Bio40S- Review Answers

Fundamentals of Heredity

**Fill in the Blanks**

1. monohybrid 2. four 3. cross pollinating 4. homozygous recessive 5. anaphase II

6. anaphase I 7. homozygous 8. 9:3:3:1 9. 3:1 10. Segregation

11. Independent Assortment 12. Diploid 13. dominant 14. recessive 15. heterozygous

16. 23 17. homologous 18. first 19. haploid 20. gametes 21. linked

22. Y 23. autosomes 24. sex chromosomes 25. sex-linked 26. polygenic 27. multiple

**Written Responses**

1. Each trait carries two copies of a unit of inheritance, one inherited from the mother and the other from the father. Alternative forms of traits are called alleles. Alternative forms can either be dominant or recessive. Dominant traits are shown over recessive traits. Genes are a series of DNA nucleotides found on a chromosome. These genes code for a particular trait.
2. There are many different varieties, they can cross-pollinate and self-pollinate, they reproduce quickly
3. A hybrid is an organism with both the dominant and recessive allele. A hybrid typically shows the dominant phenotype however exceptions occur (co-dominance, incomplete dominance).
4. ½ will be Tt
5. Two organisms can be TT, Tt. In this case both exhibit the phenotype T but have different genotypes.
6. Rr X rr Phenotypic ratio= 1round:1wrinkled Genotypic Ratio= 1 Rr : 1 rr
7. Gametes are: BRY, BRy, bRY, bRy. There are 4 possible gametes
8. R (red) r (yellow), T (tall) t (dwarf)

Cross between F1 hybrids= RrTt X RrTt

Phenotypic Ratio: 9red-tall:3red-dwarf:3yellow-tall:1yellow-dwarf

1. Do a test cross. Cross it with a homozygous green plant. If any green plants result, your plant is heterozygous.
2. Law of Segregation- Paired genes separate during meiosis so that each gamete possesses only one gene for a trait. Genes recombine at random at fertilization. ex. Tt will separate to form two gametes, T and t

Law of Independent Assortment- Each chromosome goes into a sperm or egg independently of every other chromosome. ex. TtAa- T can recombine with A or a. Gametes are TA, Ta, tA, ta

1. 5 in haploid. 15 in triploid
2. Meiosis results in cells with a haploid number of chromosomes as opposed to the diploid parent cell.
3. Because sexual reproduction is the product of 2 organisms in a species, meiosis must divide the number of chromosomes in half so that when gametes combine, they form a cell with the same number of chromosomes as the parent.
4. During synapsis of meiosis, while chromosomes are lined up, there are times when portions of the chromosomes exchange portions of themselves. This is known as crossing over. The result is a recombination of genes.
5. No, the father must have free ear lobes. The mother is aa (attached) and the child is Aa (‘A’ because he has free ear lobes and ‘a’ because he gets it from his mother). Therefore he must get the ‘A’ from his father.
6. Co-dominance
7. As seen in the punnett square below, the man can not be the father of the child with O blood because it is not a possibility. The man could be the father of the child A if the mother’s second allele is O (if it was B, then he wouldn’t be the father).

|  |  |  |
| --- | --- | --- |
|  | A | B |
| B | AB | BB |
| ? | A? | B? |

1. Genotypes: IBIA, IBIB, IAi, IBi Phenotypes: AB, B, A, B
2. **Interphase:** Before meiosis begins, genetic material is duplicated.

**First division of meiosis**

* 1. **Prophase 1:** Duplicated chromatin condenses. Each chromosome consists of two, closely associated sister chromatids. [Crossing-over](http://www.accessexcellence.org/RC/VL/GG/comeiosis.html) can occur during the latter part of this stage.
	2. **Metaphase 1**: Homologous chromosomes align at the equatorial plate.
	3. **Anaphase 1**: Homologous pairs separate with sister chromatids remaining together.
	4. **Telophase 1**: Two daughter cells are formed with each daughter containing only one chromosome of the homologous pair.

**Second division of meiosis: Gamete formation**

* 1. **Prophase 2**: DNA does not replicate.
	2. **Metaphase 2**: Chromosomes align at the equatorial plate.
	3. **Anaphase 2**: Centromeres divide and sister chromatids migrate separately to each pole.
	4. **Telophase 2**: Cell division is complete. Four haploid daughter cells are obtained.

Human Genetics

**Fill in the blanks**

1. nondisjuction 2. Trisomy 3. Turner’s 4. X 5. Karyotype 6. Amniocentesis

7. Pedigree 8. Translocation 9. Mutagen

**Written Responses**

1. Random assortment ensures that offspring (even from the same parents) will be genetically unique. Crossing over allows for new unique chromosomal makeup, so unique that the offspring has a chromosome that neither parent has. Variation is important because it allows for some organisms to better adapt to their environment.
2. Nondisjunction is the failure of chromosomes to separate correctly during meiosis. Nondisjunction is responsible for monosomy and trisomy. There is nondisjunction in meiosis 1 and nondisjunction in meiosis 2.
3. Turner’s syndrome: XO Kleinfelter’s syndrome: XXY Down’s Syndrome: Trisomy 21
4. MISTAKE … no picture
5. Chromosomal mutations involve mistakes in a large part of the chromosome. Ex. addition, deletion, inversion. A gene mutation involves the mutation of a single gene on a chromosome (remember, chromosomes have thousands of genes). Ex. point mutation, frame shift mutation
6. 
7. Inversion: a segment of a chromosome breaks off and rejoins the same chromosome but in a different orientation. Translocation: A transfer of a chromosomal segment to a new position, especially on a nonhomologous chromosome. Deletion: When a chromosome breaks and a piece is lost. Addition: a broken piece of chromosome is added to a different part of the same chromosome.
8. C= tt B= Tt A= Tt D=Tt
9. Autosomal Recessive

**Chemical Basis of Heredity**

1. A deoxyribonucleotide is a component of DNA. One deoxyribonucleotide consists of a deoxyribose sugar, a nitrogen base (A, T, C, G) and a phosphate group. A ribonucleotide is a component of RNA. One ribonucleotide consists of a ribose sugar, a nitrogen base (A, U, C, G) and a phosphate group.
2. Purines and pyramadines are nitrogen bases. Adenine and guanine are chemicals called purines, whereas cytosine and thymine are pyrimidines. (These are similar chemical structures but purines are double-ring structures and pyrimidines are single rings.)
3. The sequence of nucleotides.
4. DNA: A-T, C-G RNA: A-U, C-G
5. Double-helix: DNA consists of TWO (double) strands twisted (helix) around.

Semi-conservative replication: In DNA replication each of the two new molecules of DNA contain one strand of the original molecule.

Anti-parallel: In the DNA double helix, one DNA strand runs 5’ to 3’ and the other runs 3’ to 5’. That is to say they are anti-parallel.

1. i) The sugar component of mRNA is ribose; of DNA is deoxyribose

ii) mRNA is single stranded; DNA is double stranded

iii) mRNA is composed of the bases A, U, C, G; DNA of A, T, C, G

1. TTCGAAAGCTTAGAC
2. Hydrogen bonds, covalent bonds
3. When a DNA segment is ready for replication, it opens up at a certain point. The original strands can be called templates because they serve as a pattern from which new strands will be duplicated. The initiation of replication always starts with a short RNA piece. This is called RNA Primer. As the two old strands continue to break apart, free nucleotides from the cell are attached to the existing strands. An enzyme, **DNA polymerases,** catalyzes the elongation of new DNA at a replication fork. DNA polymerases can only add nucleotides to the free 3’ end of a growing DNA strand. This means a new DNA strand can only elongate in the 5’->3’ direction.
4. Template: the parental DNA strand (there are 2)

Lagging strand: The new strand that is copied away from the fork in short segments.

Leading strand: The new strand that is copied in one continuous strand.

1. DNA polymerase catalyses the elongation of new DNA. That is it adds new nucleotides in there correct locations. DNA ligase joins the fragmented segments of the lagging strand.
2. T, U
3. 1
4. The assembly of proteins.
5. tRNA is transfer RNA. It is found at the site of translation (ribosome). It brings the required amino acid to the site. mRNA is messenger RNA. It is formed in the nucleus via transcription and then moves to the ribosome where it codes for a certain amino acid.
6. Amino acids are either constructed in the body (non-essential amino-acids) or they come from our diet (essential amino-acids)
7. A nitrogen base triplet on an mRNA is called a codon. A nitrogen base triplet on tRNA is called an anti-codon.
8. A hereditary unit consisting of a sequence of DNA that occupies a specific location on a chromosome and determines a particular characteristic in an organism.
9. It leaves the translation site in search of another amino acid.
10. The mRNA strand breaks down.
11. mRNA- constructed in the nucleus- single stranded- travels to ribosome to code for protein

tRNA- has a t-like structure formed of a looped strand- is responsible for bringing amino acids to the ribosome

rRNA- makes up part of the ribosome- interacts with mRNA and tRNA during protein synthesis

1. CAUAUGGUC
2. One mistake on the third nucleotide. CAUAUGGUC – His-Met-Val CAAAUGGUC – Gln-Met-Val
3. In one experiment, mice were injected with two forms of *Pneumococcus*, the bacteria that causes pneumonia. One form of the bacteria had a capsule, a tough outer coating surrounding its cell. The other form did not have a capsule. The type with the capsule always reproduced more bacteria with capsules and the strain without capsules always reproduced more bacteria without capsules. Mice injected with capsulated bacteria developed pneumonia and died. Mice injected with noncapsulated cells did not get pneumonia. If capsulated bacteria were killed by heating them, mice injected with these dead capsulated cells also did not get pneumonia. The heated capsulated bacteria (dead) were mixed with noncapsulated cells and were injected into mice. These mice died of pneumonia. Somehow the harmless bacteria had become harmful. Scientists concluded that there is a chemical in the dead, capsulated cells which must have changed the genetic information of the living, noncapsulated cells. They discovered that when DNA was removed from capsulated cells and added to noncapsulated cells, the noncapsulated cells produced capsules. This is what happened in the mice. DNA from the dead bacteria was transferred to the living, noncapsulated bacteria and changed them to become capsulated.
4. Introns are nitrogen bases that do not code for amino acid. The segments of a gene that are both transcribed and translated are called exons. Most genes have both exons and introns. Somewhere in the process of making RNA, the introns are removed, leaving mRNA with only the necessary sequences and codes for the synthesis of polypeptides.
5. A polypeptide is a chain of amino acids. (shorter than a protein)
6. Translation occurs at a ribosome. The first stage is called initiation, in which mRNA at a ribosome codes for the first amino acid in a sequence of polypeptides. The next stage is called continuation or *elongation*. Here, the peptide chain is built up using amino acids transferred by tRNA. As each pair of tRNAs occupies a site at a ribosome, the amino acids are joined by a peptide bond. As the ribosome moves along the mRNA to the next codon, the next tRNA brings along its amino acid and creates a peptide bond. This process continues until the ribosome encounters a termination codon, the code for the last amino acid in the peptide chain. This last stage is called termination--when the protein molecule or polypeptide chain is complete and is released from the ribosome.
7. Frameshift mutations (missense, nonsense, silent) and point mutations.
8. **Mutagens** are chemical or physical agents that interact with DNA to cause mutations. X-Rays, chemicals…
9. Well…????

Accounting for Diversity

1. A change in the genetic makeup of populations or a change in the allelic frequencies within a gene pool over time.
2. Organic evolution is biological evolution. Geologic evolution refers to the changes that happen to the earth itself.
3. The organism found lower in the strata is older. Also, because they are similar, one could assume that they are related. Perhaps evolution has changed (or modified) the species.
4. The earth changes over time. Where there was once a sea, could now be a mountain range.
5. They are homologous structures. Homologous structures suggest that if we go back far enough, these organisms may have had a common ancestor.
6. related, protein, DNA, phylogenetic

**Fill in the Blanks**

1. Variation 2. Jean Baptiste Lamarck 3. Thomas Malthus 4. Overproduction

5. Extinction 6. Natural Selection 7. Hardy-Weinburg Principle 8. Charles Lyell 9. Charles Darwin 10. Speciation

**Written Responses**

1. a) Both b) Lamarck c) Both d) Darwin e) Both f) Lamarck g) neither (but Lamarck before Darwin) h) Darwin
2. 1. **Overproduction**- most species produce more offspring than are necessary to maintain the population

2. **Competition**- struggle for existence, for living space, food, water , a result of overproduction

3. **Variation**- differences in traits can be seen among members of the same species (because of genetics) –Certain variations will by chance make the organism better able to survive. If the traits are inheritable, these variations in organisms are passed on to the next generation.

4. **Adaptation-** Adaptation is the extent to which an organism with a particular trait is suited to a particular environment. Organisms that are better adapted to a certain environment will survive and reproduce.

5. **Natural Selection**- This means that if an organism has a particular characteristic to allow it to eat food, or compete, or reproduce, then that organism will survive. It will reproduce and have offspring with the same "ideal" characteristics. All other organisms with traits that are not suited in that particular environment will die and therefore not reproduce.

6. **Speciation**- Speciation is defined as the formation of new species as a result of geographic, physiological, anatomical, or behavioral factors that prevent previously interbreeding populations from breeding with each other.

1. i) No mutations occur. ii) Individuals neither enter nor leave the population through migration. iii)The population is large. iv) Individuals mate randomly. v) Natural selection does not occur.
2. May be because we have stopped adapting to our environment. Instead we adapt our environment to us.

- This may be premature because evolution takes millions and millions of years (it’s hard to comprehend this amount of time). Humans have been around for less than 1 million years.

1. Whatever the causes, extinction of species is thought to have a major effect on the evolution of surviving organisms. It seems extinction, while bad for the species dying out, is good for others. Extinction is a fact of life on Earth. When a niche becomes vacant (for example when the species which occupied it becomes extinct), there is a race to try and fill it. Mass extinctions open up a multitude of niches, and there is an evolutionary explosion as animals and plants adapt to fill the vacant homes.

**Classifying Diversity**

**Fill in the Blanks**

1. Kingdom 2. dichotomous key 3. phylum 4. fossil 5. Latin 6. species

7. binomial nomenclature 8. homologous 9. sedimentation 10. genus 11. class

12. analogous

**Written Responses**

1. Eukarya: human, squid, earthworm

Bacteria: E. coli*,* Salmonella typhus*,* Legionella

Archaea: methanogens, halophiles, thermophiles (these are all groups)

1. Domain-Kingdom-Phylum-Class-Order-Family-Genus-Species
2. The system uses binomial nomenclature (two words) for naming organisms. Each organism is assigned a two-word Latin name, with no two plant or animal species having the same name.
3. It simplifies the task of scientists all over the world. Confusion no longer occurs over similar species.
4. The taxonomic system gets more and more specific. Therefore two species in the same genus must be in the same class because GENUS has more defining characteristics than CLASS. Two species in the same Class might not be in the same Genus because the defining characteristics for Class are less specific than for Genus.

|  |  |  |  |
| --- | --- | --- | --- |
| 6. Kingdom | Type of Cells | Number of cells | Type of Nutrition |
| Animalia | Eukaryotic | Multicellular | Heterotrophic |
| Protist | Eukaryotic | Unicellular | Heterotrophic, autotrophic |
| Fungi | Eukaryotic | Multicellular | Heterotrophic/ parasitic |
| Plantae | Eukaryotic | Multicellular | Photosynthetic |

**Diversity of Bacteria, Protists, Fungi**

|  |  |  |  |
| --- | --- | --- | --- |
| 1. | Examples | Habitat | Type of Cell & Number of Cells |
| Bacteria, Archaea | E.coli, streptococcus | Anywhere | Prokaryotic, unicellular |
| Protists | Dinoflagellate, paramecium, amoeba | Aquatic environment | Unicellular, eukaryotic |
| Fungi | Yeast, Morels | Damp, dark, undergrowth, forest floors | Multicellular, eukaryotic |

2. Fungi are heterotrophic as opposed to plants that are autotrophic. Fungi have cell walls of chitin as opposed to plants that have cell walls of cellulose.

3. hyphae, mycelium

4. The plant-like protists are the algae because they have chloroplasts. The animal-like protists (ex. Paramecium, amoeba) are animal like because they do not have cell walls and are heterotrophic.

 6. euglena- protista e.coli- bacteria Rhizopus-fungi paramecium-protista

**Diversity of Animals**

1. Eukarya
2. **cells**: smallest unit of life; **tissues**: groups of similar cells that are part of functional unit (muscle), **organs**: structures composed of two or more tissues (liver, skin); **organ systems**: two or more organs the work together to perform certain function (respiratory system)
3. radial, bilateral

|  |  |  |  |
| --- | --- | --- | --- |
| **5. Name** | **5. Examples** | **6. State what their tissue type is (ie: diploblastic vs. triploblastic** | **7. Symmetry** |
| **Porifera/sponges** | fire sponge, reef sponge | No tissues | none  |
| **Cnidaria/cnidarians** | anemone, coral, jellyfish | Diploblastic | radial |
| **Platyhelminthes/ Flatworms** | pork tapeworm, planaria | Triploblastic – acoelomate | bilateral |
| **Annelida/segmented worms** | earthworm, leech | Triploblastic –coelomate | bilateral |
| **Mollusca/mollusks** | mussel, snail, octopus, squid | Triploblastic – coelmoate | bilateral |
| **Arthropoda/arthropods** | crayfish, dragonfly, spider | Triploblastic – coelomate | bilateral |
| **Nematoda/roundworms** | heartworm, hookworm | Triploblastic – pseudocoelomate | bilateral |
| **Echinodermata/echinoderms** | sea stars (starfish), sea urchin, sand dollars | Triploblastic – coelomate | bilateral as larva, radial as adults |
| **Chordata/chordates** | lancelets, vertebrates including fish, birds and mammals | Triploblastic - coelomate | bilateral |

8. Know the important facts from the chart given in class.

**Conserving Biodiversity**

1. the variety of in the gene pool of a species, of species in an ecosystem and of ecosystems
2. *conversion* decreases the amount of habitat available and thus reduces numbers of organisms, *fragmentation* breaks up habitat into pieces that are too small to sustain viable breeding populations, *simplification* reduces complexity in a habitat and thus numbers of species that use microhabitats,  *intrusions* by tall structures harm organisms that fly into them
3. preservation of best habitat, education of public about disturbing owl breeding areas, incentives for farmers to leave habitat in natural state, research about threats to owl populations,
4. **dichotomous key**: tool for identifying organisms that is made up of series of pairs of choices that describe characteristics of organisms; **use**: start at beginning and read first pair of choices, decide which fits the organism to be identified, follow directions in key about where to go next, continue making choices and following directions until organism is identified
5. Select quadrat locations in study site in random way. Count the number of organisms in the quadrat. Collect data in an appropriate number of quadrats. Average the number of organisms found in each quadrat. Determine the area of the study site and the quadrat. Calculate the estimate of population size using the following formula:

# organisms per quadrat x area of study site

 area per quadrat

1. field guides, dichotomous keys, quadrat or point-quarter sampling and mark and recapture sampling