|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Macro Molecule** | **Subunits** | **Function** | **Foods** | **Examples** |
| **Carbohydrates** | Monosaccharides | Quick energy | Grain, bread, pasta, rice | **Glycogen** – animals**Cellulose**-plant cell wall**Starch**- plants |
| **Protein** | Amino acids | Structure | Meat, nuts, eggs, beans | Enzymes |
| **Lipid** | Fatty acids + glycerol | Energy storage + insulation | Oil, butter, fried foods | Waxes |
| **Nucleic Acid** | Nucleotides | Store genetic info |  | DNA/RNA |

 **Enzymes**:

* Proteins that speed up chemical reactions by lowering the reaction’s activation energy
* Enzymes can be reused
* Enzymes fit together with their substrates like a lock and key.
* Every enzyme works best at a particular pH and temperature. If the pH or temperature is too high or too low, the enzyme’s ability to work decreases and as a result, the reaction rate will decrease.



A. Substrate
B. Active Site
C. Enzyme
D. Enzyme Substrate Complex
E. Products



A. Ribosomes: Make Proteins
B. Nucleus: Control Center
C. Cell Membrane: Controls what goes in and out, Homeostasis.
D. Vacuole: Storage
E. Chromatin: Loose DNA, Stores genetic information.
F. Mitochondria: Produce Energy, Cell Respiration

**Differences between Eukaryotes and Prokaryotes:**

|  |  |
| --- | --- |
| **Eukaryotes** | **Prokaryotes** |
| Animals, Plants, Protists, Fungi | Bacteria |
| Nucleus | No Nucleus |
| Membrane Bound Organelles (Mitochondria) | No Membrane Bound Organelles |
| Unicellular and Multicellular | Unicellular only |

**Differences between Plant Cells and Animal Cells:**

|  |  |
| --- | --- |
| **Plants** | **Animals** |
| Chloroplast and Mitochondria | No Chloroplast, Mitochondria Only |
| Large Vacuole | Small Vacuole |
| Cell Wall | No Cell Wall |
| No Centrioles | Centrioles |

**Embryonic Stem Cells** all have the same DNA yet when they differentiate (Cell Differentiation) they become the 210 different cell types in the human body. They do this through

**Gene Regulation**; the switching on and off of different genes. Through this process cells of very different structures and functions are produced such as:

* Nerve Cells: that send electrochemical signals.
* Muscle Cells: that contract and relax to allow for locomotion.
* Red Blood Cells: that transport oxygen to tissues

**ATP**: Cell Energy in the bonds between the phosphates. When one of the bonds is broken energy is released and the molecule loses one phosphate group and becomes ADP

**Aerobic Respiration**: Oxygen + Sugar -> Carbon Dioxide + Water + 36 ATP

**Anaerobic Respiration**: Without Oxygen

* Lactic Acid Fermentation: Sugar -> Lactic Acid + 2 ATP (sore muscles in humans)
* Alcoholic Fermentation: Sugar -> Alcohol + Carbon Dioxide + 2 ATP (yeast)

**Chloroplast**: Store Solar Energy in the bonds of Sugar

**Photosynthesis**: Carbon Dioxide + Water + Sunlight -> Oxygen + Sugar

**Passive Transport**: Molecules flow from an area of High Concentration -> Low Concentration. No ATP

* Diffusion:
* Facilitated Diffusion: Diffusion through a Transport Protein
* Osmosis: the Diffusion of Water

**Active Transport**: Materials transported against the concentration gradient using cellular energy ATP

* Low Concentration  High Concentration.
* Cellular Energy needed, ATP needed.

**Osmosis**: Remember it is the water that is going in and out of the cells not the solute. 

Hypertonic Solution Isotonic Solution Hypotonic Solution
 cell shrinks cell stays the same cell swells

**Cell Cycle**

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Interphase:
G1 – growth
S – DNA replication
G2 – prepare mitosis

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Mitosis:

* Somatic Cells
* No Genetic Diversity
* Growth and Repair
* 2 Identical Diploid Daughter Cells (Same # of chromosomes as the parent cell)

**Cancer**: Genetic Damage to Stop Enzyme Gene -> Uncontrolled Cell Division -> Tumor

DNA -> (Transcription) MRNA -> (Translation) Protein -> Trait

**Helicase:** Enzyme that Untwists and Unzips the DNA during DNA Replication and Transcription.

**Study the Diagram:**



DNA: GTA
MRNA: CAU
Amino Acid: Histidine

**Mutations**: Can disable a trait by changing one or more amino acids in the sequence in a protein. This would change the protein’s shape and as a result, disrupt its function.

**Point Mutation** (Substitution, changing one letter) could result in the change of 1 Amino Acid Ex. Sickle Cell Anemia, or no change in the Amino Acid sequence.

**Frameshift Mutation** (Deletion or Addition) (Most Harmful) changes many Amino Acids in the sequence.

**Biotechnology**:

* **Restriction Enzyme**: Used to cut DNA.
* **Gel Electrophoresis**: separates DNA (DNA Fingerprinting, Forensics and Paternity Tests)
* **Transgenic Organisms** (organisms with the DNA of one or more species) Ex. Human Insulin Producing Bacteria, Transgenic Bacteria used to clean up oil spills, GMO Crops

**Gel Electrophoresis Transgenic Bacteria**

 

**Meiosis**: Gamete Cell Division

* Lots of Genetic Diversity
* Production of Sperm or Egg for Sexual Reproduction.
* 4 Unique Haploid Gametes (half the chromosomes or the parent cell)
* Crossing Over during Prophase I

Problem: Non-Disjunction - Sperm or Egg cells end up with either 22 or 24 chromosomes instead of 23 resulting in Chromosomal abnormalities such as **Downs Syndrome** (47 Chromosomes, Trisomy 21)

**Mendelian Genetics:**

**Alleles**: Alternate versions of a gene

|  |  |  |
| --- | --- | --- |
| **Types of Dominance** | **Genotype** | **Phenotype** |
| **Complete Dominance** | BB Bb bb | Dominant and recessive |
| **Incomplete Dominance** | RR R’R’ RR’ | Blend colors (red+white=pink) |
| **Co-Dominance** | RR WW RW | Both show up (roan cattle) |

 **Multiple Alleles: Ex. Blood Types**

|  |  |
| --- | --- |
| Blood Types | Genotype |
| A | IA IA or IA i  |
| B | IB IB or IB i  |
| AB (Universal Acceptor) | IA IB (Co-dominant) |
| O (Universal Donor) | ii (Recessive)  |

 **X Linked Recessive**: Hemophilia and Colorblindness (XX; Xy)

**Polygenic**: Traits Controlled by more than one Gene. Ex. Skin, Hair, and Eye Color.

**Evolution**

* The first life form was a Anaerobic Prokaryote (Bacteria that didn’t need oxygen)
* Then Photosynthetic Prokaryotes (Chloroplasts) and Aerobic Prokaryotes (Mitochondria) evolved.
* The rest of life on Earth eventually evolved from this early life through Mutations and the process of Natural Selection. **Natural Selection** - is where the variety of a species that is better adapted to an environment survives and reproduces increasing the % of their variety in the next generation.

**Evidence for Evolution:**

1. Similar Biochemistry (DNA and Amino Acid Sequences)
2. Similar Anatomy (Homologous structures)
3. Vestigial structures
4. Fossils
5. Embryology

**Classification and Kingdoms**

* The more groups you share suggest a common ancestor
* A **scientific name** is made up of an organism’s Genus and Species. Ex. Canis lupus (Wolf)
* **Protista**: are Eukaryotes that can be animal like, fungus like, or plant like.
* **Cilia**: used for locomotion and feeding the mouth pore.
* **Contractile Vacuole**: used to transport water out of the cell using Active Transport.
* **Eye Spots and Flagellum**: Allow plant-like protists to detect and swim towards light in order to conduct photosynthesis. This behavior is called **Phototaxis**.

**Ecosystem Relationships**:

|  |  |  |  |
| --- | --- | --- | --- |
| Relationship | Organism#1 | Organism#2 | Example |
| Competition |  |  | Herbivores competing over food when the ecosystem has reached carrying capacity. |
| Mutualism | + | + | Bees get food, flowers get pollinated |
| Parasitism | + | - | Tick on a Dog |
| Predator Prey |  |  | Keep populations balanced |

 **Environmental Threats:**

* **Climate Change/Global Warming**: Increase of Carbon Dioxide
* **Acid Precipitation**: Sulfur Dioxide and Nitrogen Oxide from Car Exhaust in higher elevations
* **Habitat Destruction**: Urbanization, deforestation
* **Invasive Species** out compete native species Ex. Kudzu,Dutch Elm disease.
* **Bio-Magnification**: As you go up the food chain the concentration of Toxins go up. Ex. DDT