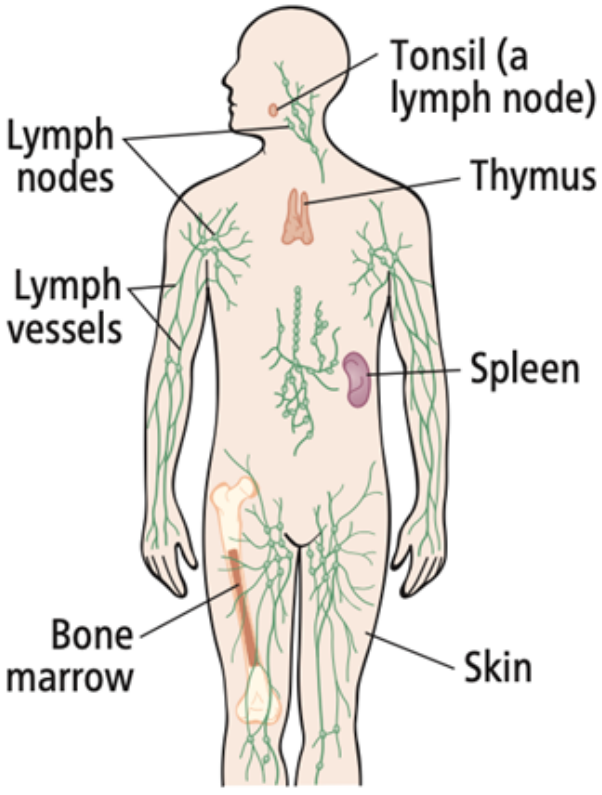
Chapter 15

Protecting Health

15.3 The Innate Immune System

Without your body's defenses, you would quickly fall prey to the bacteria, viruses, and other **pathogens**—disease-causing organisms—around you. What protects you is your immune system (Figure 15.6). Your immune system includes barriers that keep pathogens out, such as your skin. It also includes many different kinds of immune cells, also known as white blood cells. White blood cells move throughout your body constantly, looking for pathogens. White blood cells are made in the bone marrow. They then mature in the bone marrow or thymus. Most of your white blood cells are found in your circulatory system, lymphatic system, and spleen.



The *lymphatic system* is an important component of the immune system. The lymphatic system includes lymph vessels that, like blood vessels, travel all over the body. Lymph vessels carry a clear fluid called **lymph**. One function of the lymphatic system is to collect the fluid that leaks out of blood vessels and return it to the circulatory system. Another function of the lymphatic system is to carry white blood cells, which are found in large numbers in lymph. *Lymph nodes* are structures in the lymph vessels where many white blood cells are concentrated. Lymph nodes are found all over the body, including the throat (your tonsils), armpits, and groin. Swollen lymph nodes are a strong sign that the body is fighting an infection.

The immune system has two parts, the innate immune system and the acquired immune system. In the rest of this section, we consider innate immunity. In the next section, we will look at the acquired immune system.

FIGURE 15.6

The immune system includes the skin, bone marrow, thymus, spleen, and lymph nodes and vessels. It also includes numerous immune cells found in the blood and tissues.

Components of the Innate Immune System

The **innate immune system** includes nonspecific body defenses that work against many different pathogens. These defenses are described as "innate" because they do not have to be activated by exposure to a pathogen—they are all set and ready to go. Three key components of the innate immune system are the skin, the mucous membranes, and innate immune cells.

Skin

The best way to deal with pathogens is to keep them out of the body in the first place. The skin is a crucial barrier, forming a tough outer layer that is hard to penetrate when intact. In addition, skin cells are shed frequently, making it hard for pathogens to establish a foothold. Hair follicles in skin also secrete special enzymes and acids that kill bacteria and fungi. In fact, many of your body secretions contain bacteria-killing enzymes—for example, saliva, tears, sweat, and milk.

Mucous Membranes

The inside of your body is lined with *mucous membranes*. Mucous membranes are found inside your nose, mouth, and eyelids as well as in your respiratory, digestive, urinary, and reproductive tracts. Mucous membranes are not as tough as skin; however, all mucous membranes are covered by a layer of *mucus* that helps trap pathogens. The mucous membranes of the respiratory tract also include cilia that sweep mucus up to the pharynx (Figure 15.7). This mucus is then swallowed, and stomach acid kills any pathogens present. Many mucous membranes are also flushed by fluids such as tears, saliva, and urine. These fluids often contain pathogen-killing enzymes. In addition, the constant flushing makes it hard for pathogens to gain a foothold.

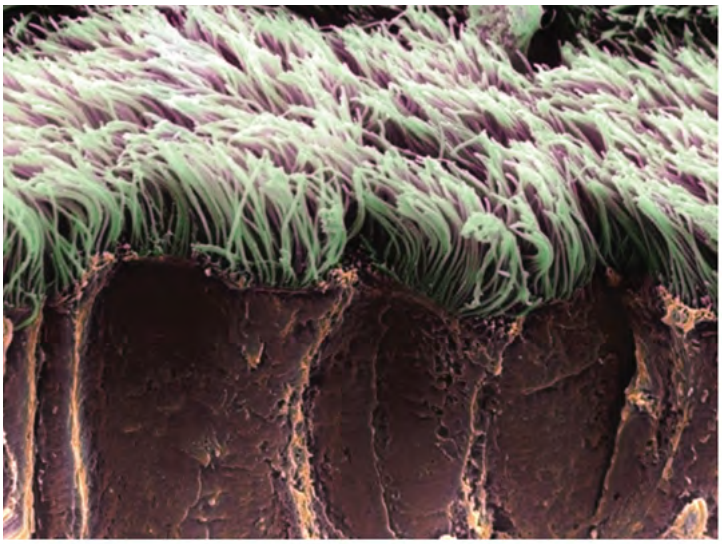


FIGURE 15.7

The lining of the respiratory tract includes numerous ciliated cells. The cilia sweep mucus, along with trapped particles or pathogens, up to the pharynx, where it is then swallowed.

Innate Immune Cells What happens when pathogens do get inside the body? Innate immune cells launch an immediate attack (Figure 15.8). Innate immune cells have receptors that recognize molecules—usually carbohydrates, proteins, or nucleic acids—found in many different kinds of pathogens (Figure 15.9). Because of this, a single innate immune cell is able to respond to many different pathogens. All in all, the cells of the innate immune system include several hundred different receptors. If the innate immune system encounters the same pathogen more than once, its response is the same: The innate immune system retains no memory of pathogens it has encountered in the past.

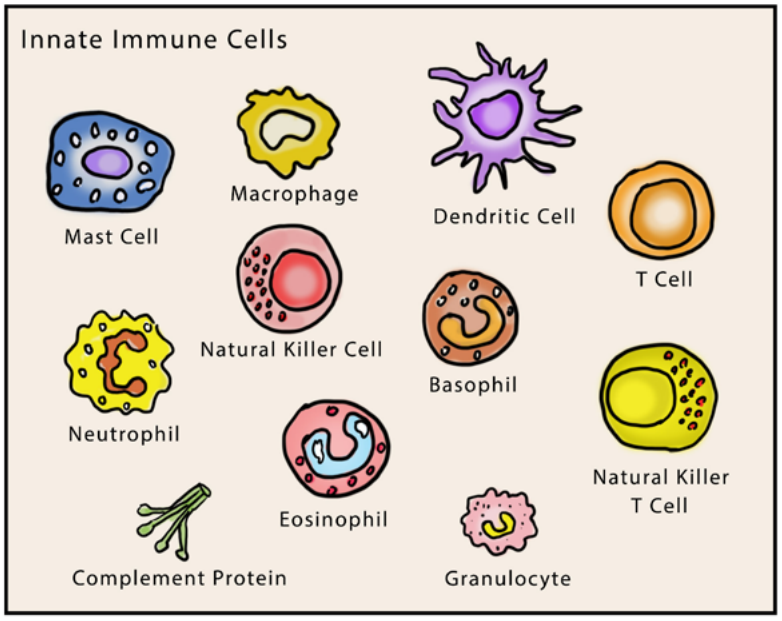


FIGURE 15.8

There are a variety of innate immune cells each with their own specialized function.

One of the most important functions of the innate immune system is to initiate the *inflammatory response*, shown in Figure 15.10. You have no doubt experienced the inflammatory response many times—it is what makes your tissues swell and turn red when you cut your finger or scrape your knee. During the inflammatory response, damaged tissues release chemicals called *histamines*. Histamines increase blood flow to the site of the injury and also cause local capillaries to leak fluid.

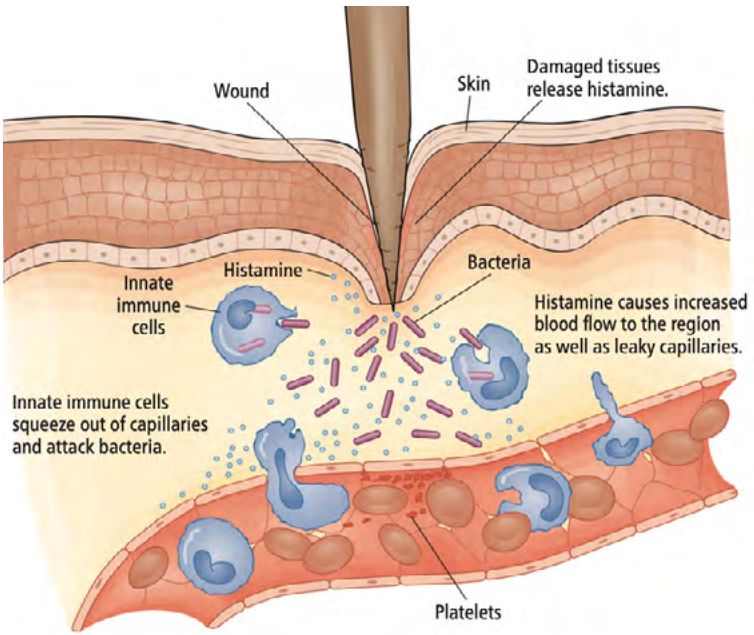


FIGURE 15.9

This innate immune cell (tan) is attacking bacteria (pink). The long stringlike structures are extensions of the immune cell's cytoplasm. They are searching the environment for pathogens.

FIGURE 15.10

The inflammatory response begins when damaged tissues release histamines, which cause increased blood flow to a wound. Local capillaries become leaky and produce swelling. Innate immune cells squeeze out of the capillaries and attack bacteria or other microorganisms that enter the body.

The extra fluid causes swelling, which helps to isolate the wound from other body tissues. Histamines also attract innate immune cells. These cells squeeze out of the capillaries and attack any pathogens they find. Sometimes, the battle between innate immune cells and pathogens produces a whitish substance called pus. Pus consists of dead bacteria, dead tissue, and dead and living innate immune cells.

READING CHECK

How does the inflammatory response help defend your body against disease?

CHECK YOUR ANSWER

During the inflammatory response, the tissues surrounding a wound swell, helping to isolate it from the rest of the body. The inflammatory response also brings innate immune cells to the site of injury so that they can attack bacteria or other pathogens.

You can read more about the immune system at the following websites:

https://www.niaid.nih.gov/research/immune-system-overview

https://medlineplus.gov/ency/article/000821.html