**Nutrition**

Objectives:

* Summarize the basics of nutrition
* Define macronutrients and micronutrients
* Categorize and describe the body’s sources of energy
* Analyze intake of nutrition and make appropriate changes

**The Basics**

**Nutrition** can be defined as the science of the action of food, beverages, and their components in biological systems. A **nutrient** is a compound that provides a needed function in the body. Nutrients can be further classified based on the amount required by the body to maintain homeostasis (normal body functioning). **Macronutrients** are the nutrients the body needs in larger amounts. **Micronutrients** are also important nutrients, but ones the body needs in smaller amounts.

|  |  |
| --- | --- |
| **Macronutrients** | **Micronutrients** |
| Carbohydrate | Vitamins |
| Protein | Minerals |
| Lipids |  |
| Water |  |

**Macronutrients**

* *Carbohydrates*

The word *carbohydrate* literally means "hydrated carbon," or carbon with water. Thus, it is no surprise that carbohydrates are made up of carbon, hydrogen, and oxygen. Sucrose (table sugar) is an example of a commonly consumed carbohydrate. Some dietary examples of carbohydrates are bread, oatmeal, rice, sugary snacks/drinks, and pasta.

* *Proteins*

Like carbohydrates, proteins are comprised of carbon, hydrogen, and oxygen, but they also contain nitrogen. Several dietary sources of proteins include nuts, beans/legumes, milk, egg whites, and meat.

* *Lipids*

Lipids are a group of molecules that includes triglycerides, phospholipids, and sterols (cholesterol). Lipids are also composed of carbon, hydrogen, and oxygen. Some dietary sources of lipids include, oils, butter, and egg yolks.

* *Water*

Water is made up of hydrogen and oxygen and is the only macronutrient that provides no energy. It is necessary for all chemical reactions in the body to occur properly.

**Micronutrients**

* *Vitamins*

Vitamins are chemical compounds are essential for normal physiologic processes in the body. They provide no energy. While the body can produce some vitamins, many must be provided by one’s diet.

* *Minerals*

Minerals are the elements (think periodic table) that are essential for normal physiologic processes in the body. They also provide no energy.

The body is unable to produce any minerals and they all must be provided by one’s diet.

**Calories (Food Energy)**

Food energy is measured in kilocalories (kcals), commonly referred to as calories. Although technically incorrect, this terminology is so familiar that it will be used throughout this course. A **kilocalorie** is the amount of energy needed to raise 1 kilogram of water 1 degree Celsius. A food’s kilocalories are determined by putting the food into a bomb calorimeter and determining the energy output: Energy = Measurement of Heat Produced.

Here is a [link](https://www.youtube.com/watch?v=YXo9B2AbH0s) to a video showing how a bomb calorimeter is used.

The number of kilocalories per gram for each nutrient is shown in the following table:

|  |  |
| --- | --- |
| **Nutrient** | **Energy (kcal/g)** |
| Carbohydrate | 4 |
| Protein | 4 |
| Lipids | 9 |
| Water | 0 |
| Vitamins | 0 |
| Minerals | 0 |

As the table above illustrates, only carbohydrates, protein, and lipids provide energy. However, there is another dietary energy source that is not a nutrient—alcohol. To emphasize, alcohol is *not* a nutrient, but it does provide 7 kilocalories of energy per gram.

Knowing the number of calories in each nutrient allows a person to calculate/estimate the amount of calories contained in any food consumed.

**Carbohydrates**

Carbohydrates have become, surprisingly, quite controversial. Some people passionately extol the merits of carbohydrates, while others berate them as nutritional assassins. However, it is important to understand that carbohydrates are a diverse group  
of compounds that have a multitude of effects on bodily functions. Thus, trying to make blanket statements about carbohydrates (or any nutrient for that matter) is not a good idea.

**High-Fructose Corn Syrup**

Food manufacturers are always searching for cheaper ways to produce their products. One extremely popular method for reducing costs is the use of high-fructose corn syrup as an alternative to sucrose. High-fructose corn syrup (HFCS) is approximately 50% glucose and 50% fructose, which is the same as sucrose. Nevertheless, because increased consumption of high-fructose corn syrup has coincided with increased obesity in the United States, a lot of controversy surrounds its use. Whether HFCS is better or worse than traditional sucrose is an area of great debate. Regardless, you should try to avoid all kinds of added sugar in your diet if possible.

The New York Times article linked below discusses the growing popularity of sugar compared to high fructose corn syrup:

["Sugar is Back on Food Labels, This Time as a Selling Point"](http://www.nytimes.com/2009/03/21/dining/21sugar.html?_r=1&ref=nutrition)

The article linked below explains why the Corn Refiners Association has asked for permission to change the name of high fructose corn syrup to corn sugar and why the US Food and Drug Administration rejected that request:

["FDA rejects industry bid to change name of high fructose corn syrup to 'corn sugar'"](https://www.cbsnews.com/news/fda-rejects-industry-bid-to-change-name-of-high-fructose-corn-syrup-to-corn-sugar/)

**Fiber**

The simplest definition of fiber is indigestible matter. Indigestible means that it survives digestion in the small intestine and reaches the large intestine. Fiber helps promote feelings of fullness, as well as aiding in regular bowl movements and maintaining colon health.

* *Dietary fiber*

This type of fiber occurs naturally in foods, including vegetables, fruits, grain products, legumes, nuts and seeds.

* *Functional fiber*

This type of fiber is extracted and isolated from whole foods, then added to processed foods.

* *Total Fiber*  
  Total fiber on a food label refers to the combined amount of both dietary and functional fiber in food products.

**Protein**

Protein is another macronutrient that, like carbohydrates, consists of small repeating units. They serve as the building blocks and are the major structural and functional components of nearly all cells. Structural proteins include keratin, collagen, elastin, and muscle fibers. Functional proteins include enzymes, hemoglobin, hormones & receptors, and membrane proteins

Proteins are made up of repeating subunits known as **amino acids**. There are 11 **non-essential** amino acids that can be produced by the body. There are 9 **essential** amino acids that cannot be produced by the body and must be provided in the diet.

Proteins can be classified as either complete or incomplete. **Complete proteins** provide adequate amounts of all nine essential amino acids. Animal proteins, such as meat, fish, milk, and eggs, are good examples of complete proteins. **Incomplete proteins** do not contain adequate amounts of one or more of the essential amino acids. For example, if a protein does not provide enough of the essential amino acid leucine it would be considered incomplete. Leucine would be referred to as the **limiting amino acid** because there is not enough of it for the protein to be complete. Most plant foods are incomplete proteins, with a few exceptions, such as soy. For this reason, people consuming a primarily plant-based diet must make sure to consume a variety of foods to assure consumption of all essential amino acids.

*SELF* magazine’s Nutrition Data website is a useful resource for determining protein quality and identifying complementary proteins. To use the site, go to [www.nutritiondata.com](http://www.nutritiondata.com), type the name of the food you want information on in the search bar and hit Enter. When you have selected your food from the list of possibilities, you will be given information about this food. Included in this information is the Protein Quality section. This will give you an amino acid score and a figure that illustrates which amino acid(s) is limiting. If your food is an incomplete protein, you can click "Find foods with a complementary profile." This will take you to a list of dietary choices that will provide complementary proteins for your food.

The chapter linked below is from a book published by the National Academies of Sciences, Engineering, and Medicine and provides an exhaustive examination of the role protein and amino acids play in human health.

[Protein and Amino Acids](https://www.nap.edu/read/10490/chapter/12)

**Fat**

Dietary fat (lipids) comes in a variety of forms, including triglycerides, phospholipids, and sterols (cholesterol). Most people are familiar with triglycerides which are the fats referred to when we use the terms saturated, monounsaturated, and polyunsaturated fats. Fats serve multiple functions in the body. These include cushioning/protection, regulation of body temperature, serving as a precursor for the production of some hormones, and as a long-term energy source. As we saw earlier, fat has more energy (calories) per gram than carbohydrates or proteins. This makes fat a desirable storage molecule for excess calories in the body.

**Cholesterol**

There is neither bad nor good cholesterol, despite the common use of these descriptions in reference to LDL and HDL cholesterol, respectively. In spite of these labels, both LDL and HDL have important functions in the body. However, excess LDL in one’s diet has been linked to an increased risk heart disease, hence the “bad” label. Because HDL has the ability to remove excess LDL from the body, it is often referred to as the “good” cholesterol.

It is not necessary to include cholesterol in your diet because our bodies have the ability to synthesize the required amounts. The linked article below gives you an idea of the cholesterol content of a variety of foods.

<http://www.webmd.com/cholesterol-management/foods-to-avoid-for-high-cholesterol>

# Vitamins

**Vitamins** are organic compounds found in foods and are a necessary part of the biochemical reactions in the body. They are involved in a number of processes, including mineral and bone metabolism, and cell and tissue growth, and they act as cofactors for energy metabolism. The B vitamins play the largest role of any vitamins in metabolism ([Table](https://cnx.org/contents/FPtK1zmh@8.108:-NeVq3fp@5/Nutrition-and-Diet#tbl-ch25_03) and [Table](https://cnx.org/contents/FPtK1zmh@8.108:-NeVq3fp@5/Nutrition-and-Diet#tbl-ch25_04)).

You get most of your vitamins through your diet, although some can be formed from the precursors absorbed during digestion. For example, the body synthesizes vitamin A from the b-carotene in orange vegetables such as sweet potatoes.

Vitamins are either fat-soluble or water-soluble. **Fat-soluble** vitamins A, D, E, and K, are absorbed through the intestinal tract with lipids in molecules known as chylomicrons. Vitamin D is also synthesized in the skin through exposure to sunlight. Because they are carried in lipids, fat-soluble vitamins can accumulate in the lipids stored in the body. If excess fat-soluble vitamins are retained in lipid stores in the body, hypervitaminosis can result.

**Water-soluble** vitamins, including the eight variations of B vitamins and vitamin C, are absorbed with water in the gastrointestinal tract. These vitamins move easily through bodily fluids, which are water based, so they are not stored in the body. Excess water-soluble vitamins are excreted in the urine. Therefore, hypervitaminosis of water-soluble vitamins rarely occurs, except with an excess of vitamin supplements.

**Antioxidants** are found in vitamins A, C, & E. and help prevent or slow damage to cells caused by free radicals. Free radicals have been linked to aging, inflammation, cancer, cardiovascular disease, and age-related vision loss and dementia

# Minerals

**Minerals** in food are inorganic compounds that work with other nutrients to ensure the body functions properly. Minerals cannot be made in the body; they must come from the diet. The amount of minerals in the body is small—only 4 percent of the total body mass—and most of that consists of the minerals that the body requires in moderate quantities: potassium, sodium, calcium, phosphorus, magnesium, and chloride.

The most common minerals in the body are calcium and phosphorous, both of which are stored in the skeleton and necessary for the hardening of bones. Most minerals are ionized, and their ionic forms are used in physiological processes throughout the body. Sodium and chloride ions are electrolytes in the blood and extracellular tissues, and iron ions are critical to the formation of hemoglobin. There are additional trace minerals that are still important to the body’s functions, but their required quantities are much lower.

Like vitamins, minerals can be consumed in toxic quantities (although it is rare). A healthy diet includes most of the minerals your body requires, so supplements and processed foods can add potentially toxic levels of minerals. [Table](https://cnx.org/contents/FPtK1zmh@8.108:-NeVq3fp@5/Nutrition-and-Diet#tbl-ch25_05) and [Table](https://cnx.org/contents/FPtK1zmh@8.108:-NeVq3fp@5/Nutrition-and-Diet#tbl-ch25_06) provide a summary of minerals and their function in the body.

**Water**

Water makes up about 45-77% water depending on age (decreases as we get older). It is necessary for all chemical reactions in the body. The average adult needs approximately 48-64 ounces of water every day. In addition to beverages, water can be obtained from fruits, vegetables, and other water-rich foods

**Phytochemicals**

Phytochemicals are chemical compounds produced by plants, generally to help them thrive or thwart competitors, predators, or pathogen. Tens of thousands of phytochemicals have been identified so far and are an area of increased research to determine their role in the body.

Research has shown that phytochemicals may stimulate the immune system, block substances we eat, drink, and breathe from becoming carcinogenic. reduce inflammation, prevent D.N.A. damage and help with D.N.A. repair, reduce oxidative damage to cells, slow the growth of cancer cells, trigger the destruction of damaged cells, and help to regulate hormone functions.

**Dietary Supplements**

Dietary Supplements are products taken that contain a "dietary ingredient" which includes vitamins, minerals, amino acids, and herbs or botanicals. Common examples include multivitamins, omega-3 or fish oil, calcium, vitamin D, and vitamin C. However, they are very rarely needed and not regulated by FDA. Research has shown that most are not effective when compared to actual food sources.

People over 50, smokers, and pregnant females or those wanting to become pregnant may undertake specific supplementation if recommended by a physician or registered dietician.

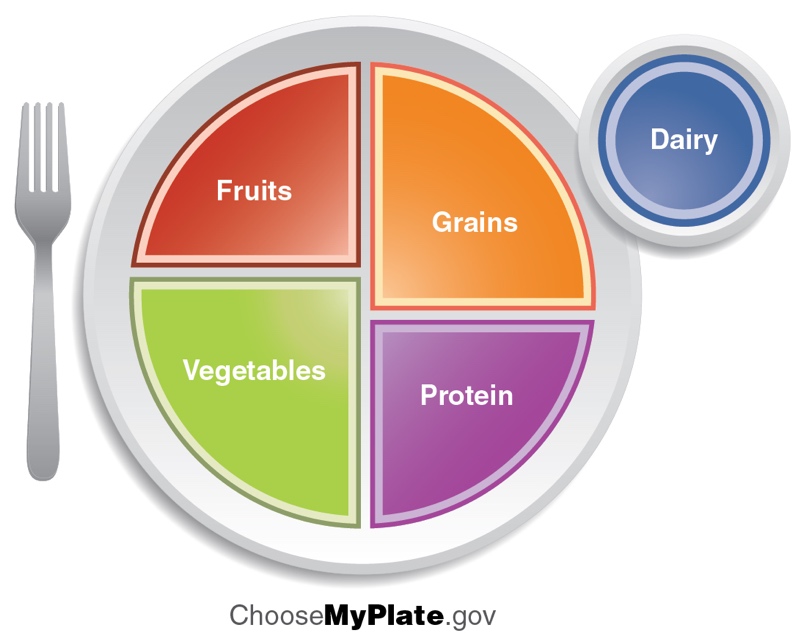
**My Plate**

On average, a person needs an estimated 1500 to 2000 calories per day to sustain (or carry out) daily activities. However, the actual number of calories needed by one person is dependent on their body mass, age, height, gender, activity level, and the amount of exercise per day. If exercise is regular part of one’s day, more calories are required. As a rule, people underestimate the number of calories ingested and overestimate the amount they burn through exercise. This can lead to ingestion of too many calories per day. The accumulation of an extra 3500 calories adds one pound of weight. If an excess of 200 calories per day is ingested, one extra pound of body weight will be gained every 18 days. At that rate, an extra 20 pounds can be gained over the course of a year. Of course, this increase in calories could be offset by increased exercise. For example, running, jogging, or walking one mile burns roughly 100 calories.

The type of food ingested also affects the body’s metabolic rate. Processing of carbohydrates requires less energy than processing of proteins. In fact, the breakdown of carbohydrates requires the least amount of energy, whereas the processing of proteins demands the most energy. In general, the number of calories ingested and the number of calories burned determines the overall weight. To lose weight, the number of calories burned per day must exceed the number ingested. Calories are in almost everything you ingest, so when considering calorie intake, beverages must also be considered.

To help provide guidelines regarding the types and quantities of food that should be eaten every day, the USDA has updated their food guidelines from MyPyramid to MyPlate. They have put the recommended elements of a healthy meal into the context of a place setting of food. MyPlate categorizes food into the standard six food groups: fruits, vegetables, grains, protein foods, dairy, and oils. The accompanying website gives clear recommendations regarding quantity and type of each food that you should consume each day, as well as identifying which foods belong in each category. The accompanying graphic below gives a clear visual with general recommendations for a healthy and balanced meal. The guidelines recommend to “Make half your plate fruits and vegetables.” The other half is grains and protein, with a slightly higher quantity of grains than protein. Dairy products are represented by a drink, but the quantity can be applied to other dairy products as well.

The U.S. Department of Agriculture developed food guidelines called MyPlate to help demonstrate how to maintain a healthy lifestyle.



**Special Considerations**

Certain groups of individuals often need to take special consideration when making dietary decisions. These include:

* Children/teens should be introduced to a wide variety of foods in their diets. Allowing them to help prepare meals can encourage this.
* College students should be taught to make better food decisions as they become responsible for their own diets.
* Pregnant & breastfeeding women must get adequate folic acid intake.
* Elderly individuals should drink more fluids, consume fewer calories, and consume more vitamins and minerals
* Athletes should consume more calories and fluids & electrolytes
* Anyone with dietary concerns should consult a registered dietician or their physician.

**Strategies for Improving Your Diet**

There are a number of strategies you can utilize as you work to improve your diet.

* Track your habits. Identify good and bad eating habits that you can later copy (good habits) or fix (bad habits).
* Change slowly. You are more likely to stick with changes if they happen slowly over time and not all at once.
* Use the strategies for change we covered in Chapter 1.
* Plan and make meals at home.
* Practice portion control, especially when eating out. Many restaurant meals actually contain enough calories for 2 people.
* Set SMART goals.
* Seek out a registered dietician. American physicians receive very little nutritional education. Registered dieticians are more likely to be up-to-date with the latest science.
* Remember, everything in moderation, even moderation.

**Terminology Checklist**

**Macronutrients:** are the nutrients the body needs in larger amounts

**Micronutrients:** are the nutrients the body needs in smaller amounts

**Carbohydrates:** The word *carbohydrate* literally means "hydrated carbon," or carbon with water. Can be either simple or complex.

**Fats:** Lipids consist of fatty acids, triglycerides, phospholipids, and sterols (cholesterol). Can be either Saturated or Unsaturated.

**Proteins:** Protein is another major macronutrient that, like carbohydrates, consists of small repeating units. But instead of sugars, proteins are made up of amino acids. Can be either complete or incomplete.

**Dietary fiber:** This type of fiber occurs naturally in foods, including vegetables, fruits, grain products, legumes, nuts and seeds.

**Functional fiber:** This type of fiber is extracted and isolated from whole foods, then added to processed foods.

**Total Fiber:** Total fiber on a food label refers to the combined amount of both dietary and functional fiber in food products.

**Vitamins:** Organic substances found in food that can either be fat or water soluble.

**Minerals:** Inorganic substances found in food or spices.

**Test Your Knowledge**

1. The type of fiber that is known for lowering cholesterol levels:
   1. Insoluble
   2. Soluble
   3. Dietary
   4. No fiber is known for this
2. What type of protein is typically found from animals?
   1. Insoluble
   2. Soluble
   3. Incomplete
   4. Complete
3. MyPlate tells you to make half your plate have:
   1. Red meat
   2. Fruits and Veggies
   3. Carbohydrates, specifically simple ones.
   4. water
4. Macronutrients are:
   1. Vitamins and Minerals
   2. Water
   3. Vitamins, Minerals and Protein
   4. Carbohydrates, Fats and Proteins
5. The calories that are found in one gram of fat is:
   1. 3
   2. 4
   3. 6
   4. 9

Key

1. b
2. d
3. c
4. d
5. d

**References & Links**

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