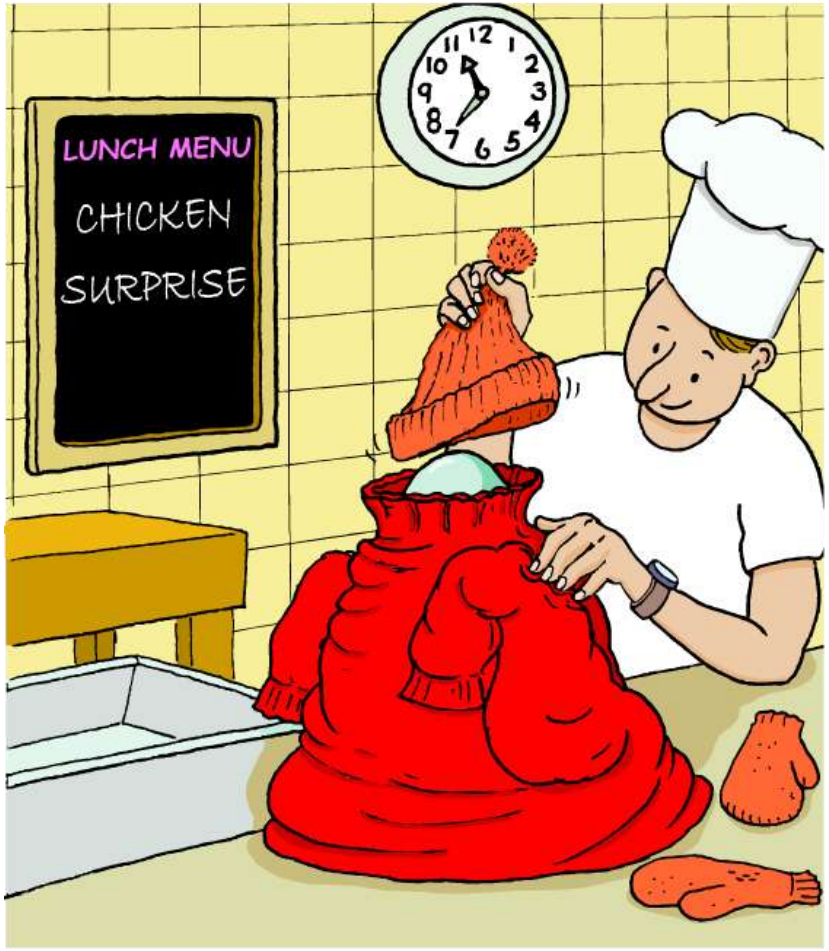
Specific Heat Capacity

Year 9, Lesson 2

Week commencing 26th March 2012

Charlie the Chef and his frozen chicken!

Charlie forgot to take the chicken out of the freezer last night! Will his plan to defrost the chicken in time for lunch work?



Important point for all – especially those who were skiing last week

- All lesson slides are online at:
- www.bioteacher.weebly.com
- Go to “Year 9 / GSCE”
- Write the website address down inside the front cover of your books

Title: Specific Heat Capacity

Objective: Investigate how energy supplied to a material affects its rise in temperature.

- I must be able to predict how a change in energy or mass will affect the rise in temperature of an object
- I should be able to carry out some calculations and re-arrange the equation
- I could apply the knowledge of heat capacity to a real life situation

Homework – for Friday

Find out how a **vacuum flask** keeps your drink warm.

Draw a picture of a flask and label it – explaining how each part keeps the drink warm.

Make sure you include the vacuum, plastic lid, and silver surface in your diagram/explanations.

Why do you think a car gets hotter in the sun than other things left out in the sun?

- It is made of metal. Metal heats up more easily than concrete and many other things.

When a substance heats up, its temperature rise depends on:

- The amount of energy supplied to it
- The mass of the substance (a higher mass will heat up less for a given energy supply)
- What the substance is

Specific Heat Capacity

“the energy needed or heat transferred to 1kg of substance to raise its temperature by 1 degree Celsius”

Different things have different heat capacities. E.g. The heat capacity of water is much greater than metals.

Comparing the temperature rises in water and metal

- Demo – we are going to supply some (heat) energy to a beaker of water and a block of aluminium and see by how much the temperature rises in each

<u>Temperature</u> – measure **at start** and **at end**

1 volunteer – measure temp. of water

2nd volunteer – measure temp. of aluminium

3rd volunteer – record the <u>mass</u> of both the metal and water

- So if the heat capacity of water is greater than metals – it means that more energy is needed for the temperature to rise to a given amount

What does this mean for a given energy supply?

- It means that for a given energy supply (as in the demo), the water temperature will rise less than the metal

$$\text{specific heat capacity} = \frac{\text{heat transferred}}{\text{mass} \times \text{temperature change}}$$

UNITS

Heat transferred – **J (joules)**

Mass – **kg**

Specific heat capacity – **J/kg °C (joules per kilogram degrees Celsius)**

Temperature change - **°C**

$$\text{specific heat capacity} = \frac{\text{heat transferred}}{\text{mass} \times \text{temperature change}}$$

Heat transferred is the same thing as energy supplied

So, in this example:

You heat a 1kg metal block using 7200J of energy. The starting temperature was 14 degrees C and the final temperature was 22 degrees C. What is the specific heat capacity?

Re-arranging the equation

$$\text{specific heat capacity} = \frac{\text{heat transferred}}{\text{mass} \times \text{temperature change}}$$

How would we re-arrange this to find out the heat transferred?

How much energy is needed to heat 5kg of water (SHC = 4200 **J/kg °C**) from 20 degrees C to 60 degrees C?

Heat transferred = energy supplied (remember previous slide)

So, energy supplied= 4200 X 40 X 5

= 840,000J

Questions

2 Use the information in Table 1 to answer this question

a Explain why a mass of lead heats up more quickly than an equal mass of aluminium.

b Calculate the energy needed

i to raise the temperature of 0.20 kg of aluminium from 15 °C to 40 °C

ii to raise the temperature of 0.40 kg of water from 15 °C to 40 °C.

Table 1

Substance	water	oil	aluminium	iron	copper	lead	concrete
Specific heat capacity (joules per kg per °C)	4200	2100	900	390	490	130	850

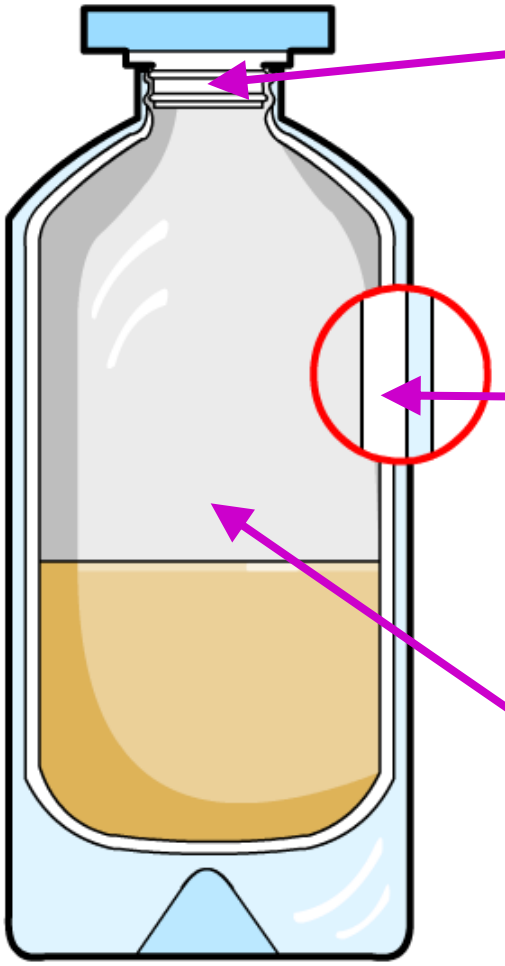
Plenary – questions – no hands!

A small bucket and a large bucket of water are left out in the sun. Which one warms up faster and why.

MBA question: A storage heater has bricks inside that store lots of energy and are plugged in to the mains electricity at night. The bricks have a high specific heat capacity. How does this relate to how the heater works?

How does a vacuum flask work?

How is a vacuum flask able to keep hot drinks hot and cold drinks cold?



2. The plastic (or cork) lid is an insulator and the screw top prevents **convection** currents escaping from the flask.

1. There is a vacuum between two layers of glass or steel, which prevents heat leaving or entering by **conduction**.

3. The walls have silvery surfaces, which prevent heat leaving or entering by **radiation**.