SECTION 2

Fluid Pressure

SECTION OBJECTIVES

- Calculate the pressure exerted by a fluid.
- Calculate how pressure varies with depth in a fluid.

pressure

the magnitude of the force on a surface per unit area

ADVANCED TOPICS

See "Fluid Pressure" in **Appendix J: Advanced Topics** to learn more about other properties of fluids.

Figure 5
Atmospheric diving suits allow divers to withstand the pressure exerted by the fluid in the ocean at depths of up to 610 m.

PRESSURE

Deep-sea explorers wear atmospheric diving suits like the one shown in **Figure 5** to resist the forces exerted by water in the depths of the ocean. You experience the effects of similar forces on your ears when you dive to the bottom of a swimming pool, drive up a mountain, or ride in an airplane.

Pressure is force per unit area

In the examples above, the fluids exert **pressure** on your eardrums. Pressure is a measure of how much force is applied over a given area. It can be written as follows:

PRESSURE

$$P = \frac{F}{A}$$

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

The SI unit of pressure is the *pascal* (Pa), which is equal to 1 N/m^2. The pascal is a small unit of pressure. The pressure of the atmosphere at sea level is about 1.01×10^5 Pa. This amount of air pressure under normal conditions is the basis for another unit, the *atmosphere* (atm). For the purpose of calculating pressure, 10^5 Pa is about the same as 1 atm. The absolute air pressure inside a typical automobile tire is about 3×10^5 Pa, or 3 atm.

Applied pressure is transmitted equally throughout a fluid

When you pump a bicycle tire, you apply a force on the pump that in turn exerts a force on the air inside the tire. The air responds by pushing not only against the pump but also against the walls of the tire. As a result, the pressure increases by an equal amount throughout the tire.

In general, if the pressure in a fluid is increased at any point in a container (such as at the valve of the tire), the pressure increases at all points inside the container by exactly the same amount. Blaise Pascal (1623–1662) noted this fact in what is now called *Pascal's principle* (or *Pascal's law*):

PASCAL'S PRINCIPLE

Pressure applied to a fluid in a closed container is transmitted equally to every point of the fluid and to the walls of the container.