

- In the stroma there are sacs called thylakoids - provide a membrane for photosynthesis
 - There are ribosomes present
 - Also contains a loop of DNA
- **Plasmodesma**
 - Openings from one cell to the next
 - Connect cells to their neighbours
 - The phospholipid bilayer continues from one cell to the next
 - Allows the passage of cytosol from cell to cell
 - Allows for material to move easily from cell to cell in the tissue

BACTERIAL CELLS

- No true nucleus - no membrane bound nucleus
- No Endoplasmic reticulum
- No Golgi Apparatus
- No mitochondria
- No Chloroplasts
- No vesicles or vacuoles
- No centrosome

ANIMAL CELLS

- No Cell Wall
- No Plasmodesmata
- No Chloroplasts
- No Central Vacuole

PLANT CELLS

- No centrosome
- No Lysosomes

GENETICS

Character or Trait: A potentially variable quality or quantity in an organism

- E.g. flower colour - purple, white
- When pea plants reproduce, if the new generation of pea plants always has the same characters, it is a *true breeding variety*

Hybrid: the offspring of two different varieties

Monohybrid Cross: Studying the inheritance of single character in a hybridization experiment

P Generation: parental generation - starting point for experiment

- **F1:** First filial generation - offspring of P generation
- **F2:** Second filial generation - offspring of F1 generation
- Gave Mendel insight into how inheritance occurred

Particles of Inheritance:

- There would be a P: purple particle of inheritance and a P: white particles of inheritance
- Each pea plant inherits two such particles
- For some reason one particles id dominant: it determines the colour of the flower even when the other type of particle is present

- Two nucleic acids that are held together by hydrogen bonds are called a base-pair
- DNA is typically found double-stranded with complementary strands held together by base pairs
- DNA must be replicated for cell division
 - 1.) break the hydrogen bonds apart
 - 2.) Use each individual strand as a template - complementary nucleic acids are brought in to attach to the templates
 - 3.) Form complementary strand for each template strand - end up with 2 double stranded DNA each with its new complementary strand
- **DNA Polymerase**: main enzyme in DNA replication
 - Works its way along the template strand and bring in complementary bases
 - Adds to new complementary strand
- 5' and 3' prime end - opposite ends
 - Called **Antiparallel** for complementary strands
- Leading Strand & lagging Strand
 - Leading Strand: when DNA gets pulled apart DNA polymerase can work in one direction when replicating
 - Lagging strand: because it can only go one way it has to copy in fragments and go back to position

GENE EXPRESSION

- DNA → Protein → Trait (Central Dogma)
 - Ex.) ATAC.... → Insulin
 - Ex.) GCCT... → enzyme → chlorophyll
- Occurs more or less constantly in living cells
- Some genes are only expressed by certain cells
- Some genes are only expressed in certain times

RNA

- Ribonucleic Acid
- Similar to DNA - both have sugar phosphate backbones with nucleotide

- Sugar in backbone is different - its ribose sugar
- RNA is typically single stranded
- One of the acid bases is different - Thymine is never found
 - **Uracil** replaces Thymine

3 Groups

1.) Messenger RNA (mRNA)

- Carries protein blueprint from DNA to ribosomes

2.) Transfer RNA (tRNA)

- Carries Amino Acids to ribosomes
- **Anticodon:** three bases are exposed on the end of the tRNA
- **Amino Acid Attachment Site:** at the other end
- 61 different tRNA molecules
- Each has a specific Anticodon and carries a specific amino acid

3.) Ribosomal RNA (rRNA)

- With certain proteins, makes up ribosomes

Ribosomes

- Made up of Subunits - Small & Large Subunits
- Subunits get built in the nucleolus

In Prokaryotes

Transcription: the process of copying DNA to RNA

Translation: Use the sequence of mRNA to direct the production of a protein

In Eukaryotes

- Also has transcription
- RNA Processing: Pre-mRNA goes through

Skeletal System

- Protection from mechanical injury
- Support - for other organs
- Leverage for movement
- Storage of minerals (e.g., Calcium)
- Production of blood cells

Animal Phyla

- Porifera - sponge
- Cnidaria (Colenenterate) - sea anemone, sea jelly, coral, hydra
- Platyhelminthes - flatworm
- Mollusca - snail, slug, limpet, chiton, clam, mussel, scallop, squid, octopus, cuttlefish, nautilus
- Annelida - segmented worm
- Nematoda - roundworm
- Arthropoda - centipede, millipede, insect, spider, scorpion, crustacean
- Echinodermata - sea star, sea urchin
- Chordata - Tunicate, fish, amphibian, reptile, bird, mammals - vertebrates

Nutrition

- Unicellular chemoheterotrophs obtain molecules from their environment
- **Intracellular digestion** - chemically breaking down food inside the cell
- **Extracellular Digestion** - digestions that takes place outside the cell - digest materials that can't fit in the cell
 - Bacteria and Fungi are good at this type of digestion

Digestive System

- Ingestion of food
- Digestion of food
- absorption of nutrients

- Muscles around the Esophagus - alternatively contracting and relaxing = **Peristalsis** - moves food down through the esophagus and into the stomach

Stomach

- At the end of the stomach there is the **Sphincter**: a ring of muscles that when contracts it closes off the tube
- There are a lot of wrinkles and folds of the lining of the stomach that allows it to expand to accommodate the incoming food
- **Gastric Glands** - openings within the epithelial tissue
 - Produce an enzyme that aid in digestion
 - Produce HydroChloric Acid
 - Produces **Mucus**: protects the epithelium from being digested
- Basic Functions:
 - Stores food
 - Digests food
 - Kills Bacteria
- Food is released into the **Small Intestine**

Pancreas and Liver

- **Pancreas**: Produces a fluid called **Pancreatic Juice** that is released through a duct into the **Small Intestine**
 - **Pancreatic Juice**: Contains bicarbonate which neutralizes the acids coming from the stomach
 - Has a wide variety of digestive enzymes
- **Liver**: Produces **Bile**
 - **Bile**: Emulsifies fats - allows fats to mix with water
 - Can store Bile in the **Gall Bladder**

Small Intestine

- Surrounded by **Smooth Muscle** that move food through **Peristalsis**
- Lining of the wall is folded and there are finger like projections called **Villi**

Nematoda

- No respiratory System
- rely on diffusion

Gill: Extension of the body that allows gas exchange

- Echinodermata
 - Also Tube feet
- Annelida
 -
- Mollusca
 - Land Snail - keep respiratory system inside - contains **Mantle Cavity** that allows gas exchange
- Arthropoda
 - **Spiracle:** Series of openings that open into a system of tubes called **Trachea** - connect spiracles to all over the body

Human respiratory System

- **Nose:** typically breathe air through the nose
 - Connects to the Oral cavity, Pharynx
 - Glottis opens between the **Pharynx and the Larynx**
 - **Larynx:** surrounded by cartilage and relatively thick

Trachea, Bronchus, Bronchial Tree

Bronchiole: smallest openings - does not have cartilage rings - connect to sacs called **Alveoli**

Heart: in the middle of the lungs

Diaphragm: Below the lungs

- Inhaling: Diaphragm

- They don't connect together, there is a space between the two called **the Synaptic Cleft**
- Vesicles within the presynaptic cell contain a certain chemical called a **Neurotransmitter**
- When an action potential reaches the end of the axon it will trigger the release of **neurotransmitters** into the **Synaptic Cleft**
- Come into contact with the **postsynaptic membrane** can cause ion channels to open to trigger a **action potential** within the **postsynaptic membrane**

Nervous System

- Coordinating activities of the body
- sensing the environment
- responding to the environment

Porifera

- No Nervous system

Cnidaria

- Has a nervous system - simple; called a **nerve net**
- Mostly rely on individual sensory neurons

Platyhelminthes

- Net-like, but with brain and nerve cords
- Simple eyes
- All other groups of Animal phyla have some sort of brain with chords
- Some groups of Ganglia: cluster of nerve cell bodies outside of the
 - Mollusca, Annelida, Arthropoda, and Chordata

- perception, language, volition

Integration

- reflexes are a simple form of integration

Peripheral Nervous System

- Nerves are bundles of myelinated axons
- Stimuli will trigger sensory receptors where the information is carried to **afferent neurons** that carry messages to the **central nervous system** where **efferent neurons** carry messages away from the **central nervous system**
- **Efferent** neurons can be split up into the **Somatic Nervous System** (voluntary nervous system) - skeletal muscles
- **Autonomic Nervous system**: no conscious control - carries messages to smooth muscle, cardiac muscles and glands
 - Into three parts
 - 1.) **Enteric Division**: basic digestive functions
 - 2.) **Parasympathetic Division**: rest and digest
 - 3.) **Sympathetic Division**: fight or flight response

Senses

- Initiating action potentials in response to specific stimuli
- **Mechanoreceptors**: respond to mechanical force
- **Chemoreceptors**: respond to specific chemicals
- **Electromagnetic receptors**: respond to electromagnetic energy
- **Thermoreceptors**: respond to temperature
- **Pain receptors**: respond to damaged tissues

Statocyst:

- Have mechanoreceptors that form a hollow ball
- The statolith tend to settle at the bottom of the cilia due to gravity, tell the animal which way is up

Human Hearing

- Outer Ear, Middle Ear, and Inner Ear
- Outer ears has 2 parts:
 - Pinna: the visible portion, helps to direct sounds waves into the ear
 - direct sound into the **auditory canal**
- **Middle Ear**: auditory canal goes along until it hits the **Tympanic Membrane** which seals off the aer
 - Sounds hit the **Tympanic Membrane** and make it vibrate and vibrations are transferred to the **ossicles of the middle ear** and transfer them to the inner ear
- Inner ear: main part concerned with hearing is the **cochlea**
 - **Basilar Membrane**: has **hair cells** sitting on top of it that are mechanoreceptors
 - Fluid transmits the pressure waves and press on the basilar membrane causing it to move up and down
 - The hair cells bash up and down with the membrane above it causes the mechanoreceptors to initiate an action potential which is carried to the brain
 - The Basilar membrane is not uniform; different parts of it will vibrate depending on the frequency
 - Also contains the vestibule, and semicircular canals

Human Balance

- Semicircular canals: that are all perpendicular to each other
 - The fluid in the ears continue to move if you move in a circle which trigger action potentials which tell the brain that you're still moving

Chemoreceptors

Human taste

- Taste Buds: clusters of chemoreceptors on the tongue

Human Smell

- Chemoreceptors embedded within the epithelial cells