    - **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 an 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
    - LOOK UP IN POWERPOINT

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

- Telophase I and Cytokinesis – Cytokinesis results in two daughter cells. Nuclear envelopes reform
- Prophase II – Microtubules lengthen
- Metaphase II – chromosomes alig at middle of cell
- Anaphase II – Sister chromatids are seprated 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

Nondisjuction

- 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 opies of chromosome 18
- 1/3,000 births
- incidence increases with materal 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 values 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 fluid exchange

Smooth muscle controls the distribution of blood

- Blood flow through capillaries
    - Restricted by smooth muscle sphincters
    - Only about 5-10% 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)

Chapter 22: Nutrition and Digestion

7/5/16 1:57 PM

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