

**Problem Set #2 Genetics 320 Due Sept 12, 11AM.**

**Answer 1 OR 2.**

**Answer 3 OR 4**

**Answer 5 or 6.**

**Answer 7**

**You will have answers to 4 questions total.**

Please provide very short and to the point answers- economy of language is important!

1. Describe in a few sentences two aspects, features, or examples of “complexity” in biological systems as we discussed in class.

*Biological complexity is due to*

*-the fact that many proteins have more than one function, for example cytochrome*

*C (with activities in cell death and electron transfer)*

*-many biological processes have connections to other biological processes: if you disturb one process you can disturb others as well.*

*-similar genes exist in the form of gene families.*

*- going from the 1 dimensional DNA sequence to how a brain functions...its gotta be complicated!*

- 2 Define what a Gene Family is, and how it arose in evolution, and what role mutations plays in their generation.

*A gene family is a set of genes that are evolutionarily related/that have similar DNA sequences/that have similar amino acid sequences/whatever.*

*Gene families arose principally by the process of duplication by error, and then the process of mutation leads to new related functions for the new genes.*

3. What is a “mutagen”? Discuss whether it causes forward mutations reverse mutations, or both.

*A mutagen is a chemical (alkylating agents) or process (UV, x-rays) that causes base pair changes that can alter gene and protein function. A mutagen can cause either forward or reverse mutations.*

4. Name two elements that can be used to identify a gene merely from the DNA sequence.

*From the presence of an ORF- open reading frame- which is a series of triplet nucleotides that encode amino acids. A second feature is a promoter where*

*RNA polymerase binds to initiate transcription. A third feature is a enhancer binding sequence.*

5. Fluctuation tests:

a. What hypotheses does a fluctuation analysis test?

*Whether mutations in a population of cells pre-exist, or are induced by physiological stress.*

b. Discuss whether a fluctuation test can be done with forward mutations, reverse mutations, neither or both. Describe if phage resistance and penicillin resistance can or cannot be used in a fluctuation test. Are the number of mutants higher with the forward mutation or reverse mutation and WHY (if in fact both can be used in fluctuation tests!)

*Both phage resistance as a measure of forward mutation, and penicillin resistance to measure reverse mutation, can be used in fluctuation tests. Forward mutation of phage resistance will likely yield more mutants than reverse mutation because with forward mutation many base pair changes can destroy protein function while with reverse mutation typically only one mutation, reversing the previous mutations, can restore protein function.*

6. A complementation table is shown below for a diploid organism. Lets say the mutations effect whether the fly has legs (+) or not (-) . One row has the maternal chromosome, the other the paternal chromosome.

Which mutations are dominant and which are recessive?

How many genes are identified unambiguously?

Is there a mutation for which it is unclear if it is a different gene then identified by the other mutations, and if so why is it unclear?

	wt	m2	m3	m4	m5	m6
wt	+	+	-	+	+	+
m2		-	-	-	+	+
m3			-	-	-	-
m4				-	+	+
m5					-	-
m6						-

*m3 is dominant, all the rest are recessive.*

*Two genes are identified, with mutation m2 and m4 in one gene, and m5 and m6, in a second gene.*

*It is unknown if m3 is in the same of different gene from the other mutations, because m3 is dominant and complementation tests are not interpretable with dominant mutations.*

7. Discuss how the arrangement of DNA sequences (synteny) between mouse and human genomes resembles the arrangement of sequences between normal Ch22 and Ch9 and the Philadelphia chromosome. (They are both examples of evolution at work!)

*Synteny between humans and mice show that DNA sequences have been rearranged during evolution to bring two sequence together that were not together before.*

*Similarly, the Philadelphia chromosome brings together two sequences that were not together before. Such changes (mutations!) can alter cell and organismal function.*