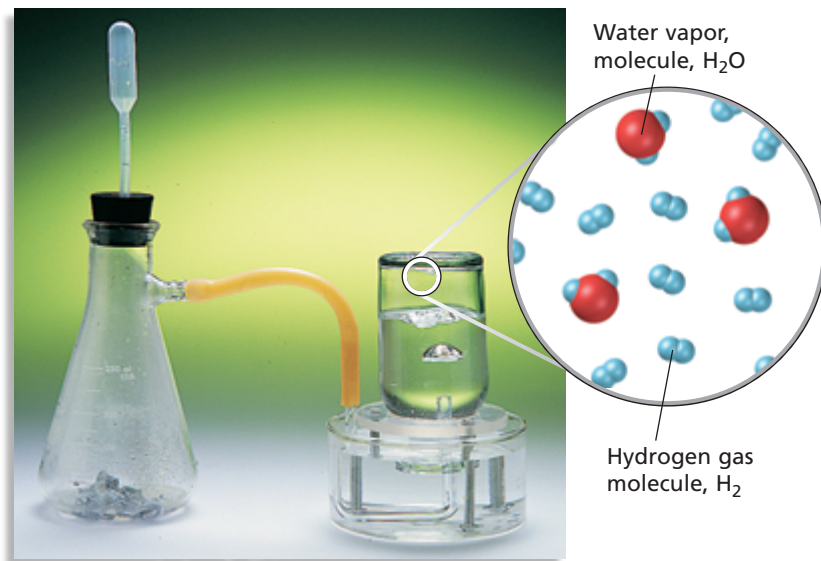


FIGURE 5 Hydrogen can be collected by water displacement by reacting zinc with sulfuric acid. The hydrogen gas produced displaces the water in the gas collecting bottle. It now contains some water vapor.



You can understand Dalton's law in terms of the kinetic-molecular theory. Each of the rapidly moving particles of gases in a mixture has an equal chance to collide with the container walls. Therefore, each gas exerts a pressure independent of that exerted by the other gases present. The total pressure is the result of the total number of collisions per unit of wall area in a given time.

Gases Collected by Water Displacement

Gases produced in the laboratory are often collected over water, as shown in **Figure 5**. The gas produced by the reaction displaces the water, which is more dense, in the collection bottle. You can apply Dalton's law of partial pressures in calculating the pressures of gases collected in this way. A gas collected by water displacement is not pure but is always mixed with water vapor. That is because water molecules at the liquid surface evaporate and mix with the gas molecules. Water vapor, like other gases, exerts a pressure known as *vapor pressure*.

Suppose you wished to determine the total pressure of the gas and water vapor inside a collection bottle. You would raise the bottle until the water levels inside and outside the bottle were the same. At that point, the total pressure inside the bottle would be the same as the atmospheric pressure, P_{atm} . According to Dalton's law of partial pressures, the following is true.

$$P_{atm} = P_{gas} + P_{H_2O}$$

Suppose you then needed to calculate the partial pressure of the dry gas collected. You would read the atmospheric pressure, P_{atm} , from a barometer in the laboratory. To make the calculation, subtract the vapor pressure of the water at the given temperature from the total pressure. The vapor pressure of water varies with temperature. You need to look up the value of P_{H_2O} at the temperature of the experiment in a standard reference table, such as Table A-8 in Appendix A of this book.