

Biology 10
Dr. Balukjian
Lecture Exam 2 Answer Key

Your Name:

Unfortunately, this is not a cruel April Fool's Joke (since some of you asked). Be sure to put your name on this sheet and your scantron. There are 4 parts to this exam, plus some extra-credit questions. Be sure to re-read and check over your work before turning it in; last time several of you skipped questions when you could have at least guessed on the answer. Read each question carefully and select **the best** answer. Make us all proud.

Part 1: Multiple Choice (15 questions, 30 points). Read each question and the 4 possible answer choices carefully, and then select the best answer by filling in the appropriate circle on your scantron. Use a #2 or mechanical pencil only.

1. In the cell cycle, during which phase do chromosomes duplicate?

- a. **S phase**
- b. G1 phase
- c. G2 phase
- d. mitotic phase

2. Male peacocks display their brightly colored feathers as a way to attract females, who choose which males get to reproduce. This is an example of

- a. natural selection
- b. genetic drift
- c. gene flow
- d. **sexual selection**

3. In the article we read about daddy longlegs, the scientists determined that what they originally thought was only a single species was actually 3 by using integrative taxonomy. Integrative taxonomy can best be described as

- a. the process of identifying and describing species
- b. using the biological species concept to identify and describe species

- c. using the morphological species concept to identify and describe species
- d. using multiple species concepts/lines of evidence to identify and describe species.**

4. Which of the following is NOT a source of genetic variation in a population?

- a. the random nature through which gametes unite during fertilization
- b. the fact that chromosomes line up during metaphase of meiosis according to their size**
- c. the fact that chromosomes line up randomly during metaphase of meiosis
- d. the crossing over that occurs between neighboring chromatids during meiosis

5. Use the chart below to translate the following DNA sequence into the correct polypeptide:
TACCCAGTCACATC

		Second base of RNA codon					
		U	C	A	G		
First base of RNA codon	U	UUU } Phenylalanine (Phe) UUC } UUA } Leucine (Leu) UUG }	UCU } Serine (Ser) UCC } UCA } UCG }	UAU } Tyrosine (Tyr) UAC } UAA } Stop UAG } Stop	UGU } Cysteine (Cys) UGC } UGA } Stop UGG Tryptophan (Trp)	U	C
	C	CUU } Leucine (Leu) CUC } CUA } CUG }	CCU } Proline (Pro) CCC } CCA } CCG }	CAU } Histidine (His) CAC } CAA } Glutamine (Gln) CAG }	CGU } Arginine (Arg) CGC } CGA } CGG }	U	C
	A	AUU } Isoleucine (Ile) AUC } AUA } AUG } Met or start	ACU } Threonine (Thr) ACC } ACA } ACG }	AAU } Asparagine (Asn) AAC } AAA } Lysine (Lys) AAG }	AGU } Serine (Ser) AGC } AGA } Arginine (Arg) AGG }	U	C
	G	GUU } Valine (Val) GUC } GUA } GUG }	GCU } Alanine (Ala) GCC } GCA } GCG }	GAU } Aspartic acid (Asp) GAC } GAA } Glutamic acid (Glu) GAG }	GGU } Glycine (Gly) GGC } GGA } GGG }	U	C
						A	G

- a. Start, Glycine, Serine, Alanine, Proline
- b. Start, Valine, Serine, Leucine, Stop
- c. Start, Glycine, Serine, Valine, Stop**
- d. Start, Proline, Arginine, Tyrosine, Stop

6. Imagine a mutation that changes the last 3 nucleotides of the DNA sequence from ATC to ATT. Would this affect the translation process?

- a. Yes

b. No

7. Generally speaking, evolution is best described as

- a. adaptation to the local environment
- b. survival of the fittest
- c. descent with modification**
- d. genetic drift

8. Cancer is the result of

- a. an error in mitosis in which cells do not get the message to stop dividing**
- b. an error in meiosis in which chromosomes do not properly separate
- c. an error in transcription
- d. an error in translation

9. Which of the following people was involved in the discovery of the molecular structure of DNA?

- a. Rosalind Franklin**
- b. Aretha Franklin
- c. Jean-Baptiste Lamarck
- d. Alfred Russel Wallace

10. During transcription, the DNA template strand is transcribed into what?

- a. tRNA
- b. DNA
- c. mRNA**
- d. rRNA

11. Which best describes one of the ways in which microevolution works?

- a. A change in the environment directs a population to devise a mutation that will make it better adapted; that mutation is represented by an allele, which increases in frequency in the population
- b. Allele frequencies change enough in a population over time that a new species eventually forms

c. a geographic barrier forms between two populations, which become different from each other over time and eventually become new species

d. a mutation arises randomly in a population creating a new allele; a change in the environment results in that allele becoming more advantageous, and it increases in frequency in the population.

12. Two species that are reproductively isolated because they mate at different times of the year are kept separate due to

a. prezygotic isolation

b. postzygotic isolation

c. midzygotic isolation

d. gene flow

13. An elephant accidentally stepping on an ant on the African savannah and causing the ant population's allele frequencies to change is an example of

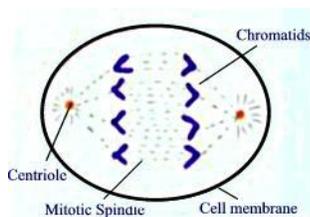
a. natural selection

b. gene flow

c. mutation

d. genetic drift

14. The chromosomes in this cell are at what stage of mitosis?



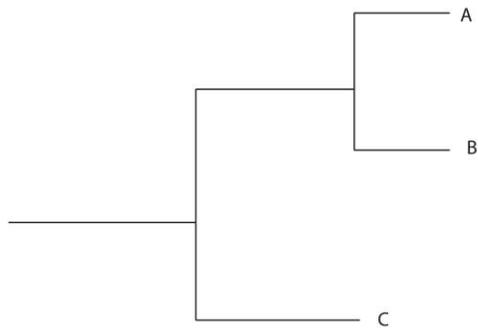
a. anaphase

b. telophase

c. prophase

d. metaphase

15. Which of the following are true about species A, B, and C?



- a. Species A is more closely related to B than it is to C
- b. Species A and B share a common ancestor
- c. Species A, B, and C share a common ancestor
- d. All of the above**

Part 2: Circle One (10 questions, 20 points): Read each statement carefully and select the word or phrase in parentheses (separated by a /) that best completes the statement by circling it.

1. Humans have (22/23) pairs of homologous chromosomes in their cells.
2. The set of three nucleotides that is translated into an amino acid is called a (nucleosome/codon).
3. The visible expression of a gene is called its (phenotype/genotype).
4. *HH* is an example of a (heterozygous/homozygous) genotype.
5. In addition to Charles Darwin, (Jean-Baptiste Lamarck/Alfred Russel Wallace) independently came up with the theory of natural selection.
6. If a cell has only a single set of chromosomes, its ploidy is (diploid/haploid).
7. In a homologous pair of chromosomes, (1/2) chromosome(s) are inherited from the mother, and (0/1) chromosome(s) are inherited from the father.

8. In order to determine how many species of plant bugs there are in Tahiti, Dr. B dissected and photographed the (antenna/**male genitalia**) of several specimens.

9. Genetic drift has a greater effect in (large/**small**) populations.

10. Transcription happens in the (**nucleus**/ribosome).

Part 3: Fill-in-the-Blanks (15 questions, 30 points): Read the following statements carefully and fill in the blanks with the appropriate word or phrase chosen from the word bank below. **Note: Each word or phrase can only be used once, but not all words and phrases in the word bank will be used.**

WORD BANK:

protein	Alfred Russel Wallace	Jean-Baptiste Lamarck	Francis Crick
land-dwelling	metaphase I	redwood tree	allopatric
3n	prophase I	cleavage furrow	codominance
2n	sympatric	Pacific yew	evolution
n	mutation	natural selection	
phylogenies	incomplete dominance	founder effect	

1. In order to show the evolutionary relationships between different species over long periods of time, scientists draw diagrams called _____phylogenies_____.

2. The frequency of allele *A* in a population is 0.8 and the frequency of allele *a* is 0.2. After several generations, a new allele called *A+* is observed in the population with a frequency of 0.1. The *A+* allele arose through_____mutation_____.

3. A group of salamanders wash onto the shore of an island after a storm and start a new population that is distinct from the mainland. The new population is an example of _____founder effect_____.

4. An evolutionary analysis shows that several dozen species of cichlid fish all arose in the same lake in Africa. This kind of speciation is called_____sympatric_____.

5. _____ Francis Crick _____ was one of the scientists who discovered the molecular structure of DNA.
6. ____ Jean-Baptiste Lamarck _____ was a scientist whose theory of evolution was called “the inheritance of acquired characteristics.”
7. The phenomenon in which the phenotype is an intermediate state of the dominant and recessive phenotypes is called ____ incomplete dominance _____.
8. During ____ metaphase I _____ of meiosis, homologous pairs of chromosomes line up in the middle of the cell.
9. Animals cells are separated during cytokinesis through the development of ____ cleavage furrow _____.
10. Taxol, a chemical compound originally found in _____ Pacific yew _____, has been used in chemotherapy.
11. In meiosis, the ploidy of the parent cells is ____ $2n$ _____ and the ploidy of the daughter cells is ____ n _____.
12. The product of translation is a _____ protein _____.
13. Fossils provide evidence that whales descended from _____ land-dwelling _____ ancestors.
14. The unifying principle for all of biology is _____ evolution _____.
15. The process through which allele frequencies change due to certain alleles providing an adaptive advantage over others is called _____ natural selection _____.

Part 4: Short-Answer Questions (4 questions, 20 points): Please read the questions carefully and then write a short response in the space provided.

1. In a population of frogs, the allele for skin with no spots is dominant to the allele for skin with spots. A heterozygous male mates with a homozygous recessive female to produce offspring. What are the genotypes of the parents (hint: choose your own letter for each allele)? Draw a Punnett square to show the genotypes of their offspring. What fraction of the offspring will have spots?

Allele F for no spots; f for spots (doesn't matter what letter you used, as long as you were consistent with your dominant/recessive alleles).

Father: Ff

Mother: ff

Punnett Square:

	f	f
F	Ff	Ff
f	ff	ff

So half of the offspring will have spots and half will not.

2. In a population of camels, the allele A codes for a protein that produces a large hump, while the allele a codes for a small hump. After studying the camel population for several generations, you notice the appearance of third allele, $A+$, which codes for an extra large hump. What are 2 possible causes for the appearance of the $A+$ allele in the population? After several more generations, you notice the frequency of the $A+$ allele has increased substantially, indicating that evolution had occurred. What are 2 possible explanations for this evolution?

Note that there were 2 parts to this question. Many of you forgot the first part.

2 possible causes for the appearance of the A+ allele: Mutation, gene flow from another population

Possible explanations for the evolution: Natural selection (having an extra large hump provided some adaptive advantage), gene flow (individuals from another population with the A+ allele migrating to this population), or genetic drift (population size is small and the A+ allele increases in frequency randomly).

3. Jean-Baptiste Lamarck proposed that individuals can pass on traits developed during their lifetime to their offspring. For many years, biology textbooks have depicted Lamarck as having been right about evolution being real, but wrong about the mechanism. How do recent discoveries in the field of epigenetics indicate that Lamarck may not have been so wrong after all?

The field of epigenetics has revealed that the events that happen during one's lifetime (their environmental experiences and exposure) can directly affect gene expression. So while certain environmental exposures may not change the underlying DNA code itself (the genome), they can change the epigenome (i.e., what is expressed). These epigenetic changes can then be passed on to offspring, which is somewhat similar to Lamarck's idea that offspring can inherit characteristics acquired during their parents' lifetimes.

4. Explain how a gene ends up as a protein; starting with the region of DNA that comprises a gene, take me through the process through which that gene codes for the end product of a chain of amino acids (a protein).

A gene is a region of DNA that codes for a protein. Within the nucleus, the DNA is unzipped (since it is double-stranded), and with the aid of the enzyme RNA polymerase, a mRNA molecule is assembled that is complementary to one of the strands of DNA, with RNA using the nucleotide uracil instead of thymine. This process is known as transcription. Once the mRNA is transcribed, the introns are spliced out, a cap and tail are added to the mRNA transcript, and the mRNA leaves the nucleus for the cytoplasm. The mRNA fits in between the two sub-units that make up a ribosome, and tRNA molecules with anti-codons complementary to the mRNA codons bind to the mRNA, bringing with them amino acids. This process is called translation. The amino acids are assembled together into a polypeptide, which forms a protein.

Part 5: Extra Credit (3 questions, 6 possible points)

1. What was the winning mnemonic device for PMAT (Prophase, Metaphase Anaphase, Telophase)?

a. Pablo Makes Awesome Tequila

b. People Must Always Try

c. Parking Meters Always Tick

2. Which is the best Bay Area sports team?

a. Oakland A's (but I accepted any answer)

b. SF Giants

c. San Jose Sharks

d. Golden State Warriors

3. What islands are home to the plant bugs that Dr. B studied?

Tahiti, or French Polynesia