# Circulatory System

2.

| Open Circulatory System | Closed Circulatory System | |
|---|---|---|
| -no separation blood and fluids<br>-fluids/blood surround organs<br>-moved by heart/movements<br>-arthropods | -blood in vessels<br>-vessels carry blood to organs | |

Two Chamber v. 3 Chamber v. 4 Chamber Heart

| Two Chamber Heart (fish) | 3 Chamber (Amphibians/some reptiles) | 4 Chamber (mammals, birds, some reptiles) |
|---|---|---|
| 1. heart<br>2. gills (capillaries spread out to pick up CO2)<br>3. capillareis/body<br>diffues O2, pick up CO2 | 1. ventricle<br>2. lungs (pick up CO2)<br>3. goes to atrium<br>4. ventricle (pump out)<br>5. body | |
| Problems: low preasure, hard to get through 2 beds of capillaries | Problems: one ventricle, pumping deoxygenated blood and oxygenated blood ----MIX (bad thing, can never carry all O2 possible) | |
| Solution: movement/swimming helps move the bood | Solution: diffues CO2/O2 through skin<br>Advantages (over 2 heart):<br>-more pressure<br>-1 pump only 1 bed capillaries<br>-double circulation (two pumps) | Advantages:<br>-more pressure<br>-1 pump 1 bed capillaries<br>-double circulation (2 pumps)<br>-2 ventricles, no mixing of<br>-blood (can carry all potential CO2/O2) |

3. Label heart

4.

| arteries | veins | capillaries |
|---|---|---|
| -away from heart<br>-made of muscle<br>-elastic so arteries can | -back to heart<br>-under less pressure than arteries | -very small<br>-connects arteries and veins<br>-small enough to go to all |

| | | |
|---|---|---|
| completely fill and w/ stand pressure from ventricular contractions<br>-can contract to help push blood (also helps w/ blood pressure) | -thinner walls<br>-less muscle and elastic<br>-have valves to prevent backwards flow<br>-skeletal muscles can help push blood back to heart | cells |

identify them under slides

5. -systolic/diastolic=blood pressure

systolic is when the ventricles are contracting (when the heart is pumping)

diastolic is when the atriums are filling (or when the heart is relaxed)

-regular blood pressure: 120/80

-hypertension: high blood pressure (hyper=high)

why is high blood pressure bad?

heart has to work harder=damage of heart (and blood vessels)

can lead to stroke

can lead to atherosclerosis (hardening of arteries or stroke)

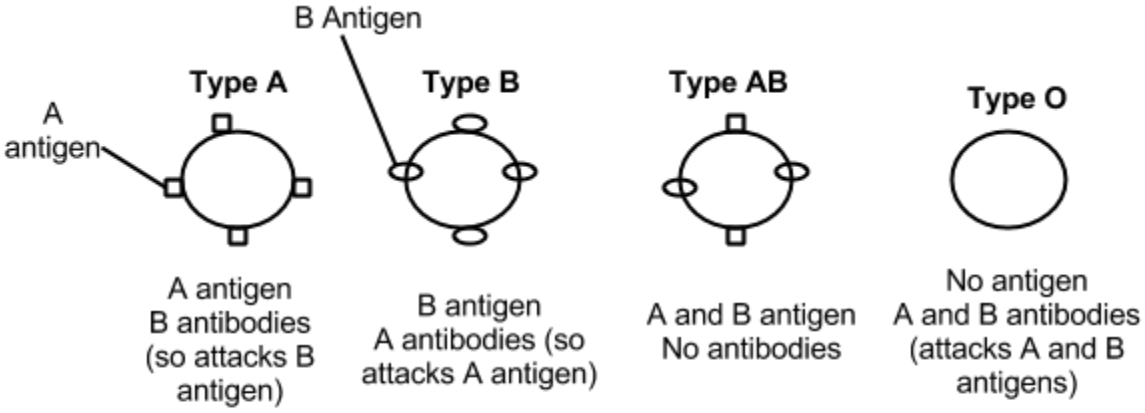
Taking blood pressure:

1. use brachieal artery
2. usually non dominant hand
3. Pump up to 160
4. Let go down listen for 1st heart beat
5. the pressure when you hear 1st heart beat is systolic pressure
6. pressure when you hear last heartbeat is diastolic

What happens when you take blood pressure?

| Pressure (mmHg) | Brachial Artery | Hear |
|---|---|---|
| 1. 0 | unobstructed | silent flow |
| 2. 160 + | obstructed (completely closed) | no blood flow (hear nothing) |
| 3. around 120 | open slightly | blood flows barely (hear first heartbeat) THIS IS SYSTOLIC |
| 4. 120-80 | open more and more | continue to hear heartbeat |
| 5. 80 | completly open | hear nothing (silent flow again) THIS IS DIASTOLIC |

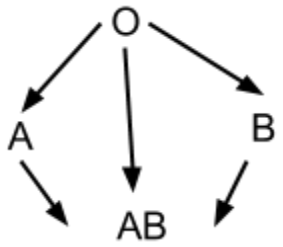
Blood Types:




- Antibodies are the body gaurds Immune response--only made if come into contact w/ wrong antigen/blood (body makes them not the blood) (which is why O can go to A, but A can't go to O)
- Antigens are name tags/say what you have (if A antigen that means you have those little squares on your blood)

| D antigen | No D antigen |
|---|---|
| -RH+ (the positive means, YES, I have the antigen!)<br>-no antibody (don't want to attack yourself) | -RH- (the negative means, NO, I do NOT have the antigen!)<br>-RH antibody (I want to attack RH+ if it enters my hosts body) |

O- is the universal DONER
AB+ is the universal ACCEPTOR
- → +




RH+(father) have baby w/ RH - (mother)
- -Baby RH-, no biggie
- -Baby RH +, AHH
  - -1st RH + kid, okay (no mixing of blood until childbirth)
    - -at childbirth, blood mixes, mom makes RH antibodies to kill + blood

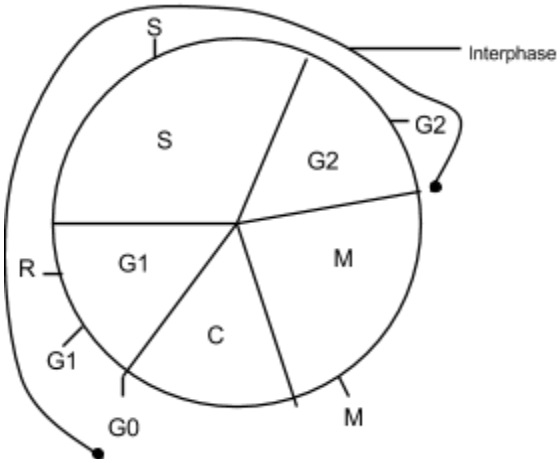
-2nd RH + kid, not okay
-moms RH antibodies can attack childs RH+ blood SO takes medicine toridbodys

6. Blood Coagulation (blood clotting):
-uses platelets that are in our blood (that's the point of platlets)
1. When we get cut, there's tissue damage
tissue damage reveals proteins
2. Platlets react w/ proteins and become sticky (like glue)
3. Platlets bind rbc and platelets=temporary clot
4. Platelets release enzymes
enzymes interact w/ plasma proteins (clotting factors)
5. Clotting factors=series of proteins where production of one catalyzes (helps make) the production of the next----SO tons are made
6. Clotting Factor X (final product of clotting cascade)
7. Ca +2 activates clotting factor x
8. Thrombin (clotting factor x changes prothrombin into active form of enzyme thrombin)
9. Fibrin (thrombin causes the soluble fibrinogen to become insoluble Fibrin)
10. Fibrin insoluble threads (like a net) catches rbc and platelets to form clot and stop bleeding
hemophilia: basically, ya can't clot, so die young, super sad, have to wear helmet while walking

7.

| RBC (erythrocytes) | WBC (leukocytes) | Plasma | Platelets |
|---|---|---|---|
| -carry O2 because of hemoglobin (protein)<br>-hemoglobin has iron which attracts O2<br>-temporary nucleus (has it until it matures) SO can't reproduce themselves<br>-live 120 days | -defend against foreign organisms<br>-engulf bacteria<br>-# of WBC go up when there's an inffection<br>-have nucleus<br>-more permanent than RBC | -90% water<br>-10% food monomers, ions, aa, surgars<br>-yellow<br>-carries waste CO2 | -little pieces of RBC and proteins<br>-help clott<br>-platelets+protein=clot |
| not as important:<br>-takes DNA from WBC<br>-produced by bone marrow<br>-regulated by kidney | | | |

## Cell Cycle




DNA is in chromatin during Interphase

G0

-normal function cell

G1 Getting Ready for S

1.replication

proteins getting ready to replicate

cell growth

cell still doing it's job

2. G1 Check

-check for undamaged DNA and size of cell

-have to make sure big enough to split

3. Restriction Point: the point of no return, committed to division

-G1 cyclins

-signal for growth

-signals for DNA replication

-cause cell to leave G0

S Replication

1. DNA is replicated

1. DNA Helicase unzips/breaks hydrogen bonds to unwind DNA strands
2. Single stranded binding proteins hold the DNA apart
3. DNA polymerase 3 builds DNA

-builds 5 prime to 3 prime

-has to build anti parallel

-leading strand: builds towards replication fork

-lagging strand: builds away from replication fork

4. Lagging Strand

1.RNA primase makes RNA primers so DNA polymerase III has a starting point

-makes okazaki fragments

2. RNAaseH gets rid of RNA primers
3. DNA polymerase I replaces RNA primer
4. DNA ligase attaches okazaki fragments

2. S Checkpoint check for unreplicated DNA

G2 Further growth

1. DNA checked by enzymes
2. prepare for division/Mitosis
3. G2 checkpoint checks for damaged DNA or DNA error

Mitosis- P Mat

Early Prophase

-chromosomes condense (DNA begins to coil into duplicated chromosomes)

-because of M cyclins

-nuclear membrane dissolves because of M cyclins

Late Prophase

-development of mitotic spindles (spindle fiber and centrioles) because M cyclins

-responsible for movement of chromosomes

-spindle fibers attach to kinetochores

Metaphase (M for get in the MIDDLE)

-duplicated chromosomes line up at equator/metaphase plate

-mitotic spindle fibers move the chromosomes and go to poles

-ensures that every new cell has identical copy

-count # chromosomes here

Anaphase (a for pull AWAY)

-duplicated chromosomes (two sister chromatids) are split

-centromere dissolves

-because of M cyclins

-kinetochores shorten spindle fiber making chromosomes move to poles

-sister chromatids move to opposite poles

-now (by themselves) chromosomes

Telophase (t for TWO nuc membranes)

-chromosomes uncoil

-nuclear membrane forms

-spindle starts to breakdown

-end telophase, two identical nuclei

M cyclins break down because of M cyclins

-M Cyclins

-causes nuclear envelope to disolve

-cause chromosomes to condense

-signals for formation of mitotic spindles

-cause breakdown of proteins or centromere that hold the sister chrom together

-cause breakdown of Mcyclin

Cytokinesis - Split the Cell

-cytoplasm is split, cleavage furrow forms

-proteins split off cell membrane

-in plants

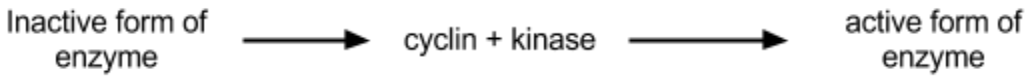
-cell plate forms to provide separate cell walls

## Cyclin and Kinase

-amounts of cyclin varies

-amount of kinase varies

-enzymes that when bounded to cyclin “phosphorylate” (transfer phosphate group) or activate other enzyme groups




## Cancer

-If there’s a mutation in proto-oncogenes=oncogenes

onco genes signals for cell reproduction at inappropriate times

-mutated tumor suppressor genes

-don’t stop the cell cycle

-mutated proto onco gene + mutated tumor suppressor gene =

uncontrolled cell growth =

cancer

| | |
|---|---|
| Mutagens | agents that can change DNA |
| Mutation | a change in any DNA |
| Proto-oncogene | accelerator<br>codes for cyclins<br>signals for reproduction |
| Tumor Suppressor Genes | breaks<br>signals for cell cycle arrest<br>codes for inhibitor proteins |
| Metastasized | tumor enters bloodstream and travels to other parts of the body |
| Carcinogen | cancer causing agent |

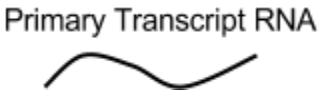
# Protein Synthesis

2. Describe what happens in each stage of transcription.
Transcription (rewriting of DNA's code onto a RNA molecule)

-one gene at a time
-code goes to ribosome
-transcription happens in nucleus

1. Initiation
   -RNA polymerase unwinds DNA
   -pomotorcide: place where RNA polymerase attaches to start transcription
2. Elimination
   -RNA polymerase adds RNA
3. Termination
   -DNA coils back up and you get one RNA site/region
   -terminator site where RNA polymerase detaches

3. Given a primary transcript, explain and/or sketch what modifications must be made to make it into mature mRNA, tRNA, and/or rRNA
happens outside the nucleus




| | |
|---|---|
| rRNA | primary transcript joins w/ proteins to make ribosomal subunits |
| tRNA | make 'clover leaf' structure<br>attach to a specific amino acid<br>  |
| mRNA | 1. add MG cap and poly A tail to prevent digestion by enzymes<br>2. Splicing<br>-exons: code for proteins<br>-introns: interruptions, don't code for proteins, removed/spliced by enzymes<br>Exons are connected by enzymes |

4. Given a mature stand of mRNA, describe the translation events that will create a protein. Include relevant details concerning codons, anticodons, ribosomal sites, etc.

-can be more than one ribosome on mRNA

-aa (from food) are floating in cytoplasam

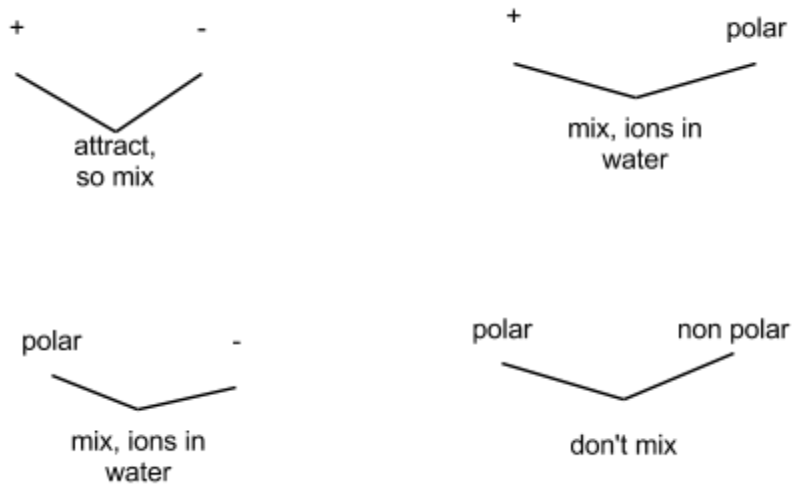
1. Ribosomal subunits attach to mRNA
    - -3 sites: E site (exit), P site (proximal), A site (acceptor)
    - -first aa is methionine (aug) stuff before it doesn't matter
2. With the start codon (AUG) in the P site, corresponding tRNA w/ the aa methionine binds the anticodon to its complementary codon
    - -ribosome attached to mRNA, starts translation in P site, corresponding tRNA (has anticodon) brings correct aa
    - -open A site, tRNA comes
3. with tRNA in the P and A sites, a peptide bond is formed between AA
    - -aa at p site detaches from tRNA
4. Ribosome shifts one reading frame (3 bases)
    - -p site → e site, a site → p site
    - -lone tRNA in e site exits ribosome
5. unoccupied a site accepts another tRNA
6. Repeat

-modification can occur in golgi apparatus

5. Given a mature stand of mRNA, use a table to determine the order of amino acids it codes for.

6. Show how functional groups interact to join the aaa together and predict aspects of protein bending by using the affinity of each R group to its neighbors and the surrounding aqueous environment.

Hydrophobic=non polar. Hydrophilic=polar. Hydrophobic things HATE water. Bend to get away.




7. Compare and contrast the lytic and lysogenic methods of viral reproduction. Which aspect of their reproduction is used in biotechnology?

Bacteria: living (have metabolism, gas exchange, can reproduce, etc.)
Viruses: non living, nucleic acid wrapped in protein, needs a host

| Lytic | Lysogenic |
|---|---|
| -active<br>-symptomatic<br>-contagious<br>-destroys cells<br>-viral nucleic acid is injected into cell<br>-spliced into genome<br>-gene is activated<br>-makes viruses | -dormant<br>-asymptomatic<br>-not contagious<br>-virus injects nucleic acid into cell<br>-DNA is spliced into genome<br>-doesn't get activated<br>-when cell replicates, new cell has mutated DNA<br>-if gets 'activated' goes to lytic |

gene splicing is used in biotechnology

Retrovirus:

-uses RNA and reverse transcriptase

-reverse transcriptase: enzyme that does reverse transcription (RNA to DNA)

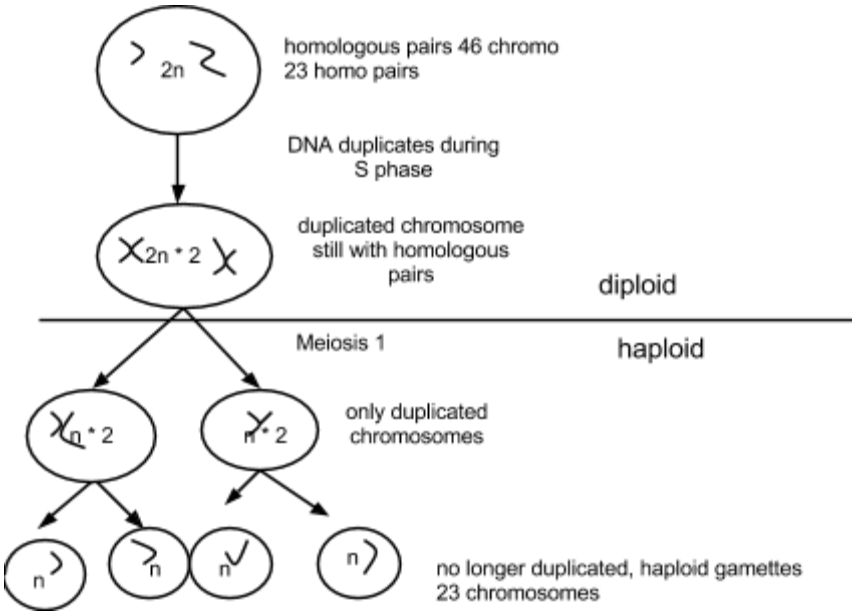
-then acts like a regular virus

-more susceptible to change than a regular virus

-RNA is single stranded, mutates faster, and doesn't have as many correcting factors as DNA

# Meiosis

Meiosis Overview:




2 Sources Genetic Variation:

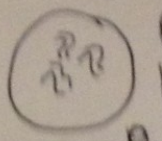
1. Random alignment of chromosomes in metaphase I
2. Crossing over in prophase I

Zygote: fertilized egg

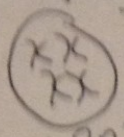
1 germ cell= 4 sperm cells

1 germ cell=1 egg

nondysjunction?



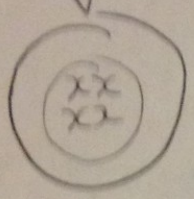
first cell
homologous pairs diploid
2n germ cell from testies/ovaries



DNA duplicates
duplicated chromosomes
2n x 2 = Homologous pairs

Meiosis I seperating homologous pairs

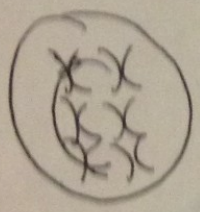
~~Prophase I~~



homologous pairs line up side by side
(as dup chrom)
crossover occurs HERE

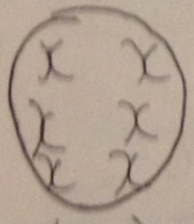
~~metaphase I~~

* random allignment?



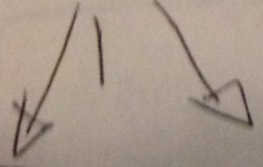
line up ~~mel~~ plate/equator — mutally exclusive
independent asortment c
(arangment of first doesn't effect nex

~~Anaphase I~~

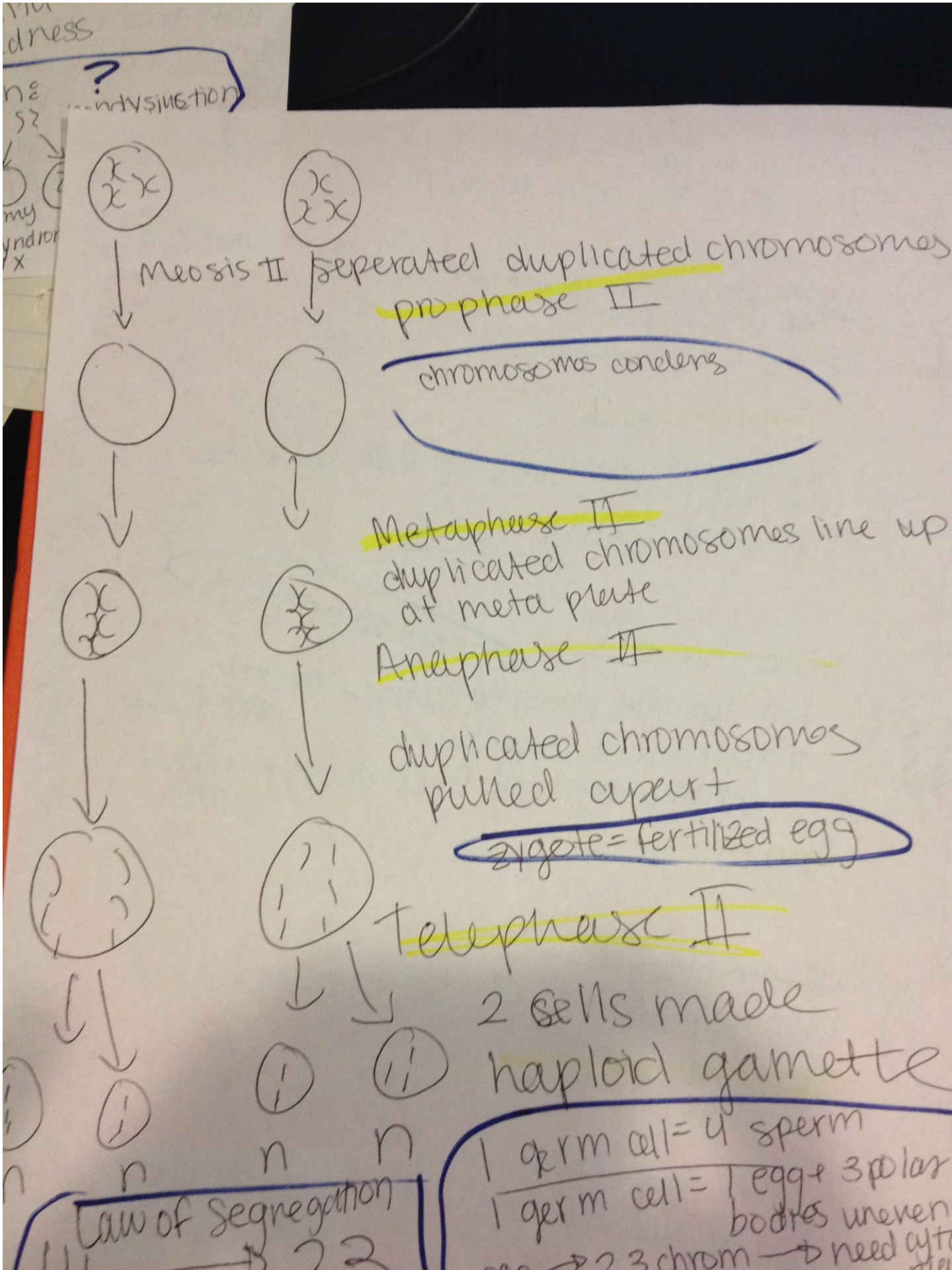


~~duplicate~~
homologous pairs seperated

Telephase I



Two sep cells
w/ duplicated chromosomes


Meosis II
seperated duplicated chromosomes
prophase II
chromosomes condens
Metaphase II
duplicated chromosomes line up at meta plate
Anaphase II
duplicated chromosomes pulled apart
zygote = fertilized egg
Telophase II
2 cells made
haploid gamette
n
n
n
n
Law of Segregation
1 germ cell = 4 sperm
1 germ cell = 1 egg + 3 polar bodies uneven

## Complete dominace -

Rr = R
RR = R
rr = r

3 geno
2 pheno

## Incomplete Dominace (blending)

RR = R
Rr = blend R + r
rr = r

3 geno
pheno

P p × P p

| | P | p |
|---|---|---|
| P | PP | Pp |
| p | Pp | pp |

P: 1:2:1
INCOMP
P: 3:1
COMP

## Codomince ~~checke~~ dominene:
(checkered)

RR = R
rr = r
Rr = pattern showing both R + r (checked)

~~hemophilia~~ ~~color blindness~~ 3 geno 3 phenotyp

## ~~Sex linked~~:
(on x)

$X^N X^N = N$
$X^N X^n = N$ > female
$X^n X^n = n$
$X^N y = N$
$X^n y = n$ > male

blood type
hemophilia
color blindness

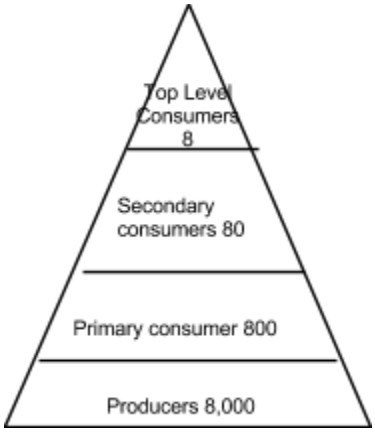
~~meiosis~~

Non dysjuction:
norm

?
nondys

# Ecology

2. Construct an energy pyramid that accurately depicts the energy relationships between trophic levels.




3. Illustrate and explain the workings of the carbon/nitrogen/water cycle.

- Water Cycle
    - absorption (water absorbed by roots of plants)
    - transpiration (evaporation of water from leaves of plants)
    - respiration (cellular respiration, food to energy)
    - evaporation (liquid to gas)
    - condensation (gas to liquid)
    - precipitation (rain/snow/hail/sleet)
    - moves through all living organisms
- Carbon Cycle

| Things that use/remove $CO_2$ | Things that Release/Add $CO_2$ |
|---|---|
| ● photosynthesis<br>● dissolved $CO_2$ in water | ● respiration<br>● combustion reactions<br>● erosion<br>● death/decay |

- Nitrogen Cycle
    - $N_2$=78% of the air
    - get $N_2$ from food
    - need it for amino acids and nucleic acids

- Nitrogen fixation: nitrogen fixing bacteria
  - rhizobium (land)
  - cyanobacteria (water)
- Assimilation
  - reason for fertilizer, nitrates and nit____ tell you how good fertilizers are

4. Classify described relationships between organisms as examples of mutualism, parasitism, or commensalism

| | |
|---|---|
| predation | +,- |
| competition | -,- |
| mutualism | both parties benefits +,+ |
| parasitism | one party benefits, other hurts +,- |
| commensalism | one party benefits, other nothing happens +,0 |

5. Describe the process of succession from bare rock to an appropriate climax community. Explain why succession stops at the level of climax community**.**

| | |
|---|---|
| succession | development of plant/animal species in a particular area and changes in ecosystem over time |
| new land | -infertile soil<br>-can develop |
| primary succession | -begins w/ pioneer species (organisms first to live in area) and bare rock<br>-wind/other organisms bring pioneer species (microbes, small plants, moss, grass) |
| climax community | expected life of that area (tundra, etc)<br>ANy number of limiting factors may determine the level of the climax community- soil, rainfall, sunlight, temperature, etc. |
| secondary succession | what happens after destruction<br>-replacement of species<br>-easier than primary (not starting from scratch)<br>-not relying on mosses/lichen<br>Primary succession happens in a place where there has never been life before. Secondary succession happens after the |

| | |
|---|---|
| | ecosystem has been disturbed.<br>An area with life has always had primary succession at some point, but some habitats may never have a secondary succession because they never had a disturbance big enough to warrant it. |

6. Explain how evolution, through natural selection to different abiotic environments, produces trade offs involving an organism's ability to tolerate extreme environments.

7. Describe conditions that lead to exponential growth, logistic growth, boom and bust cycles, and predator prey cycles.

- Exponential growth
    - J shape
    - doesn't continue for ever, run out of resources
    - need perfect conditions for exponential growth
- Carrying capacity
    - limit, max # of individuals in a part area of ecosystem that supports
    - food/disease/water/space/pollution are limiting factors
    - carrying capacity turns exponential growth into S shaped logistic growth
    - K=carrying capacity
    -

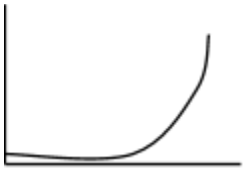
| | |
|---|---|
| Biotic Limiting Factors:<br>● competition<br>● predation<br>● bacterial disease<br>● food<br>● reproduction | Abiotic Limiting Factors:<br>● viral diseases<br>● nesting area/shelter<br>● water (clean/polluted/lack)<br>● temp/climate/precipitation<br>● sunlight<br>● natural disaster |

| | |
|---|---|
| Density Dependent limiting factors (DD) | -limiting factor more effective on pop den<br>-competition for resources<br>-predation<br>-parasitism |
| Density independent limiting factors (DI) | -limiting factor not affected by size of pop<br>-barrier to reproduction<br>-weather<br>-climate |

    - Newly introduced consumer would initially exhibit a period of exponential population growth because there are no natural predators at first, so no one will

eat them.
    - After the initial rapid increase of population has slowed, predation and competition between rabbits (DD factors)
- Boom Bust Cycle
    - during the boom periods, there is exponential growth
    - during the bust period, there is a massive death rate
    - human population continues to grow, but get smarter so can beat things

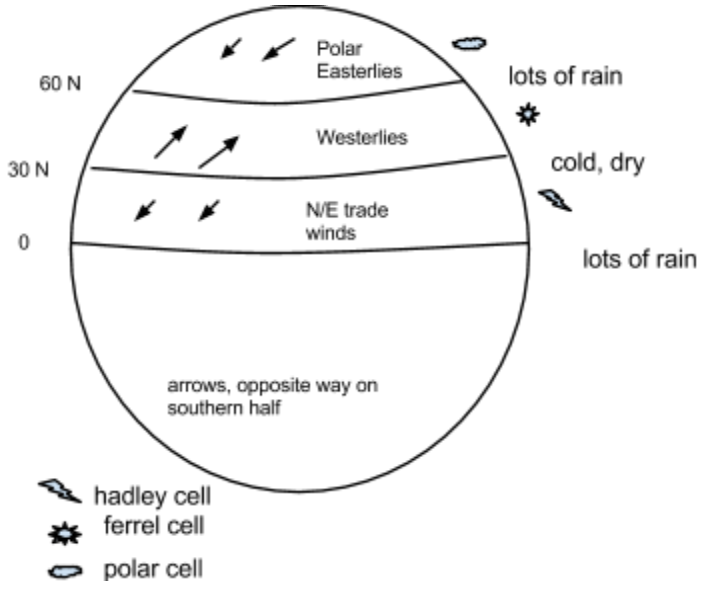
8. Explain why some exotic species are able to dominate the ecosystems they invade.

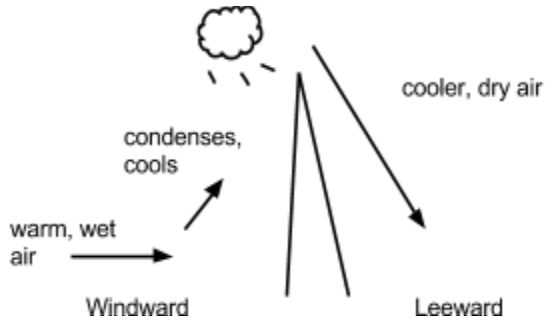



It could be because they because they have no natural predators, it could be on a great thrive in that climate, it could be because they can feed number of plants or animals. For one reason or another, as an invasive species they are going through exponential growth (J-curve) and haven't reached their carrying capacity.

Biomes:

-warm air rises
-equator warm, poles cold
-coriolis effect: northern hemisphere, apparent deflection right from the starting point, southern hemisphere apparent deflection left from the starting point
-high pressure replaces low pressure






| | |
|---|---|
| Tundra | 60-70 N, little rain, cold |
| Taiga (Coniferous Forest) | -largest biome<br>-russia/canada<br>-50 to 70 N<br>-semi rainy<br>-waxy needle, pine needles, migration, hibernation |
| Temperate Forest (Deciduous Forest) | -trees leaves fall off<br>-25-50 N<br>-warm summers, cold winters |
| chaparral (mix desert and grassland) | -30 to 50 N and 30 to 40 S<br>-summer dry, winter wet |
| tropical rain forest (most bio diversity) | -23 N to 23 S<br>-50 to 260 rain<br>-worst soil |
| Grasslands (Plains) | -mid latitude<br>-range temperature<br>-tall grass, woody plants, camouflage, deep roots |
| Savanna | -15 N to 30 S<br>-hot, dry and wet seasons |
| Desert | 15 to 28 N and S |

Have to add stuff on ozone/greenhouse gasses

# Evolution

3. Explain the concept of natural selection in terms of resources, variation, mutation, allele frequencies, and adaptation to environment.

-Natural Selection:Individuals with favorable variations are more likely to survive, reproduce, and pass on these variations.

-Variations can be caused by mutations. Mutations are random changes in DNA. Allele frequencies are based off how advantageous the alleles are. The more advantageous they are, the more likely they are to reproduce and pass on the trait or allele.

4. Given information concerning a change in allele frequencies within a population, use the concept for equilibrium to explain the frequency change in light of local environmental conditions.

6.

- Idealized mathematical model, observe phenotypes and work backwards
- Assumptions (***** means really bad assumptions)
    - diploid
    - generations don't overlap
    - mutation negligible****
    - random sexual reproduction
    - migration negligible****
    - no natural selection ****
- p+q=1
- $p^2+2pq+q^2=1$
- Darwin's 4 Facts:
    - exponential growth (free of limiting factors, more born than can survive)
    - factors will prevent exponential growth
    - variability among species
    - traits are inherited (not acquired over time, have or don't)
- Darwin's 2 Interferences:
    - competition for resources
    - individuals most fit for environment survive
- Genetic variation
    - mutation
        - can be harmful and disapeer
        - only source of genetic variation for asexual
    - meiosis
        - random alignment and crossing over (metaphase I)
    - sexual reproduction
        - comb of 2 diff ple's alleles
    - Immigration
        - incoming alleles to gene pool
- Mechanisms for change in allele frequency

- natural selection
- artificial selection (breeding)
- Gene flow
- Genetic Drift

7.

| | |
|---|---|
| Gene Flow | immigration in or out of a population |
| Genetic Drift | -random change in allele frequency<br>-no direct selection for it<br>-more common in small pop |
| Founder's Effect (genetic drift) | -small # of a large pop migrate and start new pop<br>-gene pool is less diverse<br>-loss of genetic variation |
| Genetic Bottleneck (genetic drift) | -huge gene pool, something happens, lots die<br>-loss of genetic variation |
| macroevolution | -divergence, speciation<br>-1 species becomes 2 species if they can no longer reproduce |
| Prezygotic Isolation (part of macroevolution) | geographic separation, ecological (diff habitats), behavioral (diff mating), chem (sperm won't attach) |
| Postzygotic | anything that goes along w/ egg?? |
| Adaptive Radiation | phenotypes adjusting to environment |
| gradualism | speciation can occur slow and constant |
| punctuated equilibrium | long periods of no change between short burst of change |
| anatomical comparisons | -homologous structures (same form diff use) (indication of common evolutionary ancestors)<br>-vestigial structures (evolutionary remnants i.e. goose bumps, tail bone) |
| Sickle Cell | In malaria zones:<br>-normal (SS) = bad<br>-trait (Ss, don't express) = good<br>-disease (ss, express) = don't get malaria, but have sickle cell disease, so bad |