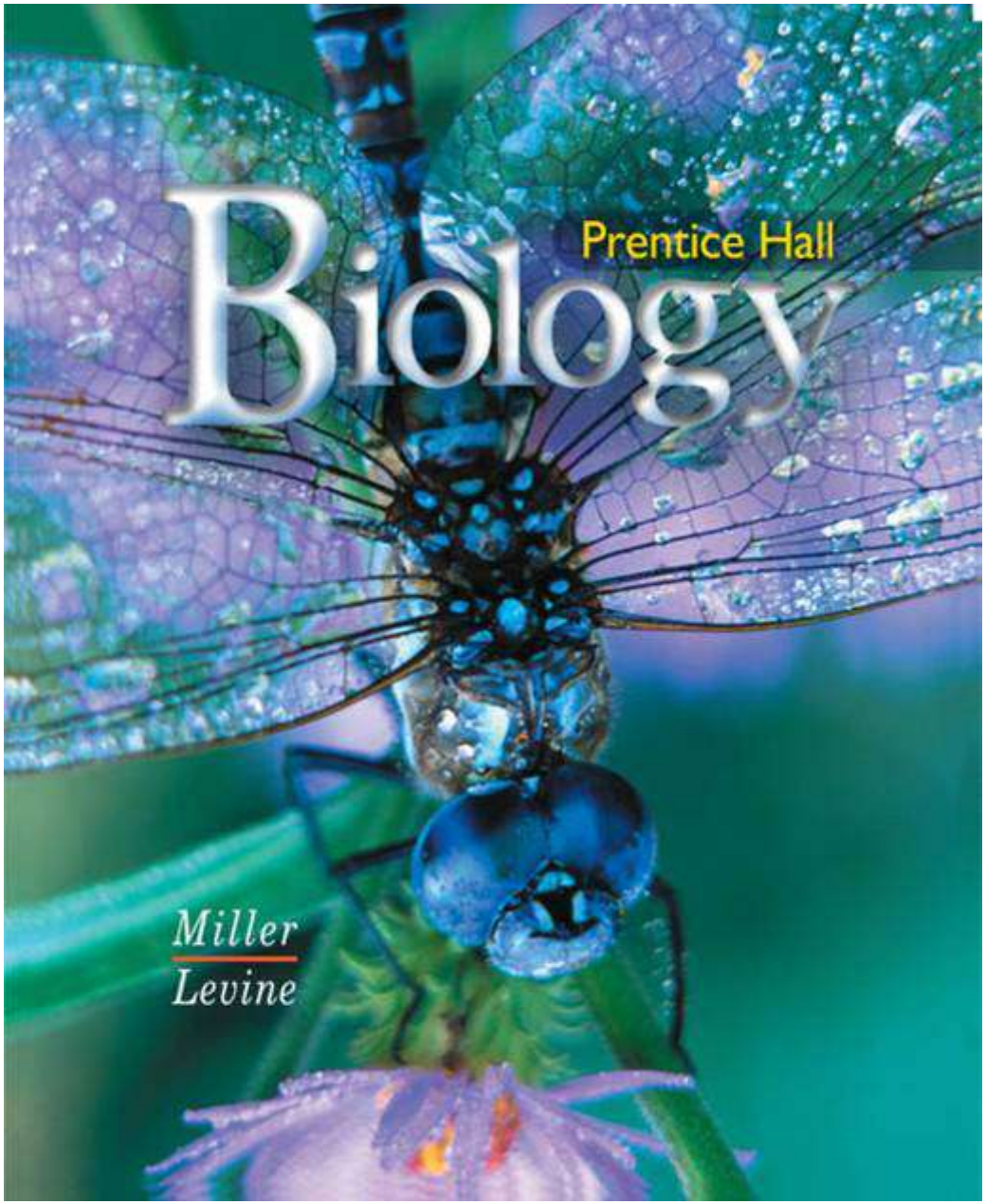


A disease is any change, other than an injury, that disrupts the normal functions of the body. Disease-causing agents are called pathogens.

Diseases caused by pathogens are called infectious diseases.

–Some diseases are produced by

•bacteria, viruses, or fungi.

•materials in the environment, ex. cigarette smoke.

•Genetics, ex. hemophilia.

Agents of Disease

– Viruses

Viruses are tiny particles that invade and replicate within living cells.

Viruses attach to a cell's surface, insert their genetic material, and take over many of the functions of the host cell.

Agents of Disease

Viruses can infect nearly every type of organism. Diseases caused by viruses include the common cold, influenza, and smallpox.

Agents of Disease

–Bacteria

Most bacteria are harmless to humans.

Bacteria that cause disease either:

- **break down tissues of the organism for food, or**
- **release toxins that harm the body.**

Bacterial diseases include streptococcus infections, diphtheria, and botulism.

Agents of Disease

–Protists

Disease-causing protists are transported from person to person by:

- **mosquitoes (malaria)**
- **insects (African sleeping sickness)**
- **contaminated water supplies (amebic dysentery).**

Agents of Disease

–Worms

Flatworms and roundworms cause many human diseases.

Other parasitic worms include *Schistosoma*, tapeworms and hookworms.

Agents of Disease

–Fungi

Fungi can infect the outer layers of the skin on the feet (athlete's foot) or the scalp (ringworm).

Other types of fungi infect the mouth, the throat, and even the fingernails and toenails.

How Diseases Are Spread

Infectious diseases are spread

- **through coughing, sneezing, or physical contact.**
- **contaminated water or food.**
- **infected animals.**

How Diseases Are Spread

– Physical Contact

Some infectious diseases can be spread by direct physical contact.

Some dangerous pathogens are spread by sexual contact.

Most diseases spread by indirect contact, such as through the air.

How Diseases Are Spread

– Contaminated Food and Water

Food poisoning is caused by eating food that has pathogens.

Bacteria are always present in uncooked meat. Bacteria grow quickly in warm, partially cooked food, so you should always cook food thoroughly.

Contaminated water also causes disease, especially in areas with poor sanitation and untreated sewage.

How Diseases Are Spread

–Infected Animals

Animals also spread infectious disease.

Animals that carry pathogens from person to person are called vectors.

Malaria, Lyme disease, West Nile virus, and rabies are diseases carried by vectors.

Deer tick = Lyme disease

Fighting Infectious Diseases

Antibiotics are compounds that kill bacteria without harming the cells of the human or animal hosts.

Antibiotics work by interfering with cellular processes of bacteria. (Ex. Stop cell wall formation)

- **Antibiotics have no effect on viruses.**
- **Antiviral drugs have been developed to fight certain viral diseases.**

Fighting Infectious Diseases

–Over-the-Counter Drugs

You can buy many medicines without a prescription.

Over-the-counter drugs treat only the symptoms of the disease, not the cause.

The best treatment for most infections includes rest, a well-balanced diet, and plenty of fluids.

40–2 The Immune System

40–2 The Immune System

The immune system is the body's main defense against pathogens.
The immune system recognizes, attacks, destroys, and “remembers” each type of pathogen that enters the body.

40–2 The Immune System

–The immune system fights infection by producing cells that inactivate foreign substances or cells.
–This process is called immunity.

40–2 The Immune System

The immune system includes two general categories of defense mechanisms against infection:

- **nonspecific defenses**
- **specific defenses**

Nonspecific Defenses

Nonspecific defenses do not discriminate between one threat and another.

Nonspecific Defenses

–First Line of Defense

The first line of defense keeps pathogens out of the body.

This role is carried out by skin, mucus, sweat, and tears.

Your body's most important nonspecific defense is the skin.

Nonspecific Defenses

Few pathogens can penetrate the layers of dead cells at the skin's surface.
However, when the skin is broken, pathogens can enter the body and multiply.
As they grow, they cause the symptoms of an infection, such as swelling, redness, and pain.

If pathogens enter the skin, mucus, saliva, and tears, contain lysozyme—an enzyme that breaks down the cell walls of many bacteria.

In addition, oil and sweat glands in the skin produce an acidic environment that kills many bacteria.

Nonspecific Defenses

Other nonspecific defenses include:

- Mucus in the nose and throat helps to trap pathogens.
- Cilia in the nose and throat push pathogens away from the lungs.
- Stomach acid and digestive enzymes destroy pathogens.

Nonspecific Defenses

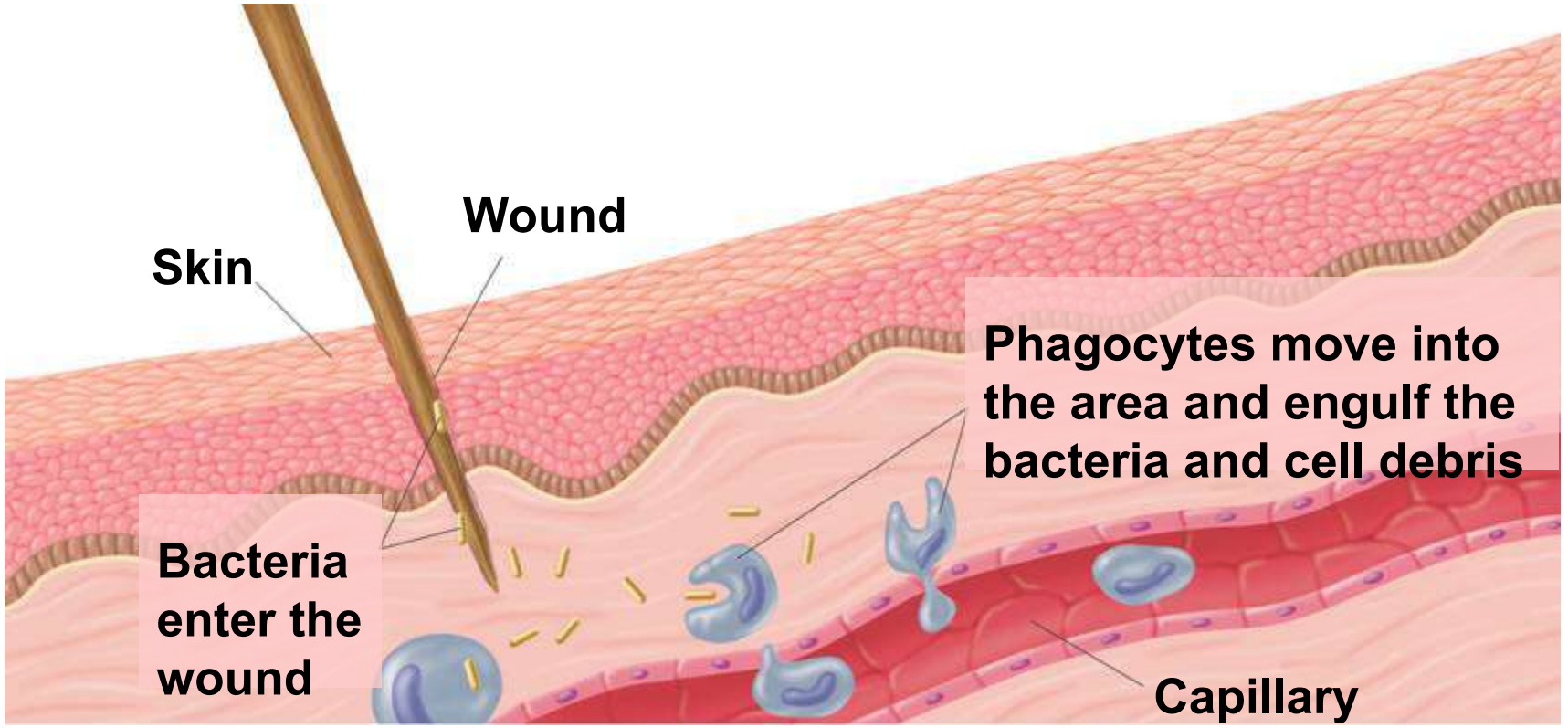
– Second Line of Defense

If pathogens enter the body, the inflammatory response is activated.

The inflammatory response is a nonspecific defense reaction that can cause pain, swelling, and fever.

Nonspecific Defenses

The Inflammatory Response



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Nonspecific Defenses

When pathogens are detected, the immune system makes white blood cells, which fight the infection.

Blood vessels near the wound expand, and white blood cells move from the vessels to enter the infected tissues.

Many are phagocytes, which engulf and destroy bacteria.

The infected tissue may become swollen and painful.

Nonspecific Defenses

The immune system releases chemicals that increase the core body temperature, causing a fever.

The high temperature of a fever slows or stops the growth of pathogens. It also increases heart rate so white blood cells get to the site of infection faster.

Nonspecific Defenses

–Interferon

Sometimes, virus-infected cells produce proteins that help other cells resist viral infection.

These proteins are named interferons because they "interfere" with the growth of the virus.

Specific Defenses

If a pathogen gets past the nonspecific defenses, the immune system reacts with a series of specific defenses.

These specific defenses are called the immune response.

Any substance, such as a virus or bacterium, that triggers this response is known as an antigen.

Specific Defenses

The cells of the immune system that recognize specific antigens are:

- **B lymphocytes (B cells)**
- **T lymphocytes (T cells)**

Specific Defenses

B cells (lymphocytes) defend the body against antigens and pathogens in body fluids. This process is called humoral immunity. T cells (lymphocytes) defend the body against abnormal cells and pathogens inside living cells. This process is called cell-mediated immunity.

Specific Defenses

–Humoral Immunity

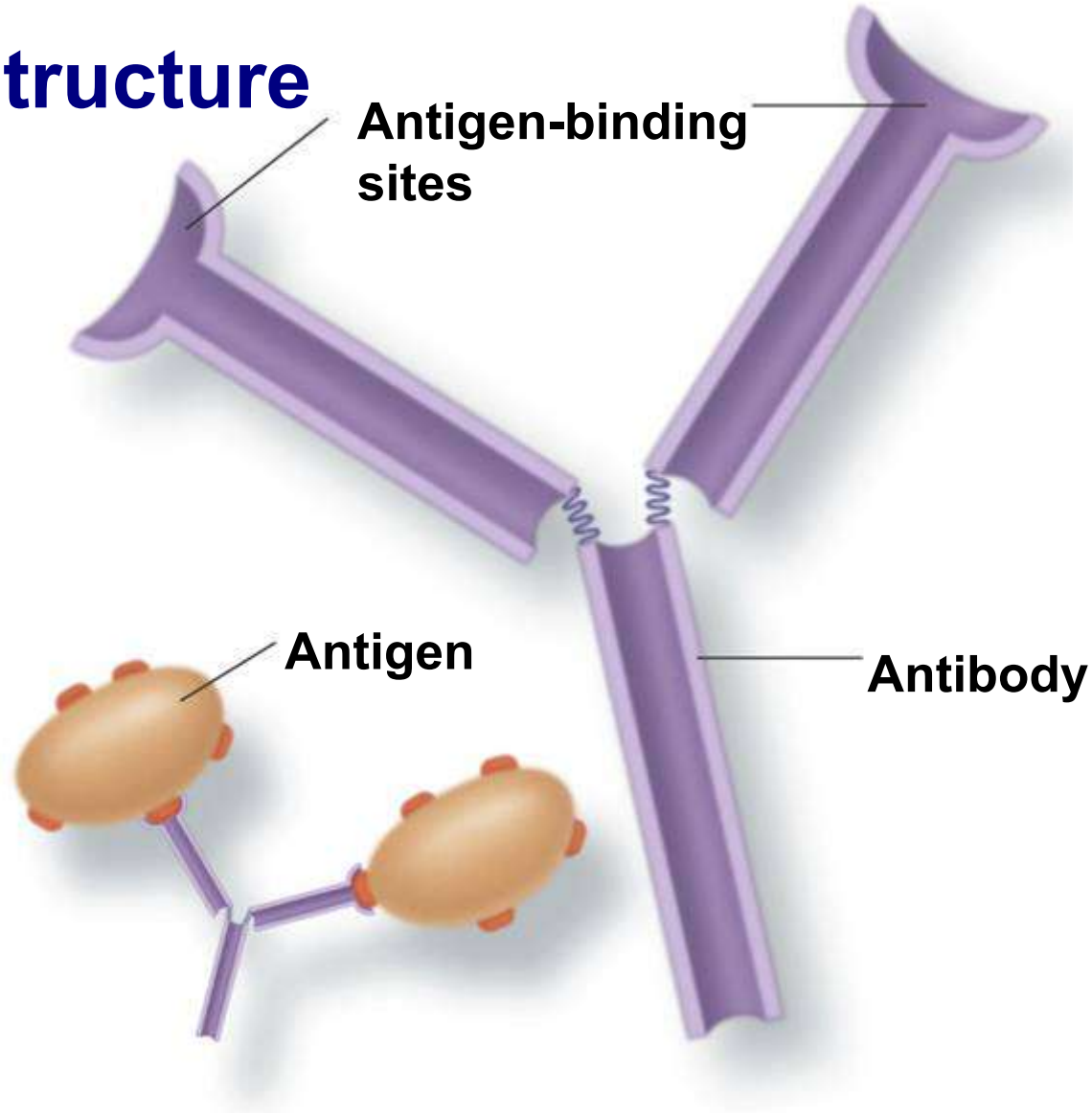
Humoral immunity produces antibodies.

An antibody is a protein that recognizes and binds to an antigen.

An antibody is shaped like the letter "Y" and has two identical antigen-binding sites.

Specific Defenses

Antibody Structure



Specific Defenses

Small differences in amino acids affect shapes of binding sites.
Different shapes allow antibodies to recognize a variety of antigens with complementary shapes.

Specific Defenses

Plasma cells release antibodies.
Antibodies are carried in the bloodstream to attack the pathogen.
As the antibodies overcome the infection, the plasma cells die out and stop producing antibodies.

Once the body has been exposed to a pathogen, millions of memory B cells remain capable of producing antibodies specific to that pathogen.

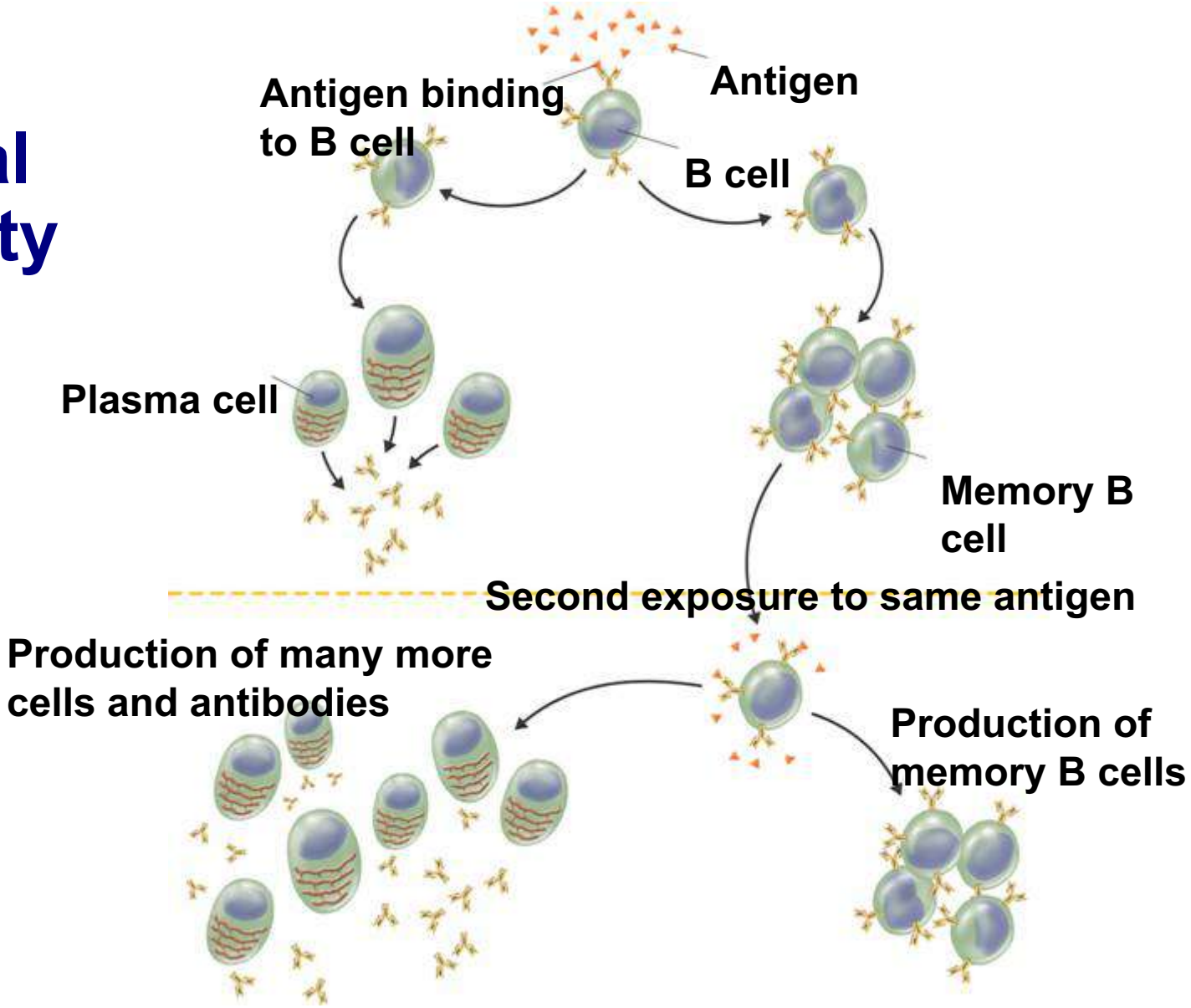
These memory B cells greatly reduce the chance that the disease could develop a second time.

Specific Defenses

If the same antigen enters the body a second time, a secondary response occurs.
The memory B cells divide rapidly, forming new plasma cells.
The plasma cells produce the specific antibodies needed to destroy the pathogen.

Specific Defenses

Humoral Immunity



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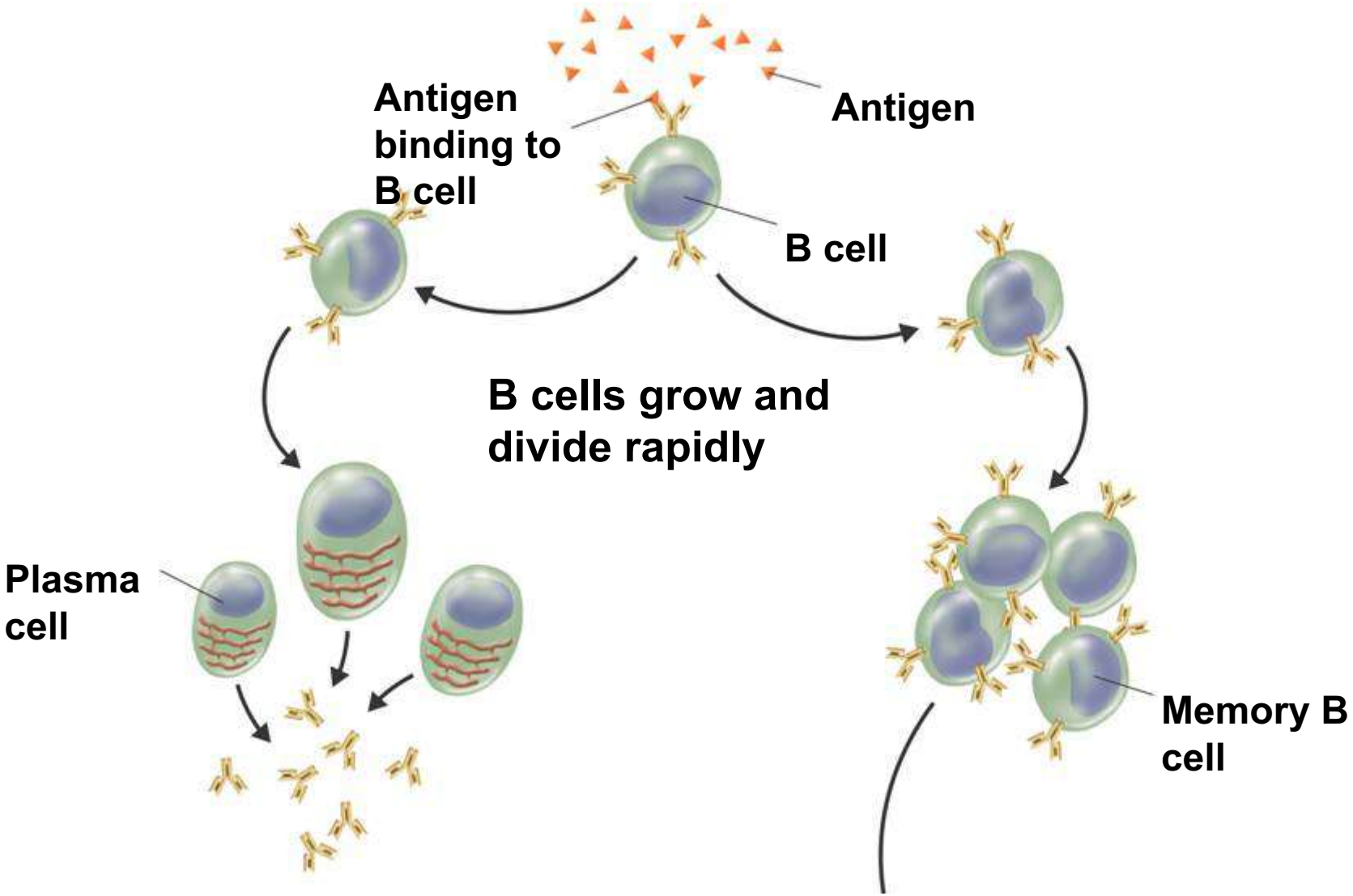
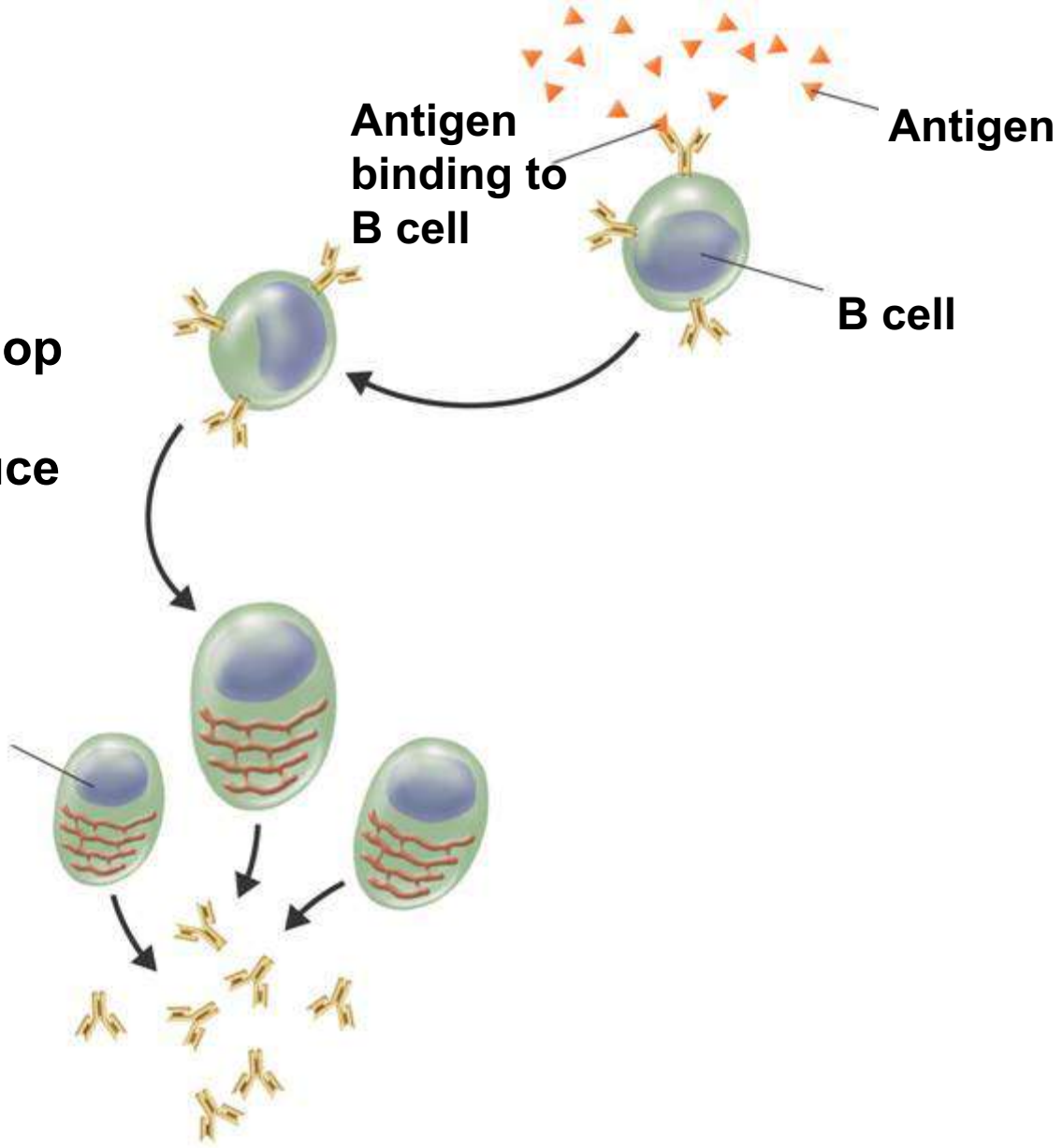
Specific Defenses

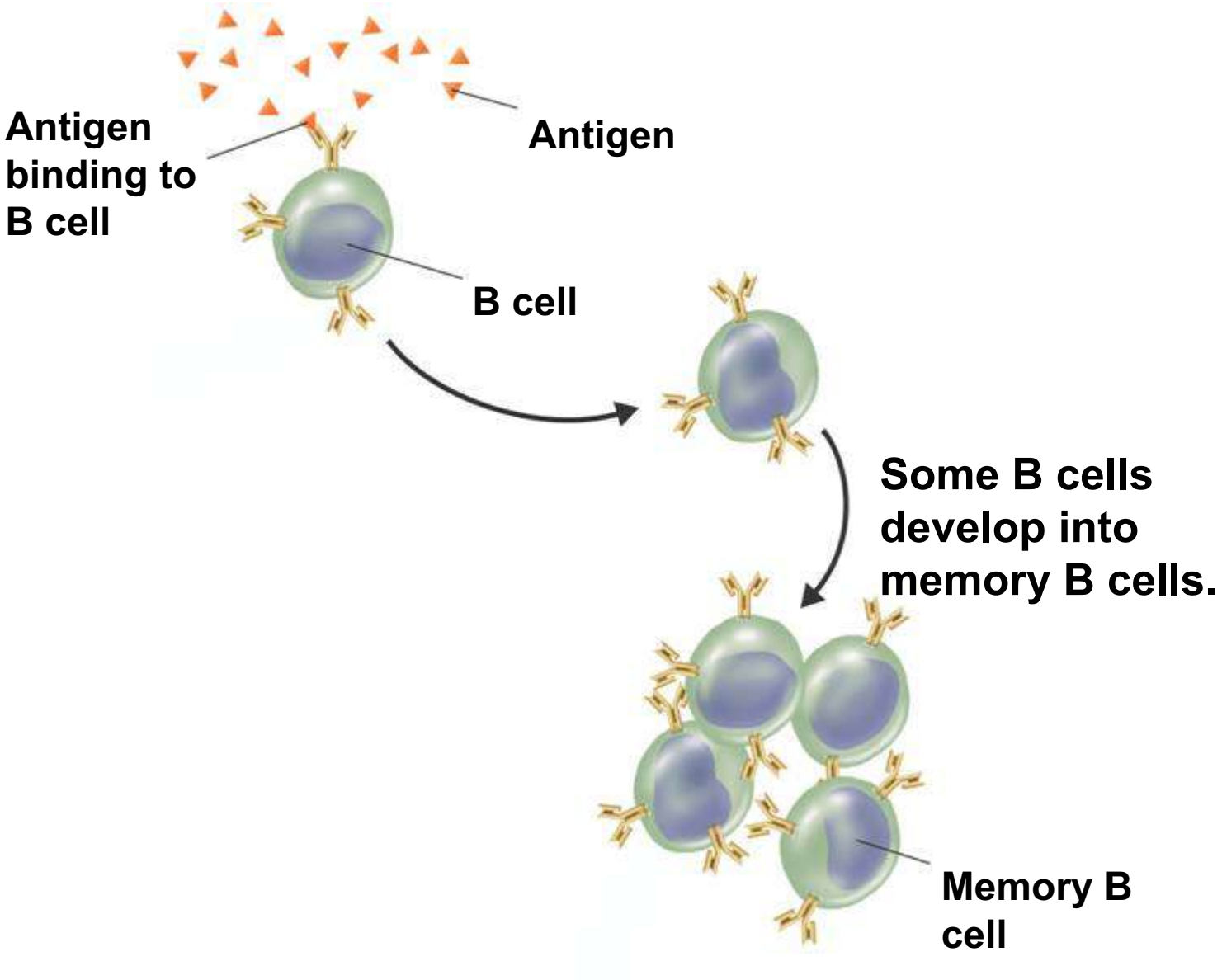


Specific Defenses

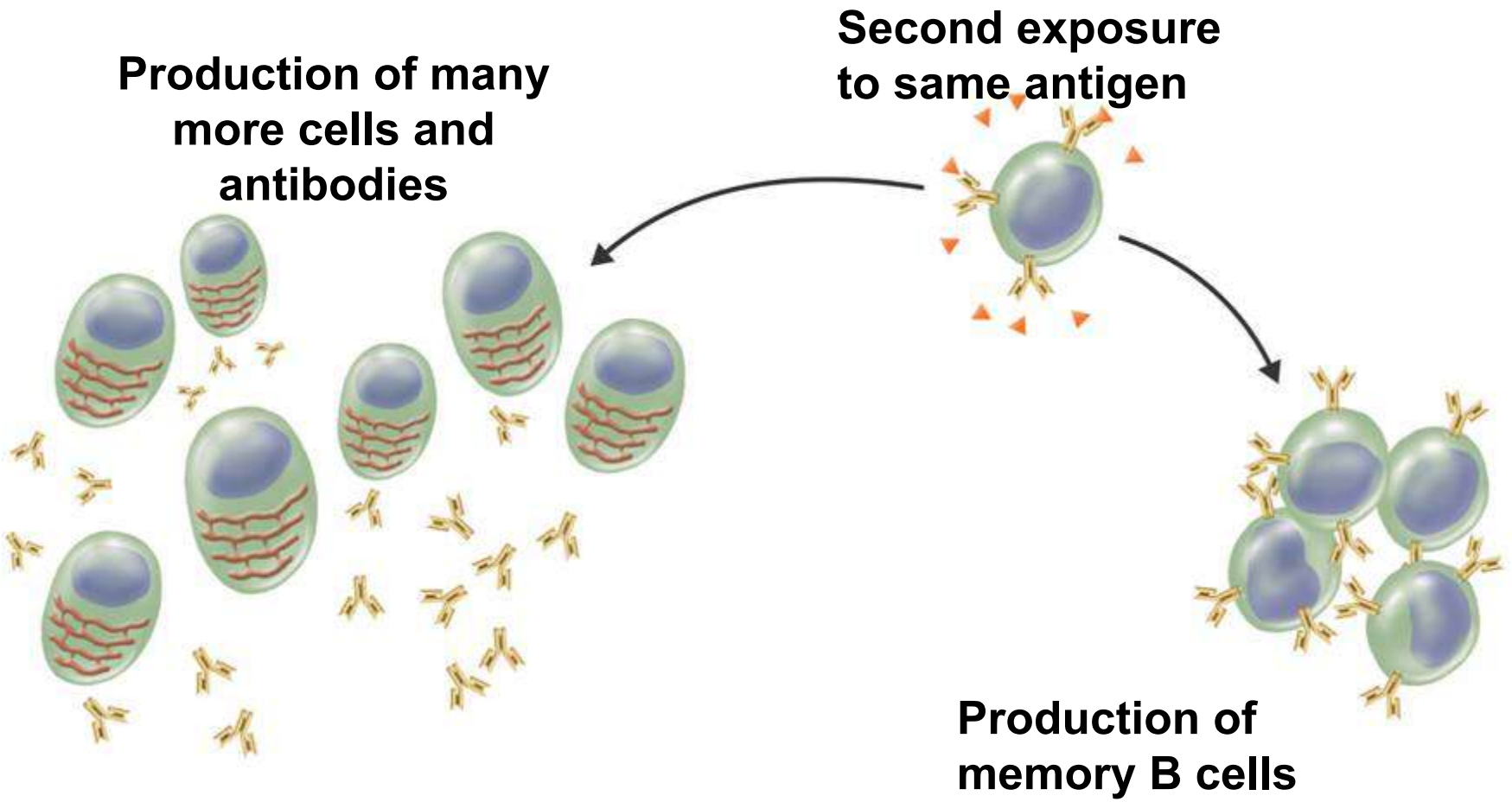
Some B cells develop into plasma cells. Plasma cells produce antibodies that are released into the bloodstream.



Specific Defenses



Specific Defenses



Specific Defenses

– Cell-Mediated Immunity

Cell-mediated immunity is the response against abnormal cells and pathogens.

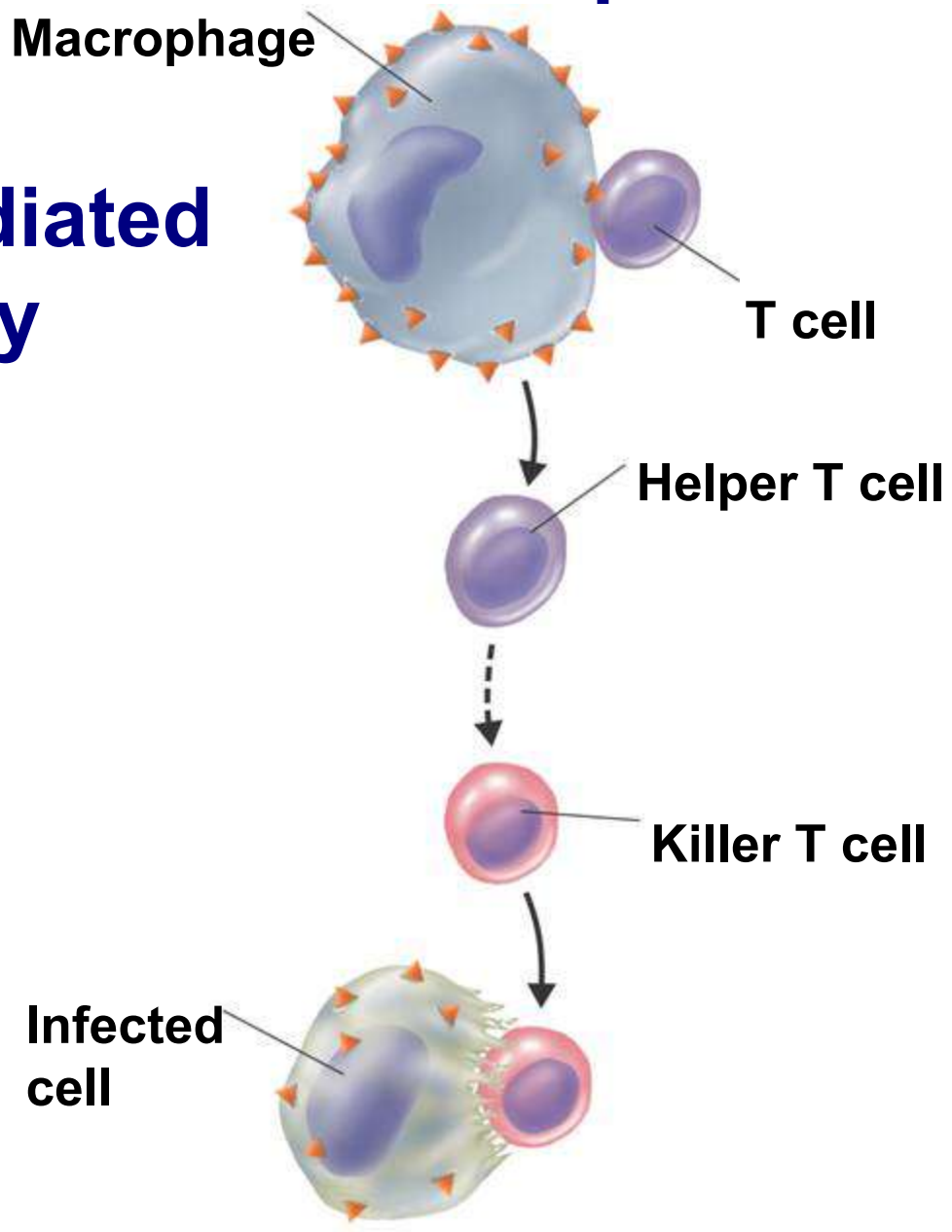
When viruses or other pathogens get inside living cells, antibodies alone cannot destroy them.

In cell-mediated immunity, T cells divide & differentiate into:

- **Killer T cells** destroy foreign tissue containing the antigen.
- **Helper T cells** produce memory T cells.
- **Suppressor T cells** shut down killer T cells when done.
- **Memory T cells** cause secondary response.

Specific Defenses

Cell-Mediated Immunity



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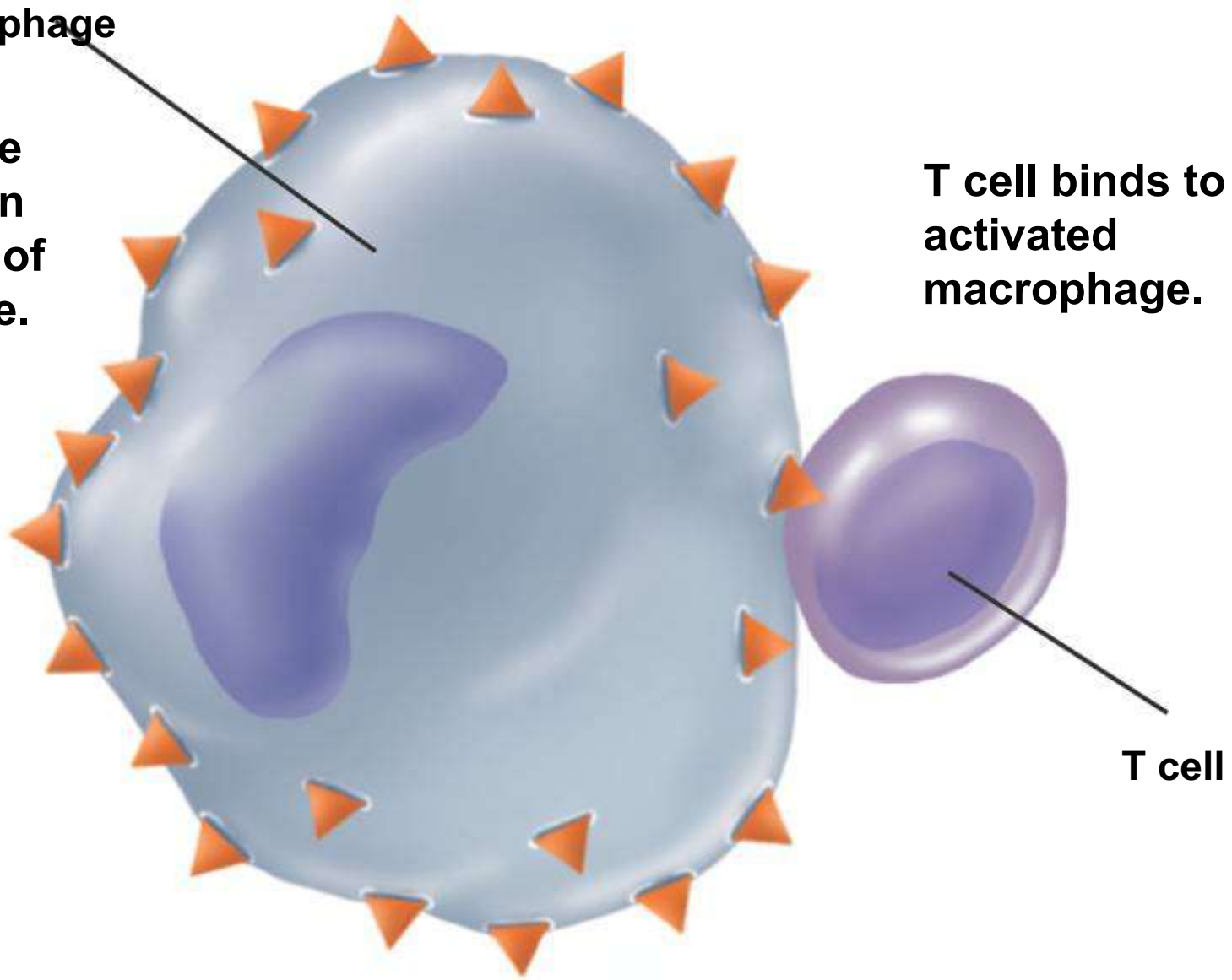
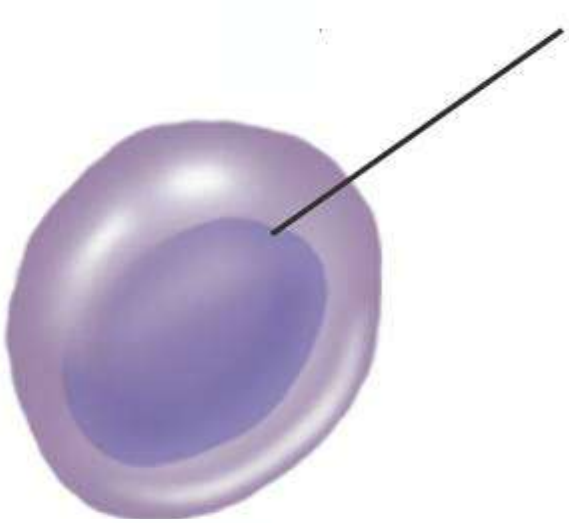
Specific Defenses

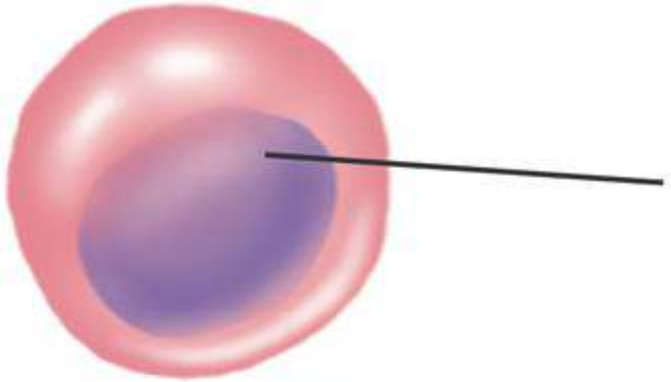


Specific Defenses

T cell, activated by macrophage, becomes a helper T cell.

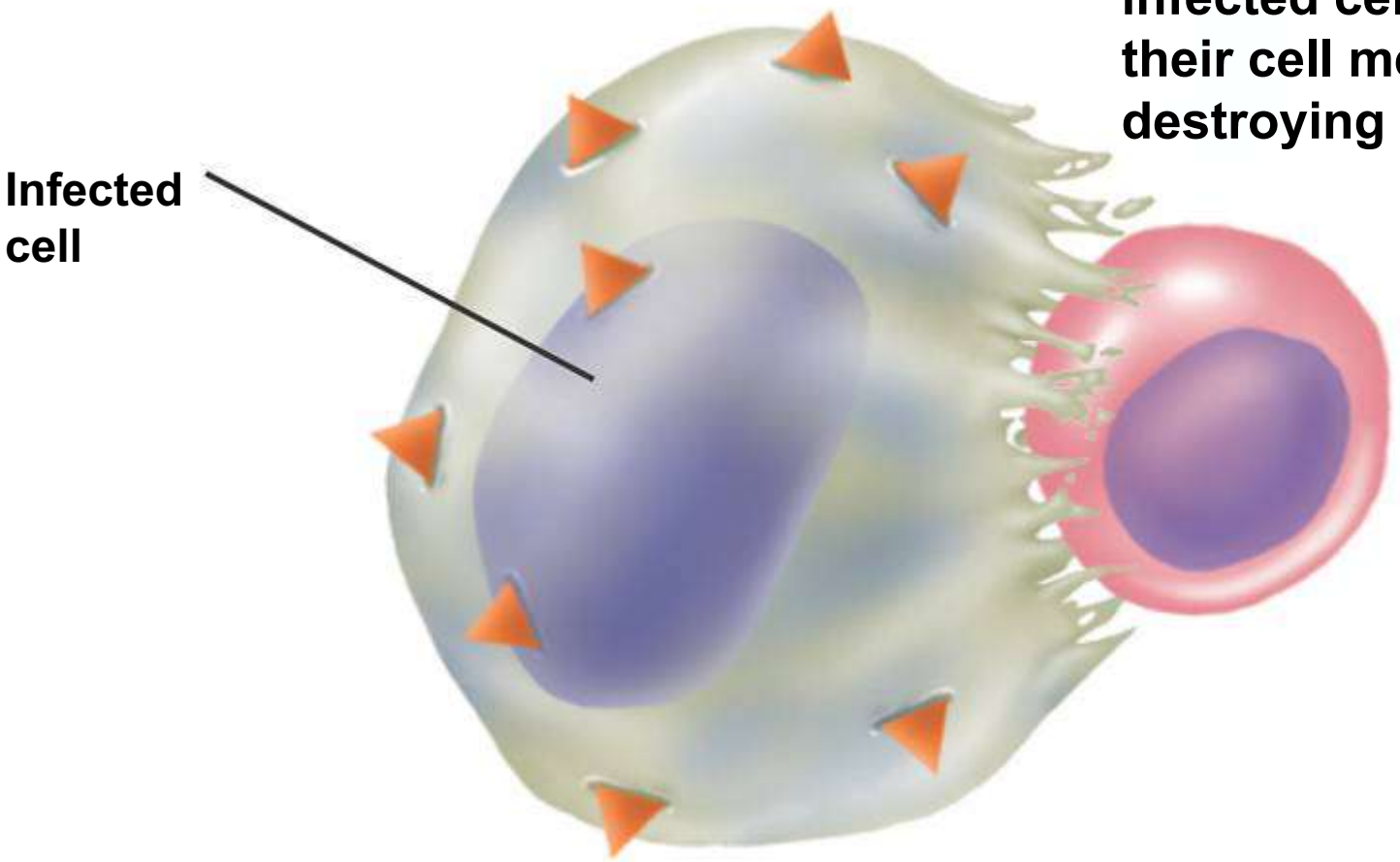


Helper T cell activates killer T cells and B cells



Specific Defenses

Killer T cells bind to infected cells, disrupting their cell membranes and destroying them.



Specific Defenses

– Transplants

Killer T cells make acceptance of organ transplants difficult.

Cells have marker proteins on their surfaces that allow the immune system to recognize them.

The immune system would recognize a transported organ as foreign and attack it. This is known as rejection.

Specific Defenses

To prevent organ rejection, doctors find a donor whose cell markers are nearly identical to cell markers of the recipient. Recipients must take drugs to suppress the cell-mediated immune response.

Acquired Immunity

–Injection of a weakened or mild form of a pathogen to produce immunity is known as a vaccination.

Vaccines stimulate the immune system to create plasma cells ready to produce specific types of antibodies.

Immunity produced by the body's reaction to a vaccine is known as active immunity.

Acquired Immunity

Active immunity may develop:

- **after exposure to an antigen (fighting an infection).**
- **from deliberate exposure to an antigen (vaccine).**

–Today, over 20 serious human diseases can be prevented by vaccination.

Acquired Immunity

–Passive Immunity

The body can also be temporarily protected against disease.

If antibodies produced by other animals are injected into the bloodstream, the antibodies produce a passive immunity.

Passive immunity is temporary because eventually the body destroys the foreign antibodies.

Passive immunity can develop naturally or by deliberate exposure.

Natural passive immunity occurs when antibodies produced by the mother are passed to the fetus during development or in early infancy through breast milk.

Passive immunity also occurs when antibodies are administered to fight infection or prevent disease.

40-3 Immune System Disorders

Ragweed Pollen

Immune Disorders

Although the immune system defends the body against pathogens, sometimes disorders occur in the immune system itself.

There are three different types of immune system disorders:

- allergies
- autoimmune diseases
- immunodeficiency diseases

Allergies

Overreactions of the immune system to antigens are allergies.

Common allergies include pollen, dust, mold, and bee stings.

Antigens that cause allergic reactions are called allergens.

Allergies

When allergy-causing antigens enter the body, they attach themselves to mast cells. Mast cells are specialized immune system cells that initiate the inflammatory response.
The activated mast cells release histamines.

Allergies

Histamines increase the flow of blood and fluids to the area.

Histamines (released in allergic response) increase mucus production in the respiratory system, which induces sneezing, watery eyes, and runny nose.

Antihistamines are drugs that counteract histamines.

Asthma

- Some allergic reactions cause asthma.
- Asthma is a chronic respiratory disease in which the air passages become narrower than normal.
- This causes wheezing, coughing, and difficulty in breathing.
- If not treated, asthma can lead to permanent damage or destruction of lung tissue.

Autoimmune Diseases

–When the immune system attacks the body's own cells, it produces an autoimmune disease.

Examples of autoimmune diseases include:

- **Type I diabetes** attacks insulin-producing cells.
- **Rheumatoid arthritis** attacks connective tissues around joints.
- **Multiple sclerosis** (MS) destroys functions of brain and spinal cord neurons.

Autoimmune Diseases

Some autoimmune diseases are treated with medications that alleviate specific symptoms.

Immunodeficiency Diseases

An immunodeficiency disease is one in which a person has a weakened immune response.

In one type of immunodeficiency disease, the immune system fails to develop normally.

AIDS is an immunodeficiency disease.

AIDS

In 1983, researchers identified the cause of AIDS—a virus that is caused by the HIV for human immunodeficiency virus.

HIV is a retrovirus—a virus that carries its genetic information in RNA, rather than DNA.

AIDS

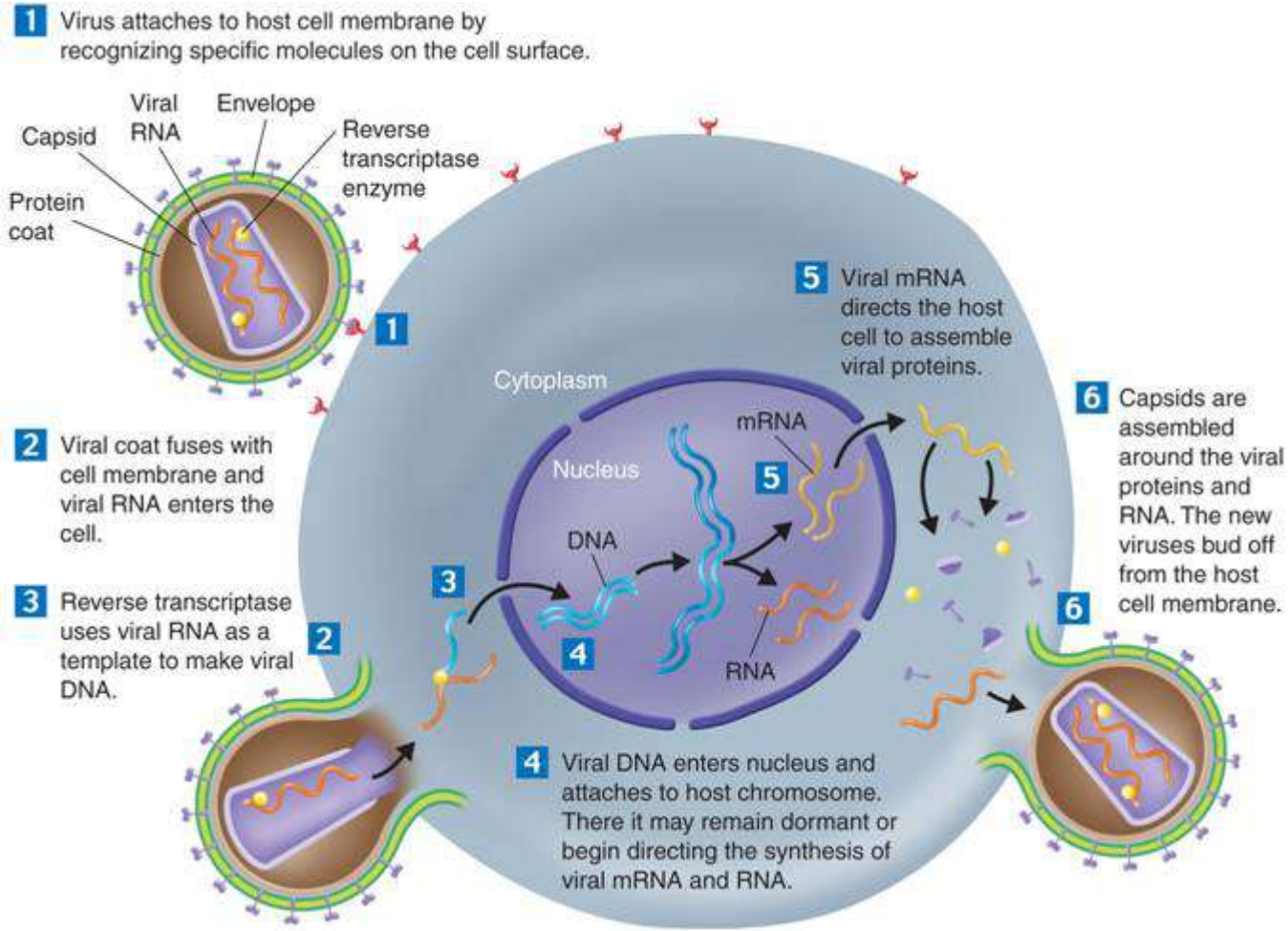
HIV attacks and destroys helper T cells.

As the number of helper T cells decreases, the body becomes more susceptible to other diseases.

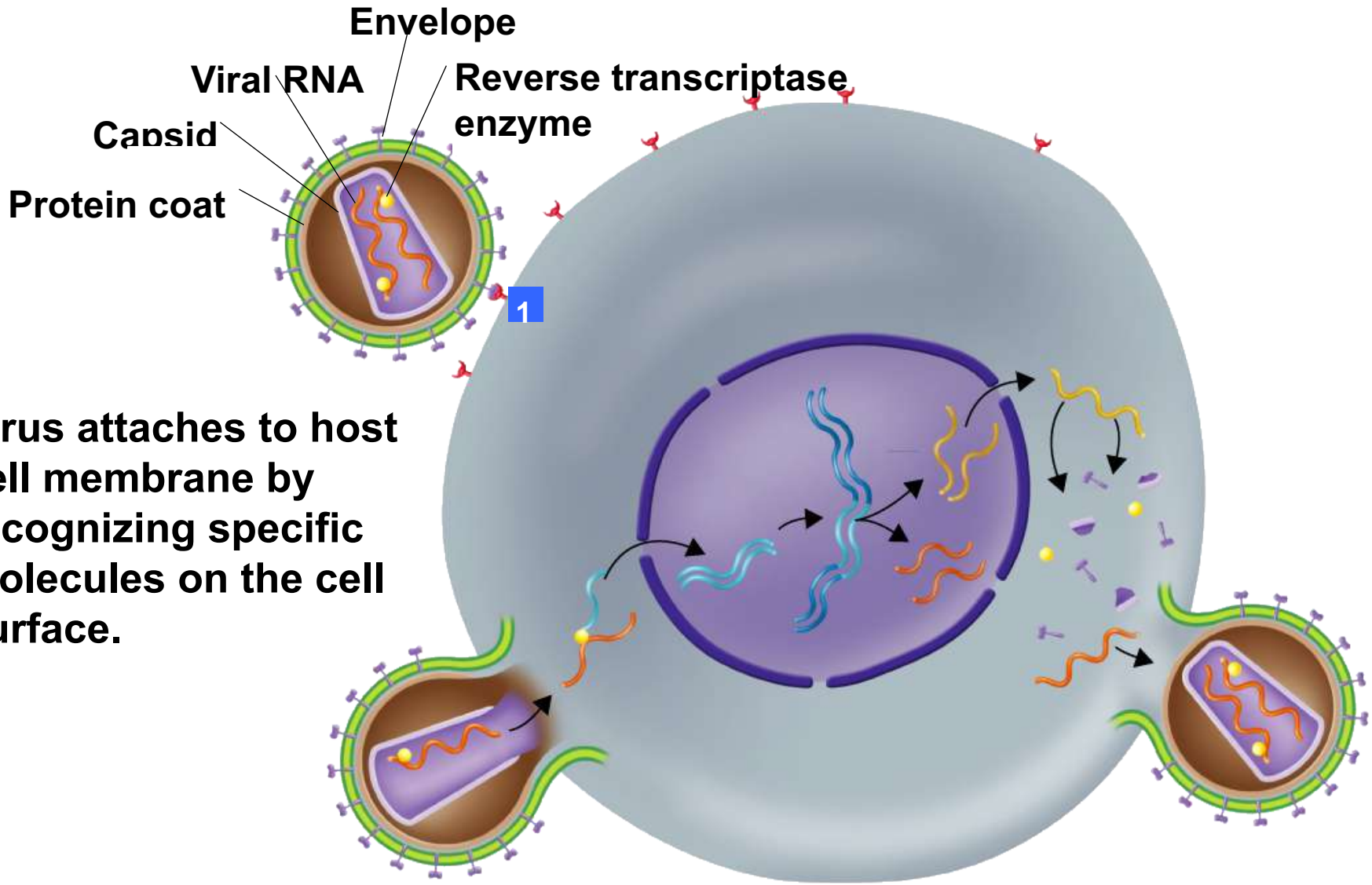
The (often rare) diseases that attack a person with a weakened immune system are called opportunistic diseases.

AIDS

HIV Infection



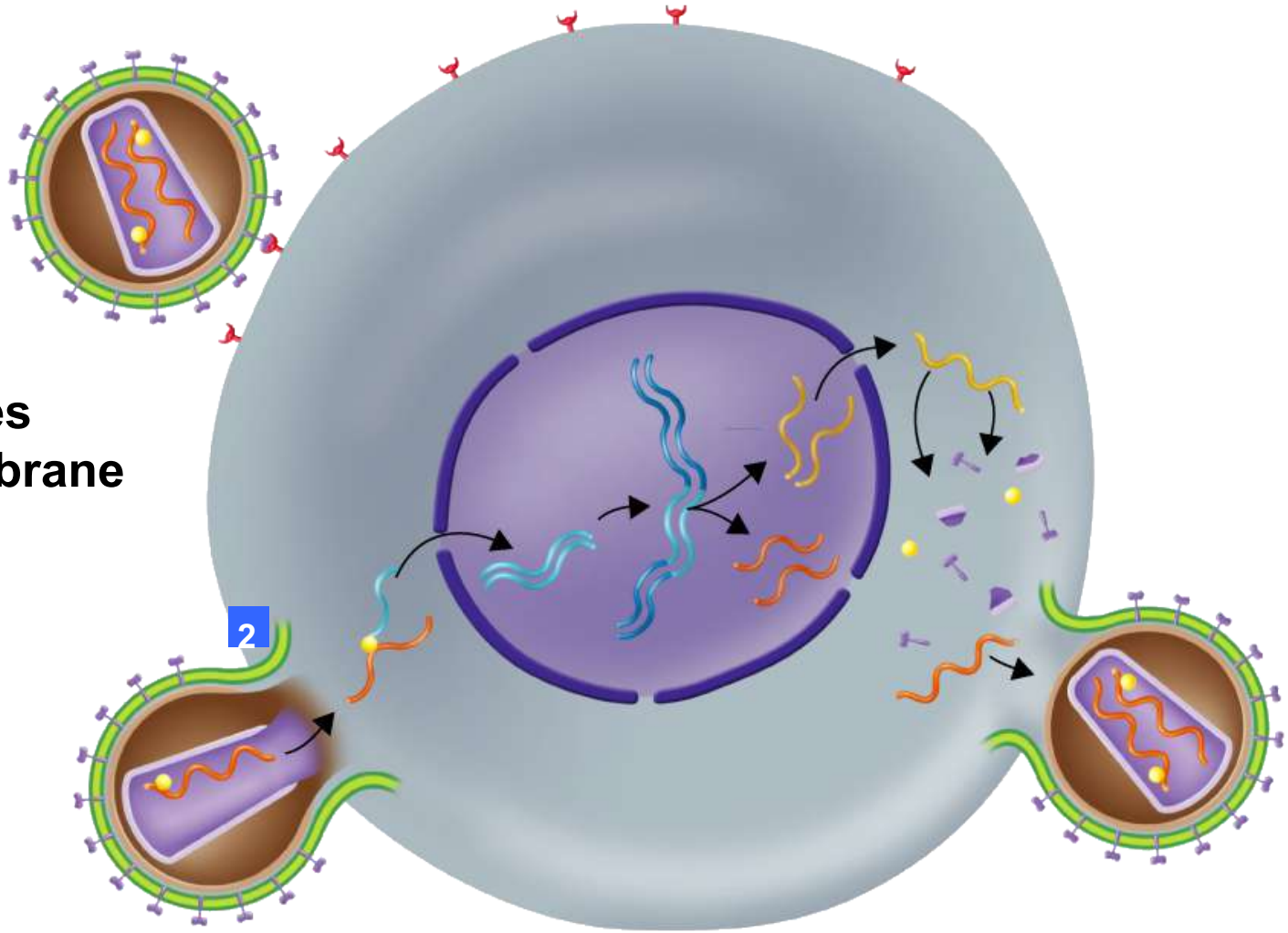
AIDS



1 Virus attaches to host cell membrane by recognizing specific molecules on the cell surface.

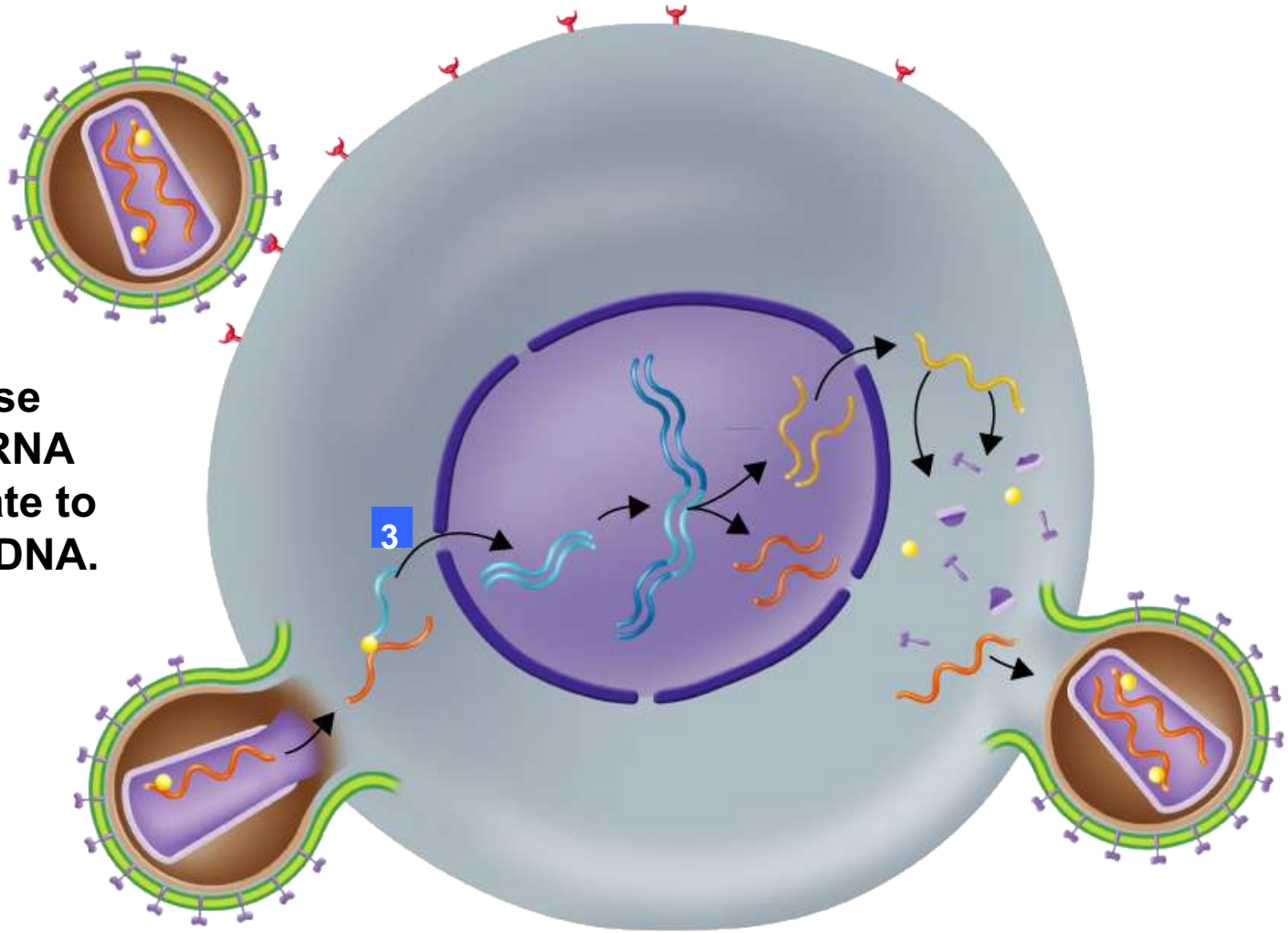
AIDS

2 **Viral coat fuses with cell membrane and viral RNA enters the cell**



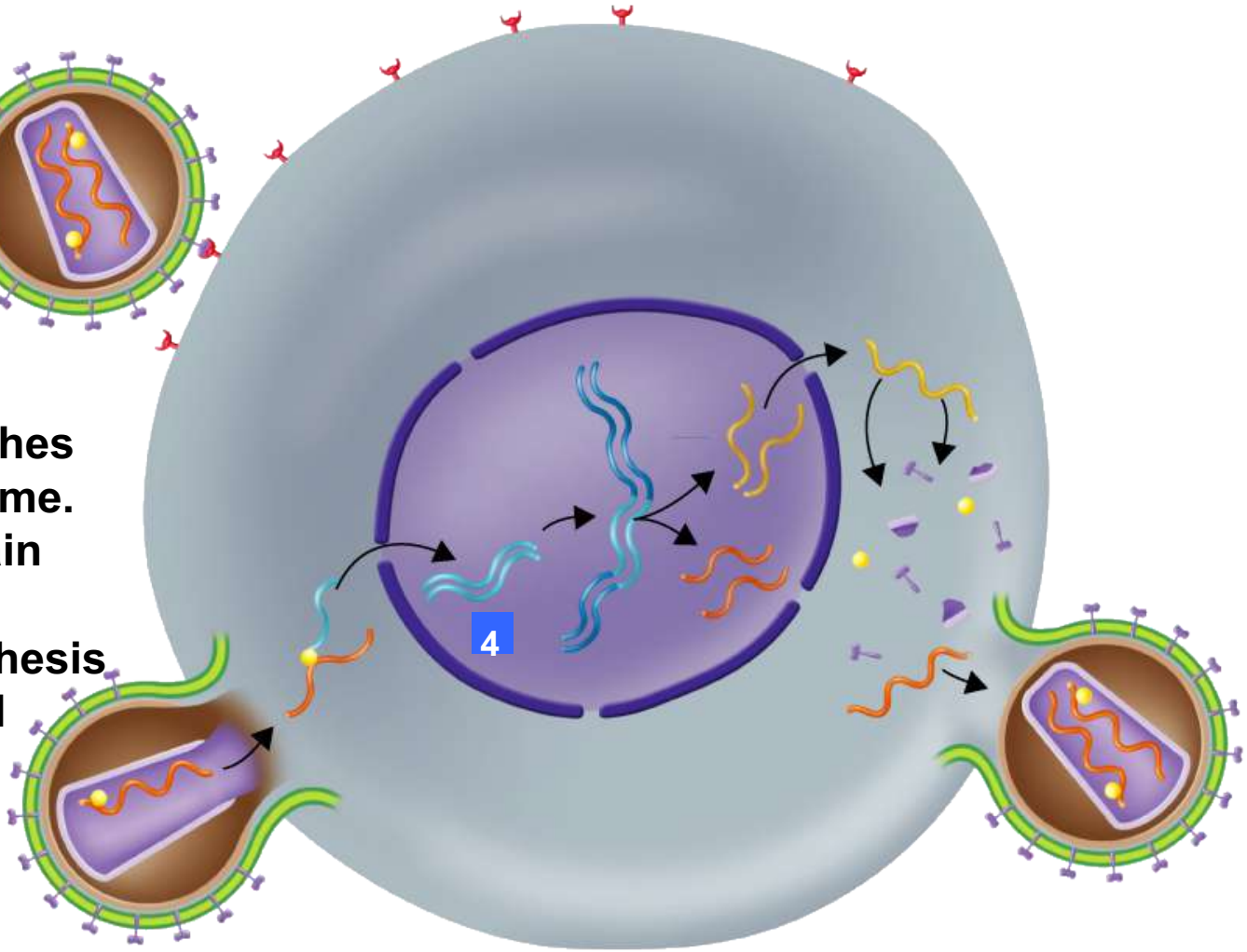
AIDS

3 **Reverse transcriptase uses viral RNA as a template to make viral DNA.**



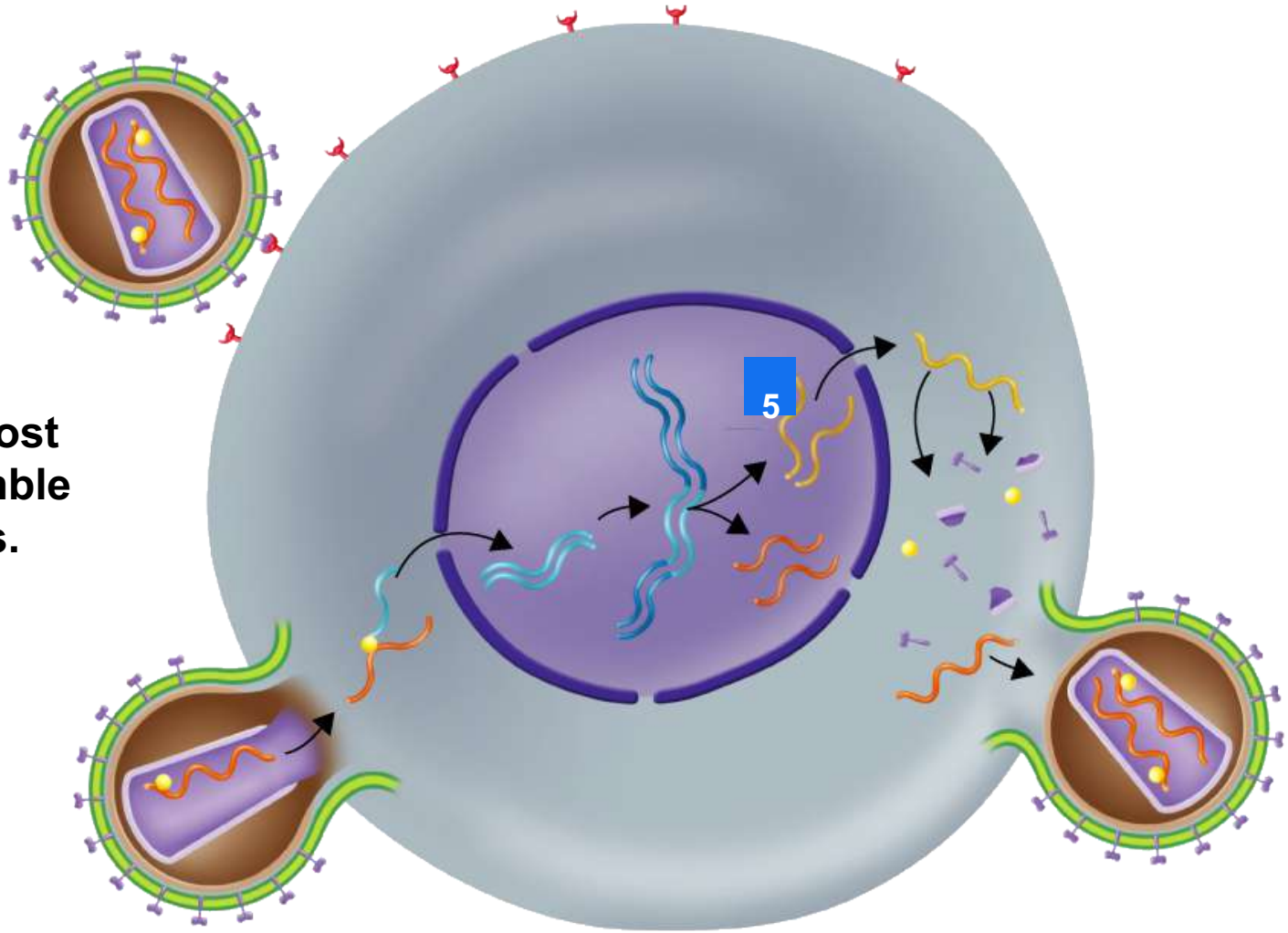
AIDS

4 **Viral DNA enters nucleus and attaches to host chromosome. There it may remain dormant or begin directing the synthesis of viral mRNA and RNA.**



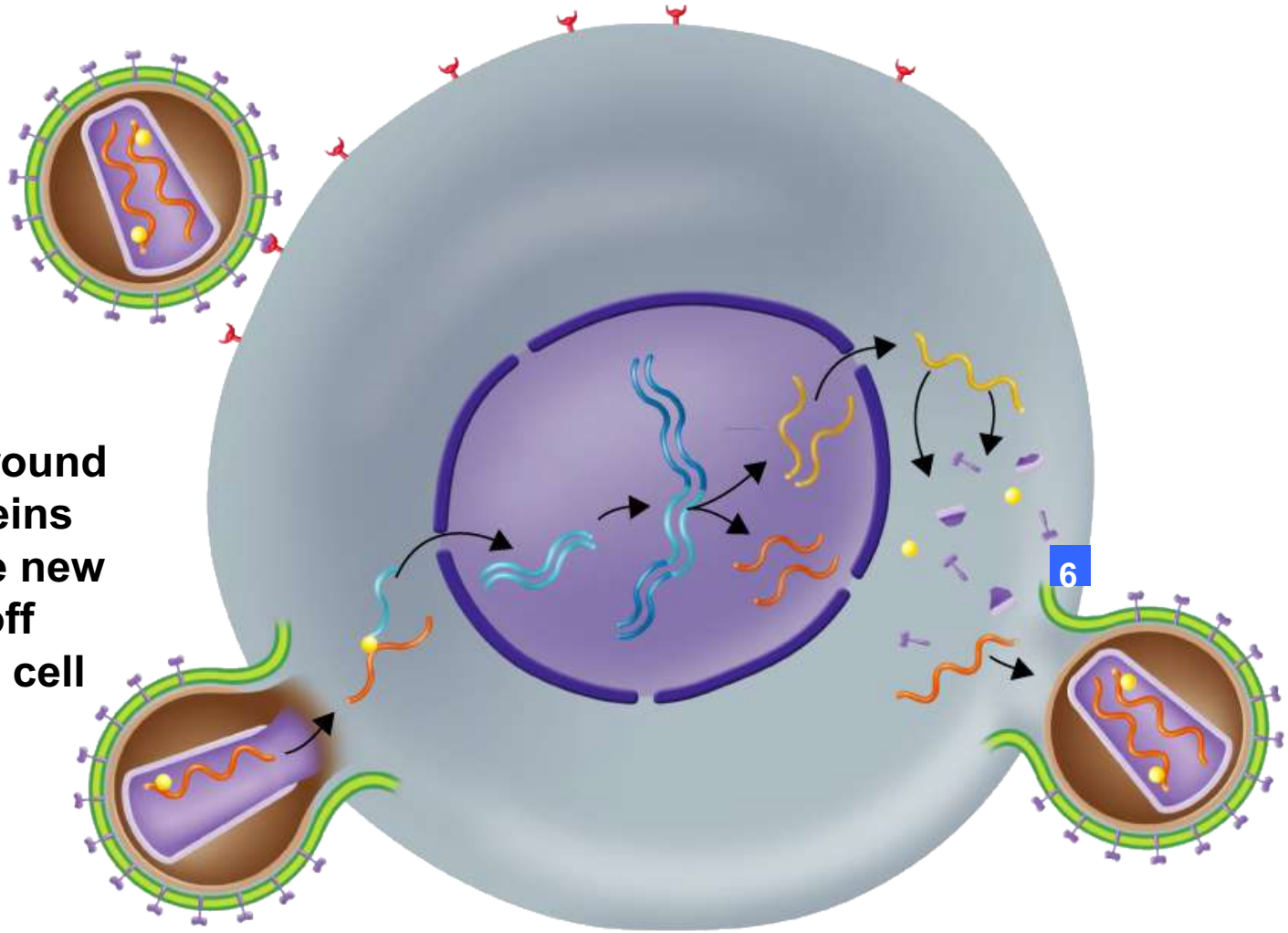
AIDS

5 **Viral mRNA directs the host cell to assemble viral proteins.**



AIDS

6 **Capsids are assembled around the viral proteins and RNA. The new viruses bud off from the host cell membrane.**



AIDS

– Transmission of HIV

HIV is not transmitted through casual contact.

HIV can only be transmitted through the exchange of blood, semen, vaginal secretions, or breast milk.

AIDS

–Preventing HIV Infection

The only no-risk behavior with respect to HIV and AIDS is abstinence.

People who share contaminated needles to inject themselves with drugs are at a high risk for contracting HIV.

People who have sex with drug abusers are also at high risk.

AIDS

–Can AIDS Be Cured?

At present, there is no cure for AIDS.

The virus can be controlled by expensive multidrug and multivitamin “cocktails” that fight the virus.

40-4 The Environment and Your Health

Environmental Risk Factors

A risk factor is anything that increases the chance of disease or injury.
Both heredity and environmental factors can affect your health.

Environmental Risk Factors

–Environmental factors that affect your health include air and water quality, poisonous wastes in landfills, and exposure to solar radiation.

Air Quality

Air quality refers to the number and concentrations of various gases present, as well as the nature and amount of tiny particles suspended in the air.

If the concentration of these impurities gets too high, they can become risk factors for various health problems.

Air Quality

–Carbon Monoxide

Carbon monoxide (CO) is an odorless gas produced when certain compounds are burned.

If you inhale carbon monoxide, it binds to hemoglobin, preventing the hemoglobin from carrying oxygen. As a result, the body does not receive the oxygen it needs.

Overexposure to carbon monoxide can be fatal.

Air Quality

– Ozone

Ozone, a highly reactive form of oxygen, is a gas found in the air.

Ozone is a potential risk factor when it occurs at ground level.

Ozone is produced by vehicle exhaust and factory emissions.

When the air is stagnant, ozone accumulates.

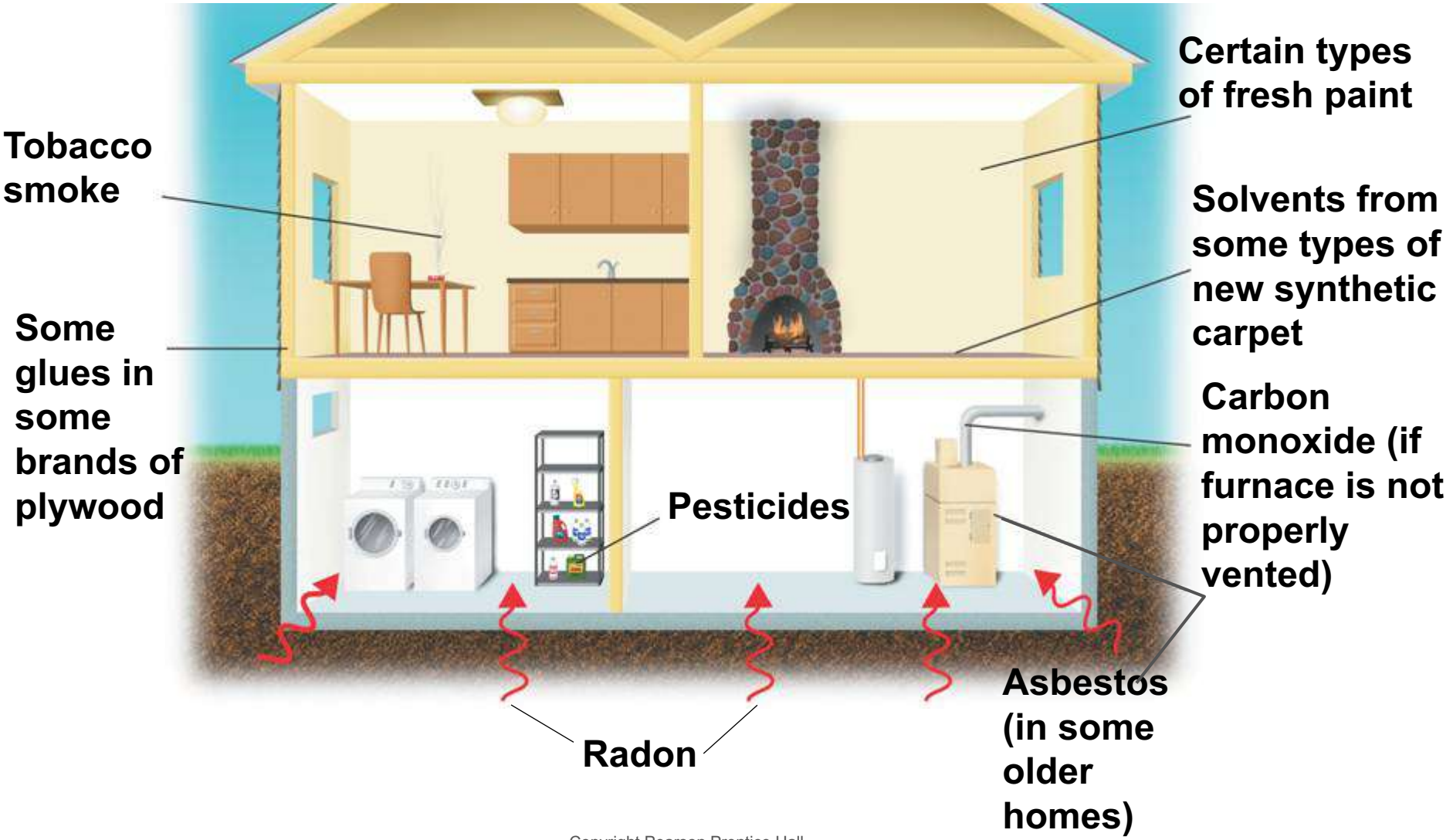
Air Quality

–Airborne Particulates

Tiny dust mites, pollen, mold spores, and animal dander can trigger allergic reactions that can lead to respiratory problems or make existing health problems worse.

Air Quality

Indoor Air Particulates



Air Quality

– Lead

Lead can poison the liver, kidneys, and nervous system.

Lead poisoning in babies and children can result in slow mental development.

Lead poisoning has decreased since lead was taken out of gasoline and paint.

Air Quality

–Asbestos

Asbestos is an airborne particulate, which was commonly used for insulation.

Asbestos fragments into fibers small enough to remain in air for some time.

When inhaled repeatedly, asbestos fibers cause lung cancer.

Water Quality

Biological pollutants in water can contain bacteria or viruses that can cause cramps, vomiting, diarrhea, or diseases such as hepatitis or cholera.

Water Quality

Regulations requiring proper treatment of residential and industrial sewage have significantly decreased bacteria in drinking-water supplies across the nation. This has been an important factor in doubling human life expectancy over the last century.

Bioterrorism

Bioterrorism is the intentional use of biological agents to disable or kill individuals.

It involves the intentional release of infectious agents or the spread of toxic compounds extracted from living organisms.

Other forms involve treating pathogens to maximize their ability to infect and cause disease.

Cancer

Cancer is a life-threatening disease in which cells multiply uncontrollably and destroy healthy tissue.

All cancers are caused by mutations in genes that control cell growth and development.

Cancer

Cancers begin when something goes wrong with normal cell growth and reproduction.
A single cell or a group of cells begins to grow and divide uncontrollably, resulting in the formation of a mass of growing tissue known as a tumor.

Cancer

Tumors are classified as:

benign, or noncancerous, which do not spread.

malignant, or cancerous, which invade and destroy surrounding healthy tissue.

Cancer

As the cancer cells spread, they absorb the nutrients needed by other cells, block nerve connections, and prevent organs they invade from functioning properly.

–Cancers are caused by defects in the genes that regulate cell growth and division.

–Cancer can be:

- **inherited.**
- **caused by viruses.**
- **caused by spontaneous DNA mutations.**
- **caused by DNA mutations produced by chemicals or radiation.**

Chemical compounds that are known to

Cancer

– Treating Cancer

Prevention is the best defense.

Reduce the risk of developing lung cancer by not smoking.

Regular exercise and a balanced diet helps lower cancer risk.

Cancer

If cancer is detected early, chances of treating it successfully may be as high as 90%.

- **Regular checkups and tests are a preventive measure.**
- **Self-examinations for skin, breast, or testicular cancer are also helpful.**

3 –Animals that carry disease from one person to another are called

- toxins.
- vectors.
- pathogens.
- parasites.

A

5

–Antibiotics kill

A

- bacteria only.
- viruses only.
- both bacteria and viruses.
- both bacteria and protists.

1

–A fever is an example of the body's

A

- nonspecific defenses.
- specific defenses.
- active immunity.
- humoral immunity.

2 –The most important nonspecific defense your body has against disease is

- inflammation.
- cilia and mucus in the nose and throat.
- the skin.
- saliva.

A

3 –During pregnancy, a mother can pass antibodies onto her developing baby, producing

- active immunity.
- passive immunity.

A • immunodeficiency.

- cell-mediated immunity.

4 –Injection of a weakened or mild form of a pathogen to produce immunity is known as a(an)

- antibody.
- vaccination.

A • antigen.

- antibiotic.

5 –The kind of white blood cells involved in cell-mediated immunity are called

A
- killer T cells.
- B cells.
- phagocytes.
- platelets.

1

–Allergies result when antigens from allergens bind to

- histamines.
- pathogens.
- mast cells.
- T cells.

A

2

–An example of an autoimmune disease is

- polio.
- multiple sclerosis.

A

- asthma.
- smallpox.

3

–In Type I diabetes, antibodies attack

- connective tissues around the joints.
- neuromuscular junctions.
- insulin-producing cells in the pancreas.
- epinephrine-producing cells in the adrenal cortex.

A

4

–The retrovirus HIV causes

A

- AIDS.
- myasthenia gravis.
- asthma.
- polio.

5 –The principle targets of the HIV virus are the body's

- red blood cells.
- helper T cells.

A • connective tissue in the joints.

- B cells.

1 –Chemical compounds known to cause cancer are called

- mutations.
- carcinogens.

A • malignancies.

- tumors.

2

–A material found in automobile exhaust that can be fatal in cases of overexposure is

- carbon dioxide.
- carbon tetrachloride.
- carbon monoxide.
- carbon disulfide.

A

3

–The most important factor in doubling the human life span in the last century has probably been

- clearing the air of chemical carcinogens.
- improvements in medical care.
- increased food production.
- providing safe drinking water.

A

4

–A life-threatening disease in which cells multiply uncontrollably and destroy healthy tissue is

- HIV.
- AIDS.
- cancer.
- diabetes.

A

5

–The best way to fight cancer is

A

- to avoid unnecessary exposure to carcinogens.
- surgical removal of tumors.
- radiation to destroy tumors.
- chemotherapy to kill cancer cells.

END OF SECTION