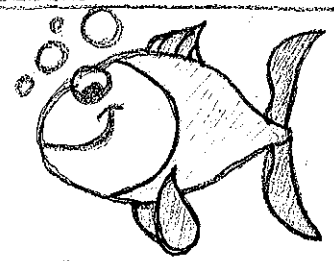
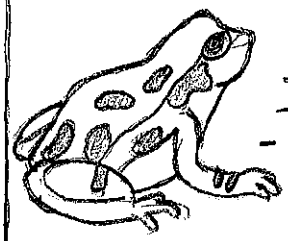
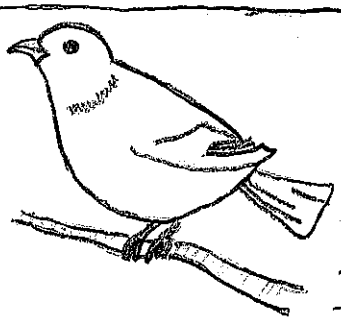
open circulatory system: no separation between blood and other fluids (insects, arthropods)
closed circulatory system: blood is confined by blood vessels (vertibrates)



2 chambered heart (fish):
- closed circulatory system
- blood slows in capillaries but is sped up by swimming

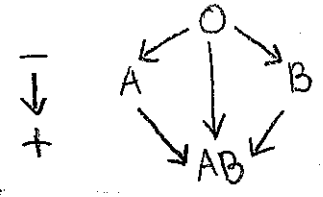


3 chambered heart:
- amphibians & reptiles
- 2 atria, 1 ventricle
- oxygenated and deoxygenated blood mixes → ↓ O_2 in body

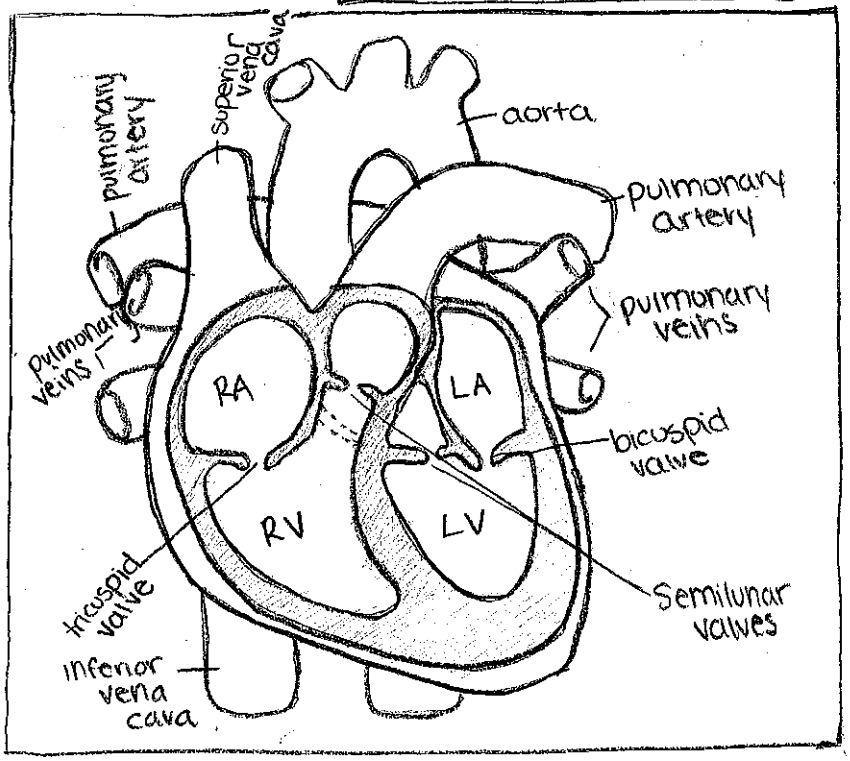


4 chambered heart:
- mammals, birds, crocodiles
- double circulation
- 2 atria: recieve blood
- 2 ventricles: pump blood away
- deoxygenated → right side
- oxygenated → left side
- sinoatrial node (pacemaker): RA, delivers electrical charge to beat

	A	B	AB	O
antigen	A	B	AB	-
antibody	B	A	-	AB



composition of blood:
- Red Blood Cells (erythrocytes):
  - carry O_2
  - hemoglobin (carries O_2)
  - lives 120 days
- White Blood Cells (Leukocytes):
  - defend against foreign items
  - macrophage: special, engulfs bacteria
  - # ↑ when infection
- Plasma:
  - fluid portion of blood
  - carries waste CO_2
  - H_2O, proteins, ions, amino acids, sugars, hormones
  - absorbs digested monomers → other parts of body
- Platelets:
  - assist in blood clotting



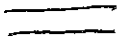
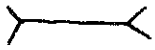
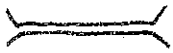
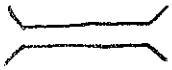
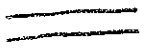
Artery vs vein:
artery: more pressure, away from ♡, thicker
vein: thinner, less pressure, → ♡, valves

Antigen: marker protein identifying a cell
antibody: attach to antigens when it is recognized as foreign substance
D antigen: RH +, no D antigen: RH −

Blood Pressure: force exerted by blood on arteries

$$\frac{\text{Systolic}}{\text{diastolic}} = \frac{\text{ventrical contractions}}{\text{atrium filling}}$$

hypertension: ↑ blood pressure → make ♡ work harder → damages ♡ muscles & blood vessels

pressure	effect on artery	sound
0 mmhg		silent
160+ mmhg		silent
135 mmhg		spirting blood → 1st beat → systolic
80-120 mmhg		beating
80 mmhg		last beat → diastolic

- brachial artery: standard for taking blood pressure
- varicose veins: valves are worn out + blood seeps through
- capillaries: connects arteries + veins, small vessels

Blood Clotting:

- coagulation: clotting of blood is necessary to prevent massive loss
- platelets: inert until tissue damage → reveals proteins → sticky → temporary clot
- platelets release clotting factors → clotting cascade → clotting factor X → prothrombin → thrombin → clot
- Hemophilia: disrupts clotting

- vascular plants: vessels to transfer H_2O and nutrients
- nonvascular plants: moist environments
- lignin: hard material in cell walls of vascular → structure

Xylem: ↑

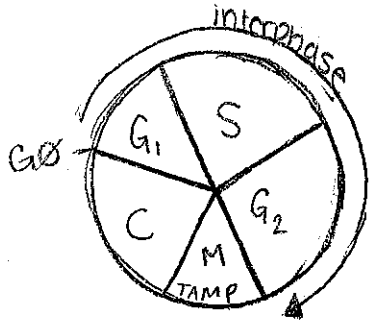
- carry H_2O and nutrients from roots → rest of plant
- cohesion-tension theory:
  - root pressure
  - transpiration
  - cohesion (H_2O-H_2O)
  - adhesion (H_2O-xylem)

} how H_2O moves up xylem

Phloem: ↑↓

- living cells that transport sugars and amino acids to parts of the plant
- sieve tubes: holes that transport materials between phloem cells
- pressure-flow hypothesis:
  - source → sink

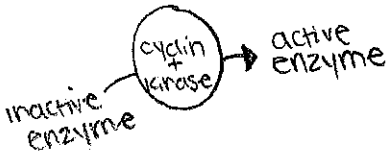
cell cycle: cellular reproduction



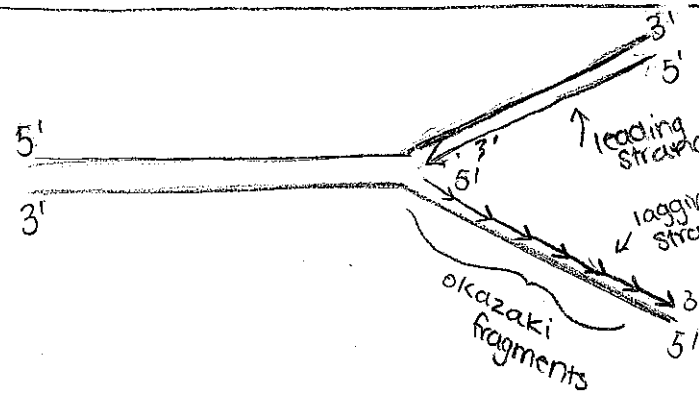
G0: normal functioning cells
G1: gap phase, growth
S: synthesis, DNA replication
G2: growth, check point; bigger nucleus
M: mitosis - separates nuclei
C: cytokinesis - separates cells

If "mistake" (mutation):
- DNA polymerase can proofread + change DNA
- Excision repair: enzymes cut out mistaken DNA + replace it

- cyclin: proteins that regulate cell cycle; amount rises/falls during different stages
- kinase: CDK (cyclin dependent kinase), enzymes that phosphorolate other enzymes same amount during different stages
- cyclin-kinase interaction:



ex: G1 cyclins...
- signal growth
- signal for DNA replication
- causes cell to leave G0



- helicase: separates strands (breaks hydrogen bonds)
- DNA polymerase III: adds complimentary nucleotides to RNA primer
- DNA polymerase I: replaces RNA primer with DNA
- DNA ligase connects okazaki fragments

Mitosis:

- Prophase:
  - chromatin → chromosomes
  - nuclear membrane dissolves
  - mitotic spindle forms
  - centrioles → poles → anchored
  - microtubules attach to centrioles
- Metaphase:
  - chromosomes line up @ equator
- Anaphase:
  - sister chromatids separate
- Telophase:
  - chromosomes → chromatin (uncoil)
  - nuclear envelope forms
  - cytokinesis

- Protooncogenes: accelerator
- Tumor Supressor genes: break
- mutated proto oncogene → oncogene (cell reproduction at inappropriate times)
- cancer = unregulated cell division = mutated protooncogenes and mutated tumor supressor genes

- RNA: single stranded, AUGC
- mRNA: temporary copy of gene
- tRNA: clover leaf, carries amino acids during translation
- rRNA: makes up ribosome

- codon: 3 base sequence of mRNA; codes for amino acid
- anti-codon: 3 base sequence of tRNA, directs sequence of AA

DNA —transcription→ RNA —translation→ protein

- Transcription: DNA → RNA
- Translation: mRNA → protein

Transcription:

- Initiation: RNA polymerase attaches to a section of DNA at promoter site (initiation factor proteins must be present)
- Elongation: RNA polymerase partially unwinds DNA, RNA polymerase adds complimentary RNA nucleotides
- Termination: RNA polymerase reaches terminator region → RNA polymerase + RNA primary transcript are released

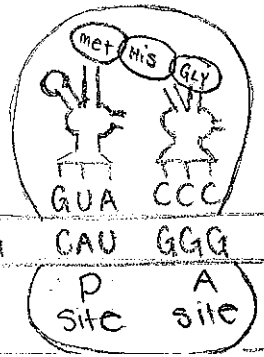
mRNA processing:

- Post Transcription modifications:
  - MG cap
  - Poly A tail

  } protect mRNA from enzymes that would break down nucleic acids
- Splicing: removal of introns (do not code for proteins), rejoining of exons

Translation Errors:

- point mutation: one base is changed, really bad if @ start or stop codon
- frameshift mutation: insertion or deletion of a base → will change every codon



1) UAC starts at P site and codon @ A site
2) peptide bond forms between amino acids
3) ribosome shifts 1 codon, tRNA @ P site → E site, tRNA @ A site → P site
4) new tRNA → A site

Viruses: non-living particle, nucleic acid in proteins

Lytic:
- active, contagious, symptomatic
- host cell enzymes and ribosomes can replicate, transcribe, and translate to make new viruses → lyse (cell bursts → virus spreads)

Lysogenic:
- inactive, non-contagious, asymptomatic
- viral DNA is inserted into host cell's DNA, replicated when cell divides (can be activated by stress)

- Bacteriophage: virus that attacks bacteria
- retrovirus: virus with RNA, uses process of reverse transcription to turn viral RNA → DNA that can join host cell's DNA, enzyme = reverse transcriptase
- no antibiotics for viruses

- diploid (2n): double set of homologous chromosomes
- haploid (n): single set of chromosomes

- Principle of Segregation: parent organisms posess two alleles for each gene, but only put one in a gamete
- principle of independent assortment: alleles for different characteristics are put into gametes independently

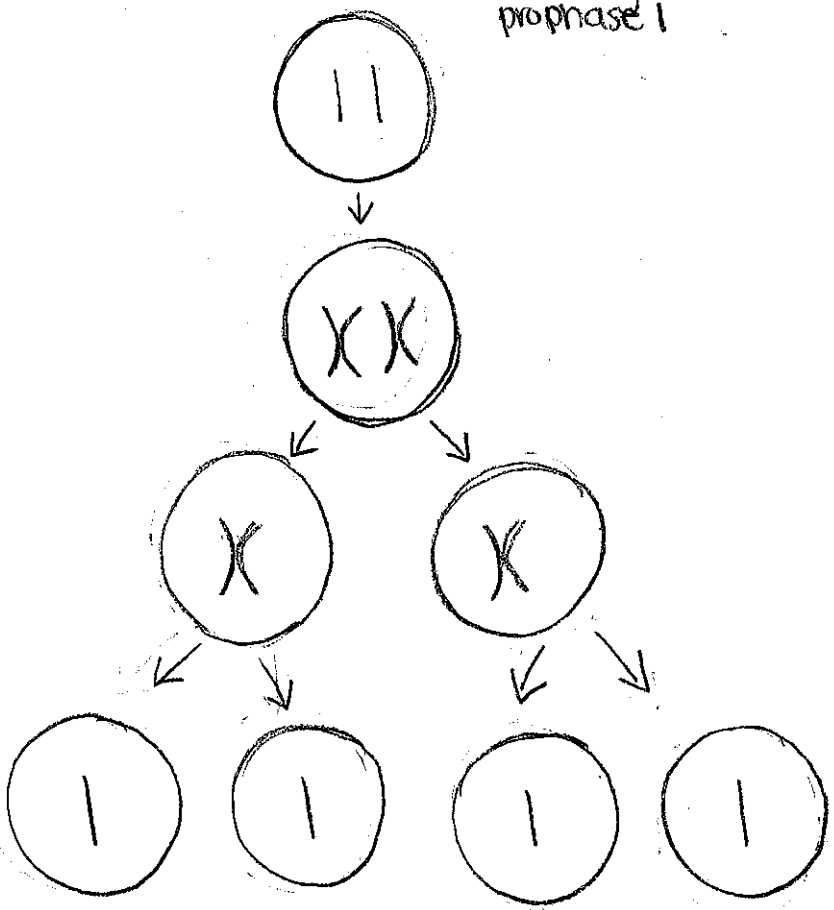
Human blood:

I^A, I^B, and i

O (i) is recessive

Meosis:

*crossing over in prophase I



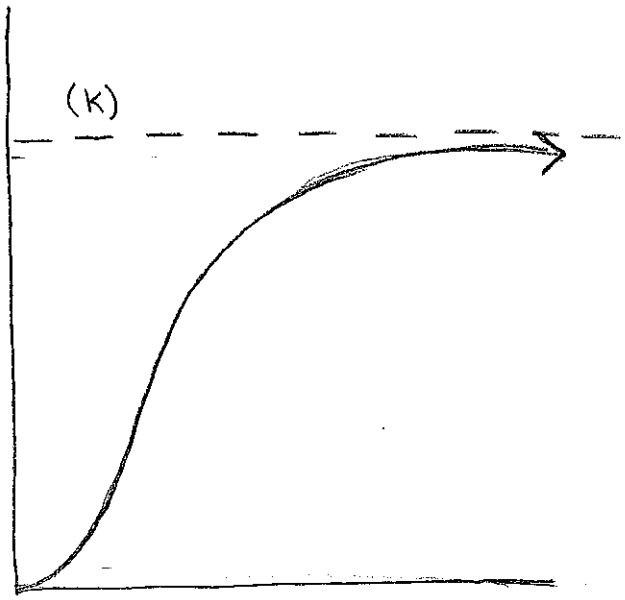
Nondisjunction: chromosomes fail to separate evenly in meosis → trisomy & monosomy → degree of retardation

- complete dominance: 3 genotypes, 2 phenotypes
- incomplete dominance: blending
- codominance: checkered, spotted
- sex-linked: X + Y
- multiple alleles: $S > S^h > S^c > s$
- polygenic: multiple genes control 1 trait (ex: hair, eyes, etc.)

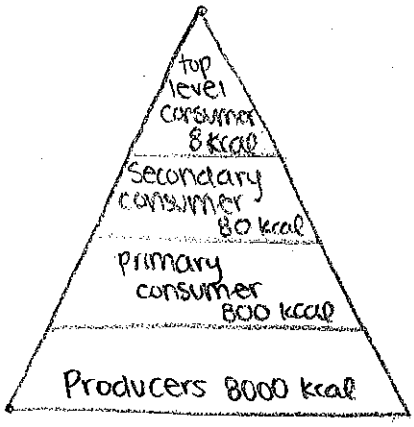
dihybrid:

TtGg x TtGg

	TG	tG	Tg	tg
TG				
tG				
Tg				
tg				



- carrying capacity: max # of organisms an environment can support (determined by limiting factors)
- density dependent (DD) limiting factors: depends on the population (ex: food)
- density independent (DI) limiting factors: same effect no matter how big the population (ex: sunlight)



10% energy remains from one level to the next

Carbon cycle:
- uses CO_2:
  - photosynthesis
  - dissolved CO_2 in H_2O
- releases CO_2:
  - combustion
  - erosion
  - death/decay
  - respiration

Boom-Bust:

- Boom: exponential growth
- Bust: massive death rate

Natural Selection: individuals w/ favorable variations are more likely to survive, reproduce, and pass on these variations

Sources of Genetic Variation:
- mutation
- meosis
  - independent assortment
  - crossing over
- sexual reproduction
- immigration

according to Darwin, natural selection = "decent with modification"

Predation: +, −
competition: −, −
mutualism: +, +
parasitism: +, −
commensalism: +, 0

Hardy-Weinberg:
$P+Q=1$, $P^2+2PQ+Q^2=1$
P/Q = allele frequency
P^2/Q^2 = homozygous
2PQ = heterozygous

Mechanisms for change in allele frequency:
- large populations:
  - natural selection
  - artificial selection
  - gene flow (immigration/emmigration)
- small populations: } genetic drift
  - genetic bottleneck
  - founders effect