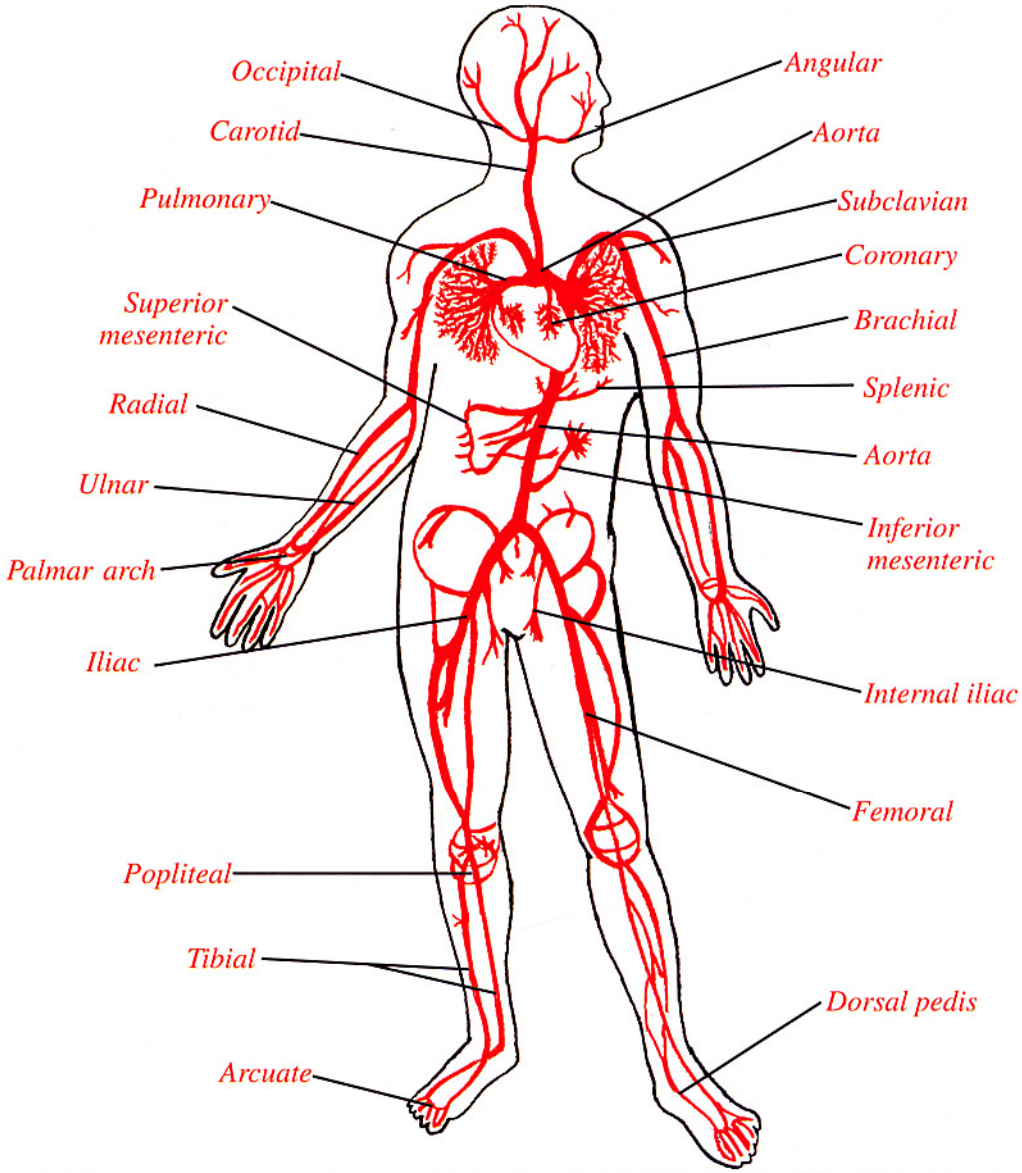
37: *Circulatory, Lymphatic and Immune Systems*

How do all of the internal organs receive food, water and oxygen? They depend on a pretty efficient distribution system. In fact, the circulatory system is that system, and it is quite efficient. Blood carries all of these goodies not only *to* the organs but also *through* them. The heart pumps blood to the major **arteries**. The arteries divide into smaller arteries and even smaller **arterioles** down to the **capillaries**. Capillaries can be so small as to allow only one or two blood cells to pass at a time. The thin outer walls of these tiny blood vessels allow nutrients and oxygen to cross through and come in contact with the cells that need these materials. After releasing their goods and collecting the waste, the blood returns to the heart through small **venules** and increasingly large **veins**.

Once returned to the heart, the blood is pumped to the lungs to gain oxygen and get rid of the extra carbon dioxide waste that it picked up at the cells. The newly oxygenated blood is returned to the heart to be pumped throughout the body.

The blood cells themselves can't get into the small spaces within the body's tissues. They remain in the blood vessels. There is liquid within these tissues that doesn't contain any blood cells. This liquid is called **tissue fluid**. It goes between the cells and keeps them bathed in the nutrients that they require. This fluid collects in special collection vessels called **lymphatics**. The fluid that collects in the lymphatics is called **lymph**. It is similar to **blood plasma**, which is just the liquid part of blood without the blood cells.

Within the circulatory and lymphatic systems, higher animals and humans have an **immune** system. The immune system protects from intruding organisms that come in to harm our bodies. These include the tiny viruses and bacteria, the worm-like parasites, fungi and other organisms that harm our bodies in their own attempts to survive. Designed right into our own bodies is the ability to tell the difference between our own cells and the cells of intruders. The immune system marks these alien cells as bad guys; it then attacks and kills them without mercy.



The human circulatory system is the body's pipeline to distribute oxygen from the lungs and nutrients from the intestines. The central organ is the heart that sends blood to the rest of the body. The blood passes from the heart through the aorta to the major arteries. Those arteries get smaller and smaller as they get farther and farther from the heart. Smaller arteries called arterioles pass blood from arteries to even smaller vessels called capillaries. Capillaries allow passage of nutrients and oxygen through their thin walls directly to the tissue fluid around the cells and of waste materials from tissue fluid into the blood. Small venules receive the blood from the capillaries and carry it, along with the waste products it now contains, to the veins. The major veins empty blood into the vena cava which delivers it back to the heart. The heart sends the blood to the lungs where it discharges carbon dioxide and picks up more oxygen. The blood then returns to the heart for redistribution throughout the body. This diagram shows the system of arteries, but the system of veins is not shown.