

- **1)** amino acids and tRNAs float freely in the cytoplasm
- **2)**
- Specific charged tRNAs join growing protein based on codon/anticodon complementary
 - **3)** a tRNA will dock if the complementary RNA codon is present on the ribosome
 - **4)** the amino acids join together to form a polypeptide
- Protein chain grows, adding new amino acids and making peptide bonds
 - **5)** the ribosome moves on to the next codon to receive the next tRNA
 - **6)** when the ribosome reaches the stop codon, no tRNA can base-pair with the codon on the mRNA. RNA and the newly synthesized protein are released
- mRNA's codon matches no tRNA = STOP
 - **7)** the chain of amino acids folds, and the protein is ready to perform its job
 - **8)** the subunits of the ribosomes separate but then reassemble and begin translation of another mRNA

How is it determined which amino acid gets inserted in a protein

Ultimately the job of the tRNA, making sure that the codons match up so that the tRNA can deposit the amino acid and move on

Information Flow

- DNA (order of base pairs)
 - → mRNA (order of bases)
 - → protein (order of amino acids)
- Order of amino acids
 - → protein shape

Permit and maintain heritable changes (mutations)

- If an incorrect amino acid is placed during translation, a mutation occurs

- Contain same and different genes

Somatic cells

- Two copies of most genes
- Every body cell gets two copies of each gene, except for genes on X and Y in males
- Homologous chromosomes can carry different versions of genes at the same locus
 - Versions of genes = alleles
 - → genetics

Asexual Reproduction

- Offspring genetically identical to original cell or organism (except mutations)
- All genes inherited from one parent

Asexual Reproduction = binary fission (prokaryotes)

- Occurs in prokaryotic cells
- Two identical cells arise from one cell (except mutations)
- Process

Eukaryotic Cell Division

- Mitosis produces new cells in order to:
 - Produce new unicellular cells
 - Heal wounds and replace damaged cells/tissues
 - Grow and develop

Cell Cycle: Interphase

- Three Stages
 - **G1**: first gap or growth phase: organelles duplicated, cells get larger
 - **S**: synthesis phase: DNA is copied
 - **G2**: second gap phase: synthesis of proteins necessary for mitosis
- Copied chromosome: two sister chromatids are connected at centromere

Cell Division

- Interphase: DNA is copied

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LOOK UP IN POWERPOINT

- Telophase I and Cytokinesis – Cytokinesis results in two daughter cells. Nuclear envelopes reform
- Prophase II – Microtubules lengthen
- Metaphase II – chromosomes align at middle of cell
- Anaphase II – Sister chromatids are separated by shortening of microtubules
- Telophase II – Four haploid daughter cells result. Nuclear envelopes reform

Sources of Variation

- Random mating, random gamete fusion
- Crossing over → recombination
 - Prophase I: homologous pairs exchange genetic information
- Random alignment
 - Metaphase I: random alignment of homologues

Crossing over in Prophase I

- Genetic recombination = production of new combinations of alleles due to crossing over
- Crossing over involves exchange of genetic material between homologous chromosomes
 - Non-sister chromatids join at a chiasma (plural, chiasmata), site of attachment and crossing over
 - Corresponding amounts of genetic material are exchanged between maternal and paternal (non-sister) chromatids

Accidents during meiosis can alter chromosomes number

Nondisjunction

- Chromosome pairs fail to separate during meiosis I
- Chromosomes fail to separate at centromere during meiosis II

Extra copy of chromosome 21 causes Down Syndrome

- Trisomy 21: 3 copies of chromosome 21
- Most common human chromosome abnormality (1/700 births)

Extra copy of chromosome 18 causes Edwards syndrome

- Trisomy 18: 3 copies of chromosome 18
- 1/3,000 births
- incidence increases with maternal age
- Edwards syndrome:
 - Heart defects

Final:

Circulatory System

Why do we need a circulatory system?

- Distribution of nutrients (from intestines to all tissues/cells)
- Pick up of wastes to be excluded (from tissues/cells to kidneys)
- Gas distribution and redistribution
 - O₂ brought from lungs to tissues/cells
 - CO₂ brought from tissues/cells to lungs
- Distribution of signaling molecules (e.g., Hormones)
- Distribution of immune cells and proteins (antibodies)
- Heat exchange

Some logistics:

- Blue = deoxygenated
- Red = oxygenated
- Vein = toward heart
- Artery = away from heart

Human cardiovascular system illustrates the double circulation of mammals

- Two thin-walled atria that pump blood to ventricles
- Thick-walled ventricles that pump blood to lungs and all other body regions
 - Left side is thicker (pumps oxygenated blood to entire body)
 - Right side is thinner (pumps deoxygenated blood to lungs)

Heart contracts and relaxes rhythmically

- During diastole
 - Blood flows from veins into heart chambers
 - AV valves open to allow all chambers to fill with blood
 - Semilunar valves close to keep blood in heart for big pump
- During systole
 - Atria contract: blood flows from atria into ventricles
 - AV valves close to prevent blood from flowing back to atria
 - Ventricles contract sending blood to lungs (if right side) and to body (if left side)

Heart contracts and relaxes rhythmically

- Cardiac Output
 - Amount of blood/minute pumped into systemic circuit
- Heart rate

- Number of beats/minute
- Heart valves

Pacemaker sets the tempo of the heartbeat

- The pacemaker (SA node)
 - Sets the rate of heart contractions
 - Generates electrical signals in atria
- The AV node
 - Relays these signals to the ventricles

Arteries – conduct blood away from the heart

Arterioles – constrict to control blood distribution

Capillaries – gas, nutrient, and waste exchange

Venules – small, thin extensions of capillaries

Veins – conduct blood back to the heart

Capillaries

- Thin walls – a single layer of epithelial cells
- Narrow – blood cells flow in a single file
- Increase surface area for gas and nutrient exchange

Smooth muscle controls the distribution of blood

- Blood flow through capillaries
 - Restricted by smooth muscle sphincters
 - Only about 15-19% of capillaries are open at one time

Blood flow against gravity

- Muscle pressure on blood in vein forces valves to open
- When muscles relax, blood pressure decreases, causing valves to close. Backflow of blood is prevented

Blood consists of red and white blood cells suspended in plasma

- Plasma: 90% water
- Rest of plasma:
 - Inorganic ions
 - Proteins

Blood cells suspended in plasma

- Platelets for clotting
- White blood cells (leukocytes)
 - Function inside and outside the circulatory system

Regulation of red blood cell production

- Hormone erythropoietin (EPO)

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Chapter 22: Nutrition and Digestion

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Why do organisms eat?

Processing food

Human digestive system

Nourishment

Why do we eat?

- Fuel to power the body
 - Proteins, carbohydrates, and fats are oxidized inside cells to make ATP
 - ATP is "currency" cell uses to do cellular work
- Organic molecules to build macromolecules
- Essential nutrients

Essential Nutrients

- Cannot be made from any raw material
- Malnourishment: missing essential nutrients
- Undernourishment: insufficient calories
- Overnourishment: too many unhealthy calories consumed

Essential Vitamins and Minerals

- Required in small amounts
- Vitamins: organic (with carbon)
 - Water-soluble
 - Fat-soluble
- Minerals: inorganic (no carbon)

Ingestion

- Entry and pre-processing
 - Initial item capture and manipulation
 - Mechanical with minor chemical action

Digestion

- Processing
 - Mechanical and chemical action
 - Prepares nutrients for absorption

Absorption and transportation

- Shipping
 - Absorbs nutrients into body fluids
 - Nutrients are delivered to necessary systems

Elimination

- Waste removal

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