

**BOT/MBIO/ZOO 1005 – Concepts in Biology**

Midterm 2 (100 points) -- Form 1 (Blue)

March 15, 2007

**Part I: Multiple choice, true-false, and matching (50 points)**

**True-false (mark A for true, B for false – please do NOT use T and F):**

1. At some point during protein synthesis, ribosomes come directly into contact with DNA.
2. Only bacteria and plants reproduce asexually.
3. When you were a zygote, you were a haploid cell.
4. If a fraggle can produce 100 genetically different gametes, then a couple of fraggles can theoretically produce about  $100 \times 100 = 10,000$  genetically different offspring.

**Multiple choice / matching**

5. Suppose that two genes control the weight (gene *F*) and taste (gene *D*) of a turkey. A male turkey that is fat and delicious is mated with a female turkey that is thin and tasteless. One hundred baby turkeys hatch, all of them fat and delicious. Which of the following are the most likely genotypes of the parents?
  - a. dad is FFDD; mom is ffdd
  - b. dad is ffdd; mom is FFDD
  - c. dad is FfDd; mom is FfDd
  - d. dad is FFDD; mom is FFDD
  - e. dad is FFDD; mom is FfDd

6. In the figure at right, a \_\_\_\_ cell is dividing into two \_\_\_\_ cells.
  - a. prokaryotic ... genetically different
  - b. prokaryotic ... genetically identical (except for mutations)
  - c. eukaryotic ... genetically different
  - d. eukaryotic ... genetically identical (except for mutations)

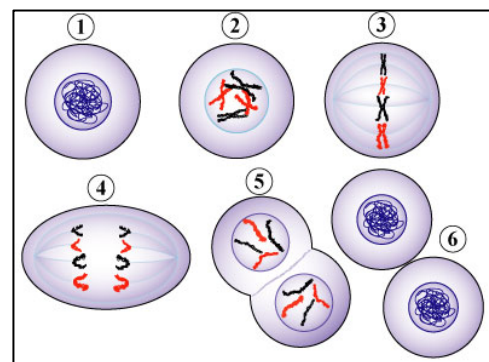
7. In the figure at right, what could be happening during stages 1 and/or 6?
  - a. crossing over
  - b. protein synthesis
  - c. DNA replication
  - d. a, b, and c
  - e. b and c only

8. In the figure at right, stage 5 comes immediately BEFORE:
  - a. anaphase I
  - b. anaphase II
  - c. cytokinesis
  - d. prophase I
  - e. prophase II

9. Hemophilia is a disease in which a person suffers from uncontrolled bleeding because of a mutation in a gene on the X chromosome. Alice is a woman whose father suffers from hemophilia. Alice's mother's family has no history of hemophilia. The likelihood that Alice is a carrier of hemophilia is:
  - a. 100%
  - b. 67%
  - c. 50%
  - d. 25%
  - e. 0% (Alice cannot be a carrier)

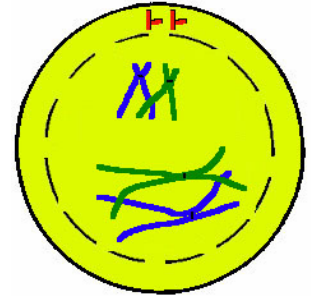
10. Both Tim and Dawn have type AB blood. Which of the following blood types could their children have?
  - a. A
  - b. B
  - c. AB
  - d. a, b, and c are all possible
  - e. only a and b

11. Which of the following accounts for the variability associated with sexual reproduction?
  - a. mitotic cell division of the sperm and egg cells
  - b. crossing over during prophase I of meiosis
  - c. the spindle pulling apart sister chromatids during anaphase of mitosis
  - d. cytokinesis
  - e. all of the above account for the variability associated with sexual reproduction



12. Scientists who study gene function often create random mutations in DNA of fruit flies or nematode worms. Which of the following is/are possible outcomes of these genetic mutations?
- the mutant allele could encode a protein that works faster than the original
  - the mutant allele could encode a protein that does not work at all
  - the mutant allele could encode a protein with the exact same amino acid sequence as the original
  - a, b, and c are all possible
  - only a and b are possible

13. The cell shown at right ...
- is undergoing a type of cell division that occurs in my skin cells
  - has a diploid number of 8
  - has two homologous pairs of chromosomes
  - a, b, and c are all correct
  - only a and c are correct



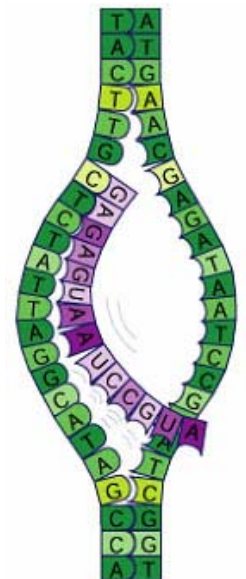
14. Watson and Crick discovered the three-dimensional structure of DNA about \_\_\_\_ scientists developed the ability to create transgenic bacteria.
- the same time as
  - 20 years before
  - 100 years before
  - 20 years after
  - 100 years after

15. Which of the following statements is FALSE?
- HIV spreads by contact with blood, semen, and other body fluids
  - being HIV positive is the same thing as having AIDS
  - HIV kills immune system cells and therefore reduces a person's ability to fight other diseases
  - HIV evolved from a virus that infects chimpanzees
  - an anti-HIV vaccine has been hard to develop, in part because HIV is an RNA virus that mutates rapidly

-----  
Matching.

- a. interphase      b. binary fission      c. telophase      d. anaphase      e. prettyphase
16. In this stage of the eukaryotic cell cycle, DNA is unwound and available for both replication and protein synthesis
17. Events that occur in this stage are essentially the *opposite* of the events of prophase.
- 

18. What is happening in the figure at right?
- DNA replication
  - binary fission
  - translation
  - nondisjunction
  - transcription



19. If you see uracil, you know you're looking at:
- DNA
  - a protein
  - an amino acid
  - a peptide bond
  - RNA
20. In lecture, I mentioned that the human "diploid number" is 46. This means that:
- you have 46 diploid cells in your body
  - your gametes consist of 46 cells
  - all of your cells (except your gametes) have 46 chromosomes
  - the highest number of children anyone can have is 46
  - the average human life span is 46 years
21. In which location would you be MOST likely to find asexually reproducing organisms?
- at the shores of a small outdoor pond
  - at the bottom of the ocean

22. The role of *Agrobacterium* in producing transgenic plants is:
- it provides the nucleus that will give rise to the new plant variety
  - it provides the restriction enzymes that create the recombinant plasmid
  - it provides the “sticky ends” needed to combine DNA from different sources
  - it injects a foreign gene into a plant cell
  - it prevents the plant from rejecting its new DNA
23. Mules are sterile (unable to reproduce) because:
- all male members of the horse family are sterile
  - their zygotes are unable to divide
  - their cells don’t contain sex chromosomes
  - mules don’t like to have sex with other mules
  - the cells of their ovaries or testes are unable to produce gametes
24. Which of the following best describes the entire process of meiosis?
- a haploid cell replicates its DNA and divides twice to produce four haploid cells
  - a diploid cell replicates its DNA and divides twice to produce four diploid cells
  - a haploid cell replicates its DNA and divides twice to produce four diploid cells
  - a diploid cell replicates its DNA and divides twice to produce four haploid cells
  - a haploid cell replicates its DNA and divides once to produce two haploid cells
25. Which statement is FALSE?
- Since the human genome was sequenced in 2003, scientists have figured out the function of all 25,000 of our genes.
  - Cloning is a form of asexual reproduction.
  - One difference between an embryonic stem cell and a skin cell is that the stem cell has not yet taken on a specialized function.
  - When I was an embryo, each of my cells had the same amount of DNA as each of my skin cells does now.
  - Exactly half of my chromosomes came from my mom, and exactly half came from my dad.
26. Important! What color is your test form? (0 points)
- blue
  - green

MC _____ / 50
SA _____ / 50
Total = _____ / 100

**BOT/MBIO/ZOO 1005 – Concepts in Biology**  
 Midterm 2 (100 points) -- Form 1 (Blue)  
 March 15, 2007

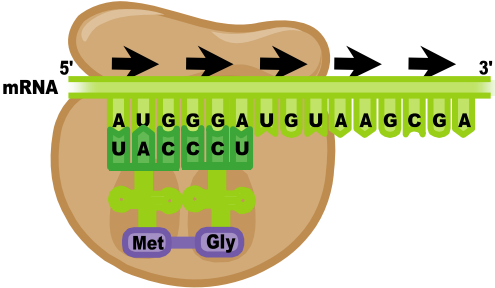
On my honor, I affirm that I have neither given nor received inappropriate aid in the completion of this exam.

(signed) \_\_\_\_\_

Score (this page) \_\_\_\_\_ / 15 points

**Part II: Short answer (50 points)**

- What is the name of the process happening in the figure at right? (1 point).
  - Draw a clear, unambiguous arrow pointing to the ribosome. (1 point)
  - Use the dictionary of the genetic code (provided) to draw in the tRNA molecule carrying the next amino acid (be sure to show the correct anticodon and amino acid; 2 points).



- Bacteria cause some of our illnesses (such as tuberculosis), and viruses cause others (such as colds). Describe one structural difference and one similarity between bacteria and viruses (2 points).  
 Difference:  
 Similarity:
  - As an infection proceeds, bacteria or viruses become more numerous within your body. Describe the difference between how viral populations increase and how bacterial populations increase (2 points).

3. In cats, orange coat color is **dominant** to black, and the gene controlling this trait is on the **X chromosome**. My cat, Sidecar, is an orange male. Let's say he has a girlfriend, a cute female kitty with black fur. What are the possible genotypes and phenotypes of their kittens? Be sure to answer separately for the male and female kittens, and show your work for full credit (4 points).

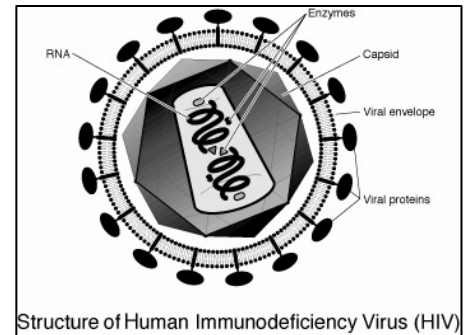
4. Place the following in order, from 1 (smallest) to 6 (largest): (3 points)

\_\_\_\_\_ chromosome    \_\_\_\_\_ atom    \_\_\_\_\_ gene    \_\_\_\_\_ nucleotide    \_\_\_\_\_ codon    \_\_\_\_\_ cell

5. (a) Below is a fragment of a gene (not necessarily from the beginning). What sequence of amino acids does the gene fragment encode? The dictionary of the genetic code is provided (3 points).

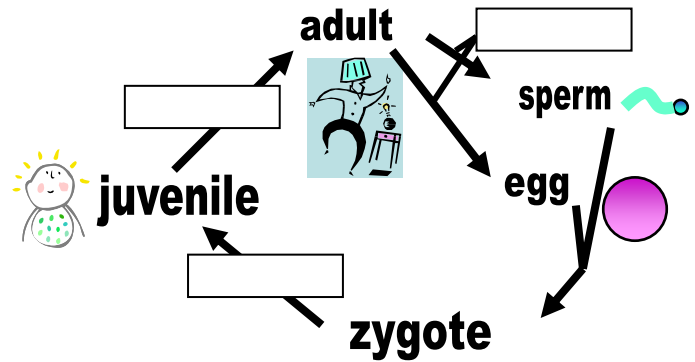
G G G A C G T C A T G G G A A C T A

- (b) If you transferred this gene fragment from a human cell to a bacterial cell, would the amino acid sequence come out the same? (A simple yes or no will suffice here; 1 point).
- (c) Circle one base in the **DNA sequence** that, if deleted in a mutation, would result in a STOP codon in the mRNA where there was none before (1 point).
- (d) If the base you circled in (c) were deleted, how many amino acids would be in the resulting protein? Explain (2 points).
6. (a) The “doorknob”-shaped proteins on the HIV particle at right must bind with a protein on a T cell’s membrane for HIV to infect the cell. Would a person who does not produce the T cell’s membrane protein be immune to HIV? Why or why not? (2 points)



- (b) HIV infects T cells, not skin cells, yet my T cells have the same DNA as my skin cells. Explain how skin cells and T cells can have identical DNA yet not express the same proteins (2 points).
- (c) Where does HIV’s viral envelope come from? (1 point)
7. In fruit flies, feeding behavior is partly controlled by a single gene called *for* (“foraging”). According to an article about the gene, “larvae with the rover allele (*for<sup>R</sup>*) move significantly more while eating during a set time period than those homozygous for the sitter alleles (*for<sup>S</sup>*).”
- (a) What are all of the possible genotypes of a fly with the “rover” phenotype? (2 points)
- (b) Set up a “test cross” that would help me determine the genotype of a fly with the dominant phenotype. Be sure to explain how to interpret the results of the test cross (4 points).

8. Fill in the three blanks in the diagram at right with the words “mitosis,” “meiosis,” and/or “binary fission.” Note that you may not have to use each of these words, and you may need one or more of the words more than once (3 points).



9. Courtney P. and Ashley P. are twins, and speculation rages on whether they are identical or fraternal. Describe how they were conceived if they are identical and if they are fraternal (4 pts).

Identical:

Fraternal:

10. (a) My cat, Two, had a fast-growing tumor that grew across her shoulders; we had to put her to sleep when she could no longer walk. Apparently, the tumor did not spread to other parts of her body; was the tumor benign or malignant? (1 point)

(b) When Two was young, her vet injected a vaccine between her shoulder blades. A chemical in the vaccine apparently mutated the DNA in the muscles near her shoulder blades. How do DNA mutations relate to the formation of the tumor? (Use the words “gene,” “protein,” and “cell cycle” in your answer; 3 points).

(c) Our cat’s tumor kept her from walking. List two other ways that a tumor can harm an animal (2 points).

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_

(d) List two of the common treatments for cancer (2 points).

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_

(e) List one example of a risk factor for cancer that you can avoid, and one example of a risk factor that you cannot control (2 points).

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_

11. EXTRA CREDIT! Suppose you find a cat with a gene that makes it non-allergenic to humans. You want to exploit the huge potential market for allergy-free cats; describe the steps you would take to clone the cat (2 points).

### Dictionary of the Genetic Code

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