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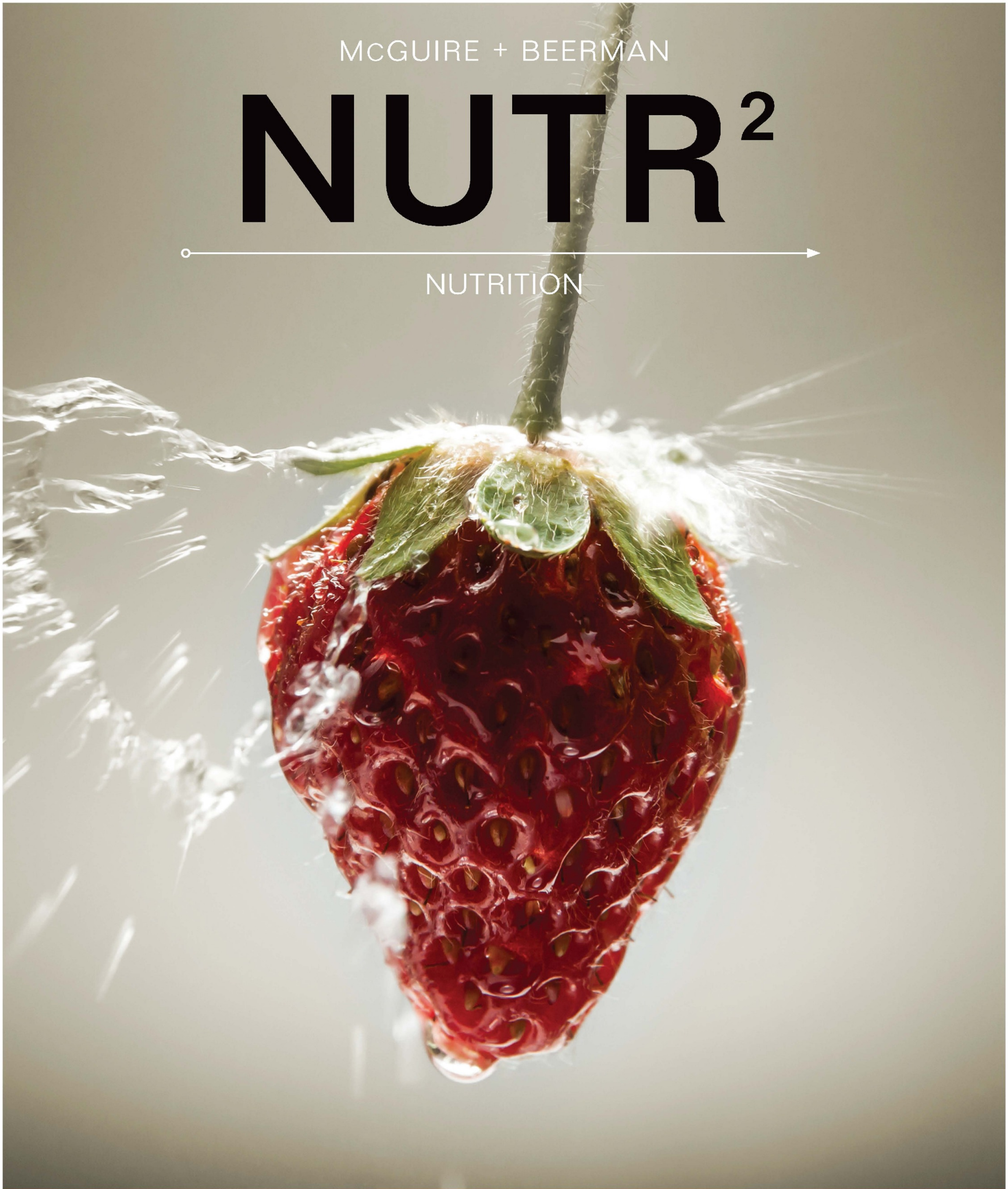

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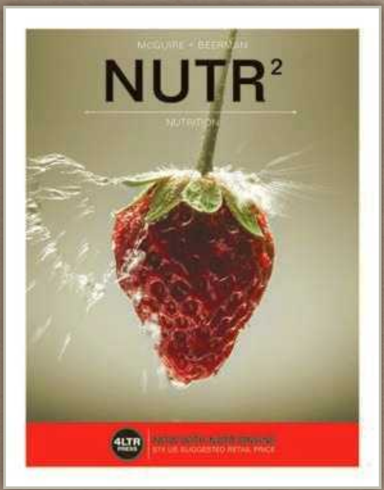

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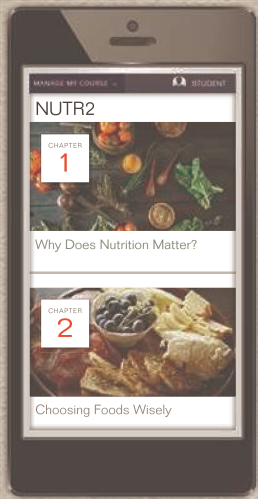

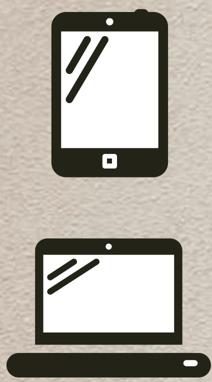

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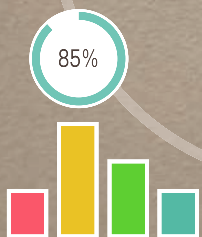

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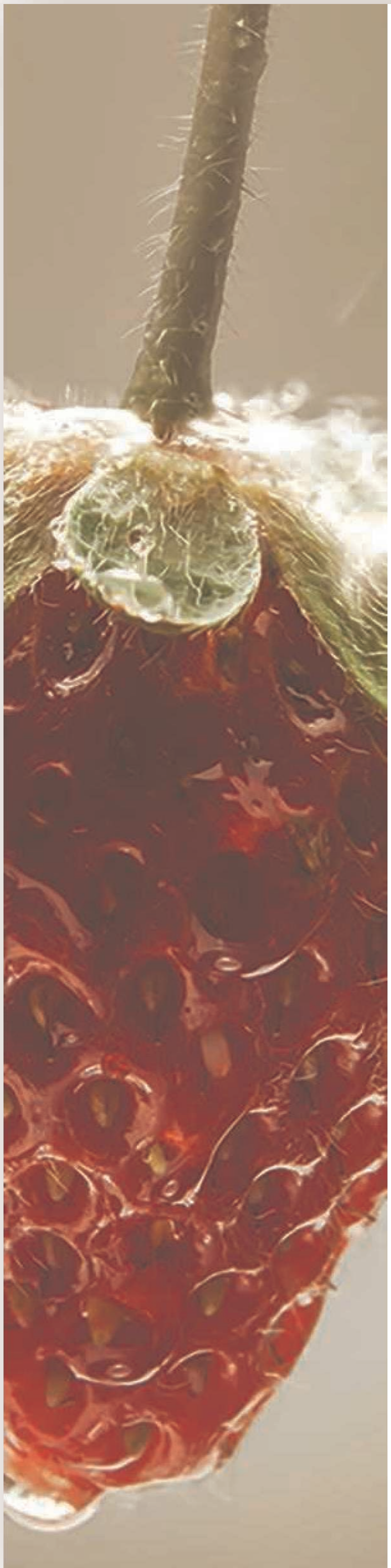
BRIEF CONTENTS



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1 Why Does Nutrition Matter? 2

2 Choosing Foods Wisely 20

3 Body Basics 48

4 Carbohydrates 72

5 Protein 98

6 Lipids 124

7 The Vitamins 152

8 Water and the Minerals 184

9 Energy Balance and Body Weight Regulation 220

10 Life Cycle Nutrition 246

11 Nutrition and Physical Activity 280

12 Eating Disorders 298

13 Alcohol, Health, and Disease 316

14 Keeping Food Safe 330

15 Food Security, Hunger, and Malnutrition 350

Endnotes 366

Index 380

Chapter Review Cards (Student Edition)

Chapter Prep Cards (Instructor Edition)

CONTENTS

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1 Why Does Nutrition Matter? 2

1-1 What Is Nutrition? 2
1-2 What Are Nutrients, and What Do They Do? 3
1-3 How Are Macronutrients and Micronutrients Classified? 6
1-4 How Is the Energy in Food Measured? 7
1-5 How Do Nutritional Scientists Conduct Their Research? 9
1-6 Are All Nutrition Claims Believable? 12
1-7 Nutrition and Health: What Is the Connection? 14
1-8 Why Study Nutrition? 19

2 Choosing Foods Wisely 20

2-1 What Is Nutritional Status? 20
2-2 How Is Nutritional Status Assessed? 23
2-3 How Much of a Nutrient Is Adequate? 26
2-4 How Can You Assess and Plan Your Diet? 32
2-5 How Can You Use Food Labels to Plan a Healthy Diet? 41
2-6 Can You Put These Concepts into Action? 45

3 Body Basics 48

3-1 Why Learn about Chemistry When Studying Nutrition? 48
3-2 How Are Cells, Tissues, Organs, and Organ Systems Related? 51
3-3 What Happens during Digestion? 55
3-4 What Happens after Digestion? Nutrient Absorption and Circulation 67
3-5 How Are Nutrients Metabolized and How Are Metabolic Waste Products Excreted from the Body? 69

4 Carbohydrates 72

4-1 What Are Simple Carbohydrates? 72
4-2 What Are Complex Carbohydrates? 78
4-3 How Are Carbohydrates Digested, Absorbed, and Circulated? 81
4-4 How Does Your Body Regulate and Use Glucose? 87
4-5 What Is Diabetes? 90
4-6 What Are the Recommendations for Carbohydrate Intake? 94

5 Protein 98

5-1 What Are Proteins? 98
5-2 How Do Cells Make Proteins? 102
5-3 Why Is a Protein's Shape Critical to Its Function? 104
5-4 What Is Meant by Genetics and Epigenetics? 107
5-5 How Are Proteins Digested, Absorbed, and Circulated? 108
5-6 Why Do You Need Proteins and Amino Acids? 111
5-7 How Does the Body Recycle and Reuse Amino Acids? 114
5-8 How Much Protein Do You Need? 115
5-9 Can Vegetarian Diets Be Healthy? 118
5-10 What Are the Consequences of Protein Deficiency and Excess? 119

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6 Lipids 124

6-1 What Are Lipids? 124

6-2 What Are Essential, Conditionally Essential, and Nonessential Fatty Acids? 130

6-3 What Is the Difference between Mono-, Di-, and Triglycerides? 133

6-4 What Are Phospholipids and Sterols? 135

6-5 How Are Triglycerides Digested, Absorbed, and Circulated? 139

6-6 What Are the Types and Functions of Various Lipoproteins? 144

6-7 How Are Dietary Lipids Related to Health? 146

6-8 What Are Some Overall Dietary Recommendations for Lipids? 148

7 The Vitamins 152

7-1 How Did Scientists First Discover Vitamins? 152

7-2 Water-Soluble Vitamins 153

7-3 B Vitamins 154

7-4 Vitamin C 167

7-5 Fat-Soluble Vitamins 169

7-6 Vitamin A and the Carotenoids 169

7-7 Vitamin D 174

7-8 Vitamins E and K 178

7-9 Taking Dietary Supplements 181

8 Water and the Minerals 184

8-1 Water 184

8-2 Minerals 191

8-3 Calcium 193

8-4 Electrolytes: Sodium, Chloride, and Potassium 199

8-5 Electrolytes: Phosphorus and Magnesium 203

8-6 Sulfur 205

8-7 Trace Minerals 206

8-8 Other Important Trace Minerals 219

9 Energy Balance and Body Weight Regulation 220

9-1 What Is Energy Balance? 220

9-2 What Factors Influence Energy Intake? 224

9-3 What Determines Energy Expenditure? 227

9-4 How Are Body Weight and Composition Assessed? 230

9-5 Genetics versus Environment: What Causes Obesity? 234

9-6 How Are Energy Balance and Body Weight Regulated? 237

9-7 What Is the Best Approach to Weight Loss? 239

10 Life Cycle Nutrition 246

10-1 What Physiological Changes Take Place during the Human Life Cycle? 246

10-2 What Are the Major Stages of Prenatal Development? 248

10-3 What Are the Nutrition Recommendations for a Healthy Pregnancy? 254

10-4 Why Is Breastfeeding Recommended during Infancy? 259

10-5 What Are the Nutritional Needs of Infants? 263

10-6 What Are the Nutritional Needs of Toddlers and Young Children? 267

10-7 How Do Nutritional Requirements Change during Adolescence? 271

10-8 How Do Age-Related Changes in Adults Influence Nutrient and Energy Requirements? 272

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11 Nutrition and Physical Activity 280

11-1 What Are the Health Benefits of Physical Activity? 280

11-2 How Does Energy Metabolism Change during Physical Activity? 286

11-3 What Physiologic Adaptations Occur in Response to Athletic Training? 289

11-4 How Does Physical Activity Influence Dietary Requirements? 291

12 Eating Disorders 298

12-1 What Is the Difference Between Disordered Eating and Eating Disorders? 298

12-2 Are There Other Disordered Eating Behaviors? 306

12-3 What Causes Eating Disorders? 309

12-4 Are Athletes at Increased Risk for Eating Disorders? 312

12-5 How Can Eating Disorders Be Prevented and Treated? 314

13 Alcohol, Health, and Disease 316

13-1 What Is Alcohol and How Is It Produced? 316

13-2 How Is Alcohol Metabolized? 321

13-3 Does Alcohol Have Any Health Benefits? 321

13-4 What Serious Health Risks Does Heavy Alcohol Consumption Pose? 323

13-5 How Does Alcohol Abuse Contribute to Individual and Societal Problems? 326

14 Keeping Food Safe 330

14-1 What Causes Foodborne Illness? 330

14-2 What Noninfectious Substances Cause Foodborne Illness? 337

14-3 How Do Food Manufacturers Prevent Contamination? 341

14-4 What Steps Can You Take to Reduce Foodborne Illness? 344

14-5 What Steps Can You Take to Reduce Foodborne Illness while Traveling? 347

15 Food Security, Hunger, and Malnutrition 350

15-1 What Is Food Security? 350

15-2 What Are the Consequences of Food Insecurity? 354

15-3 What Causes Worldwide Hunger and Malnutrition? 357

15-4 What Can You Do to Alleviate Food Insecurity? 363

Endnotes 366

Index 380

Chapter Review Cards (Student Edition)

Chapter Prep Cards (Instructor Edition)

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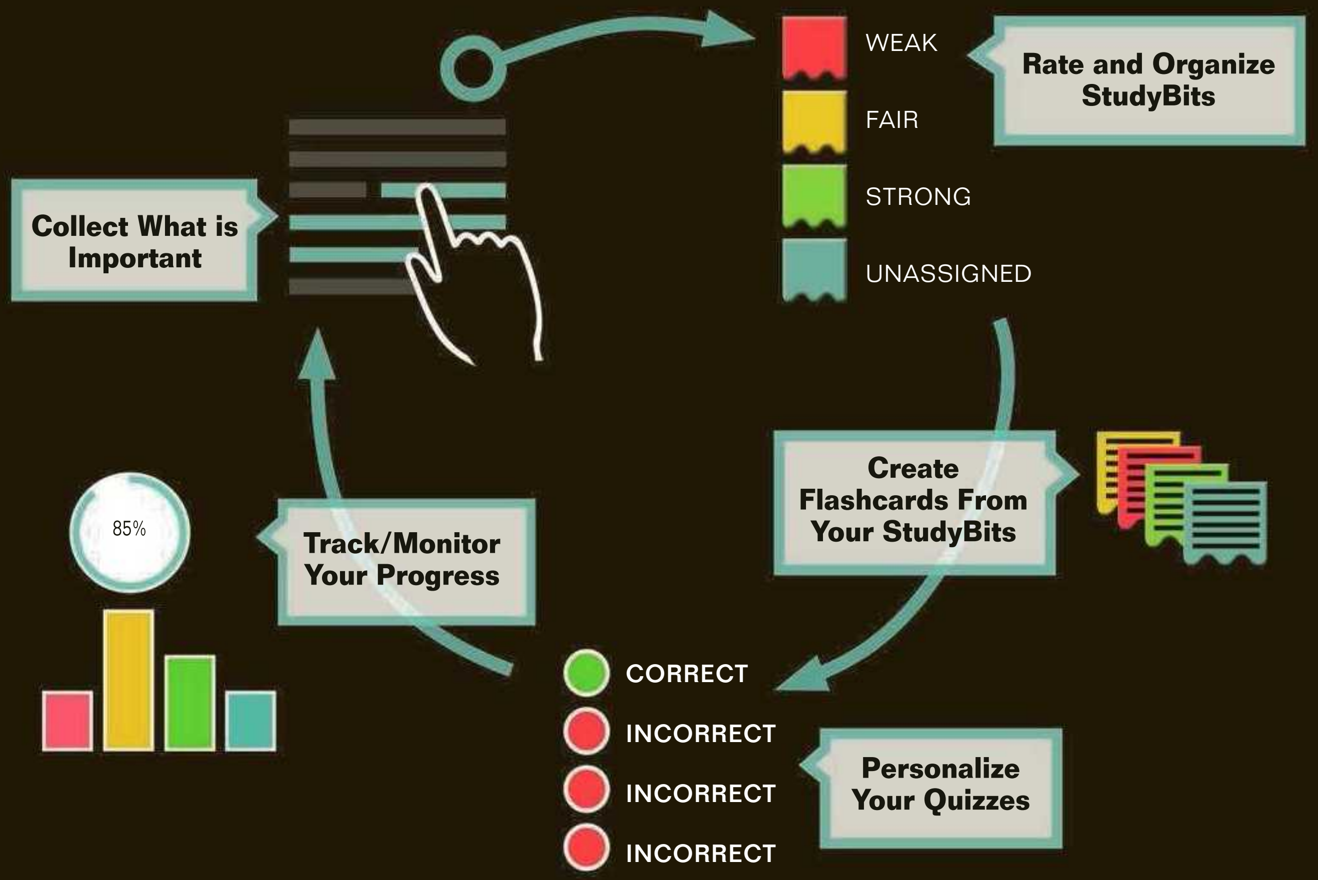

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1 | Why Does Nutrition Matter?

LEARNING OUTCOMES

- **1-1** Define and understand the meaning of nutrition.
- **1-2** Understand the main purposes of nutrients and how they are classified.
- **1-3** Differentiate among the major groups of nutrients.
- **1-4** Define *calorie* and explain the concept of *energy*.
- **1-5** Outline the scientific method.
- **1-6** Evaluate the validity of a nutritional claim.
- **1-7** Understand the connection between nutrition and health.
- **1-8** Appreciate the importance of nutrition.

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After finishing this chapter go to **PAGE 19** for **STUDY TOOLS.**

1-1 WHAT IS NUTRITION?

Life would not be possible without the nourishment of food, and your quality of life depends greatly on which foods you choose to eat. Hopefully, you are interested in making sure that your nutrition is as health promoting as possible. If you apply the information you learn in this course to your life, you may very well be on your way to reaching this goal. In this first chapter, you will learn many fundamental concepts necessary to understand the importance of good nutrition. You will also learn how scientists study nutrition, how national health is assessed, and how you can use scientific reason—not rumor—to select a healthy diet for years to come.

You have probably heard the terms *nutrition* and *nutrient*, but you may not know exactly what these words really mean. The term **nutrition** refers to how living organisms obtain and use food to support all the processes required for their existence. Because this process is complex, the study of nutrition incorporates a wide variety of scientific fields. Scientists who study nutrition, *nutritional scientists*, work in many disciplines, such as immunology, medicine, genetics, biology, physiology, biochemistry, education, psychology, sociology, and of course nutrition. A **dietitian** is a

nutrition The science of how living organisms obtain and use food to support processes required for existence.

dietitian A nutrition professional who helps people make dietary changes and food choices to support a healthy lifestyle.

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The foods you choose now will influence both your immediate and long-term health.

nutrition professional who helps people make dietary changes and food choices to support a healthy lifestyle. Some dietitians are also involved in scientific research. Thus, the science of nutrition reflects a broad spectrum of academic and social disciplines.

1-2 WHAT ARE NUTRIENTS, AND WHAT DO THEY DO?

But what are nutrients, and why do you need them? In other words, why do people actually need to eat? A **nutrient** is a substance found in food that is required by the body and used for energy, maintenance of body structure, and/or regulation of chemical processes. For example, fats and carbohydrates provide the energy needed to fuel your body, calcium and phosphorus build and strengthen your teeth and bones, and many vitamins facilitate the chemical reactions that protect your cells from the damaging effects of excessive sunlight and pollution.

Not all nutrients in foods are naturally occurring. Sometimes foods are fortified with nutrients to make the products more nutritious. When a food has been fortified in a way that meets rigorous national standards, as put forth by the U.S. Food and Drug Administration (FDA), it can be labeled as being enriched. For instance, refined wheat flour is typically available in two forms: plain and enriched. **Fortification** and **enrichment** of foods is completely voluntary in the United States. These concepts are described in more detail in Chapter 7.

There are many ways to classify nutrients, foods, and food components. These classifications help nutritionists and other scientists distinguish the source, purpose, chemical composition, and importance to sustaining life of any given substance found in food. Although a multitude of nutrient classification systems are important to scientific research, only three are needed to understand basic nutrition. Nutrients can be classified as essential, nonessential, or conditionally essential; as organic or inorganic; and as macronutrients or micronutrients. Each of these classification systems will be introduced in the following sections.

nutrient A substance found in food that is used by the body for energy, maintenance of body structure, or regulation of chemical processes.

fortification The intentional addition of nutrients to a food.

enrichment A type of fortification whereby specific amounts of selected nutrients are added to certain foods.

1-2a Essential, Nonessential, and Conditionally Essential Nutrients

One way nutritionists classify a nutrient is by whether it must be obtained from the foods you eat to support life. Although your body can theoretically use all the nutrients found in foods, you only *need* to consume some of them. A substance that must be obtained from the diet to sustain life is referred to as an **essential nutrient**. Your body needs essential nutrients, but it either cannot make them at all or cannot make them in adequate amounts. A **nonessential nutrient** is a substance that your body needs, but if necessary, can produce in amounts needed to satisfy its requirements. Therefore, you do not actually need to consume nonessential nutrients. Most foods contain a mixture of essential and nonessential nutrients. For example, milk contains a variety of essential vitamins and minerals, such as vitamin A and calcium, as well as several nonessential nutrients, such as cholesterol.

There are, however, circumstances under which a normally nonessential nutrient becomes essential. In these situations, the nutrient is called a **conditionally essential nutrient**. For example, older children and adults must obtain two essential lipids through the diet, whereas babies require at least four that they are unable to produce because their physiologic systems are too immature. The additional lipids are therefore conditionally essential during early life. Certain diseases can also cause normally nonessential nutrients to become conditionally essential. You will learn about some of these in later chapters.

1-2b Organic Nutrients, Inorganic Nutrients, and Organic Foods

essential nutrient A substance that must be obtained from the diet to sustain life.

nonessential nutrient A substance that sustains life but does not necessarily need to be obtained from the diet.

conditionally essential nutrient A normally nonessential nutrient that, under certain circumstances, becomes essential.

organic compound A substance that contains carbon and hydrogen atoms.

inorganic compound A substance that does not contain carbon.

Nutrients can also be distinguished as organic or inorganic. By definition, a substance that contains carbon and hydrogen atoms is an **organic compound**. Carbohydrates, proteins, lipids, and vitamins are therefore chemically organic nutrients because they all contain carbon and hydrogen atoms. An **inorganic compound** does not contain carbon. Because neither water nor minerals contain carbon, they are examples of inorganic compounds. In this way, all foods are considered organic—at least in the chemical sense of the term.

The term *organic* also has an additional and very different meaning when a person uses it to describe how a food is grown, harvested, or manufactured. When a food is labeled *certified organic*, it has been grown and processed according to U.S. Department of Agriculture (USDA) national organic standards. These foods are usually identified by the USDA's organic foods seal, which is displayed on the foods' packaging (see Figure 1.1). There are many rules and regulations that must be followed for

Are Organic Foods Healthier?

Because the U.S. Department of Agriculture (USDA) makes no claims that organically produced food is safer or more nutritious than conventionally produced food, the *organic* label is not meant to suggest superior nutritional quality or food safety. Furthermore, most scientific studies on the properties of organic food have not found that organic foods contain higher levels of nutrients than their nonorganic counterparts.[1] The only appreciable differences between organic and conventionally produced foods are the methods used to grow, handle, and process them. Whether these alternative agricultural practices promote enhanced environmental integrity and ecological balance is another area of active debate.

FIGURE 1.1 THE USDA ORGANIC FOODS SEAL

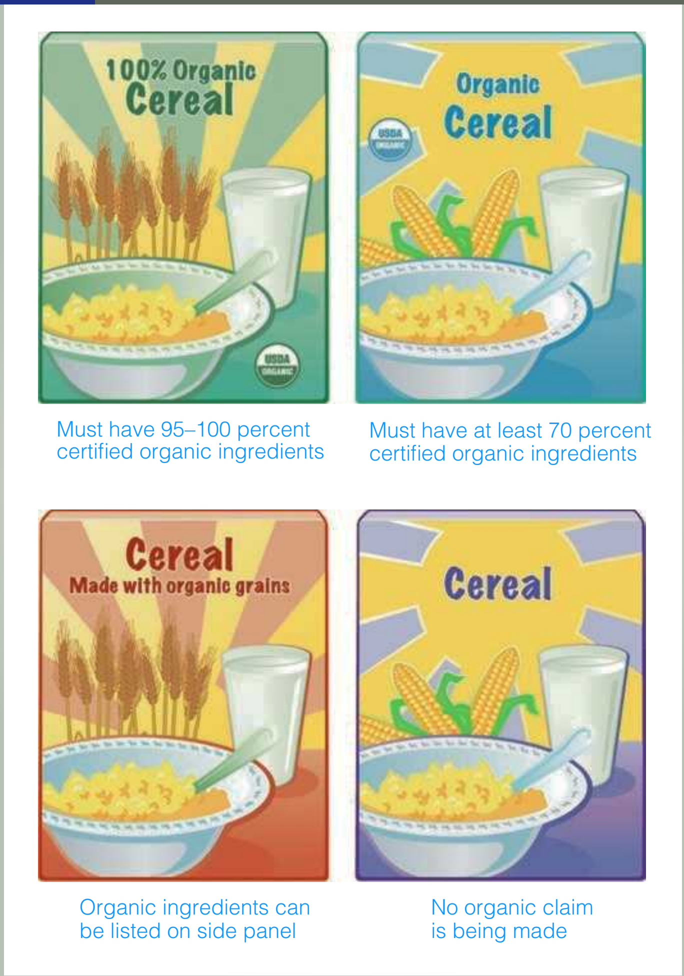
USDA, National Organic Program

***Certified organic* foods can be identified by this seal.**

a crop or food to be certified as organic by the USDA. For example, whereas a farmer growing conventional crops can use all pesticides and herbicides that have been approved by the USDA, farmers growing organic crops can only use a subset of them.

Not all organic foods are made entirely with organic ingredients. To find out the percentage of organic ingredients that a product contains, you can examine its food label (see Figure 1.2). Foods that carry the USDA organic seal and are labeled *100% organic* must have at least 95 percent organically produced ingredients. Foods labeled *organic* must have at least 70 percent organic ingredients. Products that contain less than 70 percent organic ingredients may list specific organically produced ingredients on the side panel of the package, but may not make any organic claims on the front of the package.

FIGURE 1.2 UNDERSTANDING COMPOSITION OF "ORGANIC" FOODS



When listed on food labels, the term *organic* can have different meanings.

1-2c Macronutrients and Micronutrients

Finally, nutrients are classified based on the quantity a person must consume to maintain health. Nutrients consumed in relatively large amounts (more than a gram per day) are classified as **macronutrients**. The macronutrients include carbohydrates, proteins, lipids, and water. Because you need only very small amounts of vitamins and minerals (often micrograms or milligrams each day), these substances are called **micronutrients**. Over the course of a lifetime, a typical adult requires about 2,700 pounds (1,200 kilograms) of protein, a macronutrient, but only about 0.3 pounds (0.14 kilograms) of iron, a micronutrient.

1-2d Other Health-Promoting Substances

As scientists research nutrition, they learn more and more about the relationship between diet and health. Not too long ago, scientists discovered that, in addition to the traditional established nutrients, foods contain other substances that likely benefit health. Scores of these compounds have only recently been uncovered and are therefore less understood than traditional nutrients. In fact, because scientific technology and nutritional knowledge have advanced so much during the last few decades, the definition of *nutrient* is evolving. Consequently, the list of recognized nutrients will likely grow as researchers identify how the myriad substances found in the foods we eat work together to promote health and well-being.

When a health-promoting compound is found in plants, it is called a **phytochemical** (or **phytonutrient**). When a health-promoting compound is found in animal-based food, it is called a **zoochemical** (or **zoonutrient**).[2] As scientists learn more about these compounds, some may be reclassified as nutrients.

macronutrients A class of nutrients that humans need to consume in relatively large quantities (more than a gram per day).

micronutrients A class of nutrients that humans need to consume in relatively small quantities.

phytochemical (or **phytonutrient**) A compound found in plants that likely benefits human health beyond the provision of essential nutrients and energy.

zoochemical (or **zoonutrient**) A compound found in animal-based foods that likely benefits human health beyond the provision of essential nutrients and energy.

You may have heard of functional foods or even seen them advertised. A **functional food** (or **super food**) is a food or product that likely promotes optimal health beyond simply helping the body meet its basic nutritional needs. Functional foods contain either:

1. a high concentration of traditional nutrients,
2. phytonutrients, and/or
3. zoonutrients.[3]

For example, soymilk is often referred to as a functional food because it contains phytochemicals that are believed to decrease the risk of some cancers. Other examples are cow's milk, which is rich in zoochemicals that may lower the risk of cancer and high blood pressure, and tomatoes, which may promote cardiovascular health and lower risk for prostate cancer. Although consuming functional foods may improve your health, the processes by which this occurs are often poorly understood.

1-3 HOW ARE MACRONUTRIENTS AND MICRONUTRIENTS CLASSIFIED?

Scientists organize macronutrients and micronutrients into six general groups based on their chemical natures (see Table 1.1). Each major group or *class* of nutrients consists of many different compounds, and each contributes to the structure and/or function of your body in one way or another. In this section, each of the six macro- and micronutrient classes will be introduced. This is not the last time you will see them, however; each will be addressed in much greater detail in subsequent chapters.

1-3a Carbohydrates

Carbohydrates, consisting of carbon, hydrogen, and oxygen atoms, serve a variety of functions in the body. There are many different types of carbohydrates. For example, those found in grain-based foods such as rice and pasta are quite different from those found in fruits and sweet desserts. Of the many carbohydrates that exist, perhaps the most important is glucose, which you may know as *blood sugar*. Glucose is important because most of your body's cells use it as their primary source of energy. However, your body uses other carbohydrates for many other purposes as well. For instance, some make up your genetic material (DNA). Others, such as dietary fiber, play roles in maintaining the health of your digestive tract and decreasing the risk of certain conditions such as heart disease and type 2 diabetes.


Grains and cereals are good sources of carbohydrates. Experts recommend that you choose whole-grain products at least half the time.
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functional food (or **super food**) A food that likely benefits human health by providing a high concentration of nutrients, phytochemicals, or zoochemicals.

TABLE 1.1 GROUPING MACRONUTRIENTS AND MICRONUTRIENTS

Macronutrients	Micronutrients
Carbohydrates	Vitamins
Proteins	Minerals
Lipids	
Water	

1-3b Proteins

Protein is abundant in many foods, including meat, legumes (such as dried peas and beans), dairy foods, and some cereal products. Although most proteins consist primarily of carbon, oxygen, nitrogen, and hydrogen atoms, some also contain sulfur or selenium atoms. The thousands of different proteins in your body serve many varied roles. For instance, proteins comprise the major structural materials of the body, including muscle, bone, and skin. Proteins allow you to move, support your complex internal communication systems, keep you healthy by fulfilling their roles in the immune system (which protects against infection and disease), and regulate many of the chemical reactions needed for life. When needed to do so, proteins can also serve as a source of energy.


Most dairy products are excellent sources of protein.
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1-3c Lipids

Lipids, referred to as oils when they are liquid and fats when they are solid, are the third major macronutrient class. Lipids generally consist


Olives are often recommended because they are sources of healthy oils.
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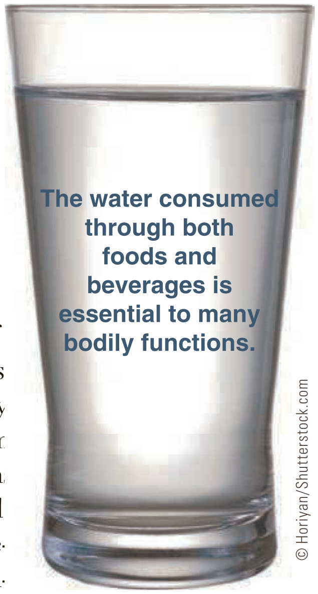
of carbon, oxygen, and hydrogen atoms. They provide large amounts of energy, are important to the structure of cell membranes, and are necessary for the development and maintenance of your nervous and reproductive systems. Lipids also regulate a variety of processes that happen within cells. Many foods contain lipids, although the types of lipids found in plant-based foods, such as nuts and corn oil, are typically quite different from those found in animal-based foods, such as meat, fish, eggs, and milk.


The water consumed through both foods and beverages is essential to many bodily functions.
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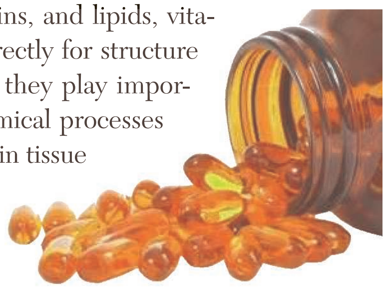
1-3d Water

Without water, the fourth macronutrient class, there would be no life. Water, which is comprised of oxygen and hydrogen atoms, makes up approximately 60 percent of your total body weight. Humans typically consume water every day, whether as a beverage or in the foods we eat. The functions of water are varied and vital. More specifically, water functions as the transporter of nutrients, gases, and waste products; as the fluid in which chemical reactions occur; and as a partner in many chemical reactions needed for your body to function. Water is also important in regulating body temperature and protecting internal organs from damage.

1-3e Vitamins

Vitamins, which are micronutrients, have a variety of chemical structures. Although they all contain carbon, oxygen, and hydrogen atoms, some vitamins also contain substances such as phosphorus and sulfur. Vitamins are abundant in most naturally occurring foods—especially fruits, vegetables, and grains. Your body requires vitamins to control hundreds of chemical reactions needed for its function. Vitamins also promote healthy and appropriate growth and development. Some vitamins, called antioxidants, protect your body from the damaging effects of harmful compounds such as air pollution. Unlike carbohydrates, proteins, and lipids, vitamins are not used directly for structure or energy. However, they play important roles in the chemical processes that build and maintain tissue and in the utilization of energy obtained from macronutrients.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Vitamins can be subdivided based on how they interact with water. Water-soluble vitamins (vitamin C and the B vitamins) dissolve easily in water, while fat-soluble vitamins (vitamins A, D, E, and K) do not. Much contemporary nutritional research focuses on the role of vitamins in the prevention and management of diseases such as heart disease and certain types of cancer.

1-3f Minerals

At least 15 minerals, each of which serves a specific purpose, are considered to be essential nutrients. For example, calcium, abundant in dairy products, provides the matrix for various structural components in your body, such as bone. Other minerals, such as sodium, help regulate a variety of body processes, such as water balance. Still other minerals, such as selenium, which is abundant in many seeds and nuts, facilitate chemical reactions. Like vitamins, minerals are not themselves used for energy, though many drive energy-yielding reactions involving the macronutrients. Scientists are still discovering new ways that minerals prevent and perhaps even treat various diseases.


The mineral sodium chloride (salt) is essential in small quantities, but harmful for some when consumed in excess.
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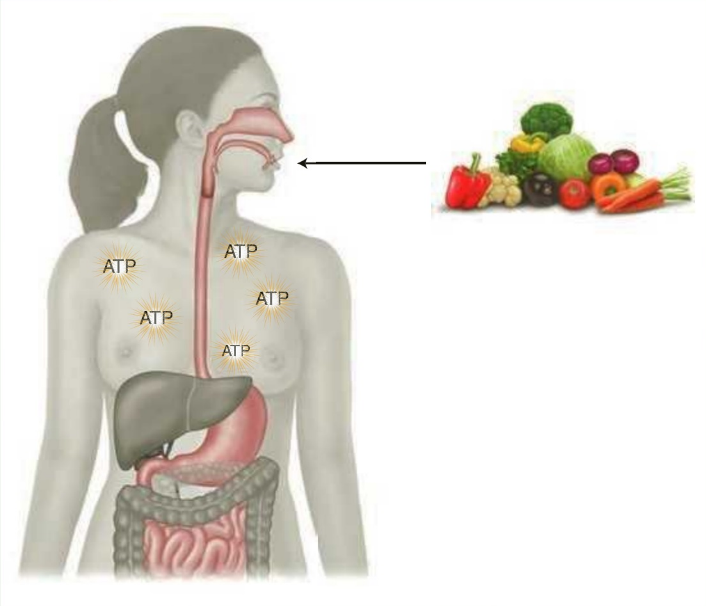
1-4 HOW IS THE ENERGY IN FOOD MEASURED?

As you have just learned, the macronutrients (with the exception of water) supply the body with energy. But what exactly is *energy*? And how can foods contain this important commodity? **Energy** is the capacity of a physical system to do work. In other words, if something has energy, it can cause something else to happen. Energy is not a nutrient, but in terms of nutrition, the body uses energy found in foods to grow, develop, move, and fuel the many chemical reactions required for life. Carbohydrates, proteins, and lipids all contain energy your body can utilize and are therefore classified as **energy-yielding nutrients**. After you eat an energy-yielding nutrient, cells in your body transfer the energy that it contains into a special

energy The capacity to do work.

energy-yielding nutrient A nutrient that the body can use for energy.

FIGURE 1.3 NUTRITIONAL ENERGY



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The body transfers energy found in carbohydrates, proteins, and lipids into AT P—the only form of energy used by cells.

substance called **adenosine triphosphate (ATP)**, which stores energy somewhat like a molecular battery. Your body can then use the energy stored in ATP to power its many processes (see Figure 1.3).

1-4a Calories Represent the Amount of Energy in a Food

The amount of energy in the food you eat varies, and the unit of measurement used to express the amount of energy in a food is called the **calorie**. The more calories a food has, the more ATP the body can make from it. Because a single calorie represents a very small amount of energy, the energy content of foods is typically expressed in a unit representing 1,000 calories—a *kilocalorie*. The kilocalorie is often abbreviated as *kcalorie* or *kcal*. Further, a kilocalorie is sometimes referred to as a *Calorie* (note the capital *C*) outside of scientific research, as on food labels. Therefore, 1 Calorie is equivalent to 1 kilocalorie, or 1,000 calories. A slice of cherry pie contains approximately 480 Calories, which is equivalent to 480 kilocalories, or 480,000 calories.

1,000 calories = 1 kilocalorie = 1 Calorie

Carbohydrates and proteins provide approximately 4 kcal/g. That is, they provide 4 kilocalories of energy for each gram (g) of substance consumed. Lipids provide approximately 9 kcal/g. Thus, 10 grams of a pure carbohydrate or protein contain 40 kilocalories (4 kcal/g × 10 g), whereas 10 grams of a pure lipid contain 90 kilocalories (9 kcal/g × 10 g). Although alcohol is not considered a nutrient, it provides 7 kcal/g. To practice figuring out how many calories are in a meal, try calculating the caloric content of a breakfast consisting of oatmeal, low-fat milk, brown sugar, raisins, and orange juice. The amount of each food's energy-yielding nutrients—carbohydrates, proteins, and lipids—can be found on the food's label or in any food composition table. By multiplying the weight (in grams) of each energy-yielding nutrient by its caloric content (kcal/gram) and then adding up these values, you can easily determine the number

Is There Actually Energy in Your Energy Drink?

Have you ever looked at the ingredient list on the label of an "energy" drink or power shot? You might be surprised to learn that many of these products—especially those labeled *diet* or *sugar free*—do not actually contain energy-yielding nutrients, and therefore do not really contain energy. Instead, they are chock full of vitamins and other substances (like caffeine) loosely associated with increased mental "energy" and enhanced wakefulness.[4] You can easily tell if a product contains true energy by checking to see if it provides calories in the form of carbohydrates, protein, or fat.

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Some energy drinks do not actually contain energy (calories).

adenosine triphosphate (ATP) A chemical that provides energy to cells in the body.

calorie The unit of measurement used to express the amount of energy in a food.

TABLE 1.2 CALCULATING THE CALORIC CONTENT OF A TYPICAL BREAKFAST

Food	Kilocalories from Energy-Yielding Nutrients: Carbohydrates (4 kcal/g)	Protein (4 kcal/g)	Lipids (9 kcal/g)	Total Kilocalories
Oatmeal, 1 cup • Carbohydrates: 25 g • Protein: 6 g • Lipids: 2 g	25 g × 4 kcal/g = 100 kcal	6 g × 4 kcal/g = 24 kcal	2 g × 9 kcal/g = 18 kcal	142 kcal
Milk, 1 cup • Carbohydrates: 12 g • Protein: 8 g • Lipids: 2 g	12 g × 4 kcal/g = 48 kcal	8 g × 4 kcal/g = 32 kcal	2 g × 9 kcal/g = 18 kcal	98 kcal
Brown Sugar, 2 tablespoons • Carbohydrates: 24 g • Protein: 0 g • Lipids: 0 g	24 g × 4 kcal/g = 96 kcal	0 g × 4 kcal/g = 0 kcal	0 g × 9 kcal/g = 0 kcal	96 kcal
Raisins, 1/2 ounce • Carbohydrates: 11 g • Protein: 0 g • Lipids: 0 g	11 g × 4 kcal/g = 44 kcal	0 g × 4 kcal/g = 0 kcal	0 g × 9 kcal/g = 0 kcal	44 kcal
Orange Juice, 1 cup • Carbohydrates: 27 g • Protein: 2 g • Lipids: 0 g	27 g × 4 kcal/g = 108 kcal	2 g × 4 kcal/g = 8 kcal	0 g × 9 kcal/g = 0 kcal	116 kcal
Total	396 kcal	64 kcal	36 kcal	496 kcal

of kilocalories provided by the meal. As illustrated in Table 1.2, the total caloric content of this breakfast is 496 kilocalories, or 496 Calories. Because of rounding errors and other factors, the total number of kilocalories (or Calories) listed in a food composition table or on a label may differ slightly from the value obtained from calculations. However, these differences are usually very small.

1-5 HOW DO NUTRITIONAL SCIENTISTS CONDUCT THEIR RESEARCH?

Few things are more significant or imperative to people than food. Food is also an important frontier of scientific research. Many questions about how food interacts with our bodies and ultimately our health are yet to be answered. But how do scientists carry out this research, and how can you distinguish reliable information from false or exaggerated claims? For centuries, scientists have explained observations (including those related to nutrition) using a series of steps collectively called the **scientific method**. There are three basic steps in the scientific method:

1. making an observation,
2. proposing a hypothesis, and
3. collecting data.[5]

1-5a Step 1: The Observation Must Be Accurate

An appropriate and accurate observation about an event or phenomenon serves as both the framework and foundation for the rest of the scientific method. If the observation is flawed, any resulting conclusions will likely be flawed as well. For example, consider the observation that there has been an alarming rise in childhood obesity over the past few decades. Before a researcher can develop an explanation for

scientific method A series of steps used by scientists to explain observations.