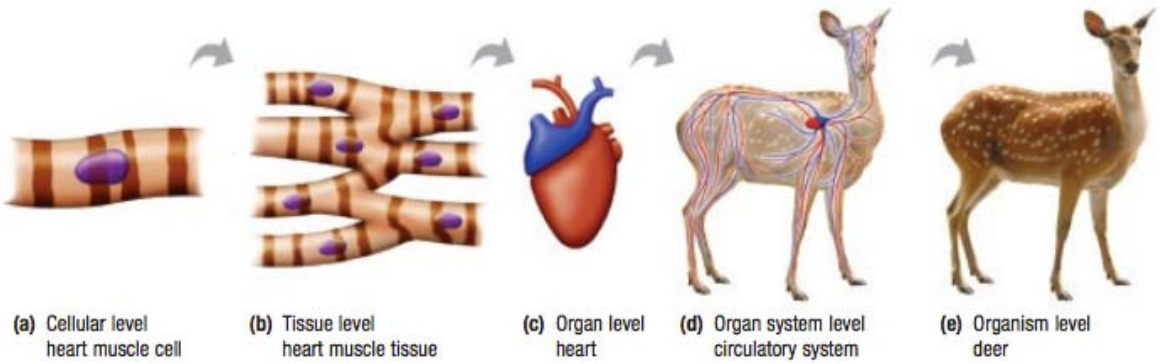
Grade 10 Science

Systems of Living Things

Class 5

Hierarchy of an Organism

Cell → Tissue → Organ → System → Organism



(a) Cellular level heart muscle cell

(b) Tissue level heart muscle tissue

(c) Organ level heart

(d) Organ system level circulatory system

(e) Organism level deer

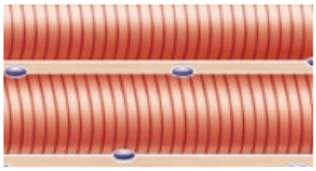
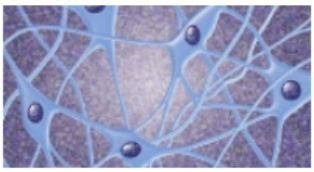
Definitions

- **Cell –** the smallest functioning unit of an organism
- **Tissue –** a group of cells that perform a similar, limited function
- **Organ** – a structure composed of different tissues to perform a complex function
- **Organ System** – a system of one or more organs that work together to perform a vital bodily function

Tissues

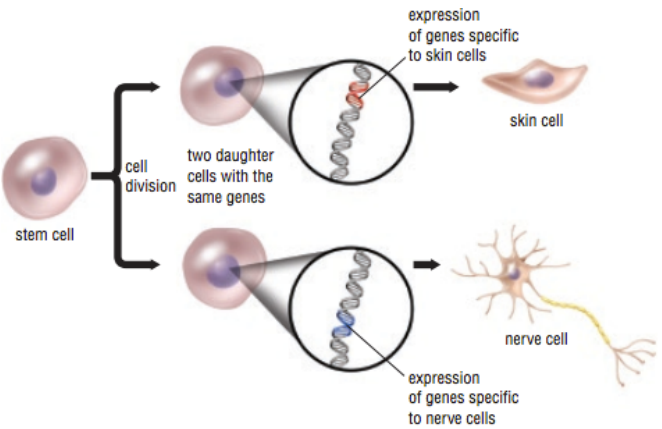
- Animals have 4 major types:
  1. **Epithelial Tissue** – thin sheet that covers body surfaces and lines internal organs
  2. **Connective Tissue** – specialized tissue that provides support and protection
  3. **Muscle Tissue** – specialized tissue containing proteins that can contract and move
  4. **Nerve Tissue** – specialized tissue that conducts electrical signals from one part of the body to another

Table 1 Animal Tissue Types

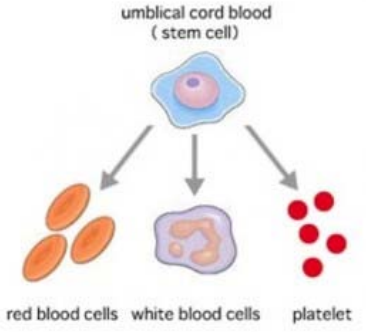
Type	Example	Description	Function
epithelial tissue 	• skin • lining of the digestive system	• thin sheets of tightly packed cells covering surfaces and lining internal organs	• protection from dehydration • low-friction surfaces
connective tissue 	• bone • tendons • blood	• various types of cells and fibres held together by a liquid, a solid, or a gel, known as a matrix	• support • insulation
muscle tissue 	• muscles that make bones move • muscles surrounding the digestive tract • heart	• bundles of long cells called muscle fibres that contain specialized proteins capable of shortening or contracting	• movement
nerve tissue 	• brain • nerves in sensory organs	• long, thin cells with fine branches at the ends capable of conducting electrical impulses	• sensory • communication within the body • coordination of body functions

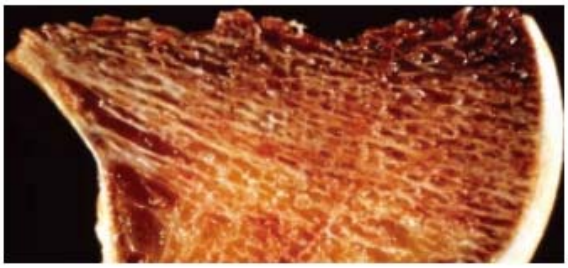
Cellular Differentiation

- The process by which a cell becomes specialized to perform a specific function
- Stem cells – a cell that can divide into many cells; divides into different cells based on which parts of DNA are switched on



- **Embryonic Stem Cell** – can differentiate into any type of cell
- **Tissue Stem Cell** – exist inside specialized tissues and can only divide into specialized cells
  - Stem cells from bone marrow can divide into red blood cells, white blood cells or platelets



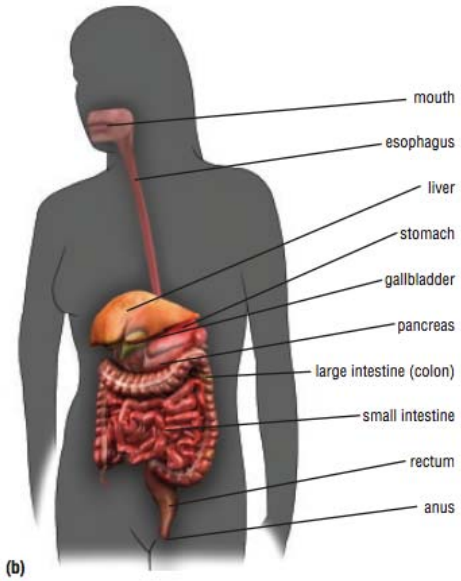


Checkpoint

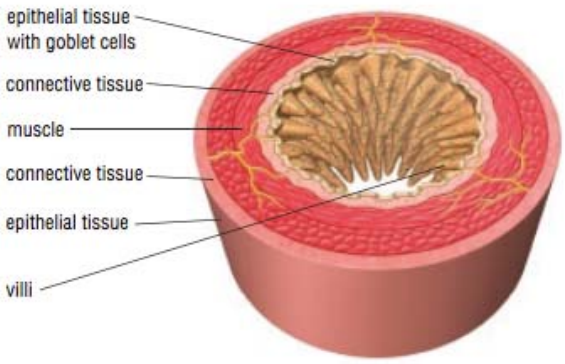
Explain how a person with leukemia can be treated with the umbilical cord stem cells of a sibling.

What are the problems with this procedure?

Digestive System



- The system that takes in, breaks up and digests food then excretes the waste
  - Mouth
  - Esophagus
  - Stomach
  - Small/Large Intestine
  - Accessory Organs

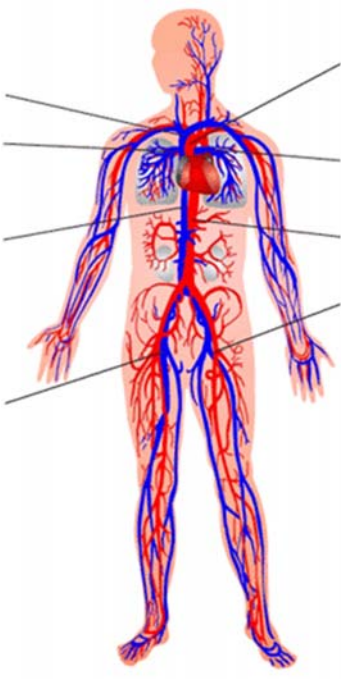


- The digestive tract is lined with epithelial tissue, goblet cells, layers of connective tissue and nerves

- **Mouth** – mechanical breakdown (chewing) and chemical breakdown (saliva)
- **Esophagus** – tube that contracts to push food down (peristalsis)
- **Stomach** – holds food and churns it; lining produces acid and enzymes

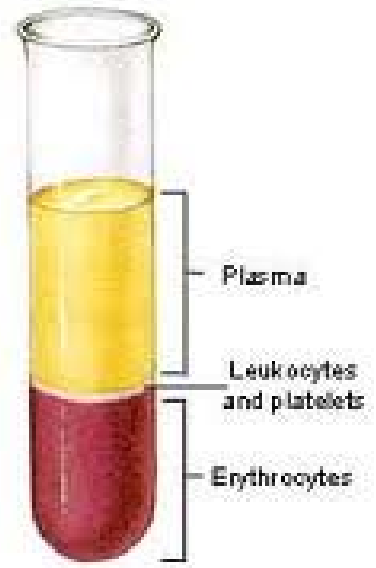
- **Small Intestine** – site of digestion and absorption of nutrients
- **Large Intestine** – site of absorption of water and minerals; probiotic environment
- **Anus** – where feces are excreted
- Accessory Organs
  - **Liver** – produces digestive enzymes and bile; removes toxins
  - **Gall bladder** – stores the bile which breaks down fat
  - **Pancreas** – produces insulin, an enzyme that regulates the concentration of glucose

The Circulatory System



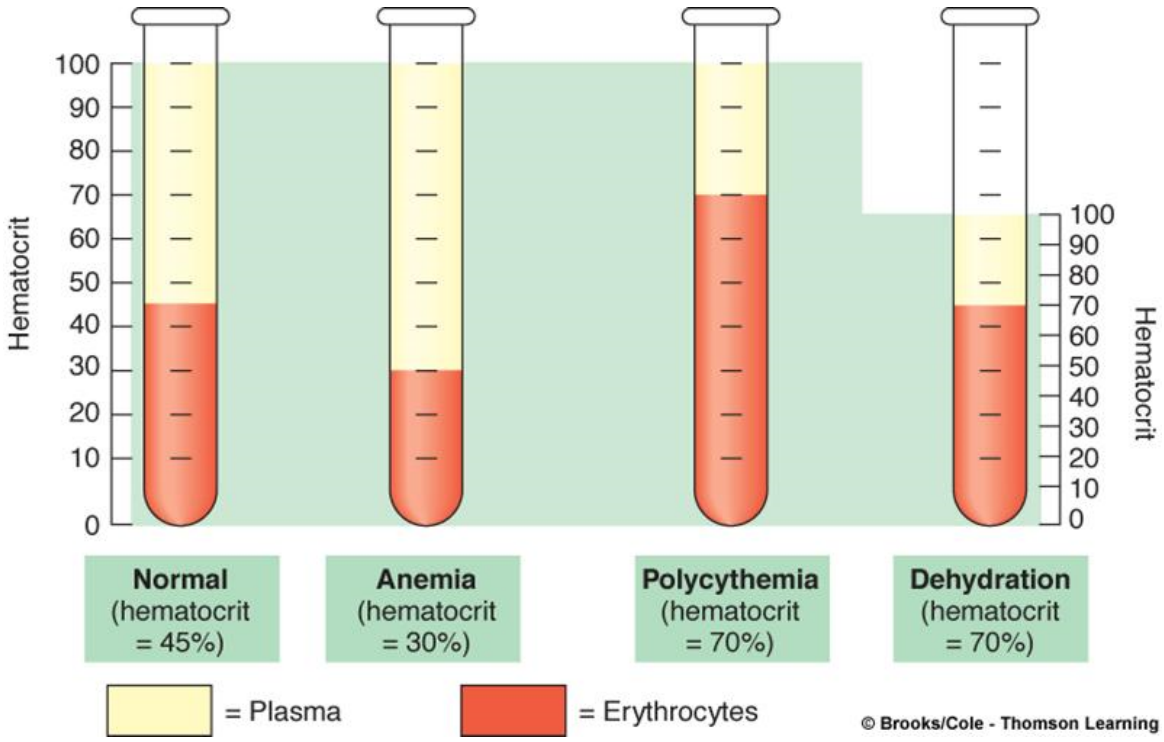
- Functions:
  - Deliver nutrients and gases
  - Regulates body temperature
  - Defense against invading organisms
- Components:
  - Heart
  - Blood
  - Blood Vessels

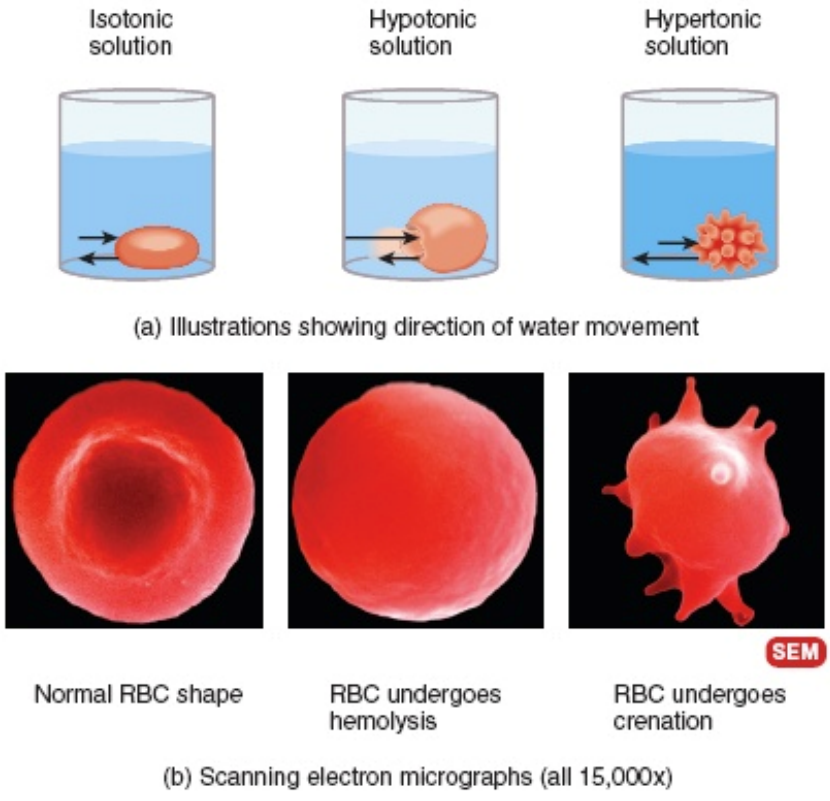
Blood

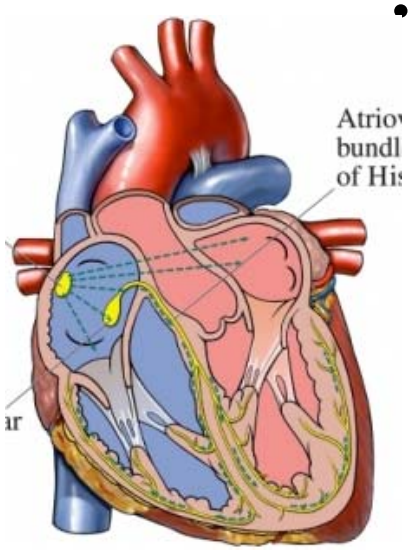


Connective Tissue

- **Red Blood Cells** (Erythrocytes) – contains a protein called hemoglobin that transports oxygen
- **White Blood Cells** (Leukocytes) – recognize and fight invading organisms; immune response
- **Platelets** – helps in blood clotting
- **Plasma** – protein rich liquid

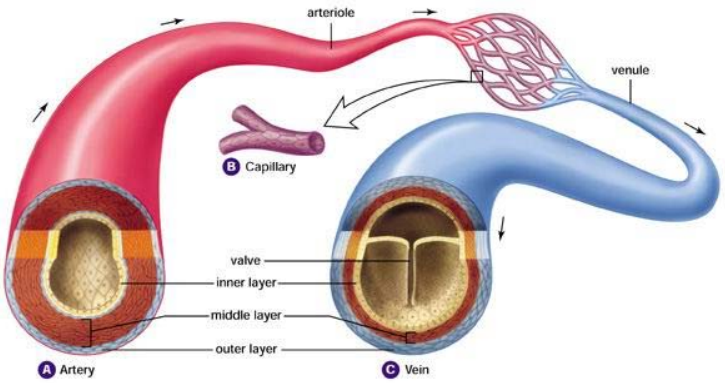






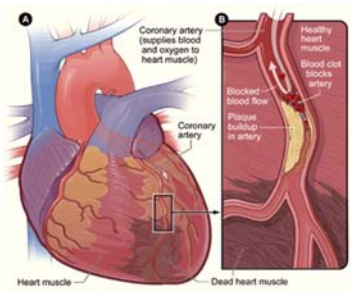
Heart

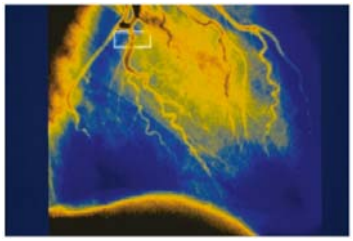
- Three types of tissues:
  - **Cardiac muscle tissue** – all tissue contracts synergistically (at the same time) to pump blood throughout the body
  - **Nerve tissue** – responsible for heartbeat and heart rate
  - **Epithelial tissue** – pericardium wraps around the heart to reduce friction as it is pumping; epithelial tissue lines the insides of the heart to allow blood to flow freely

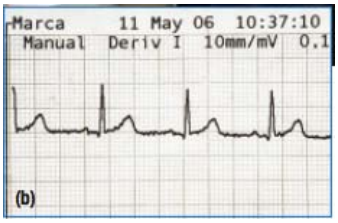


Blood Vessels

- **Arteries** – carries blood away from the heart; thicker walls
- **Veins** – carries blood to the heart; thinner walls and contain valves
- **Capillaries** – connect arteries and veins; one-cell thick walls to allow substances (nutrients, gases) to diffuse between blood and tissues







Diseases of the Circulatory System

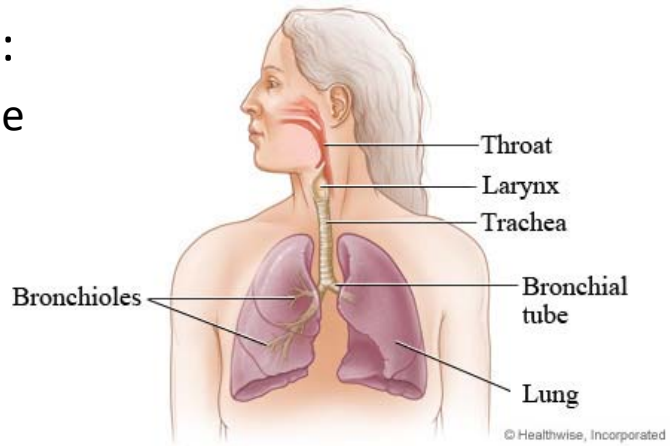
- **Atherosclerosis** – plaque formation leading to a narrowing of the arteries
- **Heart Attack** – coronary arteries (arteries providing blood to the heart) become completely blocked → heart muscle cells cannot receive nutrients and oxygen and heart tissue dies

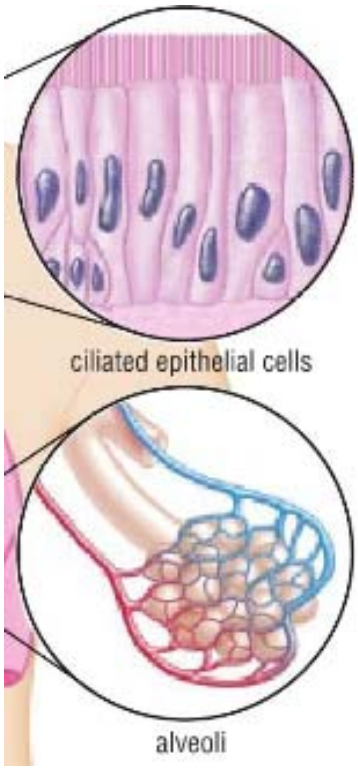
Medical Techniques

- **Angiogram** – a fluorescent dye is injected into the coronary artery → X-ray
- **Electrocardiogram** – measures the electrical signals coming from the heart

Respiratory System

- Function:
  - To provide oxygen for the body
  - To remove carbon dioxide from the body
- Components:
  - Mouth, Nose
  - Trachea
  - Bronchi
  - Lungs





- **Nose/Mouth** – air moves in and passes through the throat (pharynx) into the trachea
- **Bronchi** – trachea separates into two pipes called the left and right bronchi which split into bronchioles
  - Goblet cells in the epithelial lining produce mucus
  - Cilia (hair-like projections) sweep material out of the lungs
- **Alveoli** – small capillary-bound sacs where gas exchange occurs

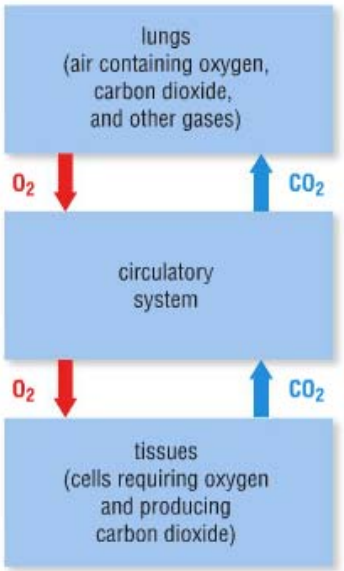
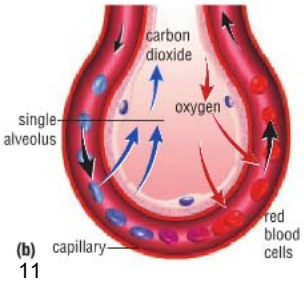


Figure 1 The respiratory system relies on the circulatory system to distribute oxygen to the cells and to remove carbon dioxide.

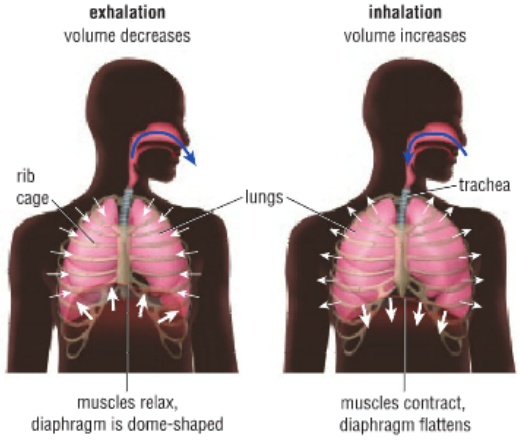
Circulatory System and Respiratory System

- Circulatory system provides a large supply of blood to the lungs
- Blood in the lungs retrieve the oxygen and deposit the carbon dioxide to be breathed out



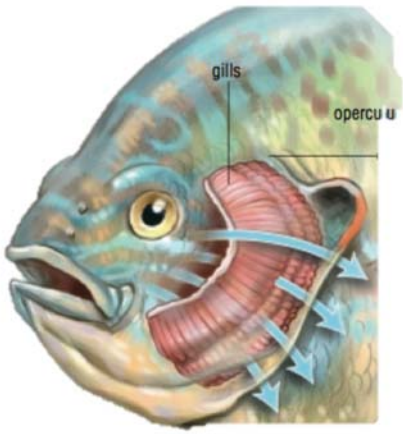
Breathing

- Inhalation - drawing air into the lungs
- Exhalation – expelling air out of the lungs
- Diaphragm – muscle responsible for increasing and decreasing the volume of the lungs



Respiratory System in Fish

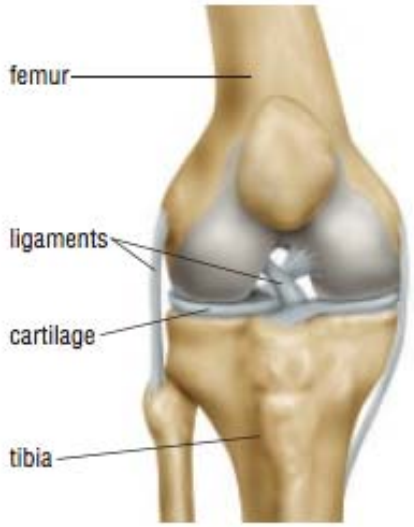
- In fish the gas exchange occurs through the gills
- Gills have capillaries that bring blood very close to the water so that soluble oxygen can diffuse into the blood
- Fish open and close their mouths to create a flow of water through their gills



Diseases of the Respiratory System

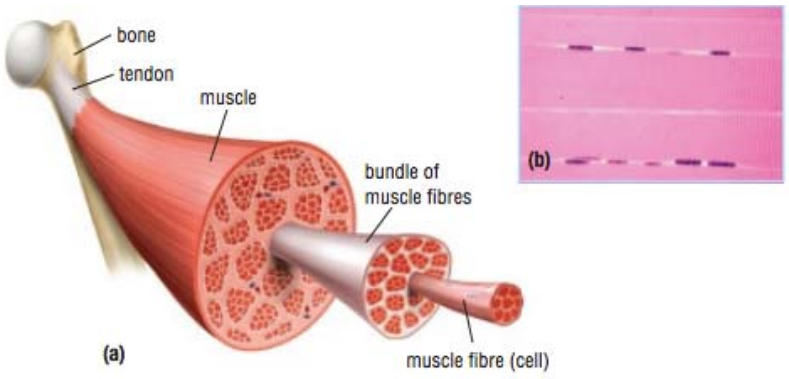
- **Tuberculosis** – caused by bacteria that grows in the lungs, which can spread to other parts of the body (nerves, bones, etc.)
- **Pneumonia** – inflammation of the alveoli due to infection
- **SARS** – a virus infection transmitted from animals to humans

The Musculoskeletal System



- Skeleton:
  - **Bones** – hard and dense; made of calcium and phosphorus
  - **Ligaments** – tough, elastic tissue that holds the bones together at the joints
  - **Cartilage** – dense tissue that provides strong, flexible, low-friction support

- **Muscle** – consists of bundles of muscle fibres that contain actin; actin allows contraction in which fibres get shorter and thicker
  - Skeletal muscle – voluntary
  - Smooth muscle – involuntary
- **Tendons** – attached bones to muscle



Diseases of the Musculoskeletal System

- Osteoporosis – loss of bone tissue making bones brittle and weak
- Torn ligaments, bone fractures

Other Animals

- All vertebrates have musculoskeletal systems
- Invertebrates vary:
  - Worms and jellyfish – no skeleton
  - Insects and arthropods – exoskeleton