CHAPTER 5

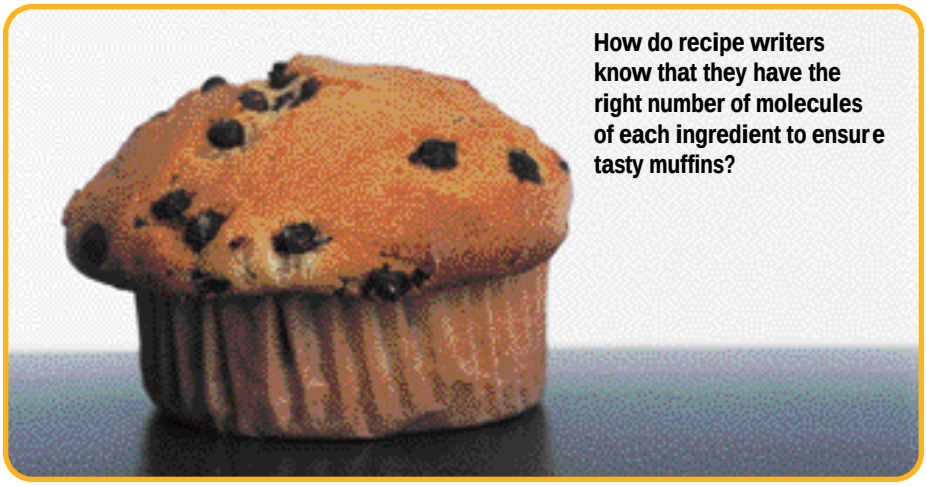
Counting Atoms and Molecules: The Mole

A recipe for chocolate chip muffins tells you exactly what ingredients you will need. One recipe might call for flour, butter, eggs, milk, vinegar, baking soda, sugar, and chocolate chips. It also tells you how much of each ingredient you will need, using convenient units of measurement. Which of the ingredients do you measure by counting? Which do you measure by volume or by mass? The recipe does not tell you exactly how many chocolate chips or grains of sugar you will need. It would take far too long to count individual chocolate chips or grains of sugar. Instead, the amounts are given in millilitres or grams—the units of volume or mass.

In some ways, chemistry is similar to baking. To carry out a reaction successfully—in chemistry or in baking—you need to know how much of each reactant you will need. When you bake something with vinegar and baking soda, for example, the baking soda reacts with acetic acid in the vinegar to produce carbon dioxide gas. The carbon dioxide gas helps the batter rise. The chemical equation for this reaction is

According to the balanced equation, one molecule of baking soda reacts with one molecule of acetic acid to form a salt, water, and carbon dioxide. If you wanted to carry out the reaction, how would you know the amount of baking soda and vinegar to use? Their molecules are much too small and numerous to be counted like eggs.

In this chapter, you will learn how chemists count atoms by organizing large numbers of them into convenient, measurable groups. You will learn how these groups relate the number of atoms in a substance to its mass. Using your calculator and the periodic table, you will learn how to convert between the mass of a substance and the number of atoms it contains.



How do recipe writers know that they have the right number of molecules of each ingredient to ensure tasty muffins?

Chapter Preview

Concepts and Skills You Will Need

Before you begin this chapter, review the following concepts and skills:

- defining and describing the relationships among atomic number, mass number, atomic mass, and isotope (Chapter 2, section 2.1)
- writing chemical formulas and equations (Chapter 3, section 3.4)
- balancing chemical equations by inspection (Chapter 4, section 4.1)