Eukaryotic and Prokaryotic Cells

1. Define:

   Organelle - The term organelle means "little organ", but refers to structures found within cells. These structures have specific functions and may be more or less numerous depending on the type of cell being studied. Some texts indicate that organelles must be membrane bound; others indicate that they may or may not be membrane bound.

   Ribosome – Ribosomes are granular bodies each made up of two sub-units composed of nucleic acid (r-RNA) and protein. Ribosomes are the site of protein synthesis within cells. They may or may not be considered organelles. They are not surrounded by membranes.

   Histone – Histones are a type of homogeneous protein found in chromatin (e.g., within the nuclei of eukaryotic cells). DNA molecules wrapped around core histone proteins (octomers), form the nucleosomes that combine to form chromatin. Histones help to maintain the structural integrity of DNA, help regulate transcription, and are involved in DNA repair.

   Glycocalyx – The glycocalyx, also known as a capsule or slime layer, is a layer of poly-saccharide or sometimes protein that is deposited outside the cell wall of some bacteria. It can serve as a reservoir of stored food, as a means of attachment to smooth surfaces, as a protection against phagocytosis by white blood cells or other predatory cells, and to prevent desiccation (drying out). Biofilms are made up of cells suspended in glycocalyx materials.

   Sporulation – Sporulation is the process by which endospores are made within certain types of bacteria. It involves forespore formation and covering formation and may be stimulated by a variety of factors. Note - this term is also applied to spore formation as it occurs in other types of organisms (fungi, algae, etc.).

2. Cytology

3. Organelles/ cytosol

4. Smooth endoplasmic reticulum/ protein

5. Golgi apparatus (body or complex)/ Assembly of complex molecules, sorting, packaging and secretion.

6. Chloroplasts /mitochondria/ These organelles have inner folded membranes that lack cholesterol and are involved in ATP synthesis (like those of prokaryotes), they also contain 70s ribosomes and have DNA in closed loops. Like bacteria, they can reproduce themselves by means of binary fission. Antimicrobial agents that kill or inhibit the growth of bacteria also cause damage to mitochondria and chloroplasts.

7. Mitochondria/ ATP/ They have 70S ribosomes and ccc-DNA.

8. Cristae/ thylakoids

9. Hydrolase enzymes or hydrolases/ lysosomes/ peroxisomes

10. Contractile vacuoles

11. Microtubules/ cilia/ flagella

12. Tubulin proteins or tubulins/ kinesin and dynein (Some kinesins move particles toward the plus ends and dyneins move particles toward the minus ends of protofilaments.)

13. Centrioles

14. Nuclei (singular = nucleus) / chromatin/ DNA

15. Nucleolus/ ribosomal RNA (r-RNA)

16. Cell walls/ Cell walls provide protection against changes in osmotic pressure and predators. They also give cells a characteristic shape significant to their function. (We use the unique shapes of cells as a means of identifying and categorizing them, but cell shapes have functional significance to organisms.)

17. Eukaryotic microorganisms contain at least one true nucleus surrounded by a nuclear membrane or envelop, prokaryotic cells do not (they have a nucleoid or nuclear region that is not membrane bound). Eukaryotic cells contain many membrane bound organelles while prokaryotic cells do not (prokaryotes often contain inclusions, but these are not surrounded by unit membrane). Eukaryotic cells contain two or more linear chromosomes while prokaryotic cells typically contain a single circular chromosome (many prokaryotes also contain plasmids and some contain more than one circular chromosome). Eukaryotic cells contain 80s ribosomes (60s and 40s subunits) while prokaryotes contain 70s ribosomes (50s and 30s subunits). The cell membranes of eukaryotic cells contain about 25% cholesterol, while the cell membranes of ordinary bacteria contain little or no cholesterol. Eukaryotic cells make most of their ATP in association with internal organelles (mitochondria and chloroplasts), while prokaryotes make their ATP in their cytoplasm, or in association with their cell membranes. In general, eukaryotic cells are larger than prokaryotic cells, but there are some exceptions.

18. Flagella/ microtubules

19. Peritrichous (Such cells are also polytrichous, but peritrichous is a better answer.)/ amphitrichous

20. Prokaryotic flagella are made of flagellin proteins, they are not membrane bound, and they move by spinning (they have rotary motion). Eukaryotic flagella are made up of microtubules that are arranged in 9 sets of 2 with 2 in the center. These are inside the cell membrane, so are surrounded by a layer of membrane. They move with a back-and-forth or whip-like motion.

21. Pili and fimbriae/ Note - In some texts these terms are used interchangeably, but pili and fimbriae do differ in both structure and function. Fimbriae are more numerous per cell, shorter, and are used for attachment to various surfaces while pili are few in number (1-2 per cell), longer, and are used for bringing bacteria together during genetic exchange. They are sometimes called sex pili.

22. Sex pili

23. Axial filaments or endoflagella

24. Matching (Cell structure and function) B=both, E=eukaryotic, P=prokaryotic
    Matching letter sequence and where most commonly found is - C/E, F/B, G/B, D/P, J/B, A/E, I/P, H/E, B/P, and E/P.
    Note - Some prokaryotic cells have histone-like proteins or histones, but histones are more likely to be found in eukaryotic cells. Some eukaryotic cells may have a glycocalyx, and a few contain plasmids, but these structures are more common to prokaryotes.

25. Peptidoglycan

26. Capsule/ slime layer/ reservoir of stored food materials

27. Glycocalyx/ The glycocalyx (capsule or slime layer) serves as a reservoir of stored food, it aids in attachment to smooth surfaces, it provides protection from predators, desiccation or phagocytosis by white blood cells. In the case of pathogenic bacteria, the glycocalyx aids pathogenicity by protecting the cells against host defenses. Glycocalyx materials plus cells form biofilms that render cells resistant to chemical damage.

28. Physical factors (heat, drying, radiation, pressure)/ chemicals

29. Mesosomes

30. Thylakoids/ ATP

31. Carboxysomes

32. Metachromatic granules/ They are used to regulate buoyancy of cells in water.

33. Nucleoid/ plasmids

34. Endospores/ heat, drying, radiation, pressure changes and toxic chemicals

35. Vegetative cells contain considerable water, RNA and enzymes and their metabolic activities occur at a rapid rate. Endospores contain little or no water and so lack metabolic activity. They contain mostly DNA and very little RNA, but also have high levels of calcium and dipicholinic acid within their cytoplasm. Endospores can remain viable (alive) much longer than typical vegetative cells (evidence is now available that indicates they can survive within amber for

millions of years), they do not reproduce, and they tend to be extremely resistant to environmental factors such as heat, radiation, pressure and toxic chemicals; much more so than are vegetative cells. While vegetative cells typically have a single membrane and wall, endospores have multiple layers of covering material (cortex, spore coat, inner and outer spore membranes). These help provide extra protection against damage.

36. Endospores/ They allow the population to survive periods of unfavorable conditions. The vegetative cells of the population may die, but the spores survive and give rise to new cells when conditions improve.

37. Germination

38. Heterocysts/ akinetes