Name:_____ Period:_____ Date:_____

IS2 Semester 2 Final Review – Due Wednesday June 7 EOP

IS2 Semester 2 Final Exam Review- Due Tuesday June 11 (BOP) 30 points for completion and 5 points for evidence of corrections

About the Final:

- 60 questions (MC, TF, Matching) /Extra credit- model of our last phenomenon
- Final will be cumulative over the last semester
    - Covers: experimental design, genetics, molecular biology and evolution:90 minutes-

- Periods 1, 2 and 3: Wednesday, June 12
- Periods 4, 5 and 6: Thursday, June 13
- Periods 7: Friday, June 14

 Understand the difference between a hypothesis, law and theory

1. Hypotheses are tentative explanations based on evidence that are limited.
2. Scientific theories are comprehensive and in-depth explanations of observed phenomenon, whereas
3. laws describe these phenomenon (usually in mathematical relationships). i.e. law of gravity

 Be able to explain how to write a conclusion and interpretation for lab data

restate hypothesis and whether it was supported, not supported or contradicted, provide supporting data (high/low value) and use explanatory language to connect evidence to conclusion.

 Explain what a control group is and how is used; know how this is different from the controlled variables in an experiment

The **control group** is defined as the **group** in an experiment or study that does not receive treatment by the researchers and is then used as a benchmark to measure how the other tested (experimental) subjects do.

 Be able to identify the key elements of a given experimental design (manipulated variable, responding, etc.)

Testable question and hypothesis
Definable MV and RV, controlled variables, experimental control (group), well thought out procedure, is both valid and reliable

 In terms of an experimental design what is the difference between reliability and validity?

Validity means that the experimental design is set up to test or answer the question investigated and that all variables are controlled except for the MV. Reliability means that the investigation can be repeated with consistent results.

Review Questions from Chapter 1:

For each experiment below, identify the manipulated variable, responding variable, control group and any controlled variables.

1. A student wanted to test how the mass of a paper airplane affected the distance it would fly. Paper clips were added before each test flight. As each paper clip was added, the plane was tested to determine how far it would fly.

    Manipulated variable _____mass of paperclip_____
    Responding variable _____distance plane travels_____
    Control group _____paper airplane w/o paperclip_____
    Controlled Variables
    The same airplane design, same force applied to launch, same launch technique, same wind speed outside, etc.

2. Two groups of students were tested to compare their speed working math problems. Each group was given the same problems. One group used calculators and the other group computed without calculators.

Manipulated variable: Use of calculators for making calculations

Responding variable: speed for doing math problems

Control group: group-group w/o/ calculators

Controlled Variables: Same problems, same testing environment, same math background.

3. Larry was told that a certain muscle cream was the newest best thing on the market and claims to double a person's muscle power when used as part of a muscle-building workout. Interested in this product, he buys the special muscle cream and recruits Patrick and SpongeBob to help him with an experiment. Larry develops a special marshmallow weight-lifting program for Patrick and SpongeBob. He meets with them once every day for a period of 2 weeks and keeps track of their results. Before each session Patrick's arms and back are lathered in muscle cream, while SpongeBob's arms and back are lathered with the regular lotion. Muscle power is measured using a "Muscle O'meter."

Time	Patrick	SpongeBob
Initial Amount	18	5
After 1 wk	24	9
After 2 wks	33	17

Which person is in the control group? SpongeBob

What is the manipulated variable? use of muscle cream

What is the responding variable? muscle power

What should Larry's conclusion be based on the data?
Claim of effectiveness of muscle cream is not supported by the data. Muscle power of SpongeBob more than tripled, whereas muscle power of Patrick only doubled.

Evolution

- Explain how competition affects an organisms chance to survive and how this may influence the composition of a community of organisms over successive generations.
  When species compete for resources they cannot fill the same niche and this competition can lead to a changed niche or one species out competing the other displacing it.
- Be able to explain what evolution is and how variation , selection and time lead to the evolution of a population.
  Evolution is the change in the allele frequency in a population over time (micro evolution) and major (macro) evolutionary change. The term applies mainly to the evolution of whole taxonomic groups over long periods of time (e.g. fish->amphibians, reptiles-> birds)
- Be able to explain on what biological "scale" evolution occurs.
  As stated above, micro evolution occurs at the population level, not the level of the individual.
- Know what a common ancestor refers to.
  an ancestor that two or more descendants have in common.
- Be able to explain some of the evidence for the theory of evolution (fossil record, homologous and vestigial structures, etc.). See below
- Be able to use the concept of natural selection to predict changes in a population over time.
- Be able to use cladograms and phylogenetic trees to interpret evolutionary history of different groupings of organisms.

Review Questions:

1. What evidence from the following fields supports the theory of evolution?

A- Molecular biology (study of DNA and proteins)

The genetic code itself is a homology (shared characteristic) that links all life on Earth to a common ancestor. This thread of genetic similarity connects us and the roughly 10 million other species in the modern world to the entire history of life, back to a single common ancestor more than 3.5 billion years ago. And the evolutionary view of a single (and very ancient) origin of life is supported at the deepest level imaginable: the very nature of the DNA code in which the instructions of genes and chromosomes are written. In all living organisms, the instructions for reproducing and operating the individual is encoded in a chemical language with four letters -- A, C, T, and G, the initials of four chemicals. Combinations of three of these letters specify each of the amino acids that the cell uses in building proteins.

- DNA and RNA possess a simple four-base code that provides the recipe for all living things.

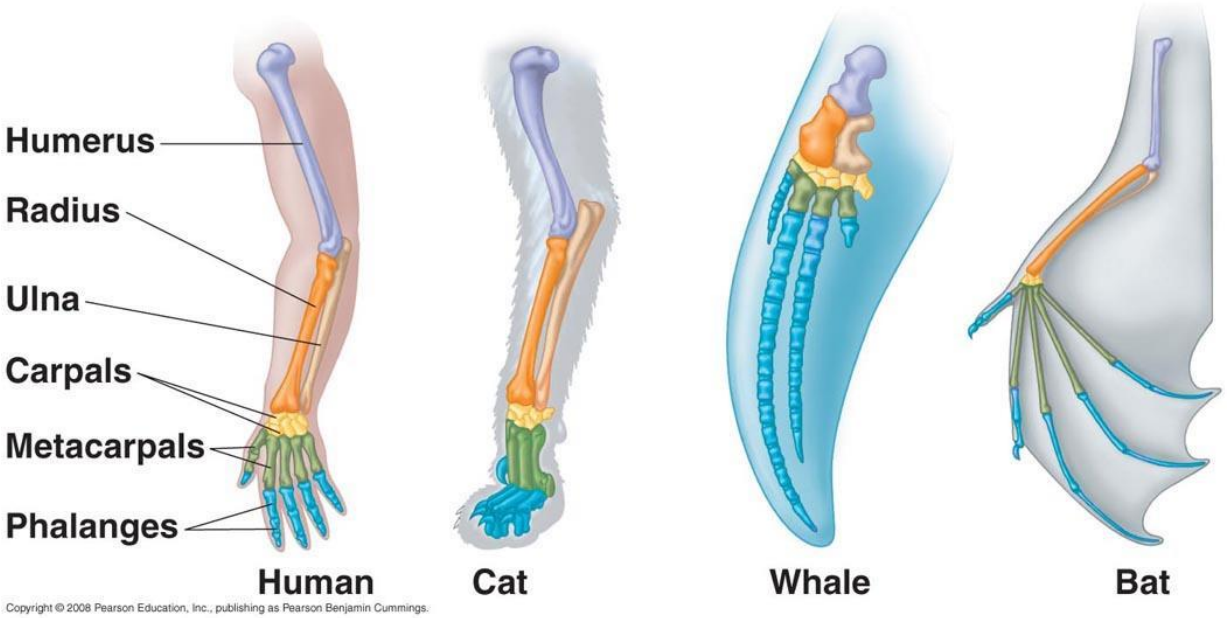
- In some cases, if we were to transfer genetic material from the cell of one living thing to the cell of another, the recipient would follow the new instructions as if they were its own (e.g. GFP gene).
- These characteristics of life demonstrate the fundamental sameness of all living things on Earth and serve as the basis of today's efforts at genetic engineering.
- The fossil record thus provides consistent evidence of systematic change through time—of descent with modification. From this huge body of evidence, it can be predicted that no reversals will be found in future paleontological studies. That is, amphibians will not appear before fishes, nor mammals before reptiles, and no complex life will occur in the geological record before the oldest eukaryotic cells. This prediction has been upheld by the evidence that has accumulated until now: no reversals have been found.

B- Paleontology

- Fossils provide evidence of past life as well as a record of major extinctions in the history of life. Fossils also provide evidence of transitional species (Tiktaalik and archaeopteryx)
  - in undisrupted layers of rock, fossils occurred in a definite sequential order, with more modern-appearing ones closer to the top. Because bottom layers of rock logically were laid down earlier and thus are older than top layers, the sequence of fossils also could be given a chronology from oldest to youngest.

C- Anatomy and physiology

- Evolutionary theory predicts that related organisms will share similarities that are derived from common ancestors. Similar characteristics due to relatedness are known as homologies.
- Homologies can be revealed by comparing the anatomical structures of different living things,.
- An example of homology is the forelimb of tetra pods (vertebrates with legs).
- Humans, cats, whales and bats all have **different forelimbs**, reflecting their **different lifestyles**. But those different forelimbs all share the **same bone elements** - the humorous, the radius, ulna and other **bone elements in common**.



D- Animal development (embryology)

- The study of one type of evidence of evolution is called embryology, the study of embryos. An embryo is an unborn (or unhatched) animal or human young in its earliest phases. Embryos of many different kinds of animals: mammals, birds, reptiles, fish, etc. look very similar and it is often difficult to tell them apart. Many traits of one type of animal appear in the embryo of another type of animal. For example, fish embryos and human embryos both have gill slits. In fish they develop into gills, but in humans they disappear before birth.
- This shows that the animals are similar and that they develop similarly, implying that they are related, have common ancestors and that they started out the same, gradually evolving different traits, but that the basic plan for a creature's beginning remains the same.
  - Darwin noted that embryonic organisms sometimes make structures that are inappropriate for their adult form but that show their relatedness to other animals. He pointed out the existence of eyes in embryonic moles, pelvic rudiments in embryonic snakes, and teeth in embryonic baleen whales

2. What is the difference between a theory and a law?

- Scientific laws and theories have different jobs to do. A scientific law describes and predicts the results of certain initial conditions. It might predict your unborn child's possible hair colors, or how far a baseball travels when launched at a certain angle.
- In contrast, a theory tries to provide the most logical explanation about why things happen as they do. A theory might invoke dominant and recessive genes to explain how brown-haired parents ended up with a red-headed child, or use gravity to shed light on the parabolic trajectory of a baseball.
- In simplest terms, a law predicts/describes **what** happens while a theory explains **why**. A theory will never grow up into a law, though the development of one often triggers progress on the other.

3. What are vestigial structures? Give an example.

- A structure in an organism that has lost all or most of its original function in the course of evolution, such as human appendixes. Others in humans include gill arches, tail bone (coccyx) and wisdom teeth, ear.

4. Define evolution in terms of genes and allele frequencies.
- Evolution is the change in the allele frequency in a population over time

5. What causes variation in traits in a population?

Genetic recombination in meiosis through crossing over and independent assortment. Random fertilization, and mutation also contribute to variation in a population..

6. What does the "fitness" of an organism refer to?

"fitness" is defined by an organism's ability to survive and produce offspring in its environment.

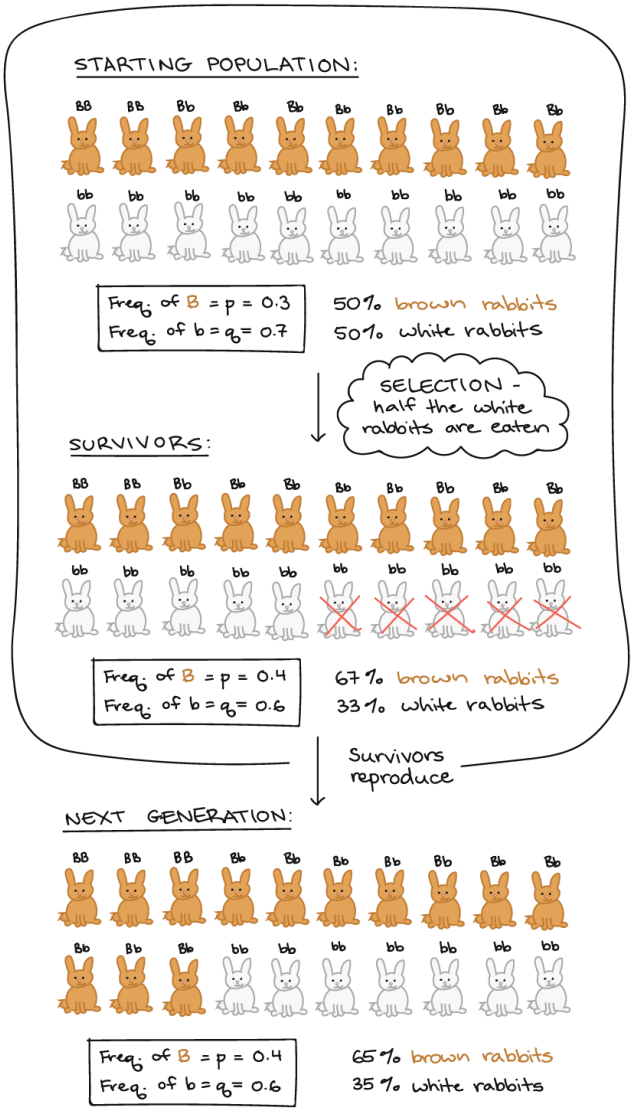
7. What are the three conditions for EVOLUTION ~~natural selection~~ to occur? Explain

• **Variation:** Within a population of mice on the lava flow, some individuals had the dark fur trait, whereas others did not. • Inheritance: The differences in mouse fur color are inherited (passed from parents to offspring). The origin of the variation stems from mutations.
• **Selection:** Differences in survival/reproduction: More offspring are born than can survive, leading to competition within a species. In certain environments, individual mice that have dark fur will survive and have more offspring than mice with tan fur.
• **Time**: The frequency of the mice with dark fur and the alleles that cause dark fur will increase in the population over generations. In this case, the population will change from one in which most of the individuals had tan fur to one in which most of the individuals have dark fur

Does this mean the biggest and fastest organisms will always survive?
- Not necessarily, sometimes behaviors can make a species more successful, species that are better camouflaged may better survive over time etc.

8. A rabbit population on a nearby glacier is hunted by a group of foxes. Some rabbits are white and some are brown. Use the concept of natural selection to explain how this population of rabbits will evolve. How might climate change affect this population?

A- As an example, let's imagine a population of brown and white rabbits, whose coat color is determined by dominant brown (*B*) and recessive white (*b*) alleles of a single gene. If a predator such as a fox can see white rabbits (genotype *bb*) more easily than brown rabbits (*BB* and *Bb*) against the backdrop of a grassy field, brown rabbits are more likely than white rabbits to survive fox predation. Because more brown than white rabbits will survive to reproduce, the next generation will probably contain a higher frequency of *B* alleles.
B- We can demonstrate this to ourselves by working through an example. Let's start with a set of allele and phenotype frequencies, shown in the diagram below, and see how they change in a generation if half of the white rabbits (but none of the brown rabbits) are eaten by foxes:



C- In this example, the frequency of the survival-promoting *B* allele rose from 0.30, to 0.40, in a single generation. The percent of the population with the survival-promoting brown phenotype also rose from 50% to 65%. (We can predict the next generation by assuming that the survivors' mate randomly and leave equal numbers of offspring on average.) This is a made-up example, but it gives us a concrete sense of how natural selection can shift allele and phenotype frequencies to make a population better-suited to its environment.

D- Will the recessive "*b*" alleles disappear from the population due to selection? Maybe someday, but not right away. That's because they can "hide" from predators in the heterozygous (*Bb*) brown rabbits. This is a good reminder that natural selection acts on phenotypes, not genotypes. A fox can tell a brown rabbit from a white rabbit, but it can't tell an "*BB*" rabbit from an "*Bb*"rabbit.

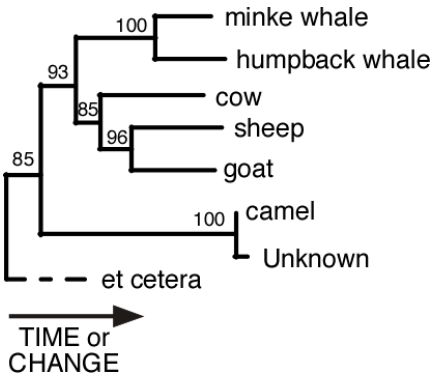
E- Environments such as this can change. One significant factor currently affecting habitats is climate change. In this hypothetical situation melting glaciers leave behind barren soil and glacier rock which might provide a selective advantage to brown-furred rabbits that can better evade predators by blending into this new environmental background (like the pocket mice).

F- Circle which organism below has the greatest fitness:

Rabbit A:
Eats a wide variety of grasses and plants. Lives in a very protected burrow. Had 3 of her offspring survive.

Rabbit B:
Has a limited diet. Lives in a forest also populated with foxes. 10 of her offspring survived out of the last brood.

Rabbit C:
Will eat almost anything. Is the largest rabbit in her neck of the woods. Due to high aggression she is able to drive off predators but hasn't succeeded in finding a mate.



- Which two pairs of organisms are more closely related?

A. Cow and camel B. Cow and goat **C. Sheep and goat** D. Cow and sheep

- Which group of organisms has the most amino acid differences?

A. Cow and camel B. Cow and goat C. Sheep and goat D. Cow and sheep

- Which number represents the common ancestor of cows, sheep, goats, and whales? ____93___

10. What is an example of convergent evolution? What is an example of divergent evolution?

Divergent Evolution

When people hear the word "evolution," they most commonly think of divergent evolution, the evolutionary pattern in which two species gradually become increasingly different. This type of evolution often occurs when closely related species diversify to new habitats. On a large scale, divergent evolution is responsible for the creation of the current diversity of life on earth from the first living cells. On a smaller scale, it is responsible for the evolution of humans and apes from a common primate ancestor.

Convergent Evolution

Convergent evolution causes difficulties in fields of study such as comparative anatomy. Convergent evolution takes place when species of different ancestry begin to share analogous traits because of a shared environment or other selection pressure. For example, whales and fish have some similar characteristics since both had to evolve methods of moving through the same medium: water.

11. What is the difference between artificial and natural selection?

Natural selection is the differential survival and reproduction of individuals due to differences in phenotype. It is a key mechanism of evolution, the change in the heritable traits characteristic of a population over generations.

Charles Darwin popularized the term "natural selection", contrasting it with artificial selection, which in his view is intentional, whereas natural selection is not. Think about some decisions you make about the types of pets you want or what kind of foods you prefer to eat. ***Artificial selection,*** also called "*selective breeding*", is where humans select for desirable traits in agricultural products or animals, rather than leaving the species to evolve and change gradually without human interference, like in natural selection.

12. What is the difference between a homologous and analogous structure?- Give examples.

Homologous structures are those organs whose underlying similarity arises from their being derived from a common ancestral structure. For example, the wing of a bird and the forelimb of a human are homologous.

Analogous structures are those whose similarity comes from their performing a similar function, rather than their arising from a common ancestor. Therefore, for example, the wing of a butterfly and the wing of a bird are analogous.

How do the following processes contribute to the variability of a population over time? Give an example for each:

- **random mating**

  Random mating is Mating between individuals where the choice of partner is not influenced by the genotypes (with respect to specific genes under study). The mating of individuals in a population such that the union of individuals with the trait under study occurs according to the rule of probability. (e.g. the random mating of bobcats in the Cedar River Watershed).

- **meiosis (crossing over/independent assortment)**

Genetic variation is increased by **meiosis**. During fertilization, 1 gamete from each parent combines to form a zygote. Because of recombination and independent assortment in **meiosis**, each gamete contains a different set of DNA. This produces a unique combination of **genes** in the resulting zygote and can contribute to genetic variability in a population over time. Coat color variation in rock pocket mice.

- **mutation**
  Mutation is a change in DNA, the hereditary material of life. An organism's DNA affects how it looks, how it behaves, and its physiology — all aspects of its life. So a change in an organism's DNA can cause changes in all aspects of its life. An example of a mutation in humans is albinism or sickle cell trait which can result in equatorial populations of humans being more resistant to malaria 9in the heterozygous condition).

- **geographic separation**

As a result of geographic separation, organisms of an ancestral species evolve into two or more descendant species after a period of physical separation caused by a geographic barrier, such as a mountain range, rockslide, road or river.

Sometimes barriers, such as a lava flow, split populations by changing the landscape. Other times, populations become separated after some members cross a pre-existing barrier. For example, members of a mainland population may become isolated on an island if they float over on a piece of debris.

Once the groups are reproductively isolated, they may undergo **genetic divergence**. That is, they may gradually become more and more different in their genetic makeup and heritable features over many generations. Genetic divergence happens because of natural selection, which may favor different traits in each environment, and other evolutionary forces like genetic drift. An example might be the finches on the Galapagos Islands described first by Charles Darwin.

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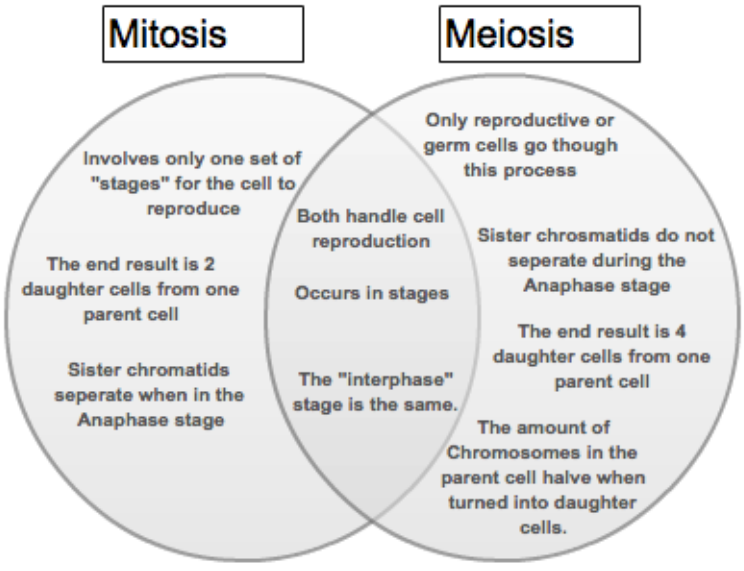
Genetics

Major Concepts from Chapter 7:

- Be able to use Punnett squares to solve monohybrid and dihybrid genetic crosses- see practice problems-
- Know the similarities and differences between meiosis and mitosis. i.e. create a Venn diagram



- How do mitosis and meiosis differ in terms of biological purpose/function?
  Mitosis- biological function is growth, repair and asexual reproduction.
  Meiosis- biological function is to produce gametes, which lead to genetic variation.
- How does the chromosome number compare in terms of parent and daughter cells in meiosis and mitosis. Use the terms diploid and haploid in your explanation.
  Mitosis: parent cell is diploid and produces two daughter cells that are diploid.

  Meiosis: parent cell is diploid and four daughter cells are haploid

- Explain where genetic variation comes from.

  In meiosis, genetic variation comes from crossing over, independent assortment (segregation for more than one genes) and random fertilization of gametes.
- Be able to use the following vocab to explain a genetic cross: P generation, F1 generation, allele, genotype, phenotype, heterozygous, homozygous, dominant, and recessive sex-linked and incomplete dominance to describe traits.

  P generation, Parent generation

  F1 generation, First generation

  allele, alternate forms of a gene

  genotype, refers to the genetic makeup of an organism; in other words, it describes an organism's complete set of genes. In a more narrow sense, the term can be used to refer to the alleles, or variant forms of a gene, that are carried by an organism. (AA)

  phenotype, the physical expression of a gene or genes. Red hair, Type A blood type etc.

  heterozygous, A dominant and recessive allele together Aa (AKA: hybrid condition)

  homozygous: Two of the same alleles together AA, aa

  dominant: For a single dominant trait to be expressed, the dominant allele must be present (Homozygous dominant or heterozygous condition)

  recessive: For a single recessive trait to be expresses, the both recessive alleles must be present (Homozygous recessive condition)

  sex-linked: applies to genes that are located on the sex chromosomes. These genes are considered sex-linked because their expression and inheritance patterns differ between males and females. While sex linkage is not the same as genetic linkage, sex-linked genes can be genetically linked

Practice Problems for Chapter 7:

1. Cross - Green sepals (G) is dominant over yellow sepals (g).

Parent 1 Gg X Parent 2 gg

	G	g
g	Gg	gg
g	Gg	gg

Predicted Results

Genotypic Ratio: 1Gg:1gg

Phenotypic Ratio: 1Green:1 Yellow

2. What is the difference between homozygous genotypes and heterozygous genotypes?
   - homozygous genotypes: alleles are the same (ll or LL)
   - heterozygous genotypes: alleles are different (Ll)

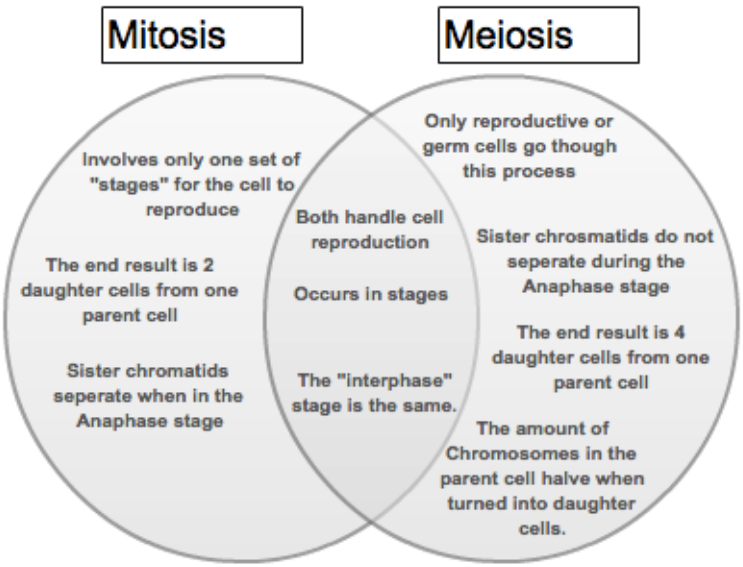
3. When are dominant traits expressed? When are recessive traits expressed?
   - For a single dominant trait to be expressed, the dominant allele must be present (Homozygous dominant or heterozygous condition)
   - For a single recessive trait to be expresses, the both recessive alleles must be present (Homozygous recessive condition)

4. What types of cells are created during meiosis, haploid or diploid? Why is this important? What is the difference between haploid and diploid cells?

   Meiosis: haploid gamete cells, conserves chromosome #. Haploid cells have half the number of chromosomes, whereas diploid cells have a full set of chromosomes.

5. What must happen before mitosis? ___DNA duplicates_____

6. Compare and contrast mitosis to meiosis



7. How does meiosis increase variation in a population?

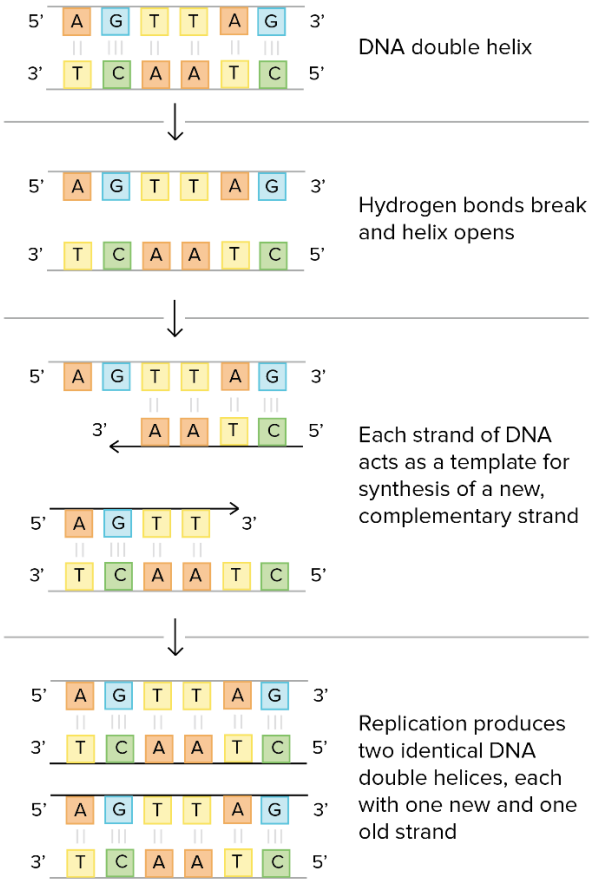
- In meiosis, genetic variation (recombination) comes from crossing over and independent assortment

7.5: Why is genetic variation important in a population?

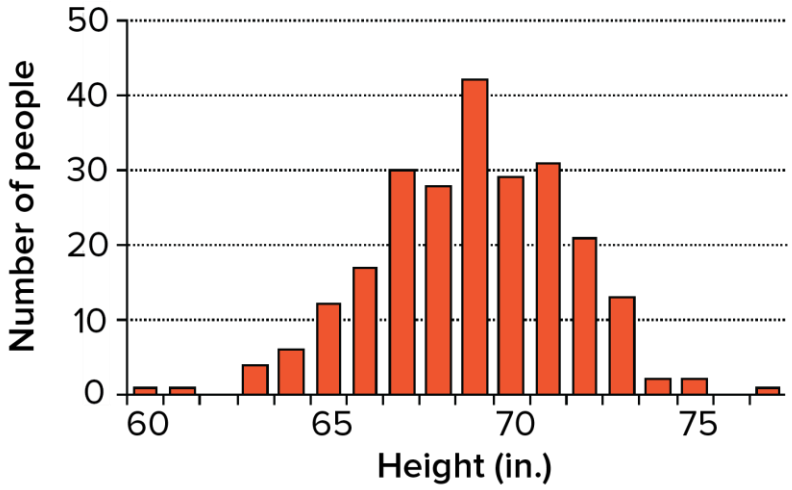
- It is necessary for a population to evolve.

8. How and why does DNA replicate itself?

- DNA replication is **semiconservative**, meaning that each strand in the DNA double helix acts as a template for the synthesis of a new, complementary strand.
- This process takes us from one starting molecule to two "daughter" molecules, with each newly formed double helix containing one new and one old strand.



9. How are polygenic traits different from single gene traits in terms of being expressed in a population?
   Many polygenic traits result in continuous variation. Unlike Mendel's pea plants, humans don't come in two clear-cut "tall" and "short" varieties. In fact, they don't even come in four heights, or eight, or sixteen. Instead, it's possible to get humans of many different heights, and height can vary in increments of inches or fractions of inches.



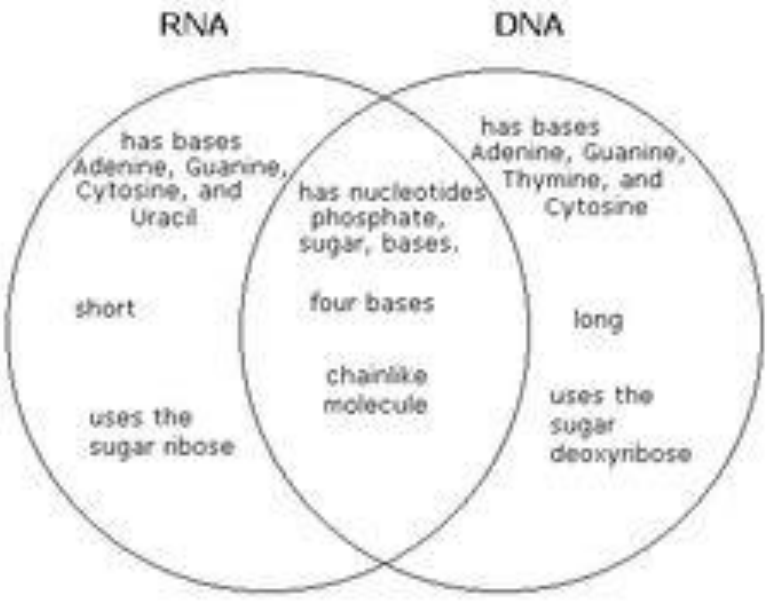
10. What is epigenetics?
    Epigenetics is the study of heritable changes in gene expression (active versus inactive genes) that do not involve changes to the underlying DNA sequence — a change in phenotype without a change in genotype.

11. How are monozygotic twins different from dizygotic twins?
    Dizygotic (**fraternal**) **twins** - **Twins** are two offspring produced by the same pregnancy. **Twins**can be either **monozygotic** ('**identical**'), meaning that they develop from one zygote, which splits and forms two embryos, or **dizygotic** ('**fraternal**'), meaning that each **twin** develops from a **separate** egg and each egg is fertilized by its own sperm cell.

Molecular biology

Major Concepts from Chapter 8:

- Describe the structure of DNA.See below
- Compare and contrast DNA and RNA.

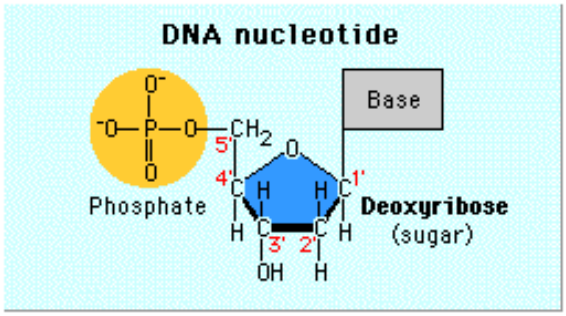


- Be able to describe the processes of transcription and translation on the way to making a protein.
- Explain how the sequence of amino acids is important in determining protein shape and function.
- Be able to describe how mutations occur in DNA and the effects that mutations have on an organism.

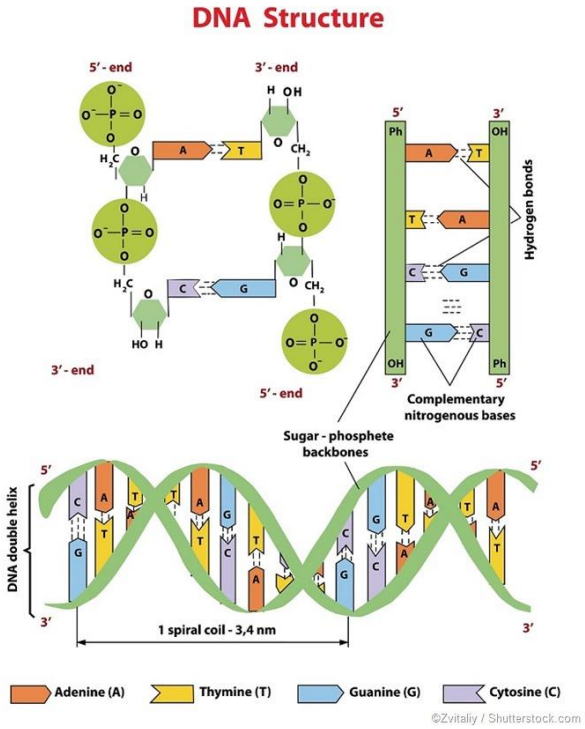
Review Questions:

1. What is the function of DNA? Where is it found in the cell?
   Deoxyribonucleic acid (**DNA**) is a nucleic acid that contains the genetic instructions for the development and **function** of living things. All known cellular life and some viruses contain **DNA**. The main **role of DNA** in the cell is the long-term storage of information. DNA is located in the nucleus in eukaryotic cells.

2. Draw a nucleotide and label the 3 parts.



Draw a labeled strand of DNA



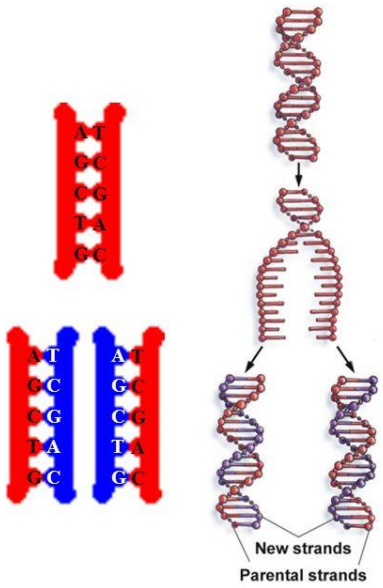
3. Name the 4 different nucleotides? How do we know this/
   The basic building block of **DNA** is the **nucleotide**. The four nucleotide bases are (cytosine (C), thymine (T), adenine (A), guanine (G).

Which nucleotides are paired together? How do we know this?
One other key piece of information related to the structure of DNA came from biochemist Erwin Chargaff. Chargaff analyzed the DNA of different species, determining its composition of A, T, C, and G bases. He made several key observations, including the one that the amount of A always equaled the amount of T, and the amount of C always equaled the amount of G (A = T and G = C). all species he analyzed had the same 1:1 ratio between A & T, and C&G.

4. Why is DNA replication said to be semi-conservative?

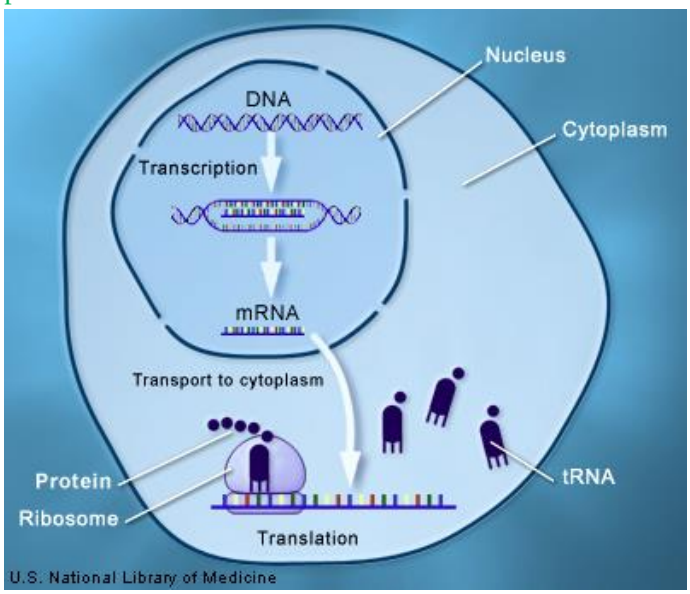
DNA Replication

- DNA Synthesis
  - ✓ The DNA bases on each strand act as a template to synthesize a complementary strand
    - Recall that Adenine (A) pairs with thymine (T) and guanine (G) pairs with cytosine (C)
  - ✓ The process is **semiconservative** because each new double-stranded DNA contains one old strand (template) and one newly-synthesized complementary strand



5. DNA is our genetic blueprint- so why do we need mRNA?

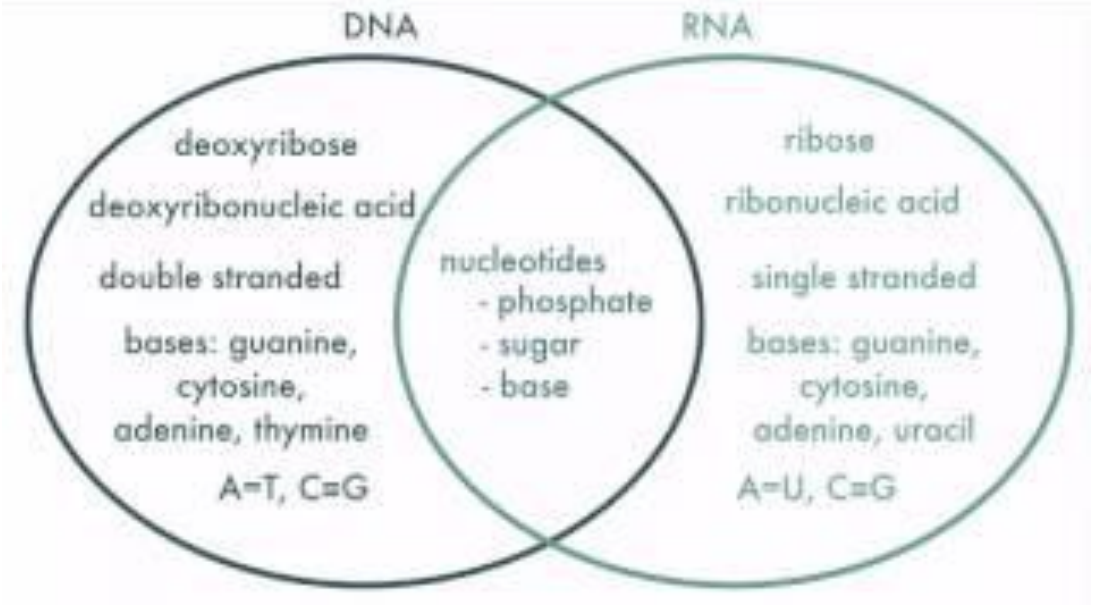
mRNA copies the genetic information from the DNA in the nucleus and transferrers it to the ribosome, where the respective protein is made.



6. Translation- explain how the steps below are necessary for translation to occur (the making of a protein)

Parts of Translation	How Translation works (write/diagram how it happens – use the vocab words on the left)
Ribosome mRNA tRNA Codon Anti-Codon Amino Acid Protein	In translation, messenger RNA (**mRNA**) is decoded by a **ribosome**, outside the nucleus, to produce a specific **amino acid** chain, or polypeptide. The polypeptide later folds into an active **protein** and performs its functions in the cell. The ribosome facilitates decoding by inducing the binding of complementary **tRNA** **anticodon** sequences to mRNA **codons**. The tRNAs carry specific amino acids that are chained together into a protein as the mRNA passes through and is "read" by the ribosome.

7. What are some of the similarities and differences between DNA and mRNA?. (Venn diagram?)



8. What is a mutation?

A mutation is a change in the genetic code.

9. Why are mutations in gametes different than mutations in somatic (body) cells? (Which mutation can be transmitted across generations?

Mutations occurring in body cells are called 'somatic **mutations**', and (unless they occur in cells that will become ovaries or testes) they will not be passed to offspring. However, **mutations** can also occur in reproductive tissues - in the cells that will produce **gametes** (or spores) which can be transmitted across generations.

10. Below is a strand of the DNA strand that is transcribed. Follow the steps of transcription and translation to determine the amino acid sequence of the protein to be made (use your DN Agent decoder☺):

A T G C C C T T C A C A G A G T A G

mRNA: U A C G G G A A C U G U C U C A U C

amino acid. sequence:___Tyr-Gly-Asn-Cys-Leu-ile

Second letter

First letter	U	C	A	G	Third letter
U	UUU, UUC } Phe UUA, UUG } Leu	UCU, UCC, UCA, UCG } Ser	UAU, UAC } Tyr **UAA Stop** **UAG Stop**	UGU, UGC } Cys **UGA Stop** UGG Trp	U C A G
C	CUU, CUC, CUA, CUG } Leu	CCU, CCC, CCA, CCG } Pro	CAU, CAC } His CAA, CAG } Gln	CGU, CGC, CGA, CGG } Arg	U C A G
A	AUU, AUC, AUA } Ile **AUG Met**	ACU, ACC, ACA, ACG } Thr	AAU, AAC } Asn AAA, AAG } Lys	AGU, AGC } Ser AGA, AGG } Arg	U C A G
G	GUU, GUC, GUA, GUG } Val	GCU, GCC, GCA, GCG } Ala	GAU, GAC } Asp GAA, GAG } Glu	GGU, GGC, GGA, GGG } Gly	U C A G