C1: ENERGY AND FOOD

Overview

These activities can be used to introduce students to energy – what it does, where it comes from, and how it can be measured. The focus is on the connection between **work**, **energy** and **food**, and the activities aim at helping students to learn how to read food labels and to understand the factors that affect reaction rates and the role of effective surface areas.

Suggested approaches:

- Let the students brainstorm and collect their ideas about energy.
  - ? *What does energy do?*
  - ? *Where does it come from?*
  - ? *Can it be measured?*
  - ? *How is it measured?*
  - ? *Is there a connection between work, energy and food?*
- During the brainstorm set up the activity **C1 ACTIVITY 1: FOOD ENERGY**. Use this activity to refine the students' understanding of the energy changes taking place.
- The energy released by food is calculated using the formula shown in Figure 1. It is advisable that students are familiar with this formula before undertaking the tasks, so that they are able to compare their results with the data given on food labels.

  Introduce the formula explaining that 4.2 is the specific heat capacity of water, i.e. the amount of joules (J) required to raise the temperature of 1 gram of water by 1°C.

$$\text{Energy released from food per gram (J)} = \frac{\text{mass of water (g)} \times \text{temperature rise (°C)} \times 4.2}{\text{mass of food sample (g)}}$$

Figure 1: Formula for calculating energy released

- After observing the teacher carrying out the first part of **C1 ACTIVITY 1: FOOD ENERGY**, students can set up their own investigation to find out how much energy is supplied by each of a selection of foods.

NOTE:

Energy in Action is an online schools resource from SEAI.
If you're reading a printout and wish to view this online to access links, visit www.seai.ie/energyinaction

C1 ACTIVITY 1: FOOD ENERGY

Background

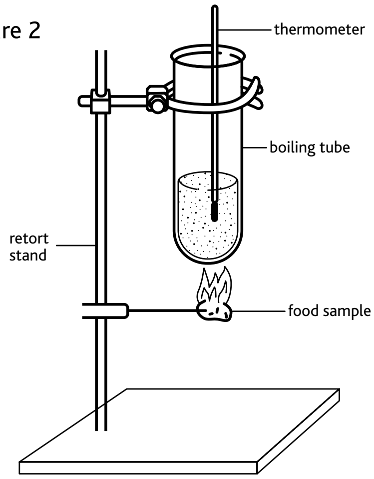
This investigation provides students with a visual and measurable example of how food provides energy. The activity is carried out in two stages; stage one is a teacher-led activity which serves to introduce the concept of burning food to supply sufficient heat energy to cause the temperature of water to rise. Although the activity is carried out by the teacher only, the students are involved through taking various readings and carrying out the calculations involved. This activity is an ideal opportunity for questions to be asked by both the teacher and the students rather than the teacher always being the questioner!

Stage two provides the students with an opportunity to apply what they learned in stage one. This time the students investigate the energy supplied by a selection of food types and compare their calculated energy with the energy information provided on the food labels. A follow-up challenge for the students might be to explain why their calculated results differ from those on the labels.

Equipment required:

- Bunsen burner
- Heatproof mat
- Retort stand with clamp
- Boiling tubes
- Measuring cylinder
- Thermometer
- Mounted needle or similar
- Food sample (i.e. a cracker or a piece of bread)
- Safety goggles
- Electric scales

Figure 2



STAGE 1 – TEACHER ACTIVITY WITH STUDENTS ACTING AS ASSISTANTS

What to do:

1. Ask one student to measure approx. 25 ml cold water into a boiling tube and clamp it onto the retort stand.
2. Assign a group of students the job of calculating the mass of water used.
   (Hint: density of water = 1 g/cm^3 and mass = volume/density)
3. Ask another student to record the temperature of the water in the boiling tube.
4. Ask another student to record the mass of the food sample being investigated.
5. Show the students how to carefully skewer the food sample onto the mounting needle taking care not to lose any crumbs.
   Possible questions:
   - ? ***Why is it important not to lose any crumbs?***
   - ? ***What measurement might be affected if some crumbs are lost?***
6. Now hold the food in the lighted Bunsen burner until it catches fire.
7. As soon as it is alight, place the burning food under the boiling tube as shown in Figure 2 until the flame goes out.
8. As soon as the flame goes out stir the water before reading the temperature.
9. Possible questions:
   - ? ***Why should the water be stirred first?***
   - ? ***How is water heated?***
   - ? ***How might this affect the temperature of the water?***
10. Let one of the students record the highest temperature.
11. Set the class the task of calculating the energy released from the food, using the recorded values and the formula shown in Figure 1.

STAGE 2 – STUDENTS INVESTIGATING THE ENERGY RELEASED BY DIFFERENT FOOD TYPES

Equipment required:

- Bunsen burner
- Heatproof mat
- Retort stand and clamp
- Boiling tubes
- Measuring cylinder
- Thermometer
- Mounted needle or similar
- Selection of food types together with their individual food labels
- Safety goggles
- Electric scales

What to do:

1. Measure approx. 25 ml cold water into the boiling tube and clamp it onto the retort stand.
2. Calculate the mass of water used.
   (Hint: density of water = 1 g/cm^3 and mass = volume/density)
3. Stir and record the temperature of the water in the boiling tube.
4. Record the mass of the food sample being investigated.
5. Carefully skewer the food sample with the mounting needle taking care not to lose any crumbs.
   ? ***Why is it important not to lose any crumbs?***
6. Hold the food in the lighted Bunsen burner until it catches fire.
7. As soon as it is alight, hold it under the boiling tube as shown above until the food flame goes out.
8. As soon as the flame goes out stir the water before reading the temperature.
   ? ***Why is it important to stir the water?***
9. Record the highest temperature reached and log it on the record sheet.
10. Repeat the procedure for the other food samples.
11. Review the data and decide on a suitable graph to draw.
12. Draw the graph and comment on it.
13. Compare the results for the individual food items with the energy information written on the food labels.
    ? ***Is there a discrepancy between the values?***
    ? ***If so, can you offer a possible explanation for this?***

C1.1 WORKSHEET A: FOOD ENERGY RECORD SHEET

	Food Sample Name	Mass (g)	Mass of water (g)	Temp. rise	Energy used = $\frac{\text{mass of water (g) x temperature rise (°C) x 4.2}}{\text{mass of food sample (g)}}$
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Graphing Results

C1 ACTIVITY 2: FIRE CLOUDS (A TEACHER DEMONSTRATION ONLY)

Background

This activity is a spectacular demonstration of the energy released from a powder. It provides an early introduction to **variables** that affect **reaction rates** and to the role of **effective surface areas**. Dried milk powder contains **carbohydrates** and **fats** that **release energy on combustion**.

There are two parts to this activity. First, a small pile of the dried milk is burned and secondly a similar quantity is sprinkled onto a glowing splint. The pile will burn slowly as the effective surface area is small, whereas the sprinkled powder has a much greater surface area and so a fire ball effect is created.

Ensure that the activity is carried out behind a safety screen and in compliance with the school's safety procedures. This is not an outdoor activity. Consider that the height from which the powder is sprinkled will determine the height of the resultant fire ball.

This activity can be used to illustrate why chewing food aids digestion, and why some foodstuffs are finely cut before cooking. It also highlights the dangers posed by dust from granary silos, coal mines, paper making factories, etc. It should be mentioned that carefully controlled dust explosions are commonly used by pyrotechnicians, special effects artists, etc.

A safer but less spectacular alternative investigation could be carried out by the students to compare the dissolving rate of jelly crystals to that of gelatine.

Suggested approach:

- Before demonstrating the activity, show the class the two piles of milk powder and tell them that you are going to light one pile as it is but will sprinkle the second pile. Ask them to **predict** the outcome and to **explain** the reasons for their predictions.

Equipment required:

- Safety goggles for each person in the room
- Safety screen
- Approximately 60 g of milk powder
- Measuring spoon (a 5 ml measure)
- Spatula
- Retort stand and clamp
- Bunsen burner
- Heatproof mat
- Metre stick
- A long splint
- Tape or a bulldog clip

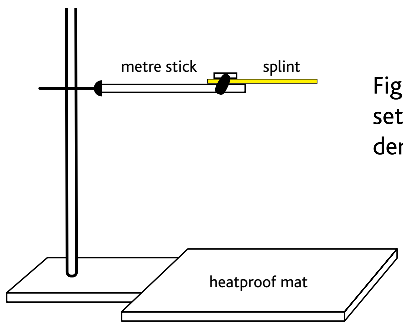


Figure 3: Experimental setup for Fire Clouds demonstration

What to do:

Ensure that all students are behind the safety screen and wearing the safety goggles throughout.

1. Fix a long splint to the end of the metre stick using the tape or clip.
2. Measure about two heaped spoons of the milk powder into a pile on the heatproof mat.
3. Try to ignite it by holding the Bunsen burner to it.
4. Fix a long splint to the end of the metre stick and light it.
5. Clamp the splint on the retort stand so that the splint can burn freely above the heatproof mat as shown in Figure 3.
6. From a height (no greater than the top of the safety screen), sprinkle the milk powder over the burning splint.

? ***Can the students explain the difference between the reactions?***

Resources:

- This activity is available on page 17 of http://www.scienceonstage.ie/resources/.

C1 ACTIVITY 2 DISCUSSION POINTS: DUST

1. The **Fire Clouds** activity illustrates the dangers posed by dust from granary silos, coal mines, paper making factories, etc. Having observed and discussed the activity, the topic of dust explosions and their containment can be explored.
2. Students might also research how pyrotechnicians and special effects artists make use of controlled dust explosions.