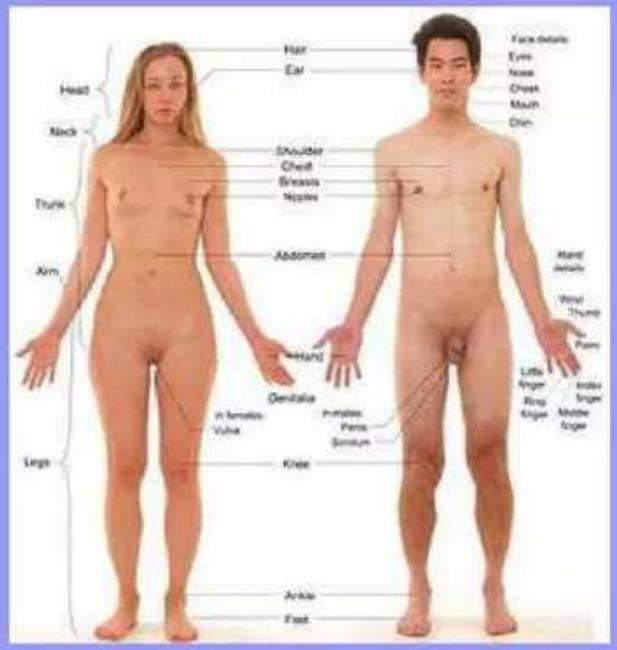
Health & Physiology

इंदिरा गाँधी राजकीय स्नातकोत्तर महाविद्यालय, बांगरमऊ, उन्नाव (उ.प्र.)
Indira Gandhi Government P. G. College (U.P.) (Accredited By NAAC)

Dr. Vishnu Mishra
(Principal & Associate Prof.)



Topic 6

Human Health and Physiology

Taking in Food

- Absorption: food passes through a layer of cells into the body's tissues
  - Takes place in the small intestines
  - Uses villi: small finger-like projections from the wall of the small intestine
- Assimilated: after food is absorbed it becomes part of the tissues of the body

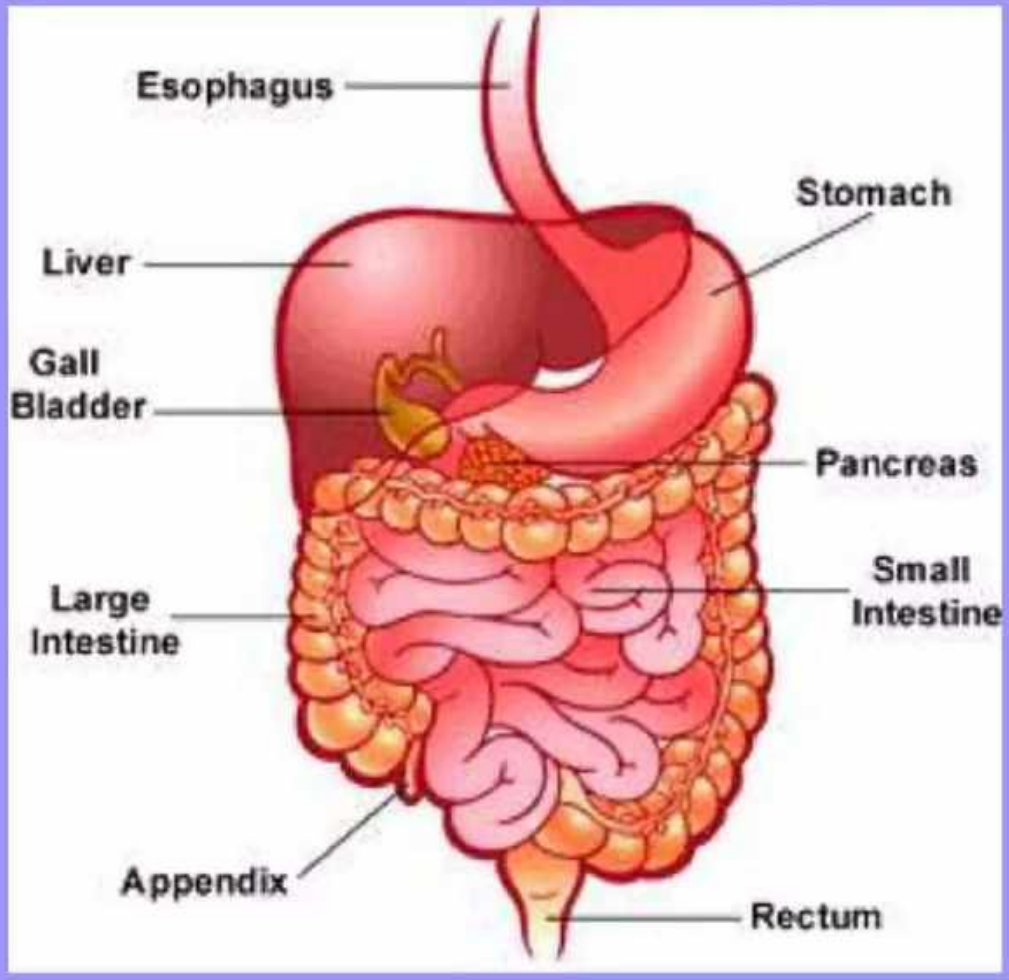
The Need for Digestion

- Some substances are not suitable for absorption into human tissues and so must be broken down and reassembled into another form
- Many molecules are too large to be absorbed by the villi and so must be broken down in size
- Three main types of food molecule that need to be digested:
  1. Starch
  2. Protein
  3. Triglycerides (fats and oils)

Enzymes of Digestion

Enzyme	Amylase	Protease	Lipase
Example	Salivary amylase	Pepsin	Pancreatic lipase
Location	Salivary glands	Wall of stomach	Pancreas
Substrate (what it breaks down)	Starch	Proteins	Triglycerides (fats and oils)
Products	Maltose	Small polypeptides	Fatty Acids and Glycerol
Optimum pH level	pH 7	Ph 1.5	Ph 7

Human Digestive System



Structure of Villi and their Functions

- Villi increase the surface area over which food is absorbed
- Have only one thin layer of cells (the epithelium) that foods have to pass through
  - Small distance for diffusion of foods
- Have microvilli to increase the surface area of the villi
- In microvilli, protein channels allow facilitated diffusion and pumps allow active transport
  - Mitochondria in the epithelium provide the ATP for this active transport
- Lacteal branch in the villi's center carries away fats after absorption

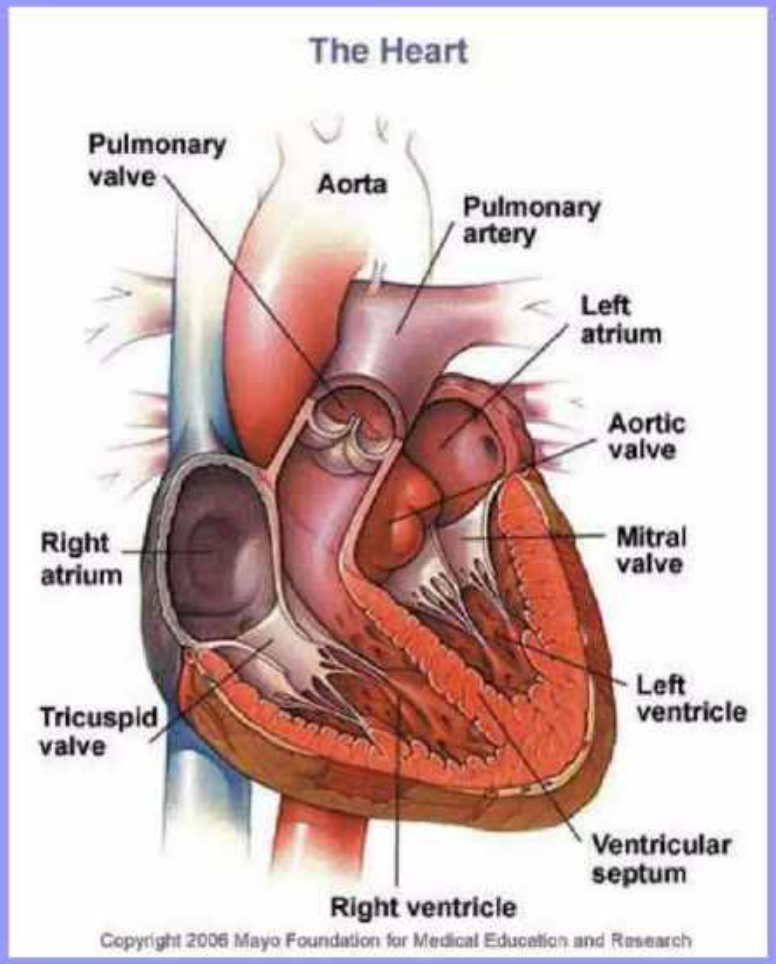
Stomach and Intestines Functions

- Pepsin in the stomach digests proteins in the stomach
- Acidity of the stomach kills most bacteria
- Villi in the small intestine absorb finished products of digestion
- Ingestible parts of food are made solid as water is absorbed by the large intestine
- Egested through the anus

Heart Structure

- Double pump: right side pumps blood to the lungs; left side pumps blood to all other organs
- Myogenic: the cardiac muscle of the heart contracts on its own w/o nerve stimulus
- There are many capillaries in the muscular wall of the heart (blood in capillaries is supplied by coronary arteries)
- Blood brought by coronary arteries bring nutrients and oxygen for aerobic cell respiration (which produces energy for cardiac muscle contraction)

Heart Diagram



- Always draw the left ventricle on the right
- Draw the left ventricle visibly **thicker** than the right ventricle

Arteries

- Arteries: carry blood from the heart
  - Thick wall to withstand high pressures
  - Thick outer layer to avoid bulges and leaks
  - Thick layers of elastic and muscle to help pump the blood on after each heart beat
  - Narrow lumen to help maintain high pressure

Veins

- Veins: carry blood to the heart
  - Thin layers with thin elastic and muscle; blood does not need to be pumped
  - Wide lumen is needed to accommodate the slow-flowing blood
  - Thin walls let the veins be pressed flat by adjacent muscles; help moves the blood
  - Thin outer layer because there is little danger of bursting
  - Some have valves to prevent back-flow

Capillaries

- Capillaries: connect arteries to veins
  - Wall is a single layer of thin cells so diffusion has a small distance
  - Pores between cells in the wall allow some phagocytes and some plasma to leak out which forms tissue fluid
  - Very narrow lumen; can fit into small spaces

The Action of the Heart

1. Walls of the atria contract, pushing blood into the open atrioventricular valves and into the ventricles, which have closed semilunar valves
2. The ventricles fill and blood pressure rises. The atrioventricular valves close and the semilunar valves open, so blood is pumped out of the arteries. Meanwhile, more blood is filling into the atria.
3. The ventricles stop contracting and the semilunar valve closes. The atrioventricular valves reopen when the ventricles have lower pressure than the atria.
4. Process repeats

Control of the Heart Beat

- Pacemaker: region located in the wall of the right atrium; its signal causes the heart to contract (beat)
- Nerves and hormones can transmit messages to the pacemaker
  - Nerves carry messages to the pacemaker to speed up or slow down the contractions
  - Adrenalin (carried by the blood stream) tells the pacemaker to speed up

Composition of Blood

- Blood is composed of plasma, erythrocytes (red blood cells), leukocytes (white blood cells), and platelets
- Two types of leukocytes: lymphocytes and phagocytes

Functions of Blood

- Two main functions of blood:
  1. Transportation
  2. Defense against infectious disease
- Red blood cells transport oxygen from the lungs to cells
- Blood plasma transports
  - Nutrients
  - Carbon dioxide
  - Hormones
  - Antibodies
  - Urea
- Blood also transports heat
- Leukocytes defend the body against infectious diseases

Phagocytes

- Phagocytes: white blood cells that can identify pathogens and ingest them by endocytosis
- Pathogens: organism or virus that causes disease

Antibodies

- Antibodies: proteins that recognized and bind to specific antigens
- Antigens: foreign substances that stimulate the production of antibodies
- Antibodies defend the body against pathogens by binding to antigens on the surface of a pathogen

Barriers to Infection

- Skin and mucous membranes form a barrier that prevents most pathogens from entering the body
  - The skin is acidic
  - Mucus found in nose, trachea, vagina, and urethra
    - Contains an enzyme that kills bacteria

Antibiotics

- Antibiotics: chemicals produced by microorganisms to kill or control the growth of other microorganisms
- Most bacterial diseases can be treated successfully with antibiotics
- Virus diseases can not be treated with antibiotics

Production of Antibodies

1. Antibodies are made by lymphocytes (type of white blood cell)
    1. Lymphocytes can only make specific types of antibodies
2. Antibodies form on the surface of lymphocytes
3. When antigens come in contact with these antibodies, the lymphocite divides by mitosis to produce clones of itself
4. These clones also produce the antibodies to attack the antigen

AIDS

- AIDS is a syndrome: group of symptoms that are found together
- Those with AIDS have low numbers of one type of lymphocyte, weight loss, and diseases
- These diseases weaken the body and eventually cause death

Cause of AIDS

- HIV causes Aids
- Infects a type of lymphocyte and eventually destroys these lymphocytes—stopping production of these antibodies
- This leaves the body vulnerable to pathogens that would normally be controlled easily

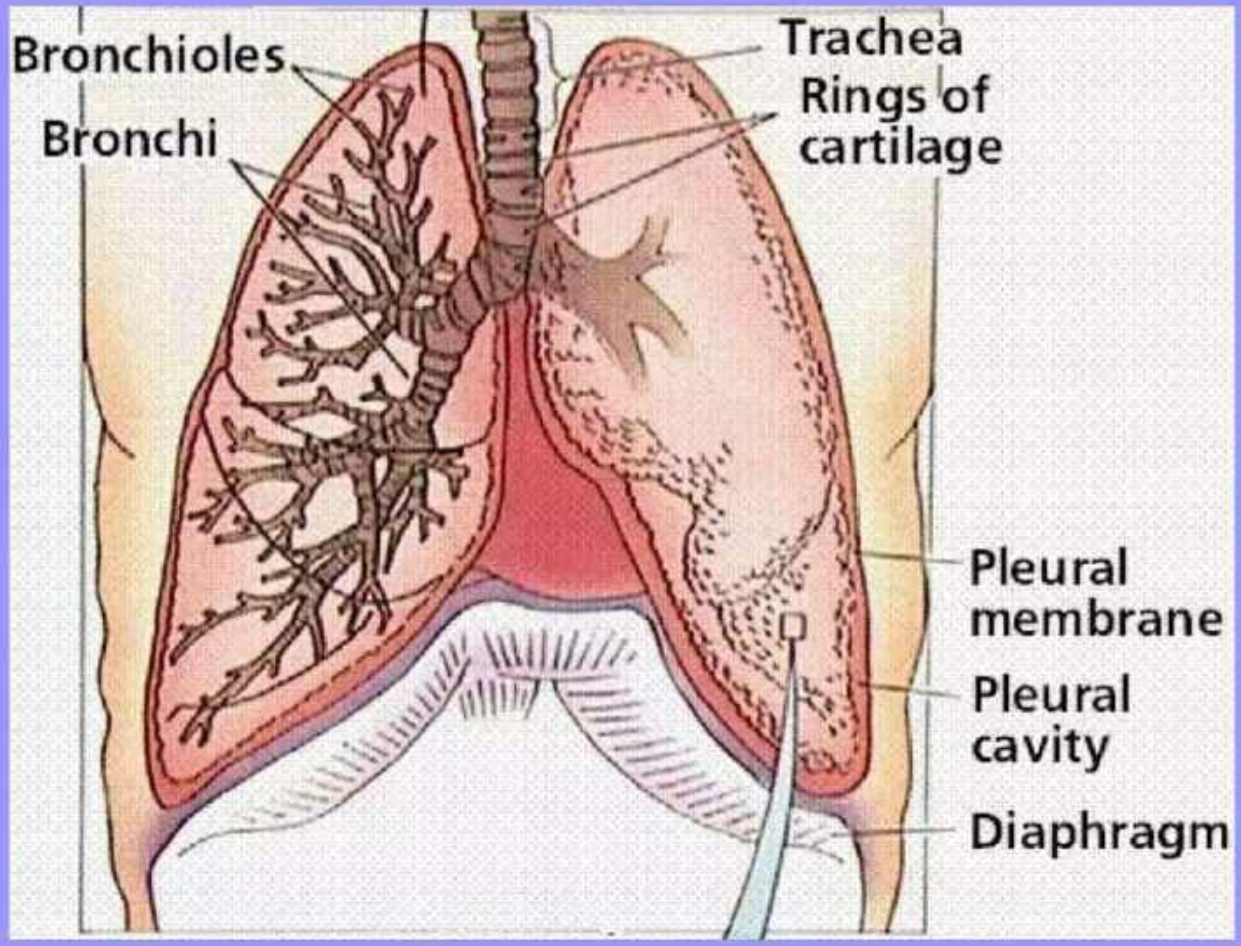
Transmission of AIDS

- HIV can't pass through skin and does not survive long outside of the body
- Transmission involves the transfer of body fluids from an infected person to an uninfected person

Need for Gas Exchange/Ventilation

- Humans must take in oxygen for cell respiration and release carbon dioxide
- Gas exchange: swapping one gas for another in the alveoli of the human lungs
- Ventilation: the process of bringing fresh air to the alveoli and removing stale air to maintain concentration gradients necessary for gas exchange

Ventilation System Diagram



Adaptations of the Alveolus to Gas Exchange

- Millions of alveoli create a huge overall surface area for gas exchange
- Alveolus walls are a single layer of cells; gases only have to diffuse a short distance
- Alveolus is covered by blood capillaries that oxygen diffuses into in place of CO2
- Alveolus is moist inside and the sides are prevented from sticking together

Ventilation of the Lungs

Inhaling	**Exhaling**
External intercostal muscles contract, moving the ribcage up and out	Internal intercostal muscles contract, moving the ribcage down and in
Diaphragm contracts, becoming flatter and moving down	Abdominal muscles contract, pushing the diaphragm up into a dome shape
Muscle movements increase the volume of the thorax	Muscle movements decrease the volume of the thorax
Pressure inside the thorax is lower than the pressure outside	Pressure inside the thorax is higher than the pressure outside
Air flows from outside the body into the lungs until the pressure rises	Air flows from inside the body outside until the pressure falls

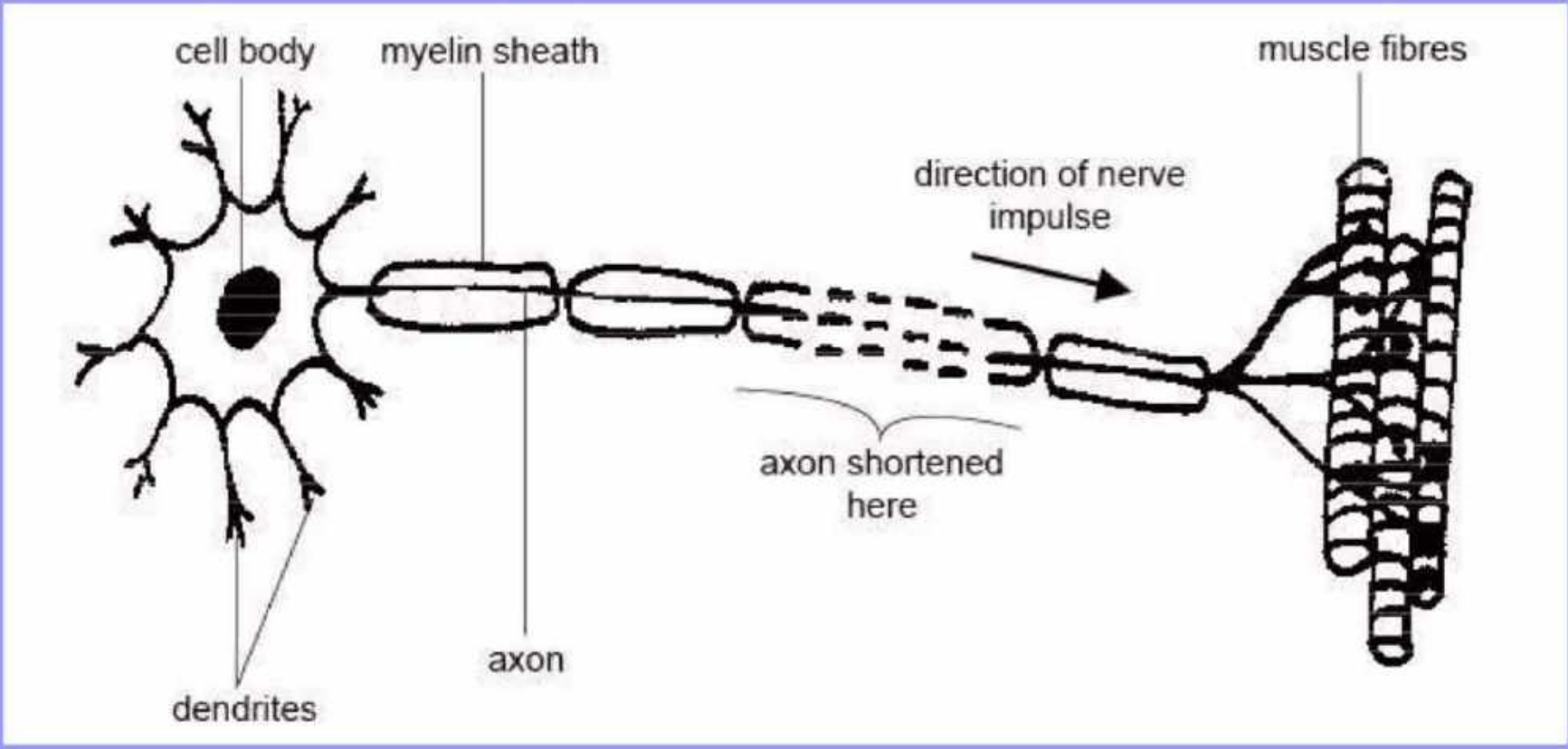
Organization of Nervous System

- Neurons: cells that carry messages at high speed in the form of electrical impulses
- Two parts of the Nervous System:
  1. Central Nervous System (CNS): Brain and spinal cord
  2. Peripheral Nervous System: nerves that connect all parts of the body to the CNS

Sensory and Motor Neurons

- Sensory neurons carry nerve impulses from receptors (sensory cells) to the CNS
- Motor neurons carry impulses from the CNS to effectors (muscle and gland cells)
- Relay neurons carry impulses within the CNS from one neuron to another

Structure of Motor Neuron



Synaptic Transmission

1. Nerve impulse reaches the end of the pre-synaptic neuron
2. Calcium diffuses in through calcium channels into the pre-synaptic neuron
3. Vesicles of neurotransmitters fuse with the pre-synaptic membrane and release their neurotransmitters
4. Neurotransmitters diffuse across the synaptic cleft and binds to receptors
5. Sodium and other positively charge ions diffuse into the post-synaptic neuron; causing depolarization of the post-synaptic membrane
6. Depolarization causes action potential
7. Calcium is pumped out. Neurotransmitter is broken down in the cleft and reabsorbed into the veins.

Resting/Action Potentials

- Resting Potential: electrical potential across the plasma membrane of a cell that is not conducting an impulse
- Acting Potential: reversal and restoration of the electrical potential across the plasma membrane of a cell, as an electrical impulse passes along it (depolarization and repolarization)

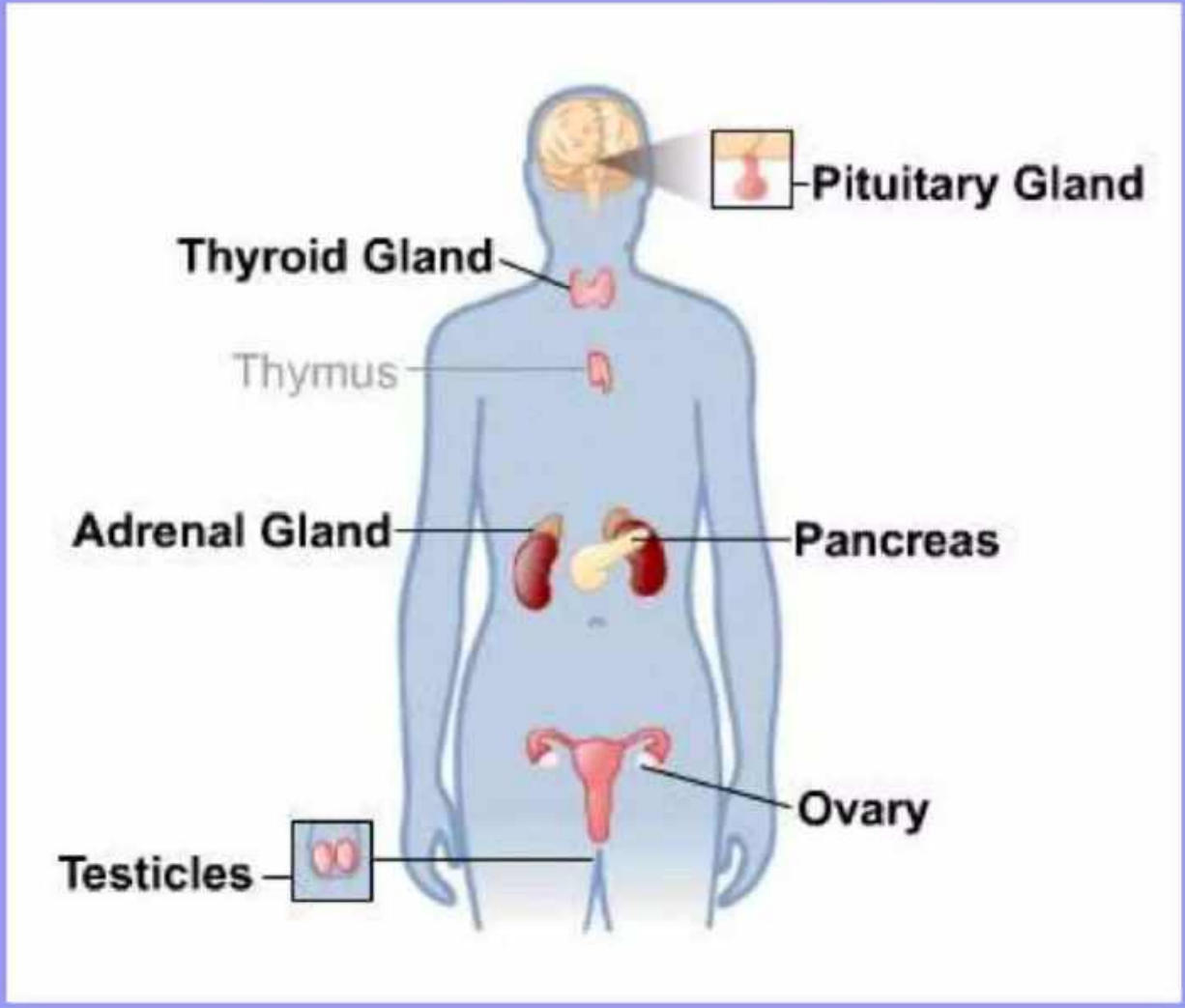
Passage of Nerve Impulse

1. Action potentials develop and reduce the resting potential; causes voltage-gated channels to open
2. Sodium channels open, reduces membrane potential, causing more channels to open. Positively charged Sodium ions cause a net positive charge to develop; reversing the membrane potential (this is depolarization)
3. Potassium channels open and positive potassium ions leave causing the membrane potential to fall back to a negative charge (this is repolarization)
4. Potassium and sodium levels are balanced and resting potential returns; waiting for the next impulse

Homeostasis

- Homeostasis: maintaining the internal environment of the body between limits
- Nervous system and Endocrine system are both involved in controlling:
  - Body temperature
  - Blood pH
  - Carbon dioxide concentration
  - Blood glucose concentration
  - Water balance

Endocrine System



Controlling Levels

- Feedback system: level of a product feeds back to control the rate of its own production
- Negative Feedback system: change in level causes the opposite change; increase in product leads to decrease in production and vice versa

Responses to Overheating

- Skin arterioles become wider so more blood flows through the skin; temperature of skin rises so more heat is lost to the environment
- Skeletal muscles remain relaxed and resting so they do not generate heat
- Sweat glands secrete seat to make the surface of the skin damp; water evaporates from the skin for a cooling effect

Response to Chilling

- Skin arterioles become narrower and bring less blood to the skin, so less heat is lost to the environment
- Skeletal muscles shiver to generate heat (small rapid muscle contractions)
- Sweat glands do not secrete sweat to keep the skin dry

Responses to High Blood Glucose Levels

- Beta cells in the pancreatic islets produce insulin
- Insulin stimulates the liver and muscle cells to convert glucose to glycogen
- Glycogen is stored in the cytoplasm
- Cells use the glucose for cell respiration
- This lowers the blood glucose level

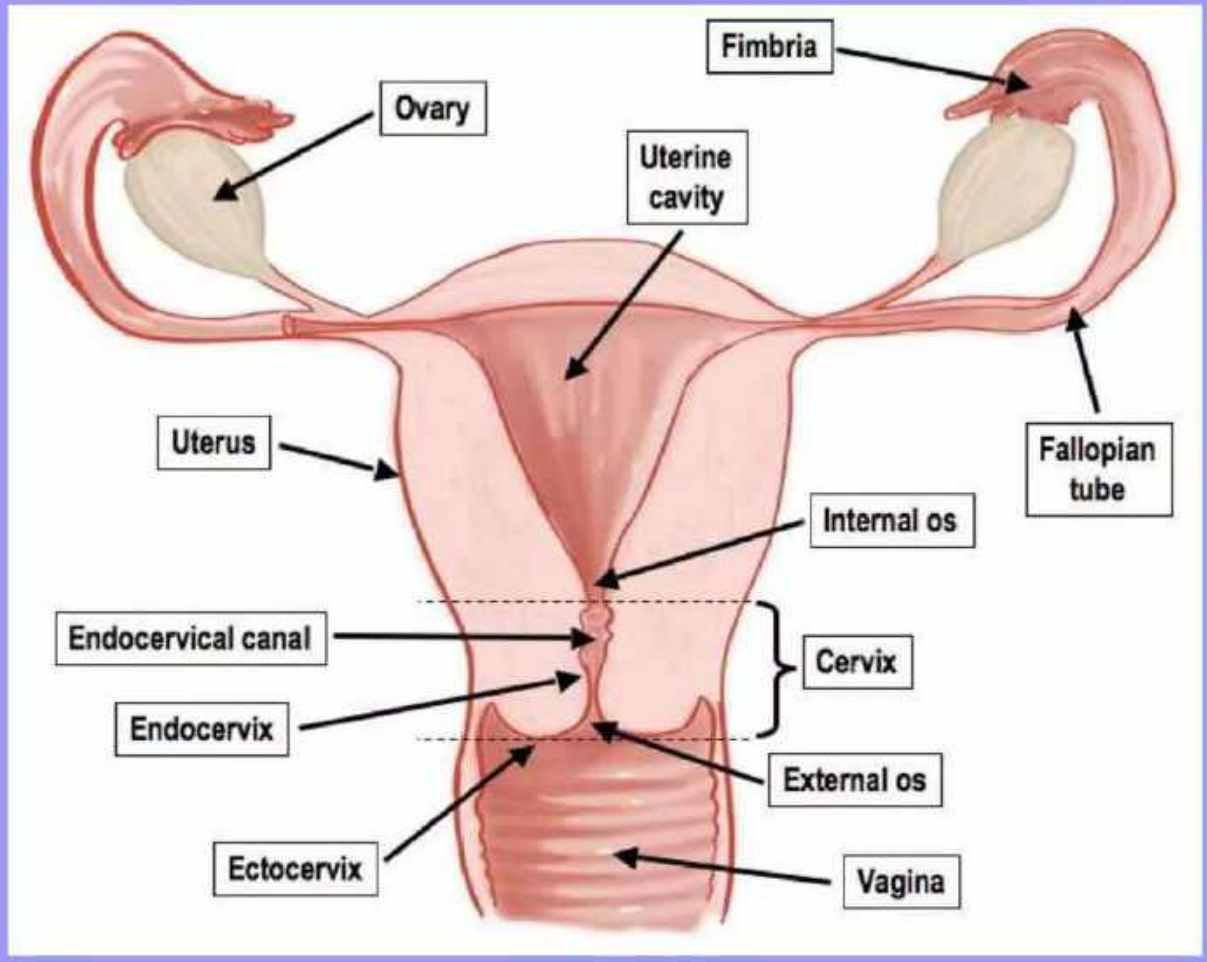
Responses to Low Blood Glucose Levels

- Alpha cells in the pancreatic islets produce glucagon
- Glucagon stimulates liver cells to break down glycogen into glucose
- Glucose is released it to the blood
- Blood glucose level rises

Diabetes

Type 1 Diabetes	**Type 2 Diabetes**
The onset is usually during childhood	The onset is usually after childhood
Beta cells do not produce enough insulin	Target cells become insensitive to insulin
Insulin injections are used to control blood glucose levels	Insulin injections are not usually needed
Diet cannot by itself control the condition	Low carbohydrate diets usually control the condition

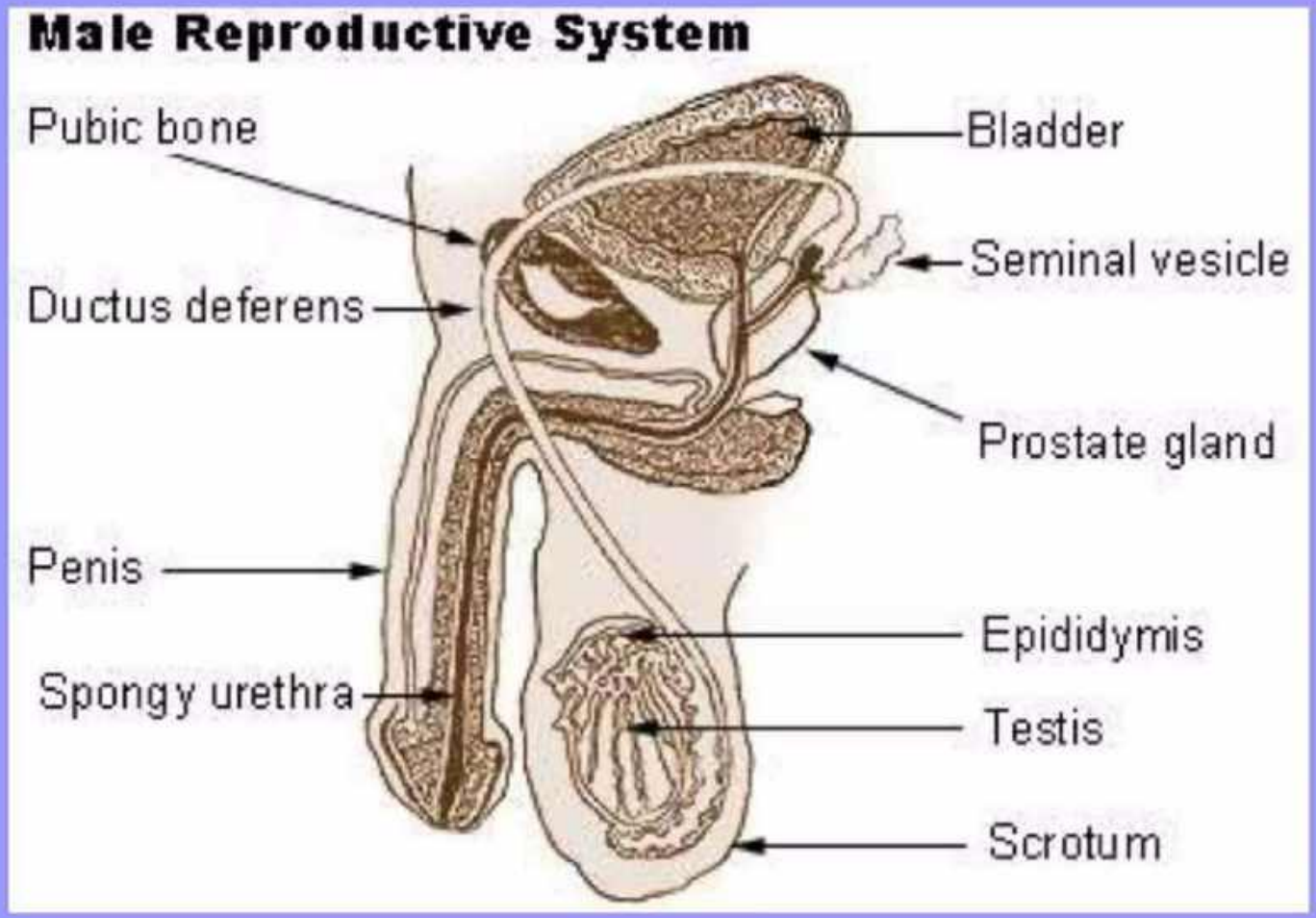
Female Reproductive System



Female Sex Hormones

- The pituitary gland produces FSH and LH
- FSH stimulates the development of follicles (contain egg cell)
- LH stimulates follicles to mature and release eggs (ovulation) and develop into the corpus luteum
- Estrogen and Progesterone stimulate creation of secondary sexual characteristics and development of uterus lining for pregnancy

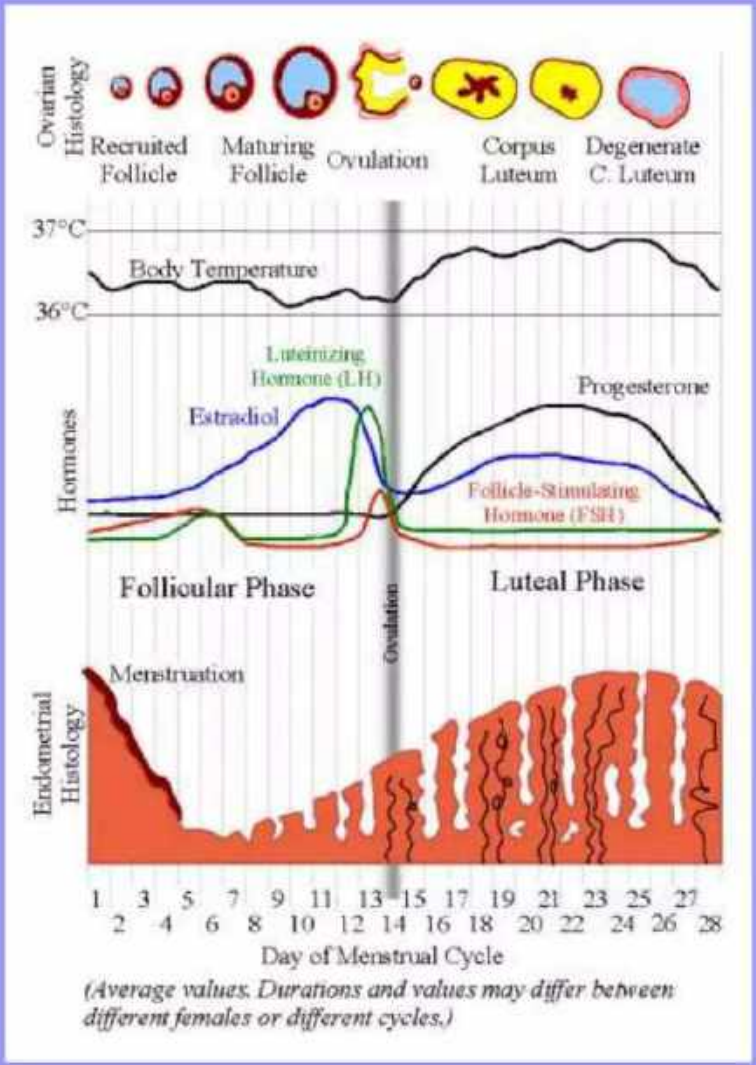
Male Reproductive System



Testosterone

- Testosterone is responsible for:
  - Development of genitalia on fetus
  - Development of secondary sexual characteristics during puberty (example: pubic hair)
  - Maintenance of the sex drive in adulthood to pass on genes to offspring

Menstrual Cycle



Infertility

- Infertility: couples do not achieve fertilization for a temporary or permanent time span
- Some problems can be solved with in vitro fertilization

In Vitro Fertilization

1. Woman's normal cycle is stopped using drugs
2. FSH is injected to stimulate ovaries to develop many follicles
3. HGG matures and loosens eggs in the follicles
4. Sperm is collected and processed
5. Eggs are extracted from the follicles
6. Eggs are mixed with sperm and incubated
7. Two or three embryos are selected and placed into the uterus
8. Pregnancy test is used to see if any embryos have implanted

Ethical Issues of IVF

Ethical arguments against IVF	Ethical arguments for IVF
Inherited forms of infertility might be passed onto the children, spreading the suffering of the parents	Many forms of infertility are due to the environment and so will not be passed onto the offspring
Spare embryos are sometimes killed; they deserve a chance at life	Embryos killed during IVF feel nothing and do not suffer
Humans are deciding whether new individuals survive or die	Genetic diseases could be reduced due to screening of embryos
IVF is unnatural; not an act of love	Parents willing to endure the process are likely to be loving parents
Infertility is an act of God	Infertility brings uphappiness and loneliness. This makes people happy.

Thankyou & Keep Healthy!