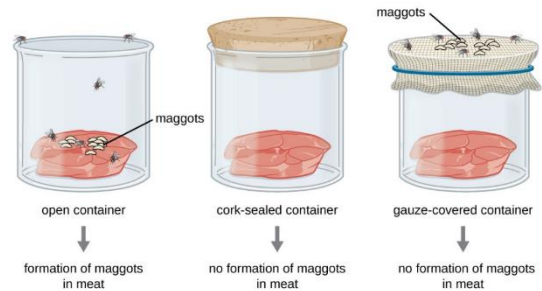


Unit I: Cell Theory & Microscopes

1. *Why is Redi's experiment on spontaneous generation considered a controlled experiment?*
Redi controlled (i.e. kept the same) all variables but one (the manipulated variable) – whether or not there was gauze over each jar. This allowed him to draw conclusions based on his results.
2. *Briefly describe and sketch a diagram to show how Redi set up his experiment to test the theory of spontaneous generation, and explain his results. Why was the gauze important?*

Redi controlled variables such as the type of jar, meat, location, temperature, time, etc. The gauze was important because it kept flies off the meat, allowing him to conclude that living flies were required to produce maggots/other flies.



3. *How did the design of Pasteur's flask help him successfully refute the hypothesis of spontaneous generation?*
The curved neck of Pasteur's flask prevented microorganisms from the air getting into the broth, keeping the broth free of microorganisms. He showed that all living things come from other living things.
4. *Explain the difference between a manipulated variable and a responding variable. Why is it advantageous for scientists to test only one variable at a time during an experiment?*
A **manipulated variable** is a factor that is deliberately changed (for example, the amount of sunlight), while a **responding variable** is a change that occurs in response to the manipulated variable (for example, the growth of a plant). It is important for scientists to test one variable at a time in order to determine what actually caused the changes they observe.
5. *What are some advantages and disadvantages of light microscopes and electron microscopes?*
Light microscopes: advantages – relatively inexpensive; easy to use; can observe living cells; disadvantage – limited magnification
Electron microscopes: advantages – much higher magnification and resolution; disadvantages – very expensive; much more difficult to prepare specimens and use the microscope; cannot be used to observe living cells
6. *Explain why you cannot draw a conclusion about the effect of one variable in an investigation when the other key variables are not controlled.*
If other variables are not controlled, you would not be able to determine if there was a relationship between the manipulated and responding variables. For example, if you changed the amount of water AND fertilizer a plant received, you could not tell which factor had an effect.
7. *What three statements make up the modern cell theory?*
 - All living things are made of cells.
 - Cells are the basic unit of structure and function in living things.
 - New cells are produced from existing cells.

8. What are the differences between prokaryotic and eukaryotic cells?

A **prokaryotic** cell does not contain its DNA inside a nucleus, while a **eukaryotic** cell has its DNA contained within a nucleus.

9. What structures do all cells have?

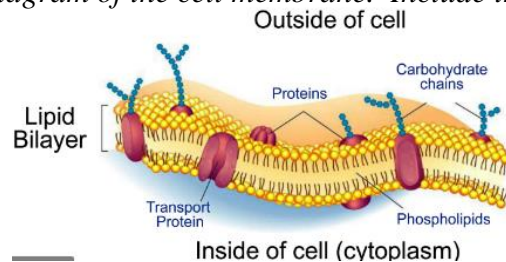
All cells contain DNA, cytoplasm, and a cell membrane.

Unit II: Cell Structure & Function

1. Describe the role of the nucleus in a cell.

The nucleus contains the cell's genetic material in the form of DNA. DNA contains coded instructions for making proteins and other important molecules.

2. Sketch and label a diagram of the cell membrane. Include the following: lipid bilayer, protein, carbohydrate chain.



a) What is the purpose of the protein channels in a cell membrane?

Proteins form channels and pumps that help move material across the membrane.

b) What is the purpose of the carbohydrate chains in a cell membrane?

Carbohydrates act like chemical identification markers, allowing individual cells to recognize one another.

3. What kinds of molecules can diffuse through the cell membrane?

Small molecules, such as water, oxygen, carbon dioxide, glucose, etc. can pass through the membrane.

4. Describe the process of simple diffusion.

The random motion of particles in solution causes collisions, which spread out molecules. Particles tend to move from an area of high concentration to low concentration – this process is known as “diffusion.”

5. What is the relationship between osmosis and diffusion?

Osmosis is the diffusion of water through a selectively permeable membrane.

6. Distinguish between hypertonic, hypotonic and isotonic solutions.

hypertonic: “above strength;” a solution that is more concentrated than the one it is being compared to

hypotonic: “below strength;” a solution that is less concentrated than the one it is being compared to

isotonic: “same strength;” a solution that is equal in concentration to the one it is being compared to

7. Describe what happens to an animal cell when placed in each of the following solutions:

a) *hypertonic* – cell would lose water, and shrink

b) *hypotonic* – cell would gain water, and swell

c) *isotonic* – no net gain or loss of water, so the cell stays balanced

8. Explain the difference between facilitated diffusion and active transport. Be sure to indicate whether or not each process requires energy.

Facilitated diffusion is the diffusion of particles from an area of high concentration to an area of low concentration through protein channels in the cell membrane. It does not require energy.

Active transport moves particles against the concentration gradient, from an area of low concentration to an area of high concentration. It requires energy use by the cell to move particles against the natural flow.

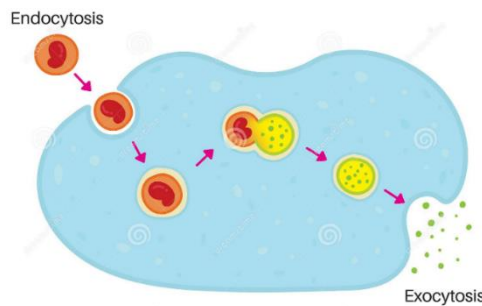
9. What is the relationship between passive transport and active transport? How does facilitated diffusion differ from simple diffusion? By definition, what is the only substance that carries out osmosis?

Passive transport includes simple diffusion, as well as facilitated diffusion, and does not require energy, while active transport moves against the concentration gradient and requires energy.

10. Distinguish between endocytosis and exocytosis.

Endocytosis: the process of taking material into the cell by means of infoldings (or pockets) of the cell membrane.

Exocytosis: the process of releasing material from the cell by fusing a vacuole with the cell membrane.



11. Name and describe the two types of endocytosis.

pinocytosis: “cell drinking;” cell takes up liquid from the surroundings

phagocytosis: “cell eating;” cell extends cytoplasm around a larger clump of material, engulfs it within a vacuole

12. Explain why cellular respiration and photosynthesis can be considered complementary processes.

The energy flows in cellular respiration and photosynthesis take place in opposite directions. The reactants in cellular respiration are the products of photosynthesis, and vice versa.

13. Write the chemical equations for cellular respiration and photosynthesis.

Cellular respiration: $C_6H_{12}O_6 + 6 O_2 \rightarrow 6 CO_2 + 6 H_2O$
glucose + oxygen \rightarrow carbon dioxide + water

Photosynthesis: $6 CO_2 + 6 H_2O \rightarrow C_6H_{12}O_6 + 6 O_2$
carbon dioxide + water \rightarrow glucose + oxygen

Unit III: Classification & Microorganisms

1. Why do biologists assign each organism a universally accepted name, rather than using common names?

Common names vary by region, for example, the same animal may be referred to as a cougar or a mountain lion, depending on where you live. Scientific, universally accepted names do not vary by region, which avoids confusion.

2. How do domains and kingdoms differ?

Domain is the highest level of classification. There are 3 domains: Eukarya, Archaea, and Bacteria. **Kingdom** is the next level below domain, and there are 6 kingdoms: Animalia, Plantae, Fungi, Protista, Eubacteria, and Archaeobacteria.

3. *Describe 3 features of binomial nomenclature that make it useful for scientists of all nations.*
 - it avoids confusion between different regions and languages
 - there is only one scientific name for each species
 - the names help to show relationships between organisms (for example, if they share the same first name (the genus name), they are closely related)

4. *What characteristics are used to place an organism in each of the following Domains?*
 - a) *Bacteria*: prokaryotic, cell walls contain peptidoglycan, unicellular
 - b) *Archaea*: prokaryotic, cell walls DO NOT contain peptidoglycan, unicellular
 - c) *Eukarya*: eukaryotic

5. *Which domain consists of prokaryotes whose cell walls lack peptidoglycan?* Archaea

6. *Describe the three main cell shapes of Bacteria.*

cocci – round/spherical
bacilli – rod/capsule shaped
spirilla – spiral/corkscrew shaped

7. *Explain how the outcome of binary fission differs from that of both endospore formation and conjugation.*

Binary fission is a form of asexual reproduction in which one cell copies its DNA, then divides into two cells. During endospore formation and conjugation, no new cells are produced. (Endospore formation involves enclosing the DNA in a protective wall while the cell remains dormant. Conjugation involves two cells exchanging portions of their DNA in order to increase their genetic variety.)

8. *Describe the basic structure of a virus. Are viruses considered to be alive?*

Viruses contain DNA or RNA surrounded by a capsid. Viruses are not made of cells, therefore they are not part of our classification of living things.

9. *Describe the major features of the four kingdoms that comprise the domain Eukarya. (see p. 459)*

Animalia: eukaryotic, no cell wall, multicellular, heterotrophic
Plantae: eukaryotic, contain chloroplasts, cell walls contain cellulose, multicellular, autotrophic
Fungi: eukaryotic, cell walls contain chitin, multicellular, heterotrophic
Protista: eukaryotic, most are unicellular, but some are multicellular; autotrophs and heterotrophs

10. *Describe the major features of members of the kingdom Fungi.*

Members of the kingdom Fungi are heterotrophs. Most feed on dead or decaying matter by secreting digestive enzymes, then absorbing small food molecules. Their cell walls contain the substance chitin.

11. *Does taxonomic classification place emphasis on the similarities between organisms, the differences between organisms, or both? Explain.*

Classification emphasizes both the similarities and differences between organisms. Similar organisms are grouped together, but their differences allow them to be further subdivided in smaller and smaller taxonomic levels.

12. Suppose you discovered a new unicellular organism. This organism has a nucleus, mitochondria, and a large chloroplast. In which kingdom would you place this organism?
Protista

13. Study the descriptions of the following organisms and place them in the correct kingdom.

Organism A: Multicellular, photosynthetic, autotrophic, with a cell wall that contains cellulose

Plantae

Organism B: Cell walls lack peptidoglycan, and cell membranes contain unusual lipids not found in other organisms; many live in extreme environments and can survive only in the absence of oxygen.

Archaeobacteria

Organism C: unicellular, eukaryotic organisms that have chloroplasts

Protista

12. Use the chart below to answer the following questions:

Classification Level	American Green Tree Frog	European Fire-Bellied Toad	Eastern Newt
Kingdom	Animalia	Animalia	Animalia
Phylum	Chordata	Chordata	Chordata
Class	Amphibia	Amphibia	Amphibia
Order	Anura	Anura	Caudata
Family	Hylidae	Bombinatoridae	Salamandridae
Genus	<i>Tursipops</i>	<i>Bombina</i>	<i>Notophthalmus</i>
Species	<i>cinera</i>	<i>bombina</i>	<i>viridescens</i>

- At what classification level do the three organisms start to diverge? Order
- What is the **scientific name** for an American green tree frog? *Tursipops cinera*
- Domain was not included on the chart. To what **Domain** do all of the organisms belong? Eukarya
- Which two organisms are the most closely related? The American Green Tree Frog, and the European Fire-Bellied Toad.

Unit IV: Plant and Animal Diversity

1. What are the four main divisions of plants?

Bryophytes (mosses), Seedless Vascular Plants (ferns and their relatives), Gymnosperms (conifers and cone-bearing plants), and Angiosperms (seed-bearing plants).

2. How does the lack of vascular tissue keep bryophytes (mosses) small?

Because bryophytes cannot move water and other solutions of nutrients against the flow of gravity, they must remain small so that their tissues are close to enough the absorb water by from the ground. These plants are thin, and rely on diffusion.

3. *Describe the functions of xylem and phloem.*

xylem transports water, while phloem transports other dissolved nutrients

4. *Of the 4 main divisions of plants we studied, which two groups are able to produce seeds? Describe how the development of fruit-covered seeds was an evolutionary advantage for those plants.*

Gymnosperms and angiosperms are able to produce seeds. This was an evolutionary advantage because it allowed them to expand into new territory, and allowed their seeds to be spread by animals, wind, etc, and survive periods of cold and drought.

5. *Describe what occurs during the processes of pollination and fertilization.*

Pollination involves the transfer of pollen (sperm cells) from the male part of the plant to the female part of the plant. Fertilization is the process by which the pollen grain travels through the female part of the plant to fertilize the egg.

6. *Describe how a sponge uses water to carry out the essential functions of life.*

The movement of water through the sponge carries needed materials, such as food and oxygen, and carries wastes away. Water also carries sperm to eggs, allowing for reproduction.

7. *Until the mid-nineteenth century, most scientists thought sponges were plants. What features of sponges might have led scientists to consider them to be plants?*

Because sponges don't appear to be eating or moving around, scientists may have assumed they were plants. They anchor themselves to the bottom of the ocean floor, and have an appearance similar to a plant.

8. *How does an earthworm ingest and digest food? Use the terms pharynx, crop, gizzard, and esophagus in your answer.*

An earthworm collects food particles by extending its pharynx, then pumping food into the esophagus. From there, food then moves into the crop where it can be stored, and through the gizzard, where it is ground into smaller pieces. The food is absorbed farther along in the digestive tract in the intestine.