The Power of Peanuts

This lesson plan is for a laboratory activity demonstrating the amount of energy found in a peanut. Peanuts contain proteins, fats, and carbohydrates. Oxidation of the molecular bonds found in these compounds leads to the release of energy.

Primary Learning Outcomes
Because oxidation through burning is one way to release energy found in the molecular bonds of proteins, fats, and carbohydrates, students will be able to measure the amount of energy contained in a peanut by burning it and measuring temperature change in water heated by the burning peanut. Students will also be able to convert the energy measurement to nutritional calories to gain a better understanding of what causes calories in various foods.

Assessed Georgia Performance Standards

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.

SCSh3. Students will identify and investigate problems scientifically.

SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.

SB4. Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.

SPS7. Students will relate transformations and flow of energy within a system.

Procedures/Activities
Step: 1 Duration: 1 hour
Wrap a cork with aluminum foil and bend a paper clip such that a peanut will rest atop the rounded portion of the paperclip and the straightened portion is stuck into the cork. Suspend an emptied soda can containing 100 ml of water using a ring stand and wire gauze over the peanut (***approximately 2.5 to 5 cm from the top of the peanut***). Using a clamp attached to the ring stand, suspend an alcohol thermometer in the water, making sure that the thermometer does not touch the can (***see attached diagram***). Have students record the initial water temperature. Using a match or butane lighter, have the students ignite the peanut. When the flame goes out, monitor the water temperature until it no longer changes. Calculate the increase in temperature.

Step: 2 Duration: 30 minutes
Have the students calculate the energy in the peanut, measured in joules, by calculating energy absorbed by the water using the following formula:

Joules = mass of the water x temperature increase x 4.2 J/(g^oC)

Students can also calculate the amount of nutritional calories in the peanut by dividing the number of joules by 4,184. This is due to the fact that there are 4,184 joules in a kilocalorie.

Students should also consider the following questions.

1. Explain why the results obtained from using this apparatus can be inaccurate.
2. How could the results of this experiment be improved?
3. How would you measure the energy content of milk? Explain your answer.

Materials and Equipment

1. Alcohol Thermometer
2. Support stand with ring clamp
3. Wire gauze
4. Clean, empty can
5. Shelled Peanut
6. Paper Clip
7. Cork covered in aluminum foil
8. Metric Ruler
9. 125 mL graduated cylinder
10. Water
11. Matches or butane lighter

Total Duration

1 hour 30 minutes

Assessment

Students can be assessed through participation in laboratory activity, as well as through the grading of the laboratory questions.

Laboratory Worksheet

Calculate the energy in the peanut (in Joules) by calculating energy absorbed by the water using the following formula:

Joules = mass of the water x temperature increase x 4.2 J/(g^oC) Show your work.

Nutritional calories are actually kilocalories (1000 calories). Therefore, we can calculate the amount of nutritional calories found in the peanut by simply making a few conversions. There are 4,184 joules in a kilocalorie. Use the answer you found above to calculate the amount of nutritional calories found in the peanut. ***Show your work.***

Answer the following questions:

1. Explain why the results obtained from using this apparatus can be inaccurate.

2. How could the results of this experiment be improved?

3. How would you measure the energy content of milk? Explain your answer.

Laboratory Apparatus Diagram