

[3 points for writing your name!]

Unit Test on Cell Biology – *please read carefully and double-check your work!*

LO: Describe and explain the Central Dogma. SLE: Meet NGSS.

1. List 2 organelles or cell parts that plant cells have that animal cells do not.

[2 points per item = 4 points total]

Any 2 of these: cell wall, chloroplast, large central vacuole.

2. A main function of the nucleus is to [3 points]

- a. replicate DNA
- b. store DNA
- c. transcribe DNA into RNA
- d. all of the above

3. Does the diffusion of perfume through a classroom count as osmosis? Why or why not?

[4 points]

No. Either of 2 reasons can be given:

- Osmosis refers only to the diffusion of water.
- Osmosis refers to diffusion across a semi-permeable membrane (which classroom air is not).

4a. What is photosynthesis? [3 points]

The process of making food (glucose) with energy from sunlight.

4b. What three elements are included in a molecule of glucose? (Write out the whole words).

Carbon, Hydrogen, Oxygen [1 point per item = 3 points total]

4c. What is the chemical formula for a molecule of glucose? (That is, how many of each of the atoms are needed to make one glucose molecule?)

$C_6H_{12}O_6$ [3 points]

4d. Is glucose a starting material of photosynthesis, or an end product of photosynthesis?

Circle “starting material” OR “end product.” END PRODUCT [3 points]

4e. Is oxygen a starting material of photosynthesis, or an end product of photosynthesis?

Circle “starting material” OR “product.” END PRODUCT [3 points]

5. Check each of the following statements that applies to meiosis and/or mitosis. For each statement you may check 0, 1, or both boxes. [1 point per box = 8 points total]

	Meiosis	Mitosis
Example: A form of cell division.	√	√
a. The process by which one skin cell produces 2 new skin cells.		√
b. Includes a stage where sister chromatids separate.	√	√
c. Includes 2 rounds of prophase, metaphase, anaphase, and telophase.	√	
d. Uses spindles to guide the movements of chromosomes.	√	√

6. Muscular dystrophy is an X-linked genetic disease. Each X chromosome carries one of the following alleles:

- X^D allele, which goes with the normal, dominant, healthy phenotype
- X^d allele, the recessive allele.

a. List all possible genotypes of females who have the disease. X^dX^d [4 points]

b. List all possible genotypes of males who do NOT have the disease. X^DY [4 points]

7. Through several years of fastidious gardening, Gregor Mendel established that a round pea shape is the dominant phenotype, and a wrinkled pea shape is a recessive phenotype. You can use R for the dominant allele, and r for the recessive allele.

a. Plants with a genotype of Rr will have a phenotype of ____round_____. [3 points]

b. In one experiment, Mendel breeds a round-seed plant with a wrinkled-seed plant. About half of the baby plants have round seeds, and about half have wrinkled seeds.

What is/are the possible genotype(s) of the round parent? Rr [4 points]

What is/are the possible genotype(s) of the wrinkled parent? rr [4 points]

8. A Punnett Square is a method of determining [3 points]

- the possible genotypes of offspring, if given the parents' genotypes
- whether an allele is dominant or recessive
- whether cells are dividing by meiosis or mitosis
- whether or not a gene mutated
- whether or not a joke can be considered a pun

9. A legitimate concern about Gregor Mendel’s work was that [3 points]
- As a monk, he explained most of his findings by saying, “That’s just the way God wants it.”
 - He only studied pea plants, which no one cares about.
 - He studied traits that were controlled by many genes and thus could not be explained well with the methods available at the time.
 - His assistants’ pollination methods were sloppy and resulted in pollen being sprayed everywhere, with fertilization occurring willy-nilly.
 - His experimental data matched theoretical ratios even more closely than they should have.

10. If you give the artificial mRNA U-G-C-U-G-C-U-G-C-U-G-C... to a ribosome, the resulting protein contains only the amino acid cysteine (Cys). Explain how this suggests that in the genetic code, 3 RNA bases (not 1 or 2 or 4) code for each amino acid. [5 points]

- If every 3 bases coded for an amino acid, each codon would be the same (U-G-C), so each amino acid would be the , and you’d get a protein of one amino acid repeated over and over, which is what you get.
- With other sets of bases (1, 2, or 4), you would have more than one codon (for 2 bases: UG, GU, and GC), which would likely give you a protein with more than 1 amino acid, which is inconsistent with the results.

11. Here is an amino acid sequence:

Met-Leu-Lys

a. Write down a DNA sequence that would result in this amino acid sequence. If needed, use the table at right (from openstax.org/details/biology).

ANY of the following [5 points]

- TAC-AAT-TTT
- TAC-AAT-TTC
- TAC-AAC-TTT
- TAC-AAC-TTC
- TAC-GAA-TTT
- TAC-GAA-TTC
- TAC-GAG-TTT
- TAC-GAG-TTC
- TAC-GAT-TTT
- TAC-GAT-TTC
- TAC-GAC-TTT
- TAC-GAC-TTC

		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	

b. [BONUS] How many possible answers are there to 11a? 12 [4 points; +1 if you put 8]

12. You are a genetic counselor. A woman visits you, concerned about her risk of developing breast cancer. You sequence her BRCA1 and BRCA2 genes and find that, toward the very end of her BRCA gene, 3 bases in a row are missing. This particular mutation has never been reported before, so you will need to use your knowledge of biology to make the best inferences that you can.

a. What is the technical name for this type of mutation? Deletion [3 points]

b. What effect, if any, will this mutation likely to have on the function of the BRCA1 protein? Explain. [4 points]

- Ideal answer: While we cannot predict the effect of mutations with perfect accuracy, this mutation is unlikely to cause problems because only 1 or 2 amino acids will be affected (depending on exactly which bases are deleted). It's not really a frameshift!

c. Briefly describe another kind of mutation that would be likely to have a similar effect. [3 points]

- Ideal answer: insertion of 3 bases in a row around the same location that the deletion occurred. Or any mutation that only affects 1-2 amino acids rather than causing a frameshift.

d. What would you tell this woman about her risk of developing breast cancer? [4 points]

- Her risk is relatively low, but increased somewhat over that of a woman with no mutations in her BRCA1 gene.

13. Check each of the following statements that applies to messenger RNA (mRNA) and/or transfer RNA (tRNA). For each statement you may check 0, 1, or both boxes. [1 point per box = 8 points total]

	mRNA	tRNA
a. Needed to make proteins at ribosomes.	√	√
b. Shaped like a cross or cloverleaf.		√
c. One molecule codes for the amino acid sequence of an entire protein.	√	
d. The longer of the two forms of RNA.	√	

14. Fill in the blanks: _____ pieces of DNA migrate rapidly toward the _____ electrode. [3 points]

a. Large, negative b. Large, positive c. Small, negative d. Small, positive

15. In just a few words, what do restriction enzymes do? [3 points]

They cut DNA (for example, plasmids) into smaller pieces.

BONUS QUESTION: Briefly describe the legendary strand of RNA that was first used by Marshall Nirenberg to start cracking the genetic code. [4 points]

Its sequence was a long series of uracils: UUUUUUUUUUUU....

(+2 if you put a long repeat of a different base or didn't specify which base was repeated, or if you put "UUU" but didn't make it clear that there was a long string of uracils)