Bio 122 – Review Answers

***Chapters 1 & 2***

1. Mitosis:
   1. Advantage – The process is quick, and since there is only one duplication and one division of genetic material, there are less chances of making mistakes.
   2. Disadvantage – Each cell’s genetic material is unique, so specialized cells can only make cells of the same type. Cells that don’t undergo mitosis can’t be regenerated if lost.

Meiosis:

1. Advantage – the process creates a cell with a unique set of chromosomes that increase genetic diversity within a population.
2. Disadvantages – the process is longer, has the potential to create more mistakes and can only be performed by cells in reproductive organs.
3. The process of crossing-over occurs in prophase I of meiosis. Homologous chromosomes and their identical pairs (created during the S phase of interphase) come into such close proximity that the genetic material they contain gets physically “tangled” and exchanges places. Each chromosome then leaves with a new, unique combination of genes.
4. The two types of cell regulators are **external** and **internal** regulators.
   1. Internal regulators make sure that all the steps necessary for cell division have taken place before allowing a cell to enter the M phase of mitosis.
   2. External regulators respond to stimuli from outside the cell to determine whether or not to initiate the cell division cycle.
5. Cancer is a disorder of the cell’s regulator’s. It occurs when a cell’s regulators malfunction or a cell does not respond appropriately to its regulators. The usual result in unregulated cell division.
6. Non-disjunction occurs when chromosome pairs fail to separate during meiosis. The result is that one cell will gain an “extra” chromosome, while the other will have one too little.
   1. Down syndrome is an example of non-disjunction in the 21st pair of chromosomes.
   2. Turner and Klinfelter’s syndromes are the result of non-disjunction in the X and Y chromosomes.
7. Cells divide in order to remain efficient. As cells grow, their volume increases exponentially faster than their surface area. This results in a limiting factor – the cell membrane cannot import the nutrients required by the increasing volume, nor can it export the wastes. As the cell stops being efficient, it has two choices: divide or die.
   1. Cells may choose to divide for several reasons, including to replace old or dead cells, to grow the organism in size (increase the number of cells) or to fill in a gap resulting from an injury.
8. a. Haploid: A cell with one set of chromosomes (half the “normal” number).

b. Diploid: A cell with two sets of chromosomes (the “normal” number)

1. Karyotype: A picture of the cell’s chromosomes organized in their homologous pairs, and ordered by size.
2. Cytokinesis: the division phase of the “M phase” of the cell cycle. It is at this time that organelles in the cytoplasm are divided between the two cells.
3. Gametes: An organism’s haploid cells. They are the result of meiosis and also known as “sex cells”.
4. Chromosomes: Defined sections of DNA carrying particular genes.
5. Homologous: 2 chromosomes that are the same linght, carry the same genes but may have different alleles.

***Chapters 3 & 4***

1. Base-pairing is a process that allows each nucleotide to bind with only one other specific nucleotide. Adenine will always bind with Thymine (or Uracil in RNA) and Cytosine will always bind with Guanine. A – T (U), C – G.
2. Original Strand: TACCGTAGTCAGTACGATAGCTAGCATAGCTA

Complimentary DNA: ATGGCATCAGTCATGCTATCGATCGTATCGAT

Original Strand: TACCGTAGTCAGTACGATAGCTAGCATAGCTA

Complimentary RNA: AUGGCAUCAGUCAUGCUAUCGAUCGUAUCGAU

1. Creating a protein:
   1. A strand of mRNA is created for a particular gene.
   2. The mRNA strand travels to a free ribosome.
   3. The rRNA “reads” the mRNA three nucleotides (or one codon) at a time.
   4. The codon from the mRNA binds to an anti-codon on a strand of tRNA.
   5. When binding occurs, the tRNA releases its amino acid into a chain (polypeptide)
   6. When the chain is complete, it folds into a protein.
2. Proteins are the cell’s “workers”. They do everything from carry messages, build organelles, allow in materials and excrete wastes from the cell. They are also a key component of the cell membrane.
3. A mutation could result in one of three options:
   1. No effect – the mutation occurs in “junk” DNA and has no effect on the organism.
   2. Beneficial effect – the mutated gene increases the organism’s fitness and increases the chances of its survival.
   3. Negative effect – the mutated gene decreases the organism’s fitness and reduces its overall life-expectancy.
4. Mutations are not all bad. Some have no effect and many are beneficial. See question #5.
5. Point mutations are the result of only one (or a few) nucleotides changing. The can be replaced by another (substitution), deleted or added. Substitution results in only one amino acid being different in the resulting protein, but addition / deletion shifts the entire reading frama and created an entirely different protein.

Chromosomal mutations affect entire genes. The genes can be deleted, switched onto another chromosome, their location can flipped within a chromosome, etc…

1. a. Transformation – a permanent change in an organisms genotype.

b. Complimentary DNA strands – Strands of DNA that can bind to each other because they have “opposite” nucleotides in the correct sequence.

c. Genes – specific sections of DNA located on specific chromosomes that code for particular traits.

d. Proteins – the result of a completed polypeptide, or chain of amino acids.

e. Introns – The sections of mRNA that contain no useful information. It is cut out during the editing process.

Exons - The sections of mRNA that contain useful information. They are “glued” together during the editing process.

f. bacteriophage – a virus that attacks and kills bacteria.

g. enzymes – chemicals found within living organisms that control chemical reactions.

h. amino acids – molecules that attack in a particular order to create a protein. There are 20 known amino acids.

i. Transcription – the process of creating a strand of mRNA from a strand of DNA.

j. codons – a section of three nucleotides that gets “read” by tRNA in the ribosome. There are 64 codons, and they code for the attachment of amino acids to the polypeptide chain.

***Chapters 5 & 6***

1. a) Mother: EE Father ee

E E

|  |  |
| --- | --- |
| Ee | Ee |
| Ee | Ee |

100% probability of being heterozygous (Brown Eyes)

b) Mother: hh Father: Hh

H h

|  |  |
| --- | --- |
| Hh | hh |
| Hh | hh |

50% probability of being heterozygous (Brown hair)

50% probability of being homozygous recessive (Blond hair)

c) Mother: HhEe Father: hhee

HE He hE he

|  |  |  |  |
| --- | --- | --- | --- |
| HhEe | Hhee | hhEe | hhee |
| HhEe | Hhee | hhEe | hhee |
| HhEe | Hhee | hhEe | hhee |
| HhEe | Hhee | hhEe | hhee |

25% probability of being Heterozygous for both traits (Brown hair, brown eyes)

25% probability of being Heterozygous for hair colour (brown hair) and homozygous recessive for eye colour (blue eyes)

25% probability of being homozygous recessive for hair colour (blond hair) and heterozygous for eye colour (brown eyes)

25% probability of being homozygous recessive for both traits (blond hair and blue eyes)

d) HHEE

e) Brown hair and brown eyes

f) hhEe – blond hair and brown eyes

2) The principle of dominance states that in some pairs of alleles, one allele will be dominant over the other, and its trait will always show up in the phenotype.

3) The principle of segregation states that alleles will separate from one another during meiosis, and that each has an equal chance of being inherited by the next generation.

4) The principle of independent assortment states that each gene can be independently passed on to the next generation. Having one gene does not make you more or less likely to receive another gene.

5) DNA can be used to identify criminals through the process of gel electrophoresis. Each person’s DNA is unique and will result in a unique pattern of bands within the DNA. Band patterns can be matched to identify two samples of DNA from the same source.

a. A person’s DNA is cut using restriction enzymes.

b. The resulting molecules are placed in wells in the gel. An electrical current is run through the gel, and DNA migrated toward the positive end. Smaller molecules move faster than larger ones and the result is a distinctive pattern of “bands”.

c. The band patterns can be compared to identify two samples of DNA from the same source.

6) Sex linked chromosomes affect inheritance patterns because in males, who have an X and a Y chromosome, the Y chromosomes often does not carry homologous genes to the those on the X chromosome. This means the principle of dominance doesn’t apply and all genes on the X chromosome are expressed, even if recessive. This does not happen in females where the regular patterns of inheritance apply.

A daughter can inherit a sex-linked chromosomal disorder from her dad, but he must express the disorder himself, and the mother must either be a carrier or express the disorder as well.

7) Genotype: The allele combination found on a person’s chromosomes.

Phenotype: The expressed trait, as a result of the principle of dominance.

8) Incomplete dominance occurs when two traits both try to dominate over each other, but neither succeeds, resulting in a “blended” trait.

Co-dominance occurs when two traits both dominate within the same organism and both traits appear.

9) a. True-breeding plant – a self-fertilizing that that has been fertilizing itself for so many generations that the result is a “known” homozygous genotype.

b. Hybrid – a genotype that contains 2 different alleles.

c. F1 – The first offspring generation

F­2 – The second offspring generation, or grandchildren of the original generation.

P – the parent generation, or original organisms.

d. Genes – Specific sections of DNA located on specific chromosomes that code for a particular trait.

e. Alleles – the different versions of a gene.

***Chapters 9 & 10***

1. Both types of digestion break down food particles into useable substances for the body. Chemical digestion, however, creates new substances whereas physical digestion simply changes the size or the appearance of the food.
2. The nervous system is a body-wide communication system that acts rapidly and has the ability to process stimuli information before reacting appropriately. It’s three types of hormones **receive**information from the environment and **transmit** it to the brain where it can be **processed** and **instructions** can be sent to the body as a response. Nerve cells create impulses from the diffusion and active transport of ions.

At rest, a neuron has a negative charged when compared to its more positively charged environment. When it receives an impulse, ion channels open up, allowing positive ions into the cell, creating a temporarily positive internal environment. This triggers the pumps ahead of the charge to open up, which allows the impulse to propel itself through the cell the length of the axon.

At the end of the axons, the electrical impulse triggers the created of packets of neurotransmitters which will be sent into the synapse to bridge to gap between a neuro and its neighbor. When the next cell receives these chemical transmitters, it will initiate an impulse.

1. Sensory neurons: receive information from the environment (both internal and external) and transmit it to the brain.

Motor neurons: take instructions from the brain and sent it to the appropriate part of the body for action.

Interneurons : serve as a connection between sensory and motor neurons. Act as the processing regions where information is sorted, processed and decisions (conscious and unconscious are made).

1. The human body uses it’s gallbladder to store bile produced by the liver. Without a gallbladder, the liver continuously pumps bile into the small intestine, and there is no “on-demand” reserve. The human body can survive without a reserve of bile.
2. Herbivores have a longer small intestine because of the cellular structure of the food they eat. Cellulose (found in the cell wall of plant cells) is a very tough molecule to digest and the extra time spend in the small intestine allows the digestive process to break it down properly, and absorb it into the bloodstream.
3. Voluntary actions are actions that a person chooses to do, such as talking, writing, brusing hair, etc… Voluntary actions are controlled by the CEREBRUM.
4. Involuntary actions are actions that a person does not or cannot, such as peristalsis or heart rate. Most involuntary actions are controlled by the brain stem. Some are controlled by the spinal cord.
5. A) homeostasis is the body’s ability to maintain all internal conditions consistent.

b) Hormones are proteins that affect cellular activity. They act as the messengers of the endocrine system

c) Enzymes are chemicals that control (speed up or slow down) chemical reactions in the body.

d) Villi are small finger-like projections of the small intestine that increase the surface area to allow for increased absorption of nutrients into the blood stream.

e) Peristalsis is the involuntary muscle contractions that keep food moving through the digestive system (and keep it going in the right direction!).

f) Chyme is the name given to the unrecognizable soft, squishy substance that enters the small intestine. At this stage of digestion, it is no longer called food.