

Food Analysis

Real World Energy
Backgrounder
Grade Level: 9-12



Take a close look at this submarine sandwich. It contains enough energy to carry one average-sized human about 40 kilometres on a bicycle. It contains large numbers of important food molecules that are necessary for a healthy functioning body.

Food & Food Molecules

All of the energy we use in a day must come from our food. From the point of view of energy, the bulk of our food falls into categories: protein, carbohydrates, and fats.

Protein

Proteins are essential to all life. A protein is a complex chemical substance formed by linking **amino acid** molecules together. Amino acids are small water-soluble molecules that contain nitrogen, carbon, hydrogen, and oxygen. You can think of a protein as a string of beads, each of the beads being one amino acid. There are literally thousands of different proteins in the body, and all of them do different jobs.

Here is a sample of a few proteins found in the body, and what they do:

Protein	Function
Collagen	Provides structure to skin and surface tissues
Keratin	Gives strength to hair and nails
Hormones (Testosterone, adrenalin, etc.)	Carry chemical signals in the blood that trigger changes in the body, can influence alertness, behaviour, etc.
Fibrinogen	Helps form blood clots at the site of a wound
Enzymes (Pepsin, trypsin, etc.)	Helps chemical reactions to happen inside or outside of cells, such as digestive enzymes.
Melanin	Gives dark colour to skin and hair.
Actin and Myosin	Work together to cause muscle fibres to contract inside muscle cells.

Another important job filled by protein is to supply energy to cells when needed. Proteins can be broken down into amino acids, and many cells in the body have the ability to change amino acids into sugar. If all other supplies of food and energy are lacking, the body can begin to convert its own protein into glucose to supply energy for essential life processes.

In most people's diets, the majority of their protein comes from meat and dairy products. This food is eaten and digested in the small intestine where enzymes dissolve the protein into amino acids. The amino acids are absorbed through the wall of the intestine into the bloodstream. Cells throughout the body are on the lookout for amino acids and use them to build new proteins wherever they are needed. Some of the amino acids are converted to glucose by the liver and stored for later use when energy is needed.

Carbohydrates

Carbohydrates are foods made from sugars. They come in several forms. The most basic carbohydrates are simple sugars. Glucose is an example of a simple sugar. You can tell that there might be simple sugar in your food by its taste: definitely sweet.

Carbohydrates also exist in the form of starches. In pure form, starches are white, tasteless, and have a powdery texture. Starches are formed in most plants by linking glucose or other simple sugar molecules. Starches can be found in seeds, roots, and stems, wherever the plant needs to lay aside supplies of glucose for later use.

Most people get their carbohydrates by eating bread, pasta, baked goods, and other sweet or starchy foods. In most cultures, agriculture supplies basic foods called **staples**, which are often starch-based. The following table shows where some cultures from around the world traditionally get their carbohydrates.

Culture	Staple Foods
Traditional American Aboriginal	Corn, beans, squash
Southeast Asia	Rice
South American Andes Mountains	Potatoes, corn
Mediterranean Sea	Wheat, barley, rye
East African	Maize, sorghum, millet

Carbohydrates represent quick energy for the body. They are easy to digest, are absorbed quickly, and go straight to the cells that need them. If you need a quick energy boost during a tiring day, the best

source is food rich in carbohydrates. Think PB&J (peanut butter and jam sandwich)!

Yet another kind of carbohydrate is something called **cellulose**. Cellulose is a tough fibre formed from glucose molecules bonded together chemically. The chemical bonds are stronger than those that hold starch molecules together, which makes cellulose indigestible to most organisms. Cellulose is the main ingredient in wood.

Even though we cannot digest it, cellulose is still an important part of our diet! It supplies the fibre we need to help clear out our intestines and to absorb wastes that our bodies have trouble removing otherwise.

Fats

Fats are found in almost all our food, from pastry, to meats and dairy products, to nuts and seeds. Like proteins and carbohydrates, fats are complex molecules formed from smaller subunits. In this case, the subunits are substances called fatty acids.

Fats are an essential part of our diet. They not only supply energy, but are also essential for the development of the brain and nervous system, for helping to control body temperature and in the production of some kinds of hormones.

The fats found in our diet are sorted into two general categories, namely **saturated fats**, and **unsaturated fats**. These two kinds of fats are chemically different from each other. Animal fats contain mostly saturated fats. They form a waxy solid at room temperature. Bacon fat and butter are examples of this. The fats found in grains, nuts and seeds are mostly the unsaturated kind of fat. These fats are liquid at room temperature.

Diet researchers have found a connection between the consumption of saturated fats, such as those from meat or dairy products, and too much **cholesterol** in the blood. Cholesterol is made by your body and is the basic raw material for hormones such as testosterone and estrogen. It is always present in the blood, but too much of it can lead to

plugged arteries and heart attacks. There is evidence that a diet high in saturated fats is often connected with high blood cholesterol levels. By switching to unsaturated fats such as olive oil and by reducing the amount of meat and dairy in the diet, people can reduce their blood cholesterol to safe levels.

Green Thumb: Organic Food

One of the surest ways to introduce poisonous substances into your body is through your food. While most of our food is very safe, some of it contains small amounts of toxic and cancer-causing chemicals. A way to reduce the chance of taking in harmful substances through our food is by eating certified organic. Organic food is grown without the use of pesticides and chemical fertilizers, which means there is less chance of toxins getting into your body when you eat this food.

Energy in Food

Measuring Energy Content in Food: Calorimetry

Fats, proteins, and carbohydrates all contain energy, but in varying amounts. This energy is in the form of stored chemical energy. To be useful as energy, these foods must all be converted to glucose. The energy they yield is used to help us move and to maintain all the normal functions of a healthy body, such as breathing, heart rate, brain activity, growth and healing.

The energy content in food is measured by using the food as a fuel and measuring how much heat is released when burning it. The stored energy in food is measured with a unit called a **food calorie**. A food calorie is equivalent to 4,184 joules, which is enough energy to warm one litre of water by one degree Celsius. To put this into perspective, a typical hamburger contains about 600 food calories, or 2.5 million joules. This is enough energy to drive a minivan just over one kilometre!

500 grams of:	Food calories	Kilometres in the minivan:
Pasta (carbohydrates)	2000	4.3
Meat. Caption: Lean meat (protein)	2000	4.3
Margarine (fats)	4500	9.7

What we learn from this is that gram for gram, fats have more than twice the energy content of either proteins or carbohydrates. This partly explains why under certain circumstances, carnivorous animals show a strong preference for the fattiest parts of the animals they eat. For example, coastal-dwelling grizzly bears “bulk up” in preparation for hibernation in the fall. They will kill hundreds of spawning salmon, but will eat only their brains, eggs and other fatty parts. Similarly, the traditional diet of Inuit living in Canada’s high Arctic consisted of mostly animal meat and fat, especially in winter when the food energy was needed more.

Key Points to Remember

- All animals get their energy through their food.
- Food for humans consists mostly of proteins, fats, carbohydrates, and fibre.
- The process of digestion uses enzymes to release nutrients from our food.
- Fats yield the most amount of energy per gram, followed by proteins and carbohydrates. Fibre is indigestible but has other health benefits.
- Animals have a great diversity of strategies for getting food in nature.