Energy in Food - Teacher Notes

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Aim

This experiment is an excellent demonstration of how energy can be transferred from one system to another (food to water) and how it is transformed from one form to another (chemical potential energy to heat energy).

The experiment is suitable for students in years 7, 8 and 9, where they are expected to learn about the different forms of energy and the flow of energy and matter through ecosystems.

Students will have the chance to learn the idea of why controlling variables is important and how to design a reliable experiment. Hence, they will address the science inquiry skills.

Students are asked to make a hypothesis and challenge it by completing the experiment. They will study the energy released when different types of food are burned and will confirm which food contains the most energy.

Plan

Encourage students to choose the food for which they will calculate the energy content. It would be interesting if they choose food from their daily diet. You can ask students to bring in samples from home to get a greater variety of foods.

Make sure the food used is dry enough to be held by thongs or by a piece of wire. Examples could be a piece of potato chip, corn chip or a biscuit, etc.

The experiment could be kept simple by only finding out how high the temperature rises with each food item. An extension to this would be to calculate the energy content whilst also acknowledging the energy loss to the environment.

The experiment involves safety precautions, as students will be using heat and flames as well as glass tubes. They should wear goggles and caution should be taken that students are not allergic to the piece of food they are examining.

Conduct

This experiment is at a structured inquiry level, in which students will be given the plan for the experiment and general guidance for the stages of planning, conducting and analysing the results.

Make sure students are aware of the safety rules and that students comply to them while conducting the experiment. Ask students not to start the experiment until you have checked their setup to avoid burning hazards.

Discuss with students which variables should be kept constant, such as the volume of water heated, the distance between the flame and the test tube and the size of the test tube.

Inform students that the thermometer should not touch the base of the tube, this can cause the thermometer to break.

This experiment can be conducted at different levels; the simplest level is to measure the change in temperature while ignoring the mass of the piece of food. A deeper examination would consider the mass burnt, while further examination would be to find the energy released per gram of food burnt.

Measure the temperature of water at the beginning and the end of the experiment, and ensure that water is stirred throughout the experiment using the thermometer so that the heat is evenly distributed.

For the extended experiment students will find the heat in joules/gram using the equation:

$$Heat\ energy\ (\frac{J}{g}) = \frac{42 \times (final\ temperature - initial\ temperature)}{mass\ of\ food\ burned\ (g)}$$

Analyse

Students should identify their independent variable as the type of food burnt and the dependent variable as the temperature rise. Control variables are the volume of water heated, the size and type of test tube and the distance between the flame and the test tube.

Students are asked to tabulate their measurements to ensure the accuracy of the calculations as follows:

1. Mass of piece of food before burning (g)	
2. Mass of any remaining piece of food after burning (g)	
3. Mass of food burnt (g) = (1) – (2)	
4. Initial temperature of water (^{0}C)	
5. Final temperature of water (^{0}C)	
6. Difference in temperature (^{0}C) = (5) – (4)	

For the younger classes, students will find the value of temperature difference per gram of food burnt by dividing the value obtained in step (6) by the value obtained in step (3), or even more simply by looking at the temperature difference and ignoring the mass.

For more advanced classes, they will use the values obtained as follows to find the heat energy released in joules per gram of food burnt.

$$Heat\ energy\ released\ \left(\frac{J}{g}\right) = \frac{42 \times (step\ 6)}{step\ (3)}$$

Students will then decide which food contains the most energy.

It would be a good idea to have more than one group doing the same type of food and getting the average result to improve the accuracy of the results.

For example if three groups are testing the same type of food:

$$average\ result = \frac{Sum\ of\ results}{number\ of\ results} = \frac{result\ 1 + result\ 2 + result\ 3}{3}$$

Problem solving and discussion

The results in this experiment should give an idea of which food has the highest stored chemical energy, however students should be aware that not all the heat energy released is transferred to the water.

Some of the heat energy is released to the atmosphere and some is used to heat the glass tube. This heat loss is not accounted for in the experiment. Also, some food types would burn faster than others, which in turn would affect the amount of heat that can be utilised for heating the water.

Discuss with students what problems they faced and how to fix them. For example, how can you keep the distance constant between the flame and the test tube for each test? One solution would be to mark a point on the retort stand using a clamp and holding the food at this point.

Conclusion

Students should be able to share if they were able to compare the energy released from different types of food and whether their prediction agreed with their results.

Students can choose a way to represent their findings to their community, such as publishing their results and recommending the best food choices for lunchboxes in their school bulletin. Students can elaborate on their findings, pointing out that food containing the highest energy content can be obesogenic; however these types of food can supply the body with quick energy if required, such as for an athlete.

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