

Cell Biology

Write your team number on EVERY page

Team Name: _____ KEY _____

Competitor Names: _____

1. (8pt) What are the four levels of protein structure? Give the terms and describe what they correspond to.

Primary – amino acid sequence

Secondary – alpha helices and beta sheets

Tertiary – 3D fold of protein

Quaternary – interaction with other protein subunits

(1pt for name, 1pt for description for each)

2. (6pt) Given this **non-template strand** DNA sequence, write the corresponding template RNA sequence, from 3' to 5' :

3'ATG GCA AAA GAG CTC GAA GCT AGG AAT TAG 5'

3'AUG GCA AAA GAG CUC GAA GCU AGG AAU UAG 5'

(.2 pt per correct base, don't need 3' and 5' markers for full pts)

3. (5pt) Given the same non-template DNA sequence, write the **1-letter amino acid** sequence of the polypeptide encoded. Write out any stop codons as (STOP)

MAKELEARN(STOP)

.5pt per amino acid, take half off if they either write out the names of the amino acids or use the three letter abbreviations:

met-ala-lys-glu-leu-glu-ala-arg-asn-STOP

methionine-alanine-lysine-glutamate-leucine-glutamate-alanine-arginine-glutamine - STOP

4. (4pt) What are the monomers that make up a triglyceride?

Fatty acids(2pt) and glycerol (2pt)

5. (2pt) How many types of amino acids are there?

20

6. (4pt) Name two storage polysaccharides of glucose and tell whether they are found in plants or animals

Glycogen (animals), starch(plants) [galactogen (animals), inulin(plants)]

Most likely answers plus “technically correct but obscure answers that can still get full pts” – 1pt for molecule, 1pt for correct organism type

7. (2pt) What is the buffering system used by the blood to maintain pH?

carbonate/bicarbonate

8. (2pt) What pH range does this system maintain?

7.35-7.45

9. (6pt) What are the two compensatory mechanisms used to help regulate the pH? Briefly describe how one of them works (your choice)

Respiratory compensation and renal compensation (2pt each)

2pt for description – one of:

Resp. is when rate/depth of breathing changes, changing partial pressure of CO₂ and altering formation of carbonic acid

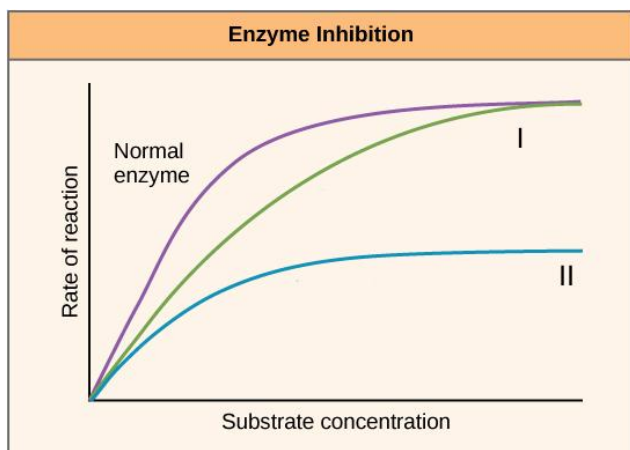
Renal is when kidneys excrete extra protons into the urine and extra bicarbonate into the plasma or vice versa

10.(2pt) A cell is placed in distilled water and begins to swell. What is the tonicity of the water?

hypotonic

11. (2pt) A cell is placed in honey and begins to shrivel. What is the tonicity of the honey?

Hypertonic



The above image shows the reaction rate vs substrate concentration plots for an enzyme with two different inhibitors.

12. (2pt) What kind of inhibitor is inhibitor I?

Competitive inhibitor

13. (2pt) How does inhibitor I affect the Michaelis-Menten constant (K_m) of the enzyme?

increases

14. (2pt) How does inhibitor I affect the maximal velocity (V_{max}) of the enzyme?

Stays same/it doesn't

15. (2pt) What kind of inhibitor is inhibitor 2?

Non-competitive inhibitor (NOT uncompetitive)

16. (2pt) How does inhibitor II affect the Michaelis-Menten constant (K_m) of the enzyme?

Stays same/it doesn't

17. (2pt) How does inhibitor II affect the maximal velocity (V_{max}) of the enzyme?

decreases

18. Which enzymes involved in the citric acid cycle involve converting NAD⁺ to NADH? What steps do they each catalyze (list enzyme, starting material and product e.g. aconitase, citrate to cis-aconitate)(12 pts)?

isocitrate dehydrogenase, D-isocitrate to alpha ketoglutarate,
alpha ketoglutarate dehydrogenase, alpha ketoglutarate to succinyl
coA

malate dehydrogenase, malate to oxaloacetate

2pt for enzyme, 1pt starting material, 1pt product

Place the letter corresponding to the function in the blank left of the organelle (1pt ea

- | | |
|---|--|
| 19. <u>E</u> Mitochondria | a. Capture solar energy |
| 20. <u>A</u> Chloroplast | b. Package and distribute products |
| 21. <u>C</u> Lysosome | c. Digest excess products |
| 22. <u>B</u> Golgi complex | d. Contain DNA |
| 23. <u>H</u> Rough endoplasmic reticulum | e. Transform energy through respiration |
| 24. <u>J</u> Smooth endoplasmic reticulum | f. Produce proteins |
| 25. <u>D</u> Nucleus | g. Store substances |
| 26. <u>F</u> Ribosome | h. Site of chemical reactions that contains ribosomes |
| 27. <u>G</u> Vacuole | i. Provides internal structure |
| 28. <u>I</u> Cytoskeleton | j. Site of chemical reactions where lipids are synthesized |

29. (2pt) What enables the apparent rigidity of plant cell walls?

Turgor pressure

30. (2pt) What does lignin do to plant cell walls?

Stiffens them

31. (3pt) What are the 3 layers that can be found in plant cell walls?

Primary, secondary, middle lamella (1pt ea)

32. (3pt) What do we call the two types of cell wall in bacteria and where do they get their names?

Gram positive and gram negative, gram staining (1pt ea)

Fill in the blanks (2pt per blank)

33. Flippases catalyze the transport of lipids from the __inner monolayer/intracellular side__ side of the membrane to the __outer monolayer/extracellular side__ side.

34. Floppases catalyze the transport of lipids from the __outer monolayer/extracellular side__ side of the membrane to the __inner monolayer/intracellular side__ side.

35. A membrane composed primarily of phospholipids with __unsaturated__ chains is more dynamic than a membrane composed primarily of phospholipids with ____saturated__ chains.

36. (4pt) What are 2 major lipid components found in lipid rafts that distinguish them from the rest of the membrane?

Cholesterol and sphingolipids (2pt ea)

37. (2pt) Caveolae are a type of lipid raft characterized by the presence of what protein?

caveolins

38. (12pt) There are three types of vesicle coat proteins. What are they and what kind of trafficking does each participate in?

1. Clathrin (1pt)

Between Golgi (1pt), plasma membrane(1pt), and endosomes (1pt)

2. COPI (1pt)

Retrograde(1pt) transport from Golgi(1pt) to ER(1pt)

3. COPII(1pt)

Anterograde(1pt) transport from ER (1pt)to Golgi(1pt)

39. (2pt) The surface proteins that identify cargo and help facilitate fusion are called what?

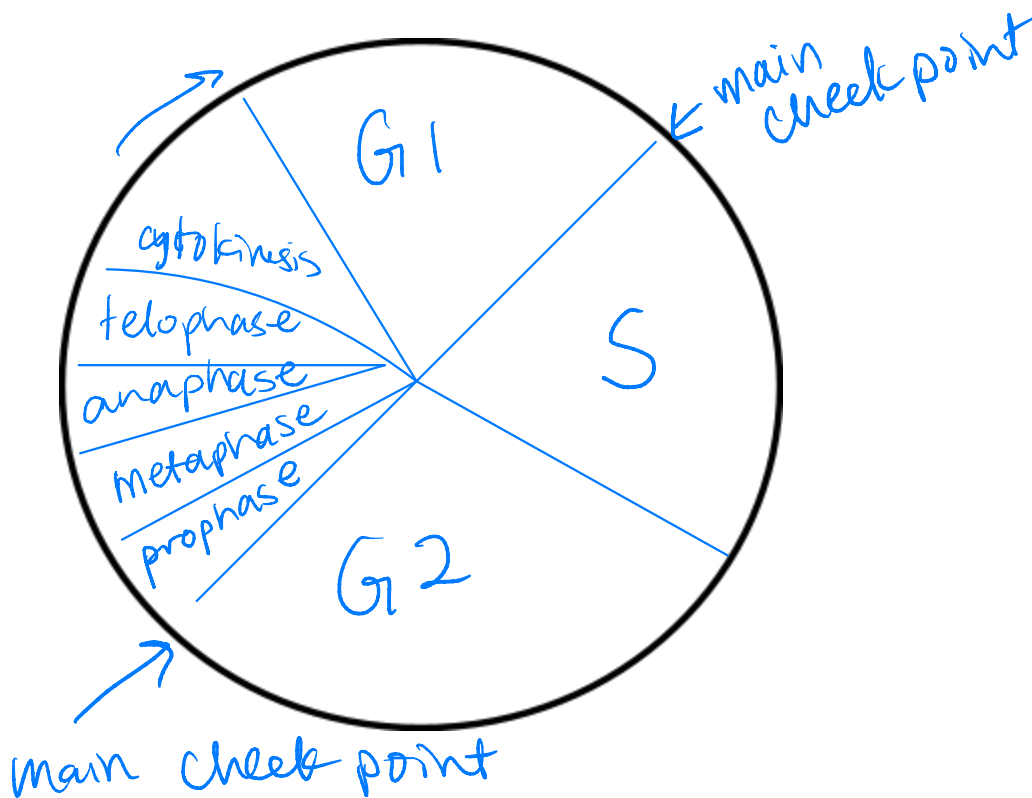
SNARES

40. (2pt) How close together do membranes need to be for vesicle fusion?

1.5nm

41. (8pt) Use the circle below to draw a diagram of the cell cycle. Use all of the words in the word bank below.

G2, metaphase, S, anaphase, G1, prophase, telophase, cytokinesis



42. (4pt) On your diagram, indicate where the two main checkpoints are.

Fill in the blanks with a word or phrase (2pt each blank)

43. At the first checkpoint (after division), the cell checks for ___DNA Damage_ so that ___DNA replication_ (process) can happen.

44. At the second checkpoint, the cell checks for ___successful chromosome replication___ so that ___mitosis___ (process) can happen.

45. What are the two main components of cell cycle regulation in eukaryotes (4pt)?

Cyclins and cyclin dependent kinases (or CDKs), 2pt each

Match the example of an oncoprotein with what kind of protein it is. Put the letter in the space left of the protein (2pt each)

46. B VEGFR

47. E C-Src

48. C Raf

49. A Ras

50. D Myc

a. Regulatory GTPase/G protein

b. Receptor tyrosine kinase

c. Cytoplasmic

serine/threonine kinase

d. Transcription factor

e. Cytoplasmic tyrosine kinase

Decide whether each plant is a C3, C4, or CAM plant. Put C3, C4, or CAM in the space left of the plant (1 pt each)

51. C4 Sugarcane

52. CAM Pineapple

53. C3 wheat

54. CAM Cacti

55. CAM Orchids

56. C4 Corn

57. C4 Daisies

58. C3 Rice

59. CAM Aloe vera

60. C4 Cabbage

61. C3 Barley

62. (2pt) Pseudoephedrine (Sudafed, a nasal decongestant) binds to and activates the beta-adrenergic receptor, a GPCR which couples to Gs. What is the second messenger effect you would expect ?

(increase) cAMP

63. (2pt) Propranolol (a beta-blocker) also binds to the beta-adrenergic receptor, but does not activate it. What is this mechanism called ?

(receptor) antagonism

64. (2pt) In 2012, the Nobel prize for Chemistry was awarded for studies on G protein coupled receptors. What are the names of the scientists who won?

Brian Kobilka and Robert Lefkowitz (1pt ea)

Match the type of signaling with the description. Put the letter in the space provided. (2pt each)

65. A Signaling that involves molecules that diffuse over short distances like fibroblast growth factors

- a. Paracrine signaling
- b. Autocrine signaling
- c. Endocrine signaling
- d. Juxtacrine signaling

66. C Signaling that involves molecules that diffuse over long distances via the circulatory system like hormones

67. D Signaling that occurs via two proteins on two different cells that interact

68. (6pt) Order the following by ability to diffuse through a lipid bilayer from most able to least able:

Ca²⁺, CO₂, Ethanol, glucose, RNA, H₂O

CO₂, ethanol, H₂O, Ca²⁺, [glucose, RNA] (either order for last pair), 1pt for each in correct order

69. (4pt) Someone's coming to dinner! Your lettuce is soggy :(Should you soak it in salt water, sugar water, or tap water to perk it up? Why?

Tap water. Water moves along concentration gradient and will pass into the cells and plump up the lettuce.

The epidermal growth factor receptor (EGFR) is an RTK activated by epidermal growth factor (EGF).

70. (2pt) When EGF binds an EGFR, what is the first change that happens?
Receptor dimerization

71. (2pt) After that change happens, what kind of side chain is phosphorylated?
tyrosine

72. (4pt) After phosphorylation, what are the two types of protein domains that can bind?
SH2 (Src homology 2), PTB (phosphotyrosine binding) (2pt each, either abbreviation or full name is fine)

73. (2pt) What kind of cell death results from acute cellular injury?
necrosis

74. (2pt) What kind of cell death results in fingers and toes during development?

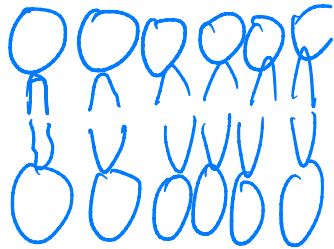
apoptosis

75. (2pt) What are the highly conserved proteases involved in apoptosis called?

caspases

Draw a picture of the following lipid structures:

76. (3pt) Lipid bilayer

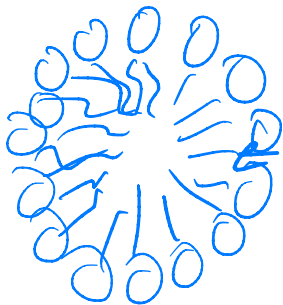


Heads outside (1pt)

Tails inside (1pt)

Two layers of heads and FLAT (1pt)

77. (3pt) Micelle

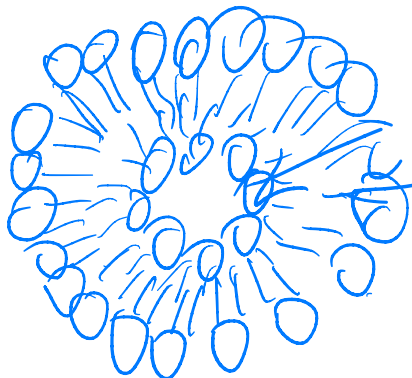


Heads outside (1pt)

Tails inside (1pt)

Spherical and one layer (1pt)

78. (3pt) Liposome



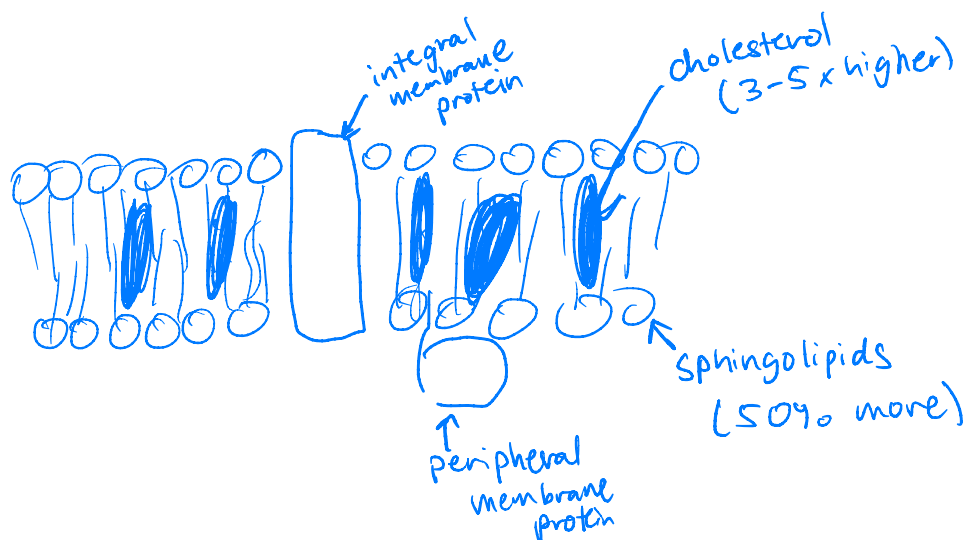
Heads outside (1pt)

Tails inside (1pt)

Spherical and in two layers (1pt)

79. (10pt) Draw and label a diagram of a lipid raft. Include both an integral membrane protein and a peripheral membrane protein, and indicate the lipid composition of the raft in comparison to normal cell membrane.

Integral protein spans (2pt)
Peripheral protein stuck to side (2pt)
Cholesterol indicated (2pt)
Cholesterol quantified (1pt)
Sphingolipids indicated (2pt)
Sphingolipids quantified (1pt)
Representations of lipids are flexible



80. (9pt) What are the three irreversible steps of glycolysis? Indicate the enzyme, substrates, and products

Okay if out of order!!, don't take off points if they include ATP/ADP and H+ (can use as a tiebreaker if they do!)

1. Hexokinase (1pt), substrate: glucose (1pt), product: glucose-6-phosphate (1pt)
2. Phosphofruktokinase (1pt), substrate: fructose-6-phosphate (1pt), product: fructose 1,6-bisphosphate (1pt)
3. Pyruvate kinase (1pt), substrate: phosphoenolpyruvate (1pt), product: pyruvate (1pt)