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| **Activity 2.2.4: How Much Energy Is in Food? (Virtual Lab Version)** |

Introduction

Your everyday actions are powered by the energy obtained from food. Your body disassembles what you eat, bit-by-bit, and captures the energy stored in the molecules that make up the food. This disassembly requires multiple body systems working together. The digestive system begins the process by mechanically and chemically breaking down the food into its component molecules. These molecules are then absorbed through the small intestine and travel via the circulatory system to all the regions of the body. Finally, the cells in the tissues of the body capture the energy as the food molecules are broken into ever smaller molecules with the help of oxygen obtained from the respiratory system.

Carbohydrates, fats, and proteins each provide varying amounts of energy for the body. The amount of energy that can be tapped is related to the structure you observed in Activity 2.2.3. The preferred macromolecule to use as an energy source is a carbohydrate. Carbohydrates are further broken down into their component sugar molecules through the process of hydrolysis. Sugars, such as glucose, are then absorbed into the bloodstream from the small intestine. The glucose molecules travel to the body’s cells where a series of chemical reactions, known as *cellular respiration*, ultimately make adenosine tri-phosphate, ATP. Using the analogy of a car, ATP is the human body’s gasoline. It is the energy compound that powers all metabolic reactions.

As you observed earlier in the unit, food labels list the number of calories in a serving of a food. The number of calories is an indication of the amount of energy that a serving of food provides to the body. When referring to food, a calorie is the amount of energy needed to raise the temperature of 1 kg of water 1° C. The number of calories in a piece of food is determined by measuring the increase in temperature of a known volume of water when a portion of the food is burned. This process for measuring the amount of energy in food is called *calorimetry*.

As you observed when you analyzed the food labels, different foods contain different amounts of calories. An average person should consume about 2000 calories per day. To measure the number of calories in a piece of food, the food is ignited and the amount of energy in the food is determined by measuring the increase in temperature of water due to the heat given off by the burning food. This process is performed in an apparatus called a *calorimeter*. In this activity you will make a simple calorimeter to measure the amount of energy in a variety of food samples. Begin to think about the specific energy content of food as you continue your investigation into Anna Garcia’s mysterious death.

Equipment

* Label Analysis Chart resource sheet from Activity 2.2.2
* Project 2.2.1 Autopsy Report
* Activity 2.2.3 Student Response Sheet
* PBS Course File

Procedure

1. Refer to your Label Analysis Chart resource sheet from Activity 2.2.2 and your Activity 2.2.3 Student Response sheet.
2. Using what you have learned in Activity 2.2.3 about the structure of macromolecules, make predictions as to which of the four food items you investigated will provide the most energy to your cells. Record your predictions in your laboratory journal. You will test these foods in this experiment.
3. Read the background information below about the term *calorie*. Return to this information as needed as you calculate the calorie content of food items in your experiment.

The word calorie is confusing because there are two definitions of the word and they differ by a factor of 1000. In chemistry, a calorie is the amount of energy needed to raise the temperature of 1 g of water 1° C. The calories listed on a food label are actually kilocalories in chemistry because the amount of water being heated is a kilogram instead of a gram. A kilogram is 1000 times more than a gram.

It was considered cumbersome to use the term kilocalorie when referring to food, so the prefix was dropped. For years when the term calorie was used to refer to food, it was written with a capitol C. A Calorie was the energy to raise the temperature of 1 kg of water, and a calorie was the energy to raise the temperature of 1 g of water. Even that practice has fallen out of favor in recent years and both types of calories are written with lower case letters. Because of the confusion, most scientists have abandoned the term calorie in favor of the Standard International metric unit of measure for energy called the Joule. One calorie (chemistry) is equal to 4.186 joules, and one Calorie (food) is equal to 4186 joules.

1. Using **Internet Explorer** google search “classzone virtual lab calorimetry” OR go to the website <https://www.classzone.com/books/hs/ca/sc/bio_07/virtual_labs/virtualLabs.html>
2. Begin the lab and follow the steps. After the introduction, you will be asked to choose 5 samples and predict which one will have the most calories.
3. In your paper lab journal make your predictions and write them in order from least calories to most calories.
4. Copy the following data table into your journal and proceed with the lab. Follow the instructions as they are given. As you type your results into the virtual lab, write them in the table in your journal.

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| --- | --- | --- | --- | --- | --- |
| Calculations | Sample 1 | Sample 2 | Sample 3 | Sample 4 | Sample 5 |
| Food Used |  |  |  |  |  |
| Initial Temp of H2O (oC) |  |  |  |  |  |
| Final Temp of H2O (oC) |  |  |  |  |  |
| **Change in Temp of H2O (°C)** |  |  |  |  |  |
| Initial Mass of Food sample (g) |  |  |  |  |  |
| Final Mass of Food sample (g) |  |  |  |  |  |
| **Change in mass of food sample (g)** |  |  |  |  |  |

1. Record each of the final calculated values in the Data Analysis Table in your Laboratory Journal.
2. Calculate the change in temperature (°C) of the water.
3. Calculate the change in mass (g) of the food samples.
4. Copy the following table into your lab notebook:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Calculations** | **Sample 1** | **Sample 2** | **Sample 3** | **Sample 4** | **Sample 5** |
| Food Calories in Sample |  |  |  |  |  |
| Chem. calories in Sample |  |  |  |  |  |
| Calories/Gram in food |  |  |  |  |  |

1. Use the following equation to calculate the amount of energy in the food samples. You may use the virtual lab to help you, but you WILL need to be able to use this equation on the quiz.



1. Use the following equation to calculate the amount of Calories/Gram of the food sample being tested. **PAY ATTENTION** to the fact that you'll be using **FOOD Calories** and NOT Chemistry Calories.



1. Take out the Project 2.2.1 Autopsy Report. Using everything you have learned in this lesson about food, energy, and macromolecules, analyze Anna’s last meal and how it could have related to her untimely death. Add this information to the Autopsy Report under the *Possible Causes of Death* section.
2. Answer the Conclusion questions.

Conclusion

1. Which of the foods you tested had the greatest energy content? Compare your findings from the experiment to the predictions you made in Step 2.
2. Calculate the food energy (joules/g) of one of your food samples. One chemistry calorie is equal to 4.186 joules.
3. Convert the energy you calculated to kilojoules (1 kJ = 1000 J). Show and label your work for your calculations.
4. Explain how knowledge of the energy content of food can help diabetics make smart diet choices.
5. Explain how both a biochemist and a food scientist may assist in making sure people consume a more nutritious diet.