Circulatory Systems

Single-celled organisms are in constant contact with their environments, obtaining nutrients and oxygen directly across the cell surface. The same holds true for small and simple plants and animals, such as algae, bryophytes, sponges, cnidarians, and flatworms. Larger and more complex plants and animals require methods for transporting materials to and from cells far removed from the external environment. These organisms have evolved transport systems.

Circulatory systems function to transport materials to and from cells throughout an organism. Organisms ranging from plants to animals have different nutritional requirements. Due to these differences, various species have evolved distinct circulatory processes to assist with their specific transport needs.

Plants

Transport systems are found in the vascular plants. Vascular networks provide intercellular communication in terrestrial plants. The systems consist of tubelike connective tissues organized into xylem and phloem. Xylem transports water and minerals in the plants, while phloem transports food materials and hormones.

Xylem and phloem tissues are grouped in arrangements called **vascular bundles.** In monocot plants, the vascular bundles are scattered throughout the parenchyma tissue in no particular pattern. In dicot plants, the vascular bundles occur in a circle around a central region of pith. In woody dicot plants, new xylem forms on the inside of the cambium each season; the old xylem forms the annual rings of the plant.

Animals

In animals, the transport system is generally called a **circulatory system** because the transport fluid flows through a circuit. Most animals have one or more organs called *hearts* for pumping the fluid. The channels through which the fluid flows are the **arteries** (which lead away from the heart), the **veins** (which lead to the heart), and the **capillaries** (the microscopic blood vessels between arteries and veins).

In animals, such as earthworms, the circulatory system consists of blood, channels, and five pulsating vessels that function as hearts, rushing blood through the vessels to all the earthworm's body parts. Gases bind to hemoglobin in the blood.

Terrestrial arthropods have an open circulatory system. A tubelike heart pumps blood into a dorsal blood vessel, which empties into the arthropod's body cavity, or*hemocoel*. Contractions of the body muscles gradually move blood back toward the animal's heart.

All vertebrates have a single, strong muscular heart to pump the blood. In fishes, the blood accumulates in a thin-walled receiving chamber called the **atrium.** The blood then passes through a valve into a pumping chamber, a **ventricle.** The ventricle contracts and forces blood out to the gills, where gas exchange occurs, and from there to the remainder of the body. Veins bring the blood back to the atrium.

Amphibians, such as frogs, have a three-chambered heart. The heart has a right and a left atrium and a single ventricle. In reptiles, a muscular septum exists between the two sides of the ventricle, creating a primitive four-chambered heart. Birds have a more sophisticated four-chambered heart than reptiles. One ventricle pumps blood to the lungs for gas exchange, while the second pumps oxygen-rich blood to the rest of the body tissues. Mammals also have a four-chambered heart.