The Immune System

Ch 40

Macrophage engulfing a parasite

40-1

- Disease-any change, besides injury, that interferes with normal body functions
- Caused by inheritance, environmental factors or infectious agents (pathogens-bacteria, viruses, fungi, parasites)

40-1 Germ Theory of Disease

- Louis Pasteur and Robert Koch
- Infectious diseases are caused by microorganisms (germs)

40-1 Koch's Postulates

- 1. Pathogen should be found in sick organism and not in a healthy one
- 2. The pathogen should be isolated and grown in pure culture
- 3. When pure pathogen is placed in a new host it gets the same disease as the original host
- 4. The injected pathogen should be reisolated and should be identical to the original

40-1 Agents of Disease

- Humans are good hosts for many microorganisms-water, good temp, nutrients
- Most are harmless
- Pathogens cause disease
- Produce toxins that disrupt cell function, live in and feed off of infected organism, remove nutrients from digestive system, use host cells to replicate itself
- Fig 40-3

40-1 Pathogens and Disease

Type of pathogen	Description	Human diseases caused by pathogens of that type
Bacteria *Escherichia coli* 	Single-celled organisms without a nucleus	Strep throat, staph infections, tuberculosis, food poisoning, tetanus, pneumonia, syphilis
Viruses *Herpes simplex* 	Thread-like particles that reproduce by taking over living cells	Common cold, flu, genital herpes, cold sores, measles, AIDS, genital warts, chiken pox, small pox
Fungi *Death cap mushroom* 	Simple organisms, including mushrooms and yeasts, that grow as single cells or thread like filaments	Ringworm, athlete's foot, tinea, candidiasis, histoplasmosis, mushroom poisoning
Protozoa *Giardia lamblia* 	Single-celled organism with a nucleus	Malaria, "traveler's diarrhea" giardiasis, trypanosomiasis ("sleeping sickness")

40-1 How Diseases Are Spread

- Person to person through coughing, sneezing, physical contact
- Contaminated food and water
- Infected animals

40-1 How Diseases Are Spread

- Vectors-when animals spread a disease from person to person
- Tick, human, mosquito

40-1 Fighting Diseases

- Prevention
- Antibiotics
  - Penicillin-inhibits cell wall synthesis
  - Streptomycin-inhibits protein synthesis
  - Antivirals, antiretrovirals-stop virus from getting into cells or replicating
- Antifungals-various mechanisms
  - Fungi are eukaryotic like humans so drugs must target some difference between fungus and humans
  - Harder to find good treatments without side effects

40-2 The Immune System

- Nonspecific Defenses-like fortress walls
- First Line of Defense
  - Skin-oil and sweat acidic
  - Mucous, cilia in mouth and nose
  - Acid and digestive enzymes in digestive system
  - Tears, saliva, mucous, sweat contain lysozyme (enzyme that breaks down cell walls of bacteria)

40-2 Nonspecific Defenses

- Second Line of Defense-Inflammatory response
- Response to toxins in tissue, or tissue damage caused by injury and infection
- Blood vessels near injury expand and white blood cells leak out
- Phagocytes engulf and destroy bacteria
- Causes swelling and pain
- Some immune cells also release chemicals that cause fever
  - Kills pathogens and speeds up enzyme activitythat repair damaged tissue

40-2 Nonspecific Defenses

- Interferon-proteins that virus-infected cells produce that helps other cells resist infection
- Inhibits production of viral proteins and block viral replication

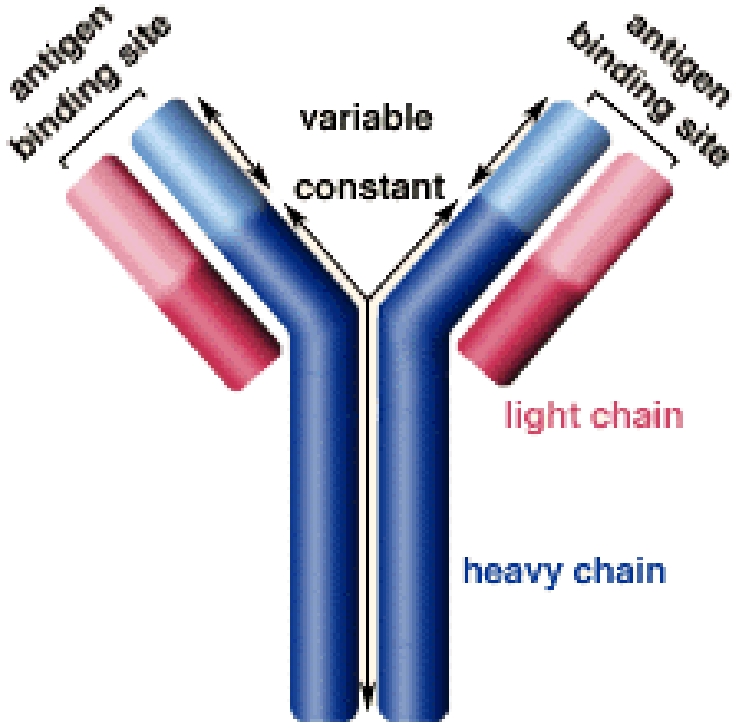
40-2 Specific Defenses

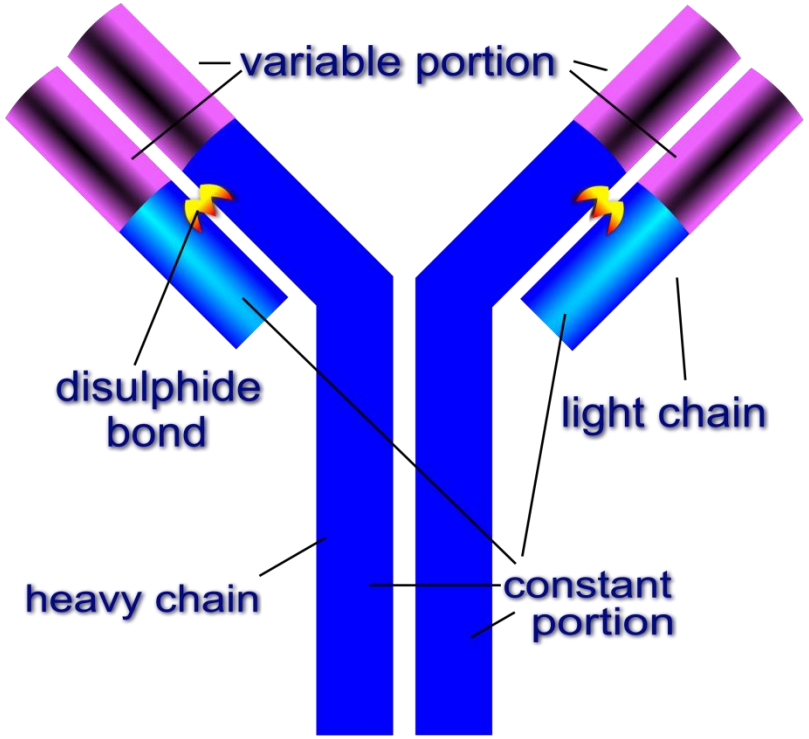
- Specific Defenses-like security guards
- Immune response triggered by antigen
- Humoral and Cell-mediated

40-2 Specific Defenses

- Humoral Immunity-immunity against pathogens in blood and lymph fluids
- Functional unit is antibody
- Produced by B-lymphocytes
- Antibodies are proteins that help destroy pathogens
- Antibodies bind viruses and bacteria and clump them together so phagocytes can engulf and destroy them

40-2 Antibodies





40-2 Specific Defenses

- Antibody production
- In B-lymphocytes genes rearrange to give different amino acid sequences in the variable antigen binding region so they make antibodies that recognize different antigens
- When a pathogen invades the body only certain antibodies recognize it
- This activates the B-plasma cells that produced those antibodies to divide and make more of those antibodies
- Activation of B plasma cells is helped by T-lymphocytes/cells

40-2 Humoral Immunity

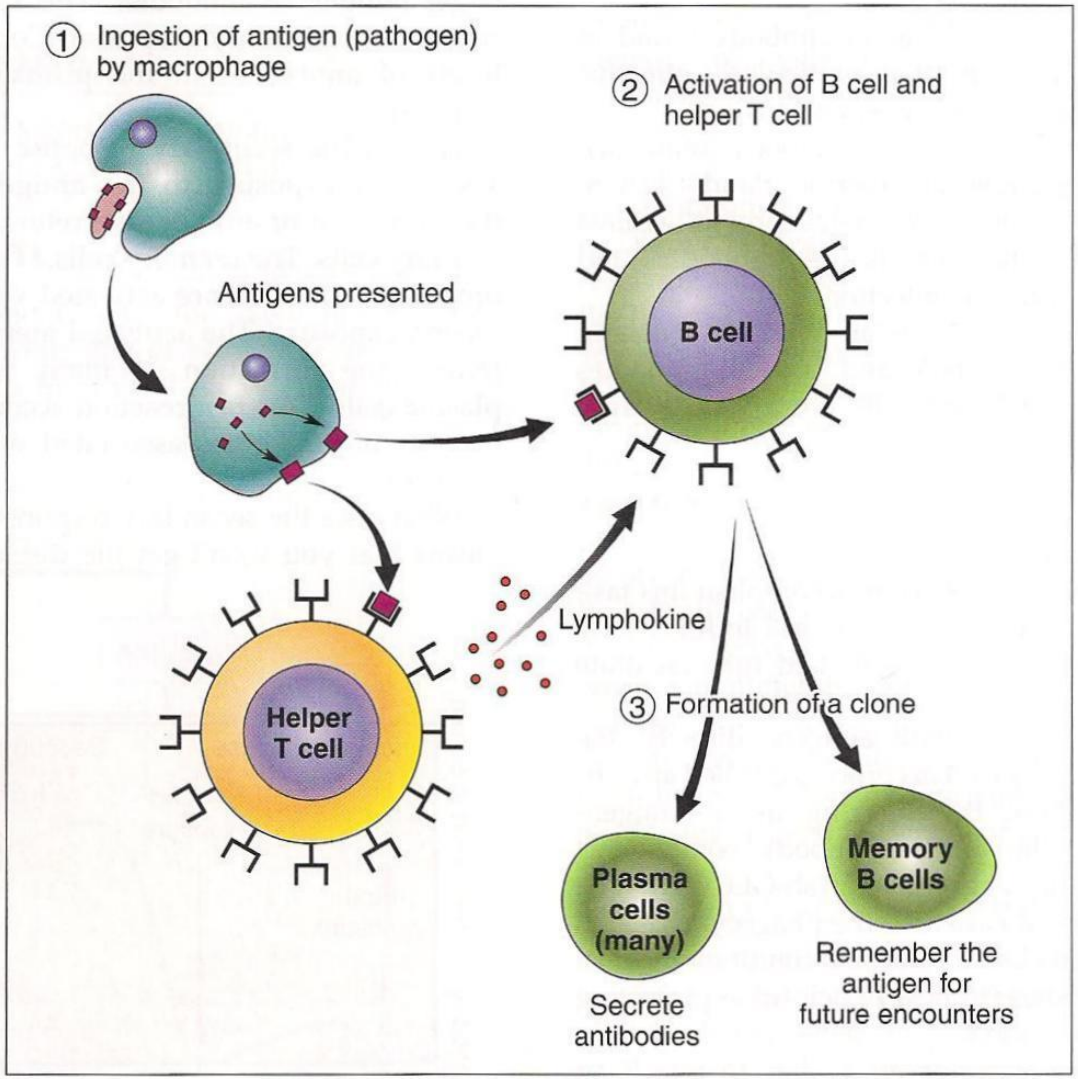
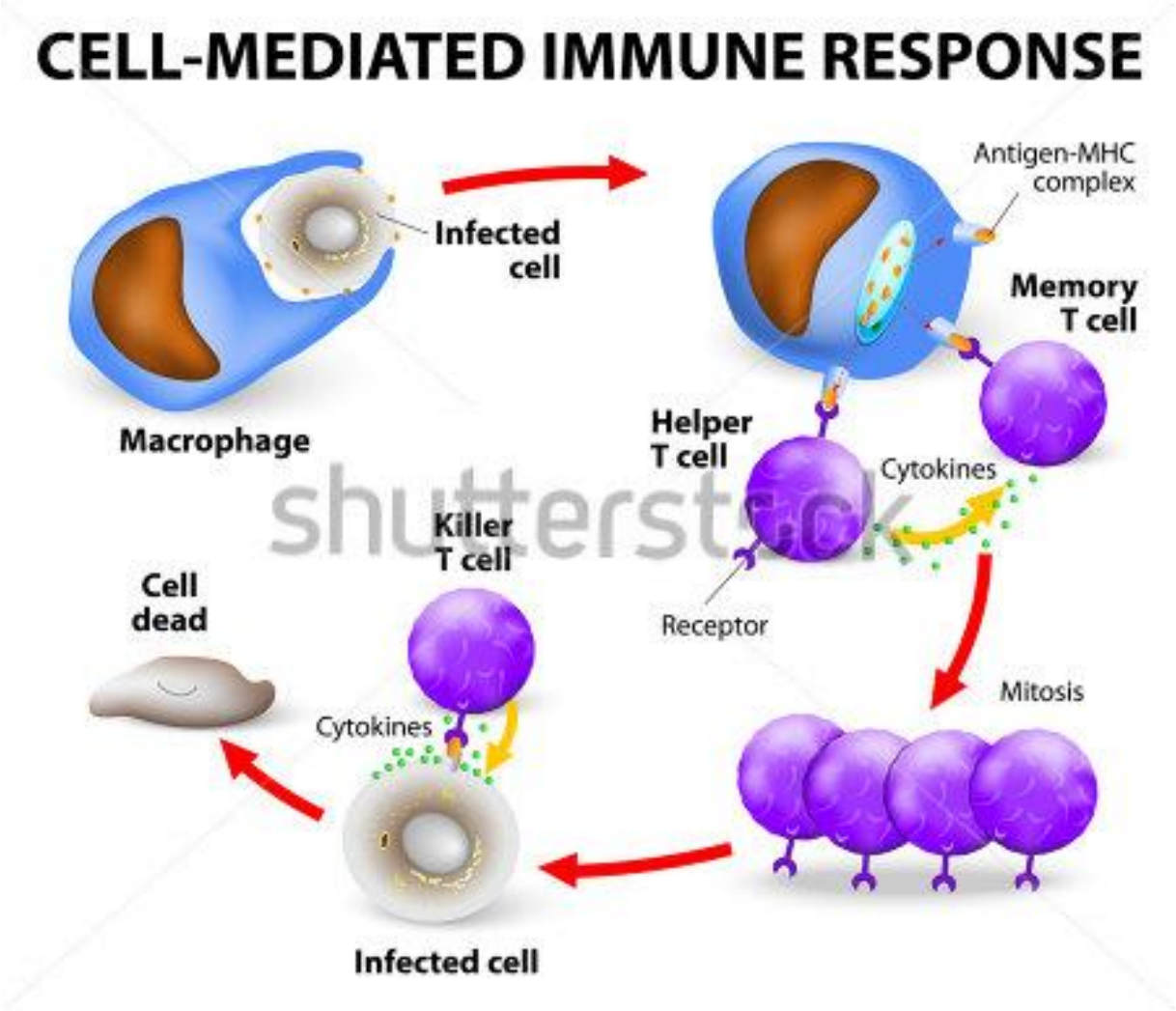


FIGURE 21-4 Antibody-mediated immunity.

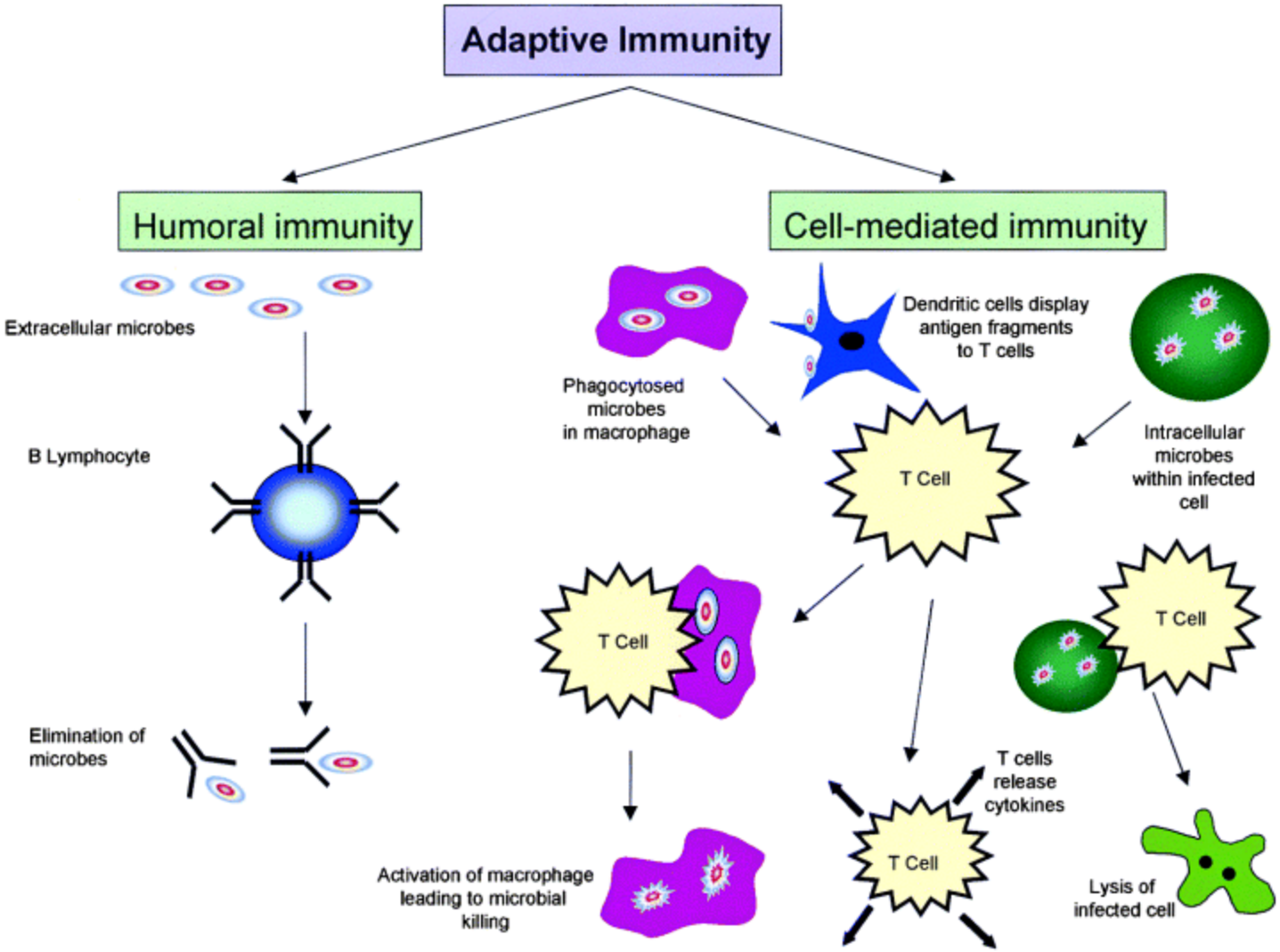
40-2 Cell Mediated Immunity

- T-cells help B-cells produce antibodies but can also attack antigen bearing cells directly
- Killer or cytotoxic T cells can inject proteins into cell membrane of pathogen which causes fluid to leak out then cells die
- Cell-mediated immunity
- Causes organ rejection; anti-rejection drugs target this process

40-2 Cell Mediated Immunity



40-2 Adaptive Immunity



40-2 Permanent Immunity

- Memory B and T cells remain capable of producing antibodies to a pathogen long after first exposure

40-2 Active Immunity

- Vaccination-injection of weakened or inactivated form of a pathogen to produce immunity
- Active immunity-body of recipient has the ability to mount an immediate immune response against the pathogen

40-2 Passive Immunity

- Antibodies from another animal for a pathogen are injected
- Gives short term immunity
- Travelers
- Maternal immunity through antibodies in milk or through placenta

40-3 Immune System Disorders

- Allergies-overreaction to antigen
- Antigens bind to mast cells in nasal passages
- Activated mast cells produce histamines
- Histamines increase blood and fluid flow to area
- Antihistamines counteract

40-3 Immune System Disorders

- Asthma is caused by allergic reaction
- Smooth muscle in airways contract and narrow airways
- Caused by specific antigens
- Drugs relax smooth muscle

40-3 Immune System Disorders

- Autoimmune Disease
- Immune system attacks the body's own cells
- Strep throat can lead to autoimmune attack on cardiac muscle cells
- Diabetes, arthritis, multiple sclerosis

40-3 Immune System Disorders

- AIDS
- Acquired immune deficiency syndrome
- Caused by HIV (human immunodeficiency virus, a retrovirus) that attaches to T-cells and prevents them from activating B cells and fighting infections, eventually kills them
- Susceptible to infections by fungal and protozoan infections, cancer
- Drugs prevent DNA from being made from the virus genetic material, RNA
- Reverse transcription

40-4 Cancer

- Occurs when some molecular event that regulates cell growth goes wrong in the cell
- Growing mass of cell is tumor
- Spread of tumors beyond original tumor is metastasis
- Changes in intercellular or intracellular signaling, transcription, post translational events

40-4 Causes of Cancer

- Viruses-viruses can have genes that affect mitosis of host cells
- Radiation-can mutate or break DNA
- Chemicals-same as radiation
- Mutations-changes genetic code, and therefore protein sequences, which affect normal functions of those proteins

40-4 Fighting Cancer

- Regular checks
- Treatments
- Surgery-for localized tumors
- Radiation-for localized tumors
- Chemotherapy- for localized and metastasized cancer

40-4 Fighting Cancer

- All affect dividing cells
- Cancer cells divide more so are more susceptible to chemotherapy
- All dividing cells are affected therefore side effects
- Now analyzing cancer tissue for markers that indicate specific gene or protein changes and making drugs specific for these cancers so less side effects and more effective