Name(s): _____

Team: _____ Date: _____

Science Olympiad - Beachwood Invitational 2023: Cell Biology

1. What are the three components of cell theory and who made the key contributions that formulated them? (3 pts.)

- **All living things are made of cells, Schwann & Schleiden**
- **All cells come from pre-existing cells, Virchow**
- **Cells are the basic unit of life, Hooke**

2. List the products for each step of Cellular respiration (per molecule of glucose). (3 pts.)
    a. Glycolysis

2 ATP **2 Pyruvate**

2 NADH

    b. Citric Acid Cycle (2 cycles)

4 CO2 **2 $FADH_2$**

6 NADH **2 ATP**

    c. Electron Transport Chain

6 H_20

32-43 ATP

3. Name the two stages of photosynthesis and briefly describe each. (2 pts.)

Light dependent - light hits chlorophyll, e- moves along ETC, photosystem II splits H2O making H+ gradient, ATP synthase uses gradient to make ATP

Light independent - ruBisCo "fixes" CO_2, ATP & NADHP give H atom to 3-phosphoglycerate, 2 molecules of 3-phosphoglycerate are reduced to make one glucose

4. What are the similarities between Meiosis and Mitosis? What are the differences? (2 pts.)

Both involve cell division to create daughter cells. Meiosis creates 1- 4 gametes, which only have half the total DNA, Mitosis creates 2 identical daughter cells with the entire set of chromosomes.

5. For each of the following fats, label them as saturated or unsaturated. (5 pts.)
    a. Coconut oil **Saturated**

    b. Butter **Saturated**

    c. Olive oil **Unsaturated**

    d. Avocado oil **Unsaturated**

    e. Omega 3 & 6 oils **Unsaturated**

6. Match the organelles with their correct functions. (5 pts.)

a. Ribosome **iv**

b. Smooth Endoplasmic Reticulum **v**

c. Lysosome **i**

d. Cytoskeleton **ii**

e. Cell Wall **iii**

i. Breaks down certain biological molecules

ii. Provides structural support and aids in movement

iii. Provides tensile strength and resistance to osmotic stress

iv. Synthesizes proteins from amino acids

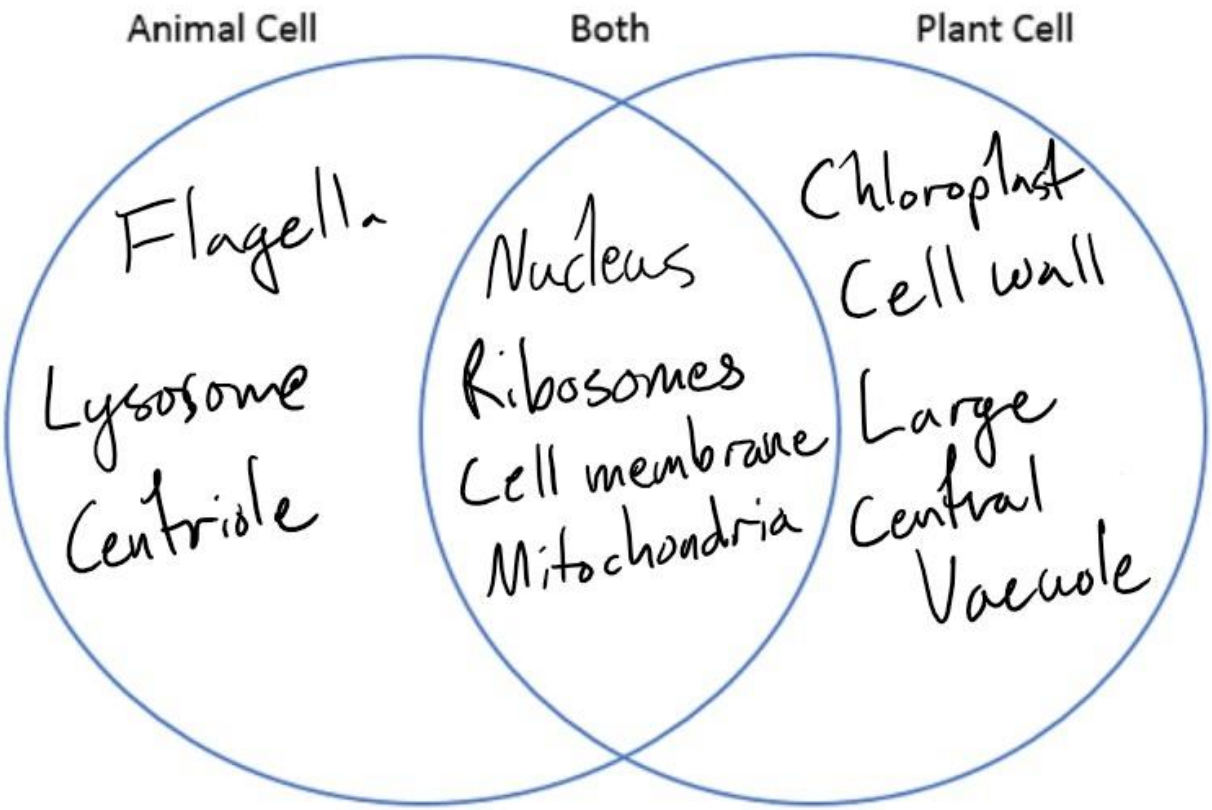
v. Folds proteins into functional forms

7. What are the five main classifications of bacterial plasmid based on function? (5 pts.)
- **Fertility**
- **Resistance**
- **Col**
- **Degradative**
- **Virulence**

8. Write the balanced net reaction for lactic acid fermentation. (2 pts.)

Glucose + 2 ADP + 2NADH $\Rightarrow$ 2 Lactic Acid + 2 ATP + 2 NAD+

9. Fill you the Venn Diagram below using the word bank. (5 pts.)



Chloroplast	Flagella	Nucleus	Centriole
Cell Membrane	Lysosome	Large Central Vacuole	Cell Wall
Ribosomes	Mitochondria		

Multiple choice: Select the option that **BEST** answers the question. (1 pt. each)

10. A Biuret test is used to detect what type of macromolecule?
    a. Nucleic Acids
    b. Proteins
    c. Carbohydrates
    d. Lipids

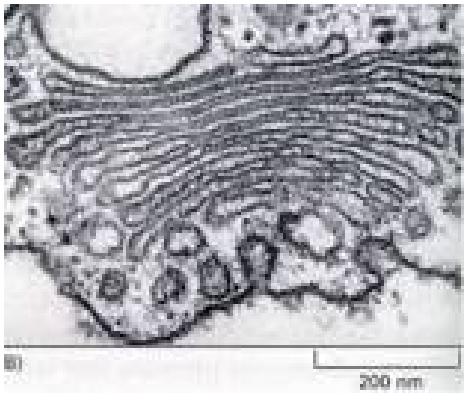
11. The use of an electrical field to separate DNA or RNA molecules by size is best known as…
    a. Assay-separation
    b. High-Throughput Screening
    c. Gel-Electrophoresis
    d. Polymerase Chain Reaction (PCR)

12. Which of the following carbohydrates is **NOT** a monosaccharide?
    a. Galactose
    b. Mannose
    c. Ketohexose
    d. Lactose

13. What process does ATP undergo to release energy used in the cell?
    a. Hydrolysis
    b. Glycolysis
    c. Hemolysis
    d. Cytolysis

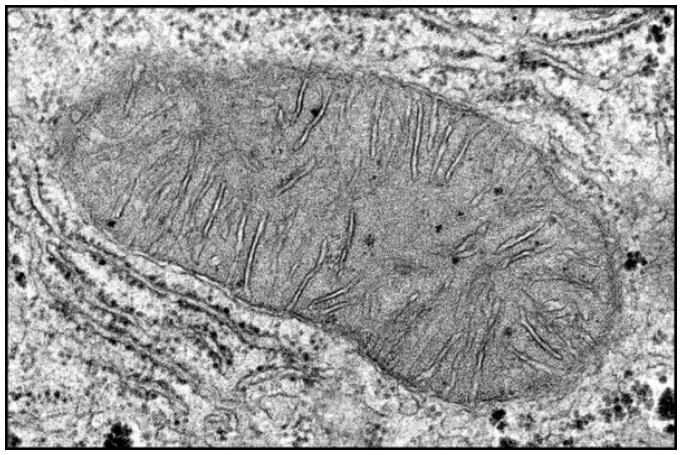
14. Which of the following is **NOT** one of the organic compounds involved in the Krebs cycle?
    a. Lactate
    b. Oxaloacetate
    c. Succinyl-CoA
    d. Citrate

15. What organelle is pictured at right?
    a. Chloroplast
    b. Nucleus
    c. Golgi Apparatus
    d. Rough Endoplasmic Reticulum



16. What is the purpose of a flagella in cells?
    a. Motility
    b. Cell Division
    c. Osmosis
    d. Structure & Support

17. What is the function of the organelle picture at right?
    a. Synthesize proteins
    b. Package and ship molecules
    c. Create ATP through respiration
    d. Break down certain molecules



18. Which of the following is a characteristic that both prokaryotes and eukaryotes share in common?
    a. Nucleus is present
    b. DNA resides in cytoplasm
    c. Ribosomes are present
    d. Capsule is present

19. The two major components of the ribosome are the…
    a. Large subunit & small subunit
    b. Ribosomal complex α & β
    c. Acetyl CoA & CoB
    d. cAMP & Ip3

20. Proteins are composed of amino acids held together by what type of bond?
    a. Peptide bonds
    b. Hydrogen bonds
    c. Ionic bonds
    d. Heteronuclear bonds

21. ATP synthase creates ATP by utilizing what phenomena?
    a. Osmotic pressure
    b. Static equilibrium
    c. Electrochemical gradients
    d. Van der Waals forces

22. What are the four major characteristics that **ALL** cells have in common? (2 pts.)

Plasma membrane, cytoplasm, ribosomes, DNA

23. The purpose of cholesterol inherent in the plasma membrane of Eukaryotic cells is to…? (1 pt.)

Increase fluidity of membrane -> allows lipids and proteins to pack in tighter and move past each other.

24. How is energy released from ATP molecules and what is the resulting molecule left over? (1 pts.)

A phosphate group is removed via hydrolysis, ADP

25. Write out the balanced reaction for photosynthesis below. (2 pts.)

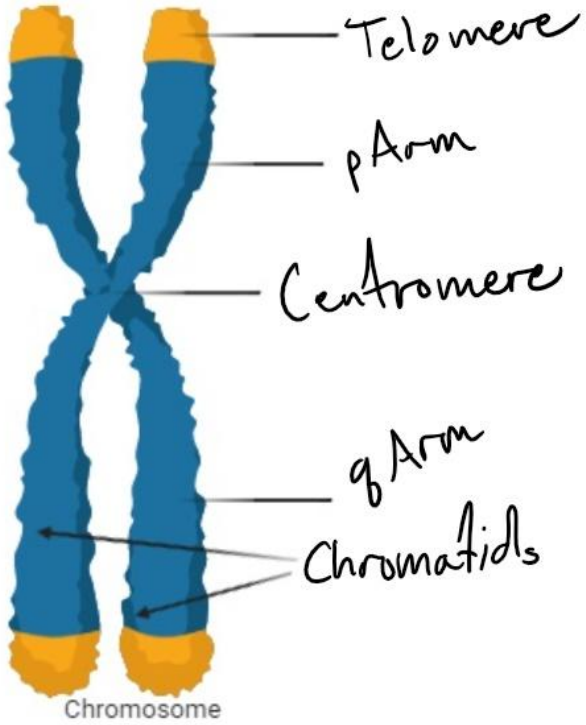
$$\mathbf{6\ C0_2 + 6\ H_20 + Light\ Energy \Rightarrow C_6H_{12}0_6 + 6\ O_2}$$

26. Why are photosynthesis and cellular respiration said to be complementary processes? (2 pts.)

The products of one reaction are the reactants of the other.

27. Label the diagram of a chromosome with the following terms: (5 pts.)

Centromere, Telomere, q Arm, p Arm, Chromatids



28. Endocytosis is the process of enveloping material in a fold of the cell membrane and pinching off a section to form a vesicle in order to move materials into the cell. What are the two general categories of endocytosis and how do they differ? (2 pts.)

Receptor or clathrin-mediated endocytosis & Caveloae

Clathrin - bigger (100nm), characterized by formation of vesicles coated in cytosolic protein clathrin, concentrate large extracellular molecules with specific receptors

Caveloae - smaller (50nm), consist of caveolin and a bilayer enriched with cholesterol and glycolipids

29. What does Chargaff's rule state? (2 pts.)

In the DNA of any organism the concentration of Guanine should be equal to the concentration of Cytosine and the concentration of Thymine should be equal to the concentration of Adenine.

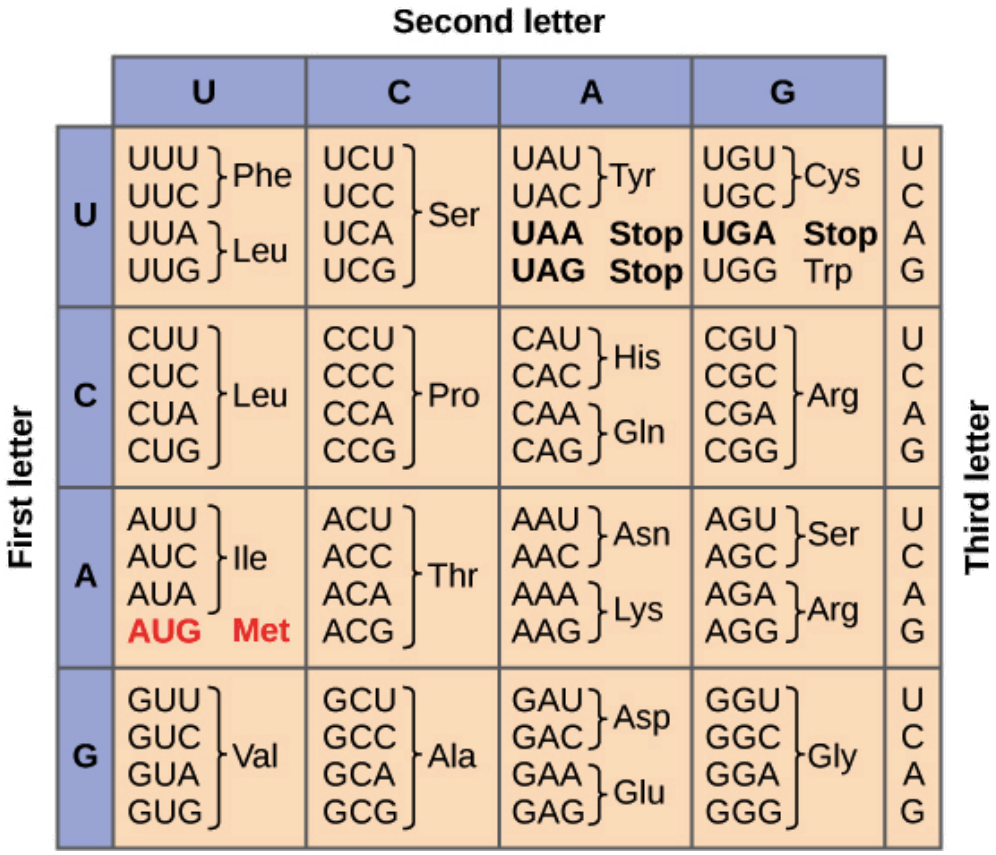
30. Transcribe the following DNA strand into the corresponding RNA Strand. (2 pts.)

5’ TACAAGATGAGATTGGCTATCATTGACTGATCGTAC 3’

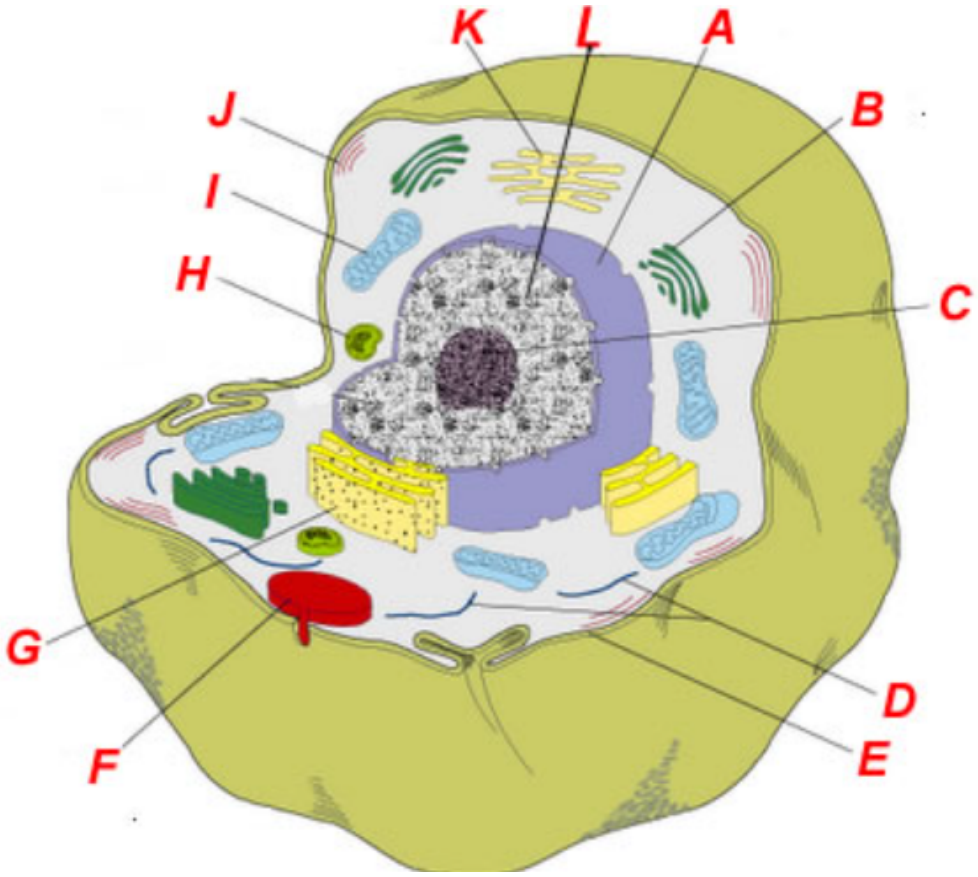
AUG-UUC-UAC-UCU-AAC-CGA-UAG-UAA-CUG-ACU-AGC-AUG

31. Using the chart below, translate your RNA strand from the previous question into a string of amino acids. (2 pts).

Methionine - Phenylalanine - Tyrosine - Serine - Asparagine - Arginine - STOP



32. Label the diagram of the cell below. (5 pts.)



A	NUCLEUS	G	ROUGH ER
B	GOLGI APPARATUS	H	LYSOSOME
C	NUCLEOLUS	I	MITOCHONDRIA
D	MICROTUBULES/MICROFILAMENTS	J	MICROTUBULES/MICROFILAMENTS
E	PLASMA MEMBRANE	K	SMOOTH ER
F	SECRETORY VESICLE		