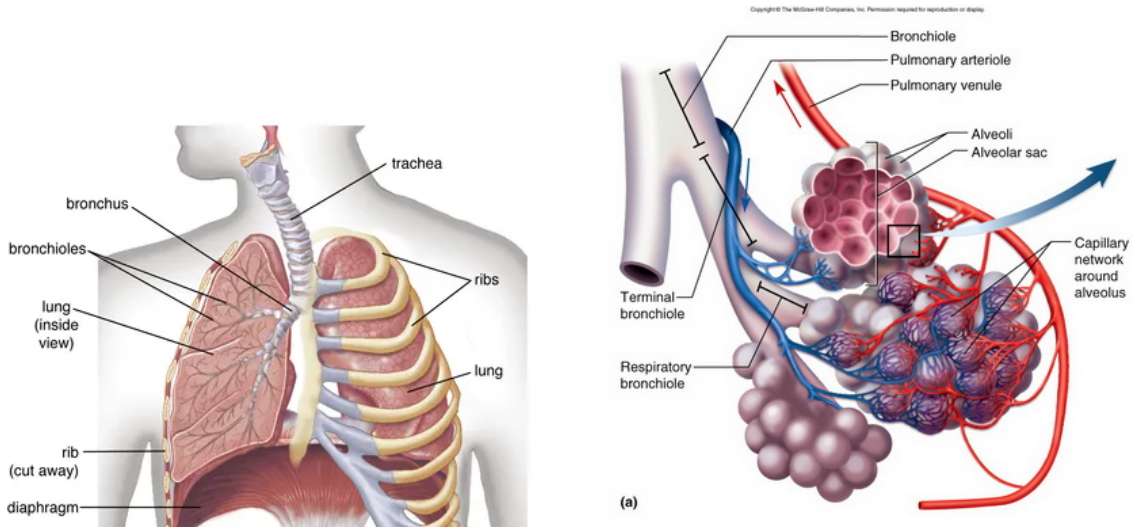
0.1 Respiratory System

Monday
April 3 2023

Definition 0.1 (Respiratory System). Responsible for providing oxygen to the body and removing carbon dioxide from the body. See Figure 0.1 (a).



(a) The lungs are protected by ribs. **(b)** The alveoli are in the lungs (search chatGPT for what this does).

Figure 0.1: The respiratory system.

0.1.1 Nose/Mouth

Definition 0.2 (Nose/Mouth). Where air enters and passes through the pharynx (throat).

- Mucous and hairs trap small particulates.
- Capillaries in the nose warm the air.

0.1.2 Larynx

Definition 0.3 (Larynx). For sound production and also functions to protect the lower airways by closing or coughing.

0.1.3 Trachea

Definition 0.4 (Trachea). The windpipe that is surrounded by cartilage rings to prevent collapse. The very top is the voice box, and it branches off into the bronchi, which

eventually branches off into the lungs. See Figure 0.2.

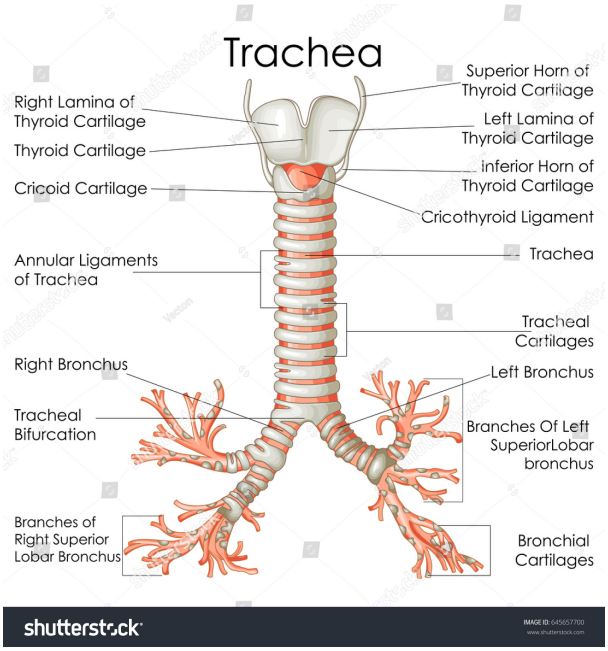


Figure 0.2: The trachea branches off into the lungs.

0.1.4 Bronchi

Definition 0.5 (Bronchi)**.** Where the trachea splits into the left and right bronchus.

- Contains goblet cells in the epithelial lining to produce mucus.
- Lined with cilia (hair-like projections) to sweep materials out of the lower airway.

0.1.5 Bronchioles

Definition 0.6 (Bronchioles)**.** Where the bronhi splits into smaller tubes.

0.1.6 In the Lungs: Alveoli

Definition 0.7 (In the Lungs: Alveoli)**.** Tiny, capillary-bound sacs where gas exchange occurs between air and blood. See Figure 0.1 (b) and Figure 0.3.

- Membranes are thin to maximize diffusion.

A better way to put it, from Figure 0.3, you can see that the alveoli and capillary are

actually separated. How it works is that oxygen from the bronchioles → alveoli gets diffused across and turns into carbon dioxide. Similarly, oxygen from the capillary itself gets diffused across and becomes deoxygenated as well.

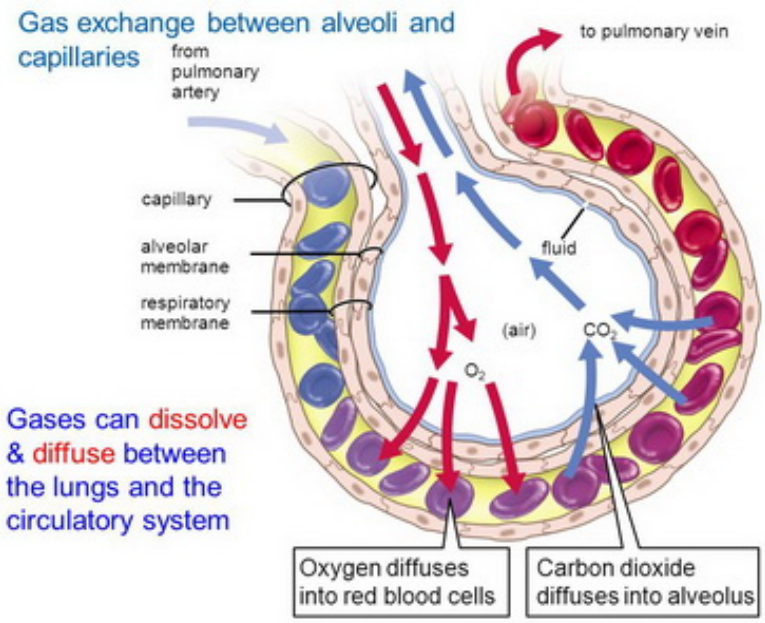


Figure 0.3: The oxygen diffuses (from blue to purple to red) and carbon dioxide is diffused out.

0.1.7 Pulmonary Arties and Capillaries

Definition 0.8 (Pulmonary Arties and Capillaries)**.** Provides a large supply of deoxygenated blood to alveoli.

0.1.8 Pulmonary Veins

Definition 0.9 (Pulmonary Veins)**.** Brings oxygenated blood back to the heart to be distributed to the rest of the blood.

0.1.9 Checkpoint: Pulmonary Fibrosis

Pulmonary Fibrosis is when the tissue around the alveoli thickens and scars. How will this affet gas exchange?

Solution: The scar tissue will make gas exchange less efficient; this will result in a slowing down of the gas exchange, and will mean that the body's cells won't get rid of waste or get a delivery of oxygen as quickly as normal.

0.1.10 Breathing

Definition 0.10 (Breathing)**.** The process of breathing is caused by pressure differences between the atmosphere and the inside of the lungs.

Air moves from an area of high pressure to low pressure.

- Pressure can be changed by changing volume.
  - Volume increases, pressure decreases. For example, imagine a balloon.
  - Volume decreases, pressure increases.

The equation is $V \propto \frac{1}{p}$.

0.1.11 Lung Volume

Definition 0.11 (Lung Volume)**.** Lung volume can be changed by:

- Contraction or relaxion of muscles in the rib cage.
- Contraction or relaxion of the **diaphragm,** which is a dome-shaped muscle underneath the lungs.

In other words, when you inhale, the diaphragm compresses, and your lungs expand. When you exhale, this is when the diaphragm "relaxes", and is when it gets back into its normal shape, casugint he lungs to get smaller and greater air pressure within the lungs.

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0.1.12 Inhalation

Definition 0.12 (Inhalation)**.**

- Rib cage expands.
- Diaphragm contracts and flattens.
- Lung volume increases.
- Lung pressure decreases.

Air moves in.

0.1.13 Exhalation

Definition 0.13 (Exhalation).

- Rib cage contracts.
- Diaphragm relaxes and arches.
- Lung volume decreases.
- Lung pressure increases.

Air moves out.

0.1.14 Respiratory System in Fish

Definition 0.14 (Respiratory System in Fish).

- Gas exchange occurs in the **gills**, which is a highly folded structure to maximize surface area.
- Undergoes countercurrnt exchang to maximize oxygen uptake from water.
- Gills are surrounded by capillaries to bring blood close to the water.

0.1.15 Diseases of the Respiratory System

	Tuberculosis
Description	Bacterial infection that mainly affects the lungs but can spread to other parts of the body.
Symptoms	Coughing for 3 or more weeks. Coughing up blood or mucous. Chest pain.
Causes	*Mycobacterium tuberculosis* is a bacterium that attacks the lungs.
Treatment	Antibiotics

Table 0.1.1: Tuberculosis

Note (Pneumonia on lungs): When someone is experiencing pneumonia as a result of COVID-19, the lungs in an x-ray wion't be dark.

	Pneumonia
Description	Inflammation of the alveoli; alveoli may be filled with fluid or pus.
Symptoms	Coughing, chest pain, fever.
Causes	Bacterial, viral, o rfungal infection.
Treatment	

Table 0.1.2: Pneumonia

	COVID-19
Description	A respiratory illness caused by the coronavirus called SARS-CoV-2
Symptoms	Fever, cough, difficult breathing.
Causes	SARS-CoV-2 virus
Treatment	

Table 0.1.3: COVID-19

0.2 Musculoskeletal System

Definition 0.15 (Musculoskeletal System)**.** The organ system that conssits of muscles and bones. Function:

- Supports the body.
- Protects delicate organs.
- Movement.

0.2.1 Bone

Definition 0.16 (Bone)**.** A hard and dense tissue that consists of bone cells within a matrix of minerals like calcium and phosphorus. Canals inside in the bones contain nerves and blood vessels.

0.2.2 Ligament

Definition 0.17 (Ligament)**.** A tough, elastic tissue that holds bones together at the joints.

0.2.3 Cartilage

Definition 0.18 (Cartilage)**.** A dense tissue that provides storng, low-friction support for bones.

0.2.4 Tendon

Definition 0.19 (Tendon)**.** A connective tissue that connects muscles to bones.

0.2.5 Muscle Types

Definition 0.20 (Muscle Types)**.** Muscle conssits of long bundles of muscle fibres that contain protein like actin and myosin for contraction. Types:

- **Skeletal Muscle** (voluntary).
- **Smooth Muscle** (involuntary).

- **Cardiac Muscle** (heart).

0.2.6 Musculoskeletal System in Invertebrates

Definition 0.21 (Musculoskeletal System in Invertebrates)**.** All vertebrates have Musculoskeletal systems. Intvertebrates have other adaptations for structure and support:

- Jellyfish rely on water to provide structural support.
- Worms have muscles that work against bodyfluids.
- Insects and arthropods have exoskeleton.

0.2.7 Diseases of the Musculoskeletal System

	Osteoporosis
Description	A diseases thatcauses bones to become weak and brittle because the creation of new bones does not keep up with loss of old bone.
Symptoms	Back pain, loss of height over time, stooped poosture.
Causes	Age, hormones, poor diet.
Treatment	Drugs like bisphosphonates, hormon-related therapy.

Table 0.2.1: Osteoporosis

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0.3 Nervous System

Definition 0.22 (Nervous System)**.** The organ system that senses the environment and coordinates appropriate reponses.

- **Central nervous system (CNS)** consists of the brain and spinal cord. The brain is protected by the skull and the spinal cord is protected by the spine.
- **Peripheral nervous system (PNS)** consists of the nerves in the rest of the body.

See Figure 0.4.

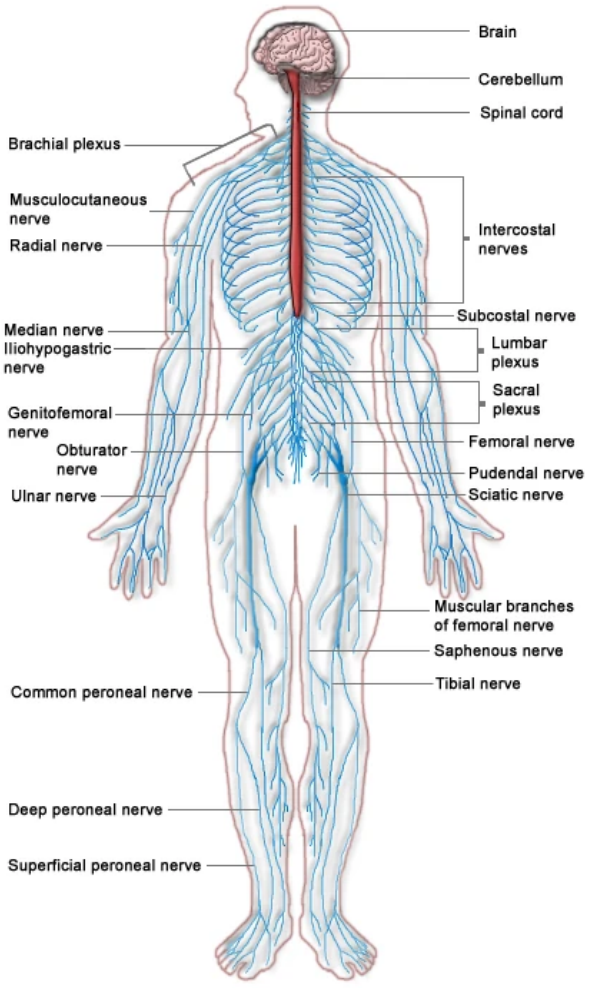

Figure 0.4: The nervous system.

0.3.1 Central Nervous System

Definition 0.23 (Central Nervous System)**.** The brain consists of over billions of neurons and synapses.

- Protected by the skull and cerebrospinal fluid.

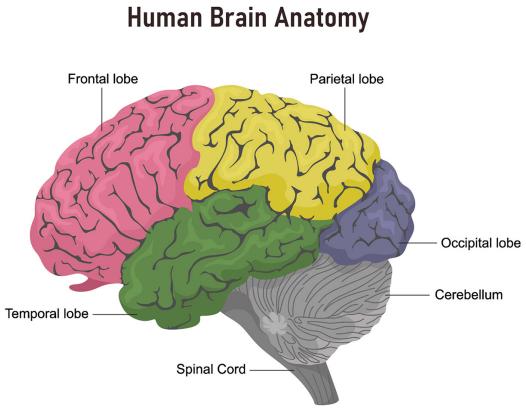

Figure 0.5: The brain is like tofuu. In the tofuu, there is some water that protects the tofuu. The cerebralspinal fluid acts like that water in the tofuu.

0.3.2 Spinal Cord

Definition 0.24 (Spinal Cord). A long, fragile tube ofn erves that carries signals between the brain and body.

- The spinal cord is protected by the spine.

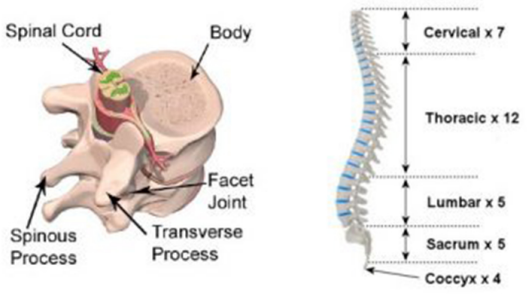

Figure 0.6: The spina cord (on the left) and the spine (on the right).

0.3.3 Peripheral Nervous System

Definition 0.25 (Peripheral Nervous System).

- The **neuron** is a nervec cell that sends electrical impulses to the target cell.

- **Myelin sheath** is a fatty material that covers the axon; acts as insulation to allow for electricla impulses to travel quickly tand from to the wrong neuron.

0.3.4 Nerve

Definition 0.26 (Nerve)**.** A bundle of neurons. Types of nerves:

- Nerves for voluntary muscles.
- Nerve for involuntary functions.
- Nerves for sensory organs.

0.3.5 Sensory Receptors

Definition 0.27 (Sensory Receptors)**.** Receive information from the external environment to be processed by the brain.

- Receptors sense sight, touch, temperature, taste, smell, sound, pressure, pain, balance, stretch, position.

0.3.6 Reflexes

Definition 0.28 (Reflexes)**.** Actions that do not require the brain and occur without conscious thought through a reflex arc in the spinal cord.

- Reflexes are intended to prevent injury and protect us from danger.
- Types:
  - Deep-tendon reflex.
  - Withdrawal reflex.
  - Startle reflex.
  - Blink reflex.
  - Gag reflex.

See Figure 0.7.

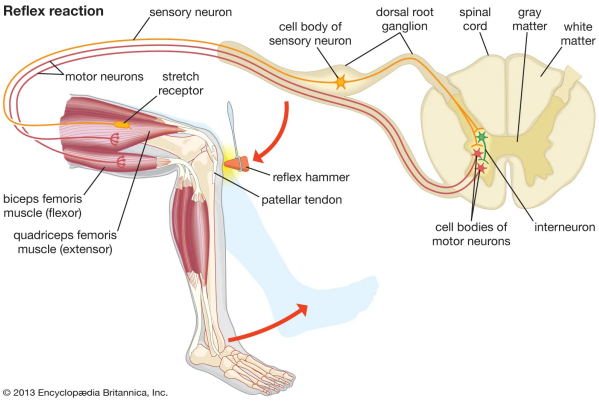

Figure 0.7: The doctor will hit your knee, and usually you will kick. If you do not kick, something is wrong.

0.3.7 Diseases of the Nervous System

	Multiple Scelrosis
Description	Myelin sheaths in the central nervous system deteriorates leading to nerve damage.
Symptoms	Numbness or weakness in one or more limbs. Electric-shock sensations. Tremor, lack of coordinate.
Causes	Autoimmune diases; the body is attacking its own mecahnism.
Treatment	No cure. Drugs to reduce nerve inflammation. Drugs to modify progression.

Table 0.3.1: Multiple Scelrosis

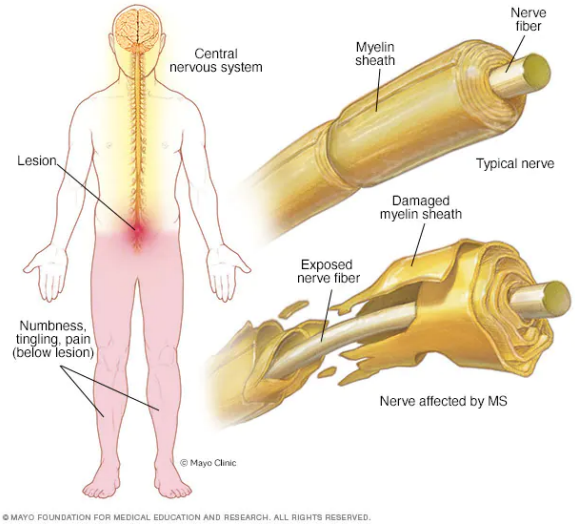

Figure 0.8: Multiple scelrosis; damaged myelin sheath.

	Concussion
Description	Brain injury that affects brain function.
Symptoms	Headache, ringing in the ears, nausea and vomiting, amnesia.
Causes	Trauma to the head from a fall or sports. Violent shaking of upper body.
Treatment	Physical and mental rest. Pain relief medication.

Table 0.3.2: Concussion

Thursday April 6 2023

0.3.8 Organ Transplant

Definition 0.29 (Organ Transplant)**.** Sugery where the organ or tissue of the donor is given to the recipient to replace a damaged organ or tissue. Organ transplants have been performed since the early 1800s when blood transfusions were explored.

0.3.9 Types of Organ Donors

Definition 0.30 (Types of Organ Donors)**.**

- **Invis donor organs** are organs that come from a living person - usually a family member with similar genetic traits to avoid rejection by the immune system. Ex: kidney, lobe of lungs, part of the liver.
- **Deceased donor organs** are organs that come from a dead person.

- **Xenotransplantation** is the transplanting of body parts from one species of another. Ex: heart valves from pigs.

0.3.10 Organ Trafficking

Definition 0.31 (Organ Trafficking)**.** The practiec of stealing or buying organs through exploitation, coercion, or fraud. Low supply of organs but a high demand for organ transplants lead to a black market. Most common trafficking organs are kidneys.