Hypothesis

Quantitative
&
Qualitative
observations

Theory

Levels of organization

Controlled experiment

Homeostasis

Characteristics of living things

pH scale

Quantitative- involves numbers, counting, measuring objects.

Qualitative- involves characteristics that cannot easily measured or counted such as color or texture.

Hypothesis- a proposed answer to a scientific question ("educated guess")

Must be specific and testable

Levels of Organization

cells→tissues→organs→ organ systems→organism

Theory- a well-tested hypothesis.

May be revised or replaced if new information becomes available.

Homeostasis- ability to maintain constant or stable conditions inside despite changes outside. (like thermostat in your house)

Controlled experiment- all variables are kept constant except one being tested.

Used to test hypothesis

pH scale- used to indicate concentration of the H+ ions.
1. Scale ranges from 0 to 14 (decreases with acidity)
2. Pure water has pH of 7
3. Acids below 7 and bases above 7

Characteristics of living things

- Made up of one or more cells
- Need source of energy
- Respond to environment
- Can reproduce
- Have genetic material (DNA)

Ribosomes

Organic compounds

Animal cells
vs.
Plant cells

Enzymes

Cell membrane

Golgi apparatus

Eukaryotic
vs.
Prokaryotic

Endoplasmic reticulum

Organic compounds- contain carbon (includes: **carbohydrates, proteins, lipids, nucleic acids**)
Large molecules (polymers) built with individual building blocks (monomers)

Amino acid → protein
monosaccharide → starch, cellulose
Nucleotide → nucleic acid

Ribosome- organelle in the cytoplasm that makes proteins using coded instructions from the nucleus

- Made of rRNA
- Site of translation

Enzymes- specialized proteins that act as biological catalysts.
Catalysts- a substance that speeds up the rate of a chemical reaction by lowering a reactions activation energy.

- Enzymes are very specific
- Enzymes are not used up in a chemical reaction.

animal cell- do not have chloroplasts, cell wall or large central vacuole

Plant cell- more rigid in shape (cell wall)

Golgi Apparatus (Bodies)- "post office" of the cell

- carbohydrates and lipids attached to proteins are "packaged"
- Then sent to final destination

Cell Membrane- thin, flexible barrier around the cell composed of lipid bilayer. Channels in membrane made of proteins.
Semi-permeable- allows some things through but not others

Endoplasmic Reticulum- cells internal transport system. Components of the cell membrane assembled and some proteins modified

Rough E.R.- (has **ribosomes** attached) Smooth E.R. (no ribosomes)

A Comparison of Cells

Structure	Prokaryotic Cells	Eukaryotic Cells	
		Animal	Plant
Cell Membrane	Yes	Yes	Yes
Cell Wall	Yes	No	Yes
Nucleus	No	Yes	Yes
Ribosomes	Yes	Yes	Yes
Endoplasmic Reticulum	No	Yes	Yes
Golgi Apparatus	No	Yes	Yes
Lysosomes	No	Yes	No
Vacuoles	No	Small or none	Yes
Mitochondria	No	Yes	Yes
Chloroplasts	No	No	Yes
Cytoskeleton	No	Yes	Yes

Mitosis

Diffusion

Meiosis

Osmosis

lysosome

Cell transport

Nucleus

ATP

Diffusion- Movement of materials from areas of high concentration to areas of low concentration

- Form of passive transport (no energy required.
- When concentration equal on both sides of membrane → equilibrium

Mitosis- Division of cells nucleus
Divided into 4 phases (**PMAT**)

- 2n cells → 2n cells
- Diploid cells → Diploid cells
- Produces 2 genetically identical cells
- Occurs in all body cells

Cytokinesis- division of cytoplasm following mitosis.

Osmosis- Diffusion of water molecules through selectively permeable membrane

- If cell has lower concentration of water → water flows into cell, causing it to burst.
- If cell has higher concentration of water → cell loses water and shrinks in size.

Meiosis

- making of sex cells (gametes)
- 2n → n
- Diploid cells → haploid cells
- Produces 4 genetically different cells
- Occurs only in sex organs
- **Fertilization** (egg + sperm)
  n + n → 2n

Cell transport- movement of materials into and our of cell.

- **Active transport**- requires energy by cell
- **Passive transport**- no energy required (diffusion and osmosis)

Lysosomes- "clean-up crew" of the cell

- break down lipids, carbohydrates, proteins from food particles ("little digestive sacs")
- Break down "old" cell parts,

ATP (adenosine tri-phosphate) - chemical fuels that power all activities of the cell

- Adenosine triphosphate (ATP)- stores energy in phosphate bonds
- Gives up energy when remove a phosphate group

Nucleus

- Controls most of cells processes and contains hereditary information (DNA).
- (Controls activities of the cell by making proteins)
- Found in eukaryotic cells

Photosynthesis

Fermentation

Cellular Respiration

DNA

Mitochondria

RNA

Chloroplast

Replication

Fermentation

- Process that allows glycolysis to continue and produce small amount of energy
- Takes place when oxygen not present (anaerobic)
- 2 kinds- Alcoholic and lactic acid

Photosynthesis

- Energy from sunlight converts water and carbon dioxide into oxygen and high-energy sugars.
- Takes place in chloroplast
- Affected by temperature, light, and amount of water
- First stage- light dependent (chlorophyll)

$6CO_2 + 6H_2O + LIGHT \rightarrow 6O_2 + C_6H_{12}O_6$

DNA

- Deoxyribonucleic acid
- Contains genetic information in segments of DNA called genes
- Made up of nucleotides
- Letters (bases)- **A-T C-G**
- Double helix shaped molecule

Cellular Respiration

- Process that releases energy by breaking down food molecules in the presence of oxygen
- Occurs in three stages- glycolysis→krebbs cycle→electron transport
- Occurs in mitochondria

$6O2 + C6H12O6 \rightarrow 6CO2 + 6H2O + ENERGY$

RNA

- ribonucleic acid
- 3 types made from DNA (mRNA, tRNA, and rRNA)
- Made up of nucleotides
- Letters (bases)- **A-U C-G**
- Single stranded

Mitochondria

- Cells “Powerhouse”
- found in nearly all eukaryotic cells.
- use energy from food to power growth, development, and movement
- Cells that require more energy have more mitochondria

Replication

- DNA making exact copy of itself before cell division
- Occurs in nucleus
- DNA “unzips” and complimentary bases pair up with each side of DNA to form two new identical strands.

Chloroplast

- found in plants and some other organisms (none found in animals and fungi)
- produce energy-rich food molecules (glucose) from sunlight by photosynthesis
- Green pigment- **chlorophyll** found in photosynthetic membranes

Transcription

Principle of Independent assortment

Translation

Haploid vs. Diploid cells

Genes

Principle of segregation

Principle of Dominance

mutation

Principle of Independent Assortment

- Allele pairs separate independently of each other during meiosis (gamete formation)
- Different traits are inherited separately
- Use FOIL rules to determine gametes from two-factor cross (i.e. TtFf would produce TF, Tf, tF, tf gametes)

Transcription

- DNA making RNA
- Occurs in nucleus of cell
- DNA "unzips" and one side codes for new single strand of RNA
- A→U T→A C→G G→C
- Makes 3 kinds of RNA (mRNA, tRNA, and rRNA)
- 3-letter "word" called **codon**

Haploid & diploid cells

- **Haploid (n)** - half the number of chromosomes. Found in gametes (sex-cells) produced by meiosis

- **Diploid cells (2n)** - two sets of chromosomes (one from each parent). Found in all body cells (i.e. skin cells, bone cells, etc.)

Translation

- RNA making proteins
- Occurs in cytoplasm
- Uses all 3 kinds of RNA
- Code carried on mRNA
- Occurs at ribosomes which are made of rRNA in the cytoplasm
- tRNA transports amino acids to ribosomes
- 3-letter "word" called **anticodon**

Principle of Segregation

- that two alleles for traits separate (segregated) from each other during meiosis (formation of sex cells (gametes)
- Like flipping a coin (50/50)

Genes

- Segment of DNA molecule
- Found on chromosomes
- Carries instructions to make one protein
- Proteins control traits
- 20,000 - 25,000 genes in humans

Mutation

- Any change in DNA of an organism.
- May or may not affect individual (phenotype)
- May be small change in sequence of DNA, or may involve extra or missing chromosomes.

Principle of dominance

- Some alleles are dominant and some are recessive
- Use capital letter for dominant trait (i.e. T=tall and t=short)
- TT and Tt would be tall, tt = short
- Only way to have recessive trait is to have 2 recessive alleles (tt)

Polygenic traits

Amino acids & Proteins

Crossing over

Sex-linked traits

Heterozygous & Homozygous

Multiple allele traits

Genotype & Phenotype

Incomplete dominance

Amino acids and Proteins

- Amino acids are monomers that build proteins
- 20 kinds of amino acids
- 64 codons on mRNA for amino acids (more than one codon codes for each amino acid
- Thousands of proteins using different types and number of amino acids

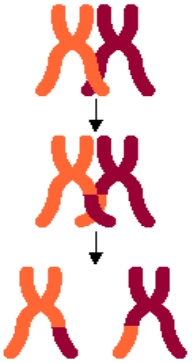
Polygenic traits

- Traits which are controlled by more than one gene
- Examples are eye color and skin color

Sex-linked traits

- Traits on the X-chromosome
- Occur more often in males because males only have a single X-chromosome
- Males - XY Females - XX
- Include colorblindness, hemophilia
- Females can be **carrier**, males cannot . Example- X^HX^h **and** X^hY

Crossing over



- Exchange of portions of chromatids takes place while chromosomes exist as tetrads during meiosis
- Increased variety in gametes (mixes up the genes more)

Multiple allele traits

- More than 2 choices (tall/short), such as in Blood type. 3 alleles- I^A, I^B, **i**
- Can exhibit dominant/recessive, as well as co-dominance. E.g. I^A and I^B are codominant, and are both dominant over **i.**
- Can lead to 4 phenotypes (A, B, AB, 0)

Heterozygous & homozygous

- **Heterozygous**- different alleles (Tt)
- **Homozygous**- same alleles (TT or tt)

Incomplete dominance

- Blending of traits
- Purebred Red flower crossed with purebred white gives pink flowers
- Heterozygous is blending of 2 traits
- RR x WW = RW (pink flower)

Genotype & Phenotype

- **Genotype**- the letters (TT, Tt, tt)
- **Phenotype**- The physical traits (tall or short, red or white flowers, etc.)

Dom/Rec cross
Phenotypic ratio- **3:1**
Genotypic ratio- **1:2:1**

	T	t
T	**TT**	**Tt**
t	**Tt**	**tt**

Punnett square

Dominant-Recessive Punnett square

Genetic Code

Incomplete dominant Punnett square

Pedigree

Multiple alleles Punnett square

Human Genome

Chlorophyll

If Tall (T) is **dominant** over short (t)
Cross two heterozygous parents

Phenotypic ratio - **3:1**
Genotypic ratio - **1:2:1**

TT, Tt- tall tt-short

	T	t
T	TT	Tt
t	Tt	tt

	T	t
T	TT	Tt
t	Tt	tt

Punnett Squares- a tool to show the probable outcome of genetic cross

- Dominant / Recessive
- Incomplete Dominant
- Multiple alleles
- Sex-linked

If Tall (T) is **incompletely** dominant over short (t)
Cross two heterozygous parents

Phenotypic ratio - **1:2:1**
Genotypic ratio - **1:2:1**

TT-tall Tt- medium
Tt-short

	T	t
T	TT	Tt
t	Tt	tt

Codons Found in Messenger RNA

First Base	Second Base: U	Second Base: C	Second Base: A	Second Base: G	Third Base
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	Stop	Stop	A
	Leu	Ser	Stop	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

UUU = Phe

UUC = Phe

UCU = Ser

GAU = Asp

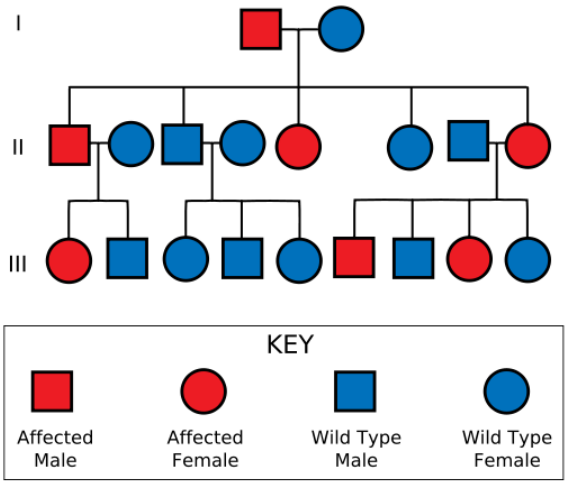
AGG = Arg

Multiple allele- I^A & I^B are codominant and both are dominant over i.

Phenotypic ratio - **2:1:1**
Genotypic ratio - **1:1:1:1**

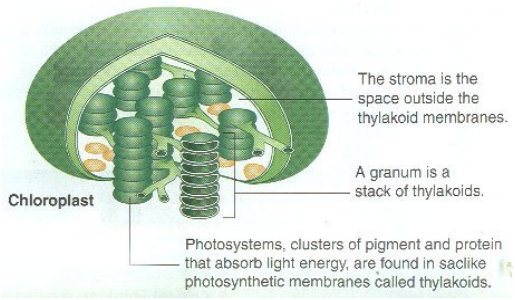
I^AI^A, I^Ai- type A
I^AI^B- type AB
I^Bi- type B

	I^A	i
I^A	I^AI^A	I^Ai
I^B	I^AI^Bt	I^Bi



Chlorophyll- pigment found in chloroplast that captures energy from sunlight

- Reflects green light (look green)
- Found in plants (chloroplasts)



23 pairs - 46 chromosomes

22 pair (autosomes)
1 pair (sex-chromosomes)

One of each pair from mother and father (50/50)

Each chromosome contains many genes.