# Lab 6. Energy in Food: Which Type of Nut Is Best for a New Energy Bar?

## Introduction

All living things must take in nutrients to survive. In plants, the process of photosynthesis converts light energy from the sun, along with carbon dioxide and water to generate sugar molecules that the plant then uses for chemical energy to complete cellular processes that are required for the plant to live and grow. Animals (including humans), however, must consume food to obtain the nutrients and chemical energy they need to complete the cellular processes that allow them to live and grow. People get energy to live by consuming a variety of food types, such as carbohydrates, proteins, and fats. Each of these food types has different properties and provides our bodies with different amounts of energy. Plants and animals break down nutrients to release chemical energy through a process called *cellular respiration*. During cellular respiration, large molecules containing carbon, hydrogen, and oxygen atoms are broken down into smaller molecules in a process similar to the combustion (or burning) of wood in a fire.

The amount of chemical energy that is stored in a food source is measured in *food calories*. A food calorie is also called a *kilocalorie* and is defined as the amount of energy needed to heat 1 kilogram of water by 1 degree Celsius. The chemical energy stored in food is released through the processes of digestion and cellular respiration so that our bodies can then use the energy for important tasks such as moving our muscles. Different food types contain different amounts of energy that our bodies can use; in general, fats provide the most energy at about 9 food calories per gram. Carbohydrates and proteins both provide about 4 food calories per gram.

FIGURE L6.1

**Example of a nutrition facts label**

**Nutrition Facts**

Serving Size 2/3 cup (55g)
Servings Per Container About 8

**Amount Per Serving**

| | |
|---|---|
| **Calories** 230 | Calories from Fat 4 |
| | **% Daily Value** |
| **Total Fat** 8g | **12** |
| Saturated Fat 1g | **5** |
| *Trans* Fat 0g | |
| **Cholesterol** 0mg | **0** |
| **Sodium** 160mg | **7** |
| **Total Carbohydrate** 37g | **12** |
| Dietary Fiber 4g | **16** |
| Sugars 1g | |
| **Protein** 3g | |
| Vitamin A | 10 |
| Vitamin C | 8 |
| Calcium | 20 |
| Iron | 45 |

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

| | Calories: | 2,000 | 2,500 |
|---|---|---|---|
| Total Fat | Less than | 65g | 80g |
| Sat Fat | Less than | 20g | 25g |
| Cholesterol | Less than | 300mg | 300mg |
| Sodium | Less than | 2,400mg | 2,400m |
| Total Carbohydrate | | 300g | 375g |
| Dietary Fiber | | 25g | 30g |

Many foods contain a mix of carbohydrates, protein, and fats; this is true of nuts (peanuts, pecans, almonds, etc.). The nutrients found in different foods are shown on the *nutrition facts* label that is included on most food items sold in the United States (see Figure L6.1 for an example of this label). These labels also include information about the types of vitamins found in foods, such as vitamin A or vitamin C, or minerals found in food, such as calcium or iron. Vitamins and minerals are important for certain cellular processes, but they do not provide any calories or energy for our bodies.

Each day our bodies need a minimum number of calories so that we have enough energy to complete the tasks that keep us alive, such as maintaining our core body temperature, breathing, and keeping our heart beating and circulating blood and oxygen throughout our body. The amount of calories an individual needs to complete the most basic functions of life is called the *resting metabolic rate*. Resting metabolic rates differ from person to person based on gender, height, weight, and many other factors. People need additional energy so they can walk, talk, or do other everyday tasks, and people who exercise or play sports need even more energy so that they can complete the tasks associated with those activities such as running, jumping, or lifting heavy objects. To get all the energy we need on a daily basis, we must eat enough food to provide our bodies with all the calories we need. On average, an adult should consume about 2,400 food calories a day. In addition to eating three meals a day, sometimes it is necessary to have a snack to take in enough calories for the day. Many athletes, for example, must eat "energy bars" before they exercise or even during long exercise sessions to make sure they get the extra calories they need.

## Your Task

Collect data to help you determine which type of nut would be the best to use for a new energy bar. To do this, you will need to measure the amount of energy in a variety of nuts and consider several other factors, such as cost, size of bar, and/or amount of calories that are necessary to complete different exercises.

The guiding question of this investigation is, **Which type of nut is best for a new energy bar?**

## Materials

You may use any of the following materials during your investigation:

| Consumables | Equipment |
|---|---|
| • Nuts (peanut, cashew, pecan, almond, walnut)<br>• Matches | • Calorimeter<br>• Combustion stand<br>• Thermometer or temperature sensor<br>• Graduated cylinder (100 ml)<br>• Timer<br>• Electronic or triple beam balance<br>• Sanitized indirectly vented chemical-splash goggles<br>• Chemical-resistant apron<br>• Gloves<br>• Lab 6 Reference Sheet |

## Safety Precautions

Even though there are food items used during this lab investigation, they should be treated as chemicals and not eaten. In addition, take the following safety precautions:

1. Notify the teacher immediately if you have an allergy to nuts.
2. Put on sanitized indirectly vented chemical-splash goggles and laboratory apron and gloves before starting the lab activity.
3. Never put consumables in your mouth.
4. Use caution when working with open flames while burning the nuts and using matches. Open flames can burn skin, and combustibles and flammables must be kept away from the open flame. If you have long hair, tie it back behind your head.
5. Handle all glassware with care to avoid breakage. Sharp glass can cut skin!
6. Wash your hands with soap and water after completing the lab activity.

**Investigation Proposal Required?** ☐ Yes ☐ No

## Getting Started

During your investigation you will need to determine the amount of energy in each type of nut. To do this, you can use a calorimeter to measure the amount of heat energy released by burning each type of nut (see Figure L6.2). Measuring the temperature change in a sample of water will provide information related to the amount of energy stored in the nut.

To answer the guiding question, you will also need to consider other factors such as the cost of different types of nuts and how many calories it takes to complete various exercises. To accomplish this task, you must first determine what type of data you need to collect, how you will collect it, and how you will analyze it. To determine *what type of data you need to collect*, think about the following questions:

- What information will tell you which nut(s) have the most energy?

**FIGURE L6.2**

**A simple calorimeter that can be used to measure the amount of energy in a nut**

- How will the calorimeter and thermometer (or temperature sensor) help you measure the energy in the nuts?
- What type of measurements or observations will you need to record during your investigation?

To determine how you will collect your data, think about the following questions:

- What will serve as a control (or comparison) condition?
- What types of treatment conditions will you need to set up and how will you do it?
- How often will you collect data and when will you do it?
- How will you make sure that your data are of high quality (i.e., how will you reduce error)?
- How will you keep track of the data you collect and how will you organize it?

To determine how you will analyze your data, think about the following questions:

- How will you determine if there is a difference between the treatment conditions and the control condition?
- What type of calculations will you need to make?
- What type of graph could you create to help make sense of your data?
- How many calories should your energy bar have?
- How much will your energy bar cost?

## Connections to Crosscutting Concepts, the Nature of Science, and the Nature of Scientific Inquiry

As you work through your investigation, be sure to think about

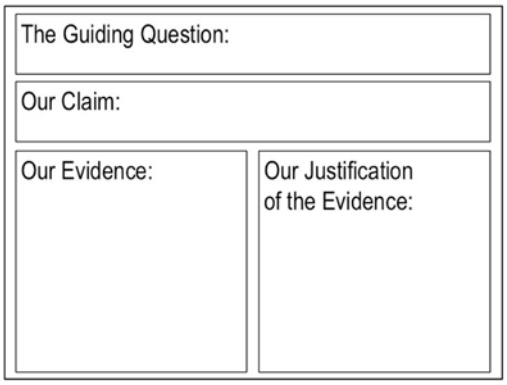
- how energy and matter flow through living things while being totally conserved,
- how an object's shape or structure determines many of its properties and functions,
- the difference between data collected and evidence created in an investigation, and
- the role of imagination and creativity when solving problems in science.

## Initial Argument

Once your group has finished collecting and analyzing your data, you will need to develop an initial argument. Your argument must include a claim, evidence to support your claim, and a justification of the evidence. The claim is your group's answer to the guiding question. The evidence is an analysis and interpretation of your data. Finally, the justification of the evidence is why your group thinks the evidence matters. The justification of the evidence is important because scientists can use different kinds of evidence to support their claims. Your group will create your initial argument on a whiteboard. Your whiteboard should include all the information shown in Figure L6.3.

**FIGURE L6.3**

**Argument presentation on a whiteboard**




## Argumentation Session

The argumentation session allows all of the groups to share their arguments. One member of each group will stay at the lab station to share that group's argument, while the other members of the group go to the other lab stations one at a time to listen to and critique the arguments developed by their classmates. This is similar to how scientists present their arguments to other scientists at conferences. If you are responsible for critiquing your classmates' arguments, your goal is to look for mistakes so these mistakes can be fixed and they can make their argument better. The argumentation session is also a good time to think about ways you can make your initial argument better. Scientists must share and critique arguments like this to develop new ideas.

To critique an argument, you might need more information than what is included on the whiteboard. You will therefore need to ask the presenter lots of questions. Here are some good questions to ask:

- What did your group do to collect the data? Why do you think that way is the best way to do it?

- What did your group do to analyze the data? Why did your group decide to analyze it that way?
- What other ways of analyzing and interpreting the data did your group talk about?
- What did your group do to make sure that these calculations are correct?
- Why did your group decide to present your evidence in that way?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those other ideas?
- How sure are you that your group's claim is accurate? What could you do to be more certain?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the research question!

## Report

Once you have completed your research, you will need to prepare an investigation report that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. The report must be typed and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!