Cells - Answer Key

1. What did people believe about how disease originated and where living organisms came from before germ and cell theory developed (What experiments were performed and by who)?
   1. People believed in spontaneous generation, which stated that infectious disease could be due to behaviors and nonliving agents.
2. How were the germ and cell theory developed (what experiments were performed and by who)?
   1. Louis Pasteur showed that when meat broth is sterilized it will not grow new organisms until exposed to the environment supporting the germ theory. Rudolf Virchow proposed the cell theory after combining experiments of others such as one that showed that maggots only grow on meat which flies are allowed to touch. Both Pasteur and Virchow disproved spontaneous generation.
3. How did germ theory alter medical and public health practices?
   1. Doctors became more aware of the need for sterile techniques during surgeries and people started to associated personal hygiene with prevention of disease.
4. What are two main differences between prokaryotes and eukaryotes?
   1. Eukaryotes but not prokaryotes have a nucleus and membrane bound organelles (like Golgi, ER, and mitochondria).
5. Which two of the three domains are composed of all prokaryotic organisms?
   1. Bacteria an Archea Domains
6. Which organelle necessary for protein synthesis is found in both prokaryotic and eukaryotic cells?
   1. Ribosome
7. What three components do plant cells have that animal cells do not?
   1. Cellulose cell walls, chloroplasts, and one large vacuole
8. What are the channels between cells called in plants vs. animal cells?
   1. Plasmodesmata between plant cells vs. gap junctions between some animal cells
9. What two organelles are present in most animal cells but only in few plant cells?
   1. Lysosomes and centrioles
10. How do shapes of plant and animal cells differ?
    1. Animal cells are usually rounds and can vary greatly in shape, while most plant cells have regular, rectangular shape.
11. How is the last step in cell division (cytokinesis) different in plant vs. animal cells?
    1. Animals divide by forming a cleavage furrow (pinching) while plants form a cell plate (lined up vesicles).
12. What are the main functions of organelles mitochondria and chloroplasts?
    1. Aerobic portions of cellular respiration occur in mitochondria, while photosynthesis takes place in the chloroplasts
13. What are the similarities and differences between the number, structures and names of membranes in mitochondria and chloroplast?
    1. Both mitochondria and chloroplast have 2 phospholipid bilayer membranes (inner and outer). However, mitochondria’s inner membrane has invaginations or infoldings (cristae) and chloroplasts have a totally separate 3rd set of stacked membranes each called a thylakoid (or collectively each stack is known as a granum).
14. Why do mitochondria and chloroplasts have so many extensive membranes?
    1. Many of the most important metabolic reactions occur due to enzymes embedded within these membranes; the more surface area, the greater the number of enzymes that can fit.
15. What is the endosymbiont hypothesis and what evidence supports it?
    1. A hypothesis that one prokaryote engulfed another one, which eventually became mitochondria and chloroplast of a eukaryotic cell. Mitochondria and chloroplast share many features with prokaryotes.
16. Where in a eukaryotic is the genome (all of the organism’s chromosomes) located?
    1. Nucleus
17. What happens in the nucleolus?
    1. Ribosomal RNA (rRNA) is synthesized.
18. What organelle is responsible for synthesis of proteins for transport?
    1. Rough endoplasmic reticulum
19. What organelle synthesizes lipids for cellular membranes and sometimes stores calcium rich ions.
    1. Smooth endoplasmic reticulum
20. What part of the cell processes and packages macromolecules such as proteins and lipids.
    1. Golgi apparatus
21. What structures form the endomembrane system?
    1. Nuclear envelope, endoplasmic reticulum, Golgi apparatus, lysosomes, vesicles, and the cell membrane.
22. What critical cellular process happens at the ribosomes?
    1. Proteins are synthesized
23. What are the functions of the 3 main cytoskeletal components in order from the thinnest to thickest?
    1. Microfilaments participate in cytoplasmic streaming, cleavage furrow formation during cytokinesis and cell extensions;
    2. Intermediate filaments maintain cell shape and resist tension; and
    3. Microtubules resist compression, transport organelles, form flagella/cilia, and the mitotic spindle which participates in separation of chromosomes during cell division
24. What are the 3 main components of the plasma membrane and what model explains how they are arranged and how they move?
    1. Phospholipids, proteins, cholesterol; fluid mosaic model
25. What characteristic of the phospholipids that form the cellular membrane bilayer makes them ideal for their function?
    1. Two layers of phospholipids form the plasma membrane; their hydrophilic (water loving) heads face the often watery outer and inner (cytoplasm) environments while their hydrophobic (water hating) tails face inwards toward each other and away from water, creating an efficient barrier to most chemicals and particles.
26. What is the function of the semipermeable cellular membrane?
    1. To allow certain components to pass while preventing the passage of others- to be selectively permeable.
27. What are 3 of the examples of passive transport, which moves particles with the concentration gradient (from high to low concentration)?
    1. Simple diffusion, facilitated diffusion (channels, carrier proteins), and osmosis (movement of water)
28. What is the difference between active and passive transport?
    1. Active transport which pumps ions from low to high concentration (against a concentration gradient) requires energy while passive transport does not.
29. What happens to water movement when an animal cell is placed in a hypotonic, hypertonic or isotonic environment?
    1. In hypotonic solution water will move into an animal cell and it may lyse ; in a hypertonic solution water will move out of the cell and it may shrivel up (crenate); and in an isotonic solution water will move in and out at the same rate and cell should remain viable.
30. What is the difference between endocytosis and exocytosis?
    1. Endocytosis is a process by which a cell engulfs materials while exocytosis is the opposite process of cellular secretion.
31. What are the reactant and products of glycolysis?
    1. 1 Glucose (6 carbons) molecule -> 2 pyruvate (3 carbons each) molecules
32. Does glycolysis require oxygen and where within a cell does it occur?
    1. No, glycolysis is anaerobic and therefore does not require oxygen; it occurs within the cytoplasm
33. Into what usable form and amount is the chemical energy transformed during glycolysis?
    1. 2 net ATPs
34. Where does citric acid cycle occur?
    1. Within the inner compartment (matrix) of mitochondria
35. What are the products of the citric acid cycle?
    1. Carbon dioxide, NADH, FADH2, and ATP
36. What is the process called and where does it occur that converts the energy transferred from NADH and FADH2 into a H+ (proton) gradient needed to synthesize ATP?
    1. Electron transport chain in the inner membrane (cristae) of mitochondria
37. What molecule is the final electron acceptor and what does it become once it accepts the electrons?
    1. O2 becomes H2O
38. What are the differences between aerobic and anaerobic respiration with respect to oxygen use and resulting usable energy?
    1. Aerobic respiration requires oxygen and results in synthesis of far more ATPs; while anaerobic respiration does not require O2 and results in fewer ATPs
39. What are the two forms of anaerobic respiration also known as fermentation?
    1. Alcoholic and lactic acid fermentation
40. How is light energy converted to chemical energy?
    1. Photons energize electrons which transfer their energy to establishing a H+ gradient which powers an ATP synthase that synthesizes ATP
41. Electrons of what molecule become energized by light and in which organelle does this happen?
    1. Molecule: Chlorophyll
    2. Organelle: Chloroplast
42. Where do the electrons come from to replace the ones that get energized, travel through the electron transport chain of photosynthesis building the H+ gradient?
    1. The replacement electrons come from splitting of water (2H2O -> O2 + 4H+ + electrons)
43. What is the main purpose of light independent reactions and what role do ATP and NADPH play in this process?
    1. CO2 fixation: incorporation of inorganic carbon into an organic sugar molecule utilizing ATP and NADPH molecules for energy
44. What is the difference between organisms that are autotrophs vs. heterotrophs?
    1. Autotrophs can make their own food using energy from the sun or inorganic compounds; while heterotrophs consume other organisms to obtain their energy
45. What are the overall chemical reactions of cellular respiration and photosynthesis; how are they related?
    1. Cellular respiration reaction: C6H12O6 + 6 O2 → 6 CO2 + 6 H2O+ energy
    2. Photosynthesis reaction: [](http://upload.wikimedia.org/wikipedia/commons/f/fd/Photosynthesis_equation.svg)
    3. These 2 reactions are opposite each other; what one produces the other one uses (a cycle)
46. What occurs during each of the main steps of the cell cycle?
    1. Interphase: [G0](http://en.wikipedia.org/wiki/G0_phase)- resting, [G1](http://en.wikipedia.org/wiki/G1_phase)-growth, S-DNA synthesis/replication, [G2](http://en.wikipedia.org/wiki/G2_phase)-growth) and
    2. Mitosis: M0 division of genetic material
47. What phases are part of mitosis and what happens during each one; what happens to the cytoplasm as mitosis is concluding?
    1. Prophase: nuclear envelope disintegrates and chromatin condenses into chromosomes
    2. Metaphase: Chromosomes are lines up at the center of the cell
    3. Anaphase: sister chromatids attached at centromere are separated and pulled by the mitotic spindle to opposite sides of the cell
    4. Telophase: reversal of prophase; chromosomes uncoil and nuclear envelope reforms.
    5. Cytokinesis (not really part of mitosis): division of cytoplasm (not chromosomes) into two daughter cells ( in an animal cell by cleavage furrow formation; in a plant cell by plate formation)
48. What is the main purpose of meiosis?
    1. Meiosis is the first step of sexual reproduction, which increases genetic diversity within a population. The main purpose of meiosis is to decrease the number if chromosomes in gametes by half so a new organism can be produced by fertilization (joining of two gametes). Recombination (exchange of genetic material between homologous chromosomes) also occurs during meiosis and increases genetic diversity.
49. What are the 3 main differences between mitosis and meiosis?
    1. Mitosis is a single division which results in two identical daughter cells, while meiosis produces four different cells, while meiosis produces four different cells after two divisions.
    2. At the end of mitosis the two daughter cells have the same number of chromosomes as the original cell, whereas, at the end of meiosis each daughter cell has half (n, haploid) as many chromosomes as the original cell (2n, diploid).
    3. During mitosis only identical sister chromatids separate, while during meiosis homologous chromosomes recombine (exchange genetic material) and separate first as well.
50. In which cells in our body does meiosis occur?
    1. Meiosis occurs in gametes (eggs and sperm)