Contents

Physics 322

CHEMISTRY UNIT PREVIEW

Chemistry

Focus on the BIG Ideas

Chemistry is the study of the composition, structure, properties, and reactions of matter. Matter that always has exactly the same composition is classified as a substance. Elements are the simplest substances. The smallest particle of an element is an atom.

There are only about 100 elements. In the modern periodic table, elements are arranged by increasing atomic number (number of protons). Based on their chemical and physical properties, elements are classified as metals, nonmetals, and metalloids.

Unlike physical changes, chemical changes involve a change in the composition of matter. During a reaction, chemical bonds in the reactants are broken and chemical bonds in the products are formed. Mass is conserved in chemical reactions.

Nuclear changes (such as radioactivity) involve the conversion of atoms of one element to atoms of another. During nuclear reactions, mass can be created or destroyed, and it is the total sum of mass and energy that is conserved.

Fireworks Display in ► Sydney, Australia
When fireworks explode, they produce colorful displays of light.

Pure Substances

Matter that always has exactly the same composition is classified as a **pure substance,** or simply a substance. Table salt and table sugar are two examples of pure substances. Every pinch of salt tastes equally salty. Every spoonful of sugar tastes equally sweet. **Every sample of a given substance has the same properties because a substance has a fixed, uniform composition.** Substances can be classified into two categories—elements and compounds.

Elements

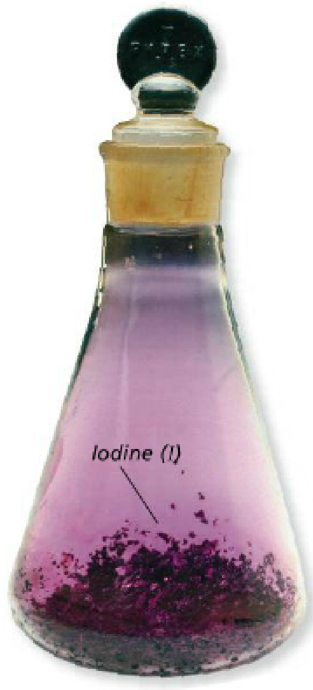
Although there are millions of known substances, there are only about 100 elements. An **element** is a substance that cannot be broken down into simpler substances. Imagine cutting a copper wire into smaller and smaller pieces. Eventually you would end up with extremely tiny particles called copper atoms. An **atom** is the smallest particle of an element. **An element has a fixed composition because it contains only one type of atom.**

No two elements contain the same type of atom. In Chapter 4, you will find out more about atoms, including how the atoms of one element differ from the atoms of every other element.

Examples of Elements

At room temperature (20°C, or 68°F), most elements are solids, including the elements aluminum and carbon. You have seen aluminum foil used to wrap food. Most soft drink cans are made from aluminum. Carbon is the main element in the marks you make with a pencil on a piece of paper. Some elements are gases at room temperature. The elements oxygen and nitrogen are the main gases in the air you breathe. Only two elements are liquids at room temperature, bromine and mercury, both of which are extremely poisonous. Figure 2 shows four elements and their symbols.

Figure 2 Aluminum, carbon, and gold are elements that you can see in common objects, such as cans, pencils, and rings. Mixtures containing iodine are used to prevent and treat infections. **Analyzing Data** ***Which of these elements has a symbol that is not related to its name in English?***



Data Analysis

Do the Contents of Two Cans of Mixed Nuts Meet FDA Regulations?

The Food and Drug Administration (FDA) has two main areas of concern about food. First, and most important, the FDA ensures that food sold in the United States is safe to eat. Second, the FDA ensures that the information on a food label accurately describes a food product.

What can you assume when you see the label "mixed nuts" on a can of nuts? According to the FDA regulations, a can labeled *mixed nuts* must contain at least four types of shelled nuts other than peanuts. The mass of each type of nut must be not less than 2 percent of the total mass and not more than 80 percent of the total mass.

Contents of Two Cans of Mixed Nuts

Type of Nut	Mass in Brand A	Mass in Brand B
Peanut	152.39 g	191.96 g
Almond	47.02 g	31.18 g
Brazil nut	57.88 g	19.60 g
Cashew	46.20 g	73.78 g
Hazelnut	19.90 g	16.90 g
Pecan	21.40 g	16.90 g

1. **Comparing and Contrasting** How are the two brands of mixed nuts alike? How are they different?
2. **Calculating** What is the percent by mass of each type of nut in each can?
3. **Drawing Conclusions** Do the contents of each can meet the FDA regulations? Explain.
4. **Inferring** On the Brand A label, the nuts are listed in this order: peanuts, Brazil nuts, almonds, cashews, pecans, and hazelnuts. What do you think determines the order?

Homogeneous Mixtures If you collect water from both the shallow end and the deep end of a swimming pool, the water samples will appear the same. The water in a swimming pool is a homogeneous (hoh moh GEE nee us) mixture of water and substances that dissolve in water. In a **homogeneous mixture**, the substances are so evenly distributed that it is difficult to distinguish one substance in the mixture from another. A homogeneous mixture appears to contain only one substance. The serving spoon in Figure 5 is made of stainless steel—a homogeneous mixture of iron, chromium, and nickel.

Solutions, Suspensions, and Colloids

It isn't always easy to tell a homogeneous mixture from a heterogeneous mixture. You may need to observe the properties of a mixture before you decide. The size of the particles in a mixture has an effect on the properties of the mixture. **Based on the size of its largest particles, a mixture can be classified as a solution, a suspension, or a colloid.**

Solutions If you place a spoonful of sugar in a glass of hot water and stir, the sugar dissolves in the water. The result is a homogeneous mixture of sugar and water. When substances dissolve and form a homogeneous mixture, the mixture that forms is called a **solution**. The windshield wiper fluid in Figure 6 is a solution. So is tap water.

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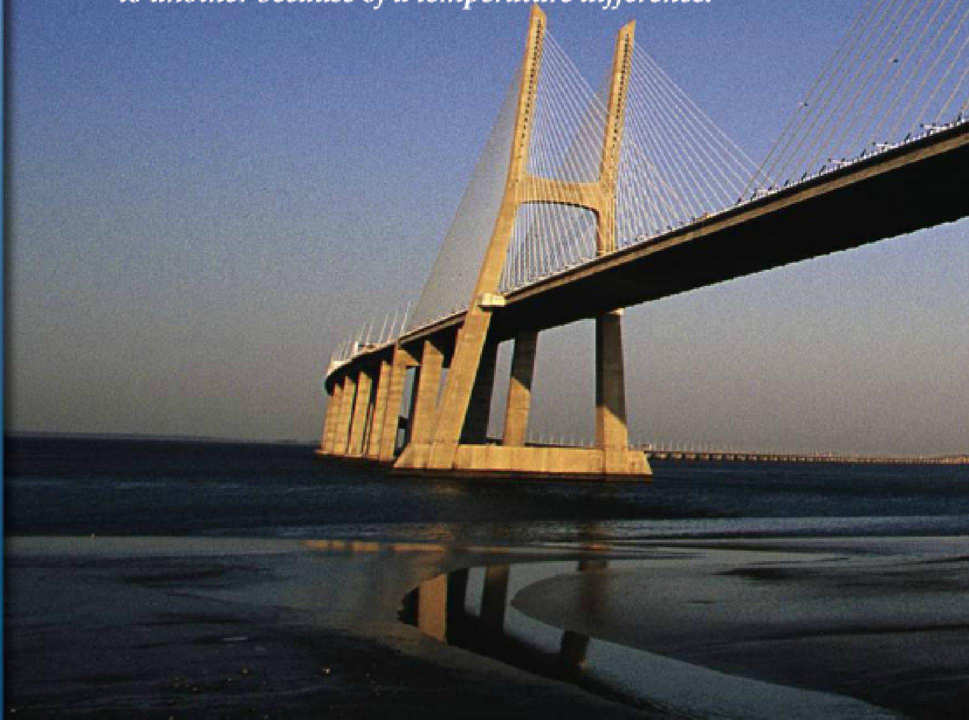
PHYSICS UNIT PREVIEW

Physics

Focus on the BIG Ideas

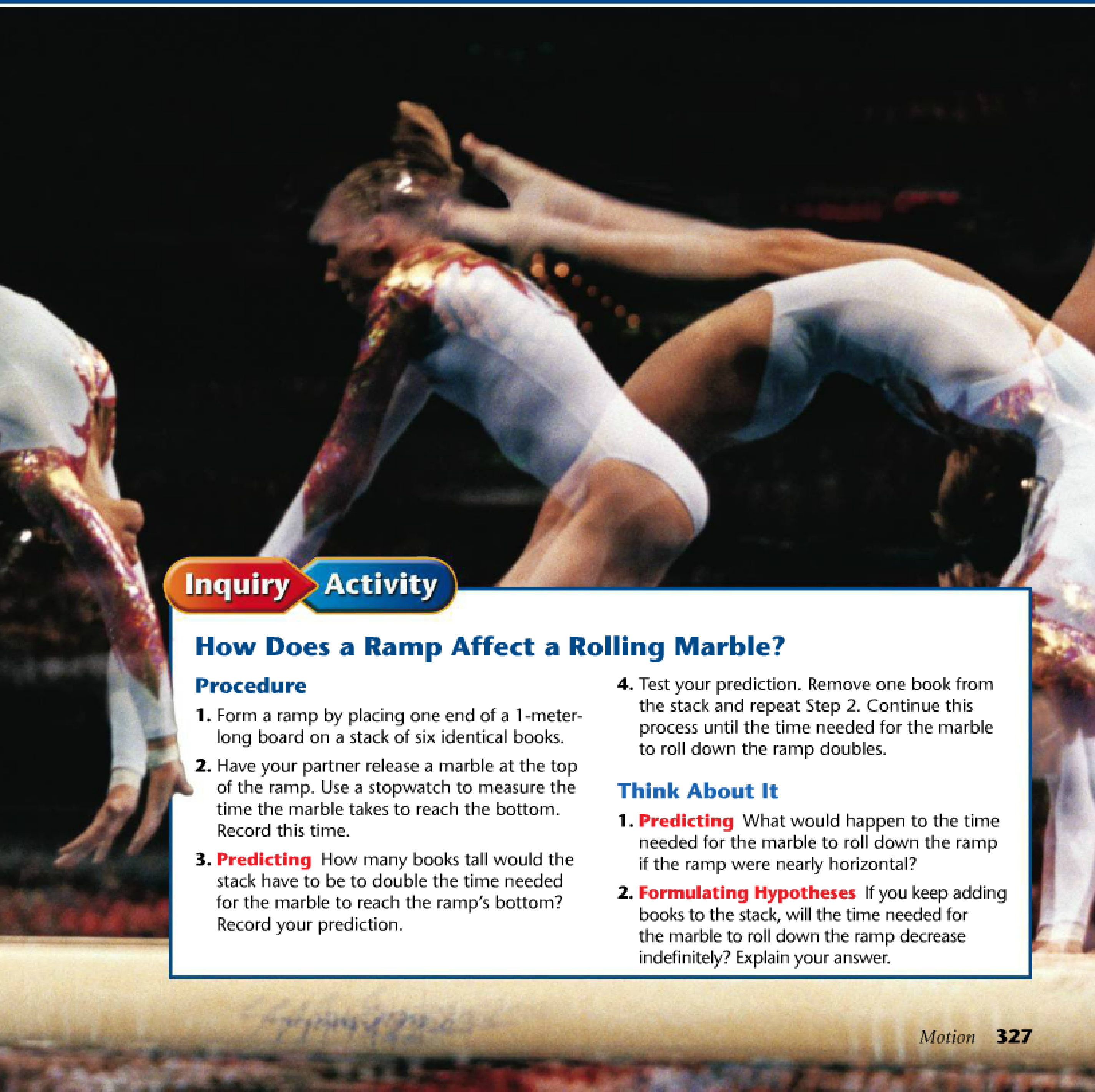
Physicists investigate the laws that govern space, time, forces, motion, matter, and energy. Newton's laws of motion describe the relationship between the forces acting on a body and its motion. The motion of objects is governed by four universal forces: gravitational forces, electromagnetic forces, strong nuclear forces, and weak nuclear forces.

Energy is defined as the ability to do work. The amount of energy in the universe is constant, and energy is conserved within any closed system. However, energy can change between many different forms of kinetic energy and potential energy. The total potential and kinetic energy of all the microscopic particles in an object make up its thermal energy. Heat is the transfer of thermal energy from one object to another because of a temperature difference.



Vasco da Gama Bridge ▶ The Vasco da Gama Bridge spans the water at Lisbon, Portugal. Large ships can pass under the bridge to reach the port.

Chapter Preview



Inquiry Activity

How Does a Ramp Affect a Rolling Marble?

Procedure

1. Form a ramp by placing one end of a 1-meter-long board on a stack of six identical books.
2. Have your partner release a marble at the top of the ramp. Use a stopwatch to measure the time the marble takes to reach the bottom. Record this time.
3. **Predicting** How many books tall would the stack have to be to double the time needed for the marble to reach the ramp's bottom? Record your prediction.
4. Test your prediction. Remove one book from the stack and repeat Step 2. Continue this process until the time needed for the marble to roll down the ramp doubles.

Think About It

1. **Predicting** What would happen to the time needed for the marble to roll down the ramp if the ramp were nearly horizontal?
2. **Formulating Hypotheses** If you keep adding books to the stack, will the time needed for the marble to roll down the ramp decrease indefinitely? Explain your answer.

11.1 Distance and Displacement

Reading Focus

Key Concepts

- What is needed to describe motion completely?
- How are distance and displacement different?
- How do you add displacements?

Vocabulary

- frame of reference
- relative motion
- distance
- vector
- resultant vector

Reading Strategy

Predicting Copy the table below and write a definition for *frame of reference* in your own words. After you read the section, compare your definition to the scientific definition and explain why the frame of reference is important.

Frame of reference probably means	Frame of reference actually means
a. ?	b. ?

On a spring day a butterfly flutters past. First it flies quickly, then slowly, and then it pauses to drink nectar from a flower. The butterfly's path involves a great deal of motion.

How fast is the butterfly moving? Is it flying toward the flower or away from it? These are the kinds of questions you must answer to describe the butterfly's motion. To describe motion, you must state the direction the object is moving as well as how fast the object is moving. You must also tell its location at a certain time.

Choosing a Frame of Reference

How fast is the butterfly in Figure 1 moving? Remember that the butterfly is moving on Earth, but Earth itself is moving as it spins on its axis and revolves around the sun. If you consider this motion, the butterfly is moving very, very fast!

To describe motion accurately and completely, a frame of reference is necessary. The necessary ingredient of a description of motion—a **frame of reference**—is a system of objects that are not moving with respect to one another. The answer to "How fast is the butterfly moving?" depends on which frame of reference you use to measure motion. How do you decide which frame of reference to use when describing the butterfly's movement?

Figure 1 You must choose a frame of reference to tell how fast the butterfly is moving.
Applying Concepts ***Identify a good frame of reference to use when describing the butterfly's motion.***