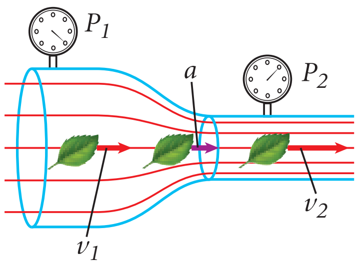

Figure 11
A leaf speeds up as it passes into a constriction in a drainage pipe. The water pressure on the right is less than the pressure on the left.

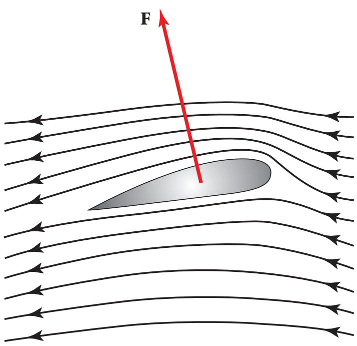

Figure 12
As air flows around an airplane wing, the air above the wing moves faster than the air below, producing lift.

The pressure in a fluid is related to the speed of flow

Suppose there is a water-logged leaf carried along by the water in a drainage pipe, as shown in **Figure 11.** The continuity equation shows that the water moves faster through the narrow part of the tube than through the wider part of the tube. Therefore, as the water carries the leaf into the constriction, the leaf speeds up.

If the water and the leaf are accelerating as they enter the constriction, an unbalanced force must be causing the acceleration, according to Newton's second law. This unbalanced force is a result of the fact that the water pressure in front of the leaf is less than the water pressure behind the leaf. The pressure difference causes the leaf and the water around it to accelerate as it enters the narrow part of the tube. This behavior illustrates a general principle known as *Bernoulli's principle,* which can be stated as follows:

BERNOULLI'S PRINCIPLE

The pressure in a fluid decreases as the fluid's velocity increases.

The lift on an airplane wing can be explained, in part, with Bernoulli's principle. As an airplane flies, air flows around the wings and body of the plane, as shown in **Figure 12.** Airplane wings are designed to direct the flow of air so that the air speed above the wing is greater than the air speed below the wing. Therefore, the air pressure above the wing is less than the pressure below, and there is a net upward force on the wing, called *lift.* The tilt of an airplane wing also adds to the lift on the plane. The front of the wing is tilted upward so that air striking the bottom of the wing is deflected downward.

SECTION REVIEW

1. Water at a pressure of 3.00×10^5 Pa flows through a horizontal pipe at a speed of 1.00 m/s. The pipe narrows to one-fourth its original diameter. What is the speed of the flow in the narrow section?

2. A 2.0 cm diameter faucet tap fills a 2.5×10^{-2} m^3 container in 30.0 s. What is the speed at which the water leaves the faucet?

3. **Critical Thinking** The time required to fill a glass with water from a large container with a spigot is 30.0 s. If you replace the spigot with a smaller one so that the speed of the water leaving the nozzle doubles, how long does it take to fill the glass?

4. **Interpreting Graphics** For this problem, refer back to **Figure 9.** Assume that the cross-sectional area, A_2, in the tube is increased. Would the length, Δx_2, need to be longer or shorter for the mass of liquid in both sections to still be equal?