Unit 4 – Organelles (“Cell Parts”)

1. **Cell**: the basic unit of life; the smallest unit that can perform basic life functions. There are 2 types of cells: prokaryotic and eukaryotic.

2. **Organelles**: means “little organs” – specialized parts of a cell that have specialized jobs – similar to our heart, liver, stomach, etc.

3. **Prokaryote** or **prokaryotic cell**
   A. Old fashioned “model T cell”
   B. Has a cell membrane, cytoplasm, a few basic organelles
   C. Does **NOT** have a nucleus – DNA floats around in the cytoplasm
   D. Does **NOT** have “membrane-bound organelles” (so organelle is **NOT** wrapped in membrane)
   E. 3.8 billion years old! Oldest fossil on earth, so probably the first type of cell on earth
   F. Prokaryotes are small and simple BUT are biologically very successful. Evidence:
      1. Prokaryotes have been around a very long time – at least 3.8 billion years.
      2. Prokaryotes can live in the harshest conditions and are found virtually everywhere on earth – in areas that are very hot, very cold, very acidic, very poisonous; found under ice and in ice, and found underground.
   G. Only bacteria are prokaryotic cells.

4. **Eukaryote** or **eukaryotic cell**:
   A. Newer cell – the Ferrari model – "high performance" cell
   B. First appeared about 1.5 billion years ago
   C. DOES have a nucleus, DOES have membrane-bound organelles
   D. Contains many more specialized organelles
   E. Is capable of much more complex functions
   F. This complexity is needed to create multicellular critters because the cells in a multicellular organism must communicate with each other, coordinate efforts, and work together.
   G. Eukaryotes are large and complex, and biologically very successful: all organisms except bacteria are made of eukaryotic cells.

5. **3 basic parts to a eukaryotic cell**:
   A. **Cell membrane** – outer wrapper – needed to keep harmful chemicals out, keep necessary chemicals in, so cell can maintain homeostasis.
   B. **Nucleus** – contains DNA – the brain center of the cell
   C. **Cytoplasm** – watery “filling” of cell – dissolves chemicals, moves them around so chemical reactions can occur to maintain life.

6. **Cell Theory**: all cells come from existing cells. Cells today are not created out of nonliving chemicals.

7. **How all membranes are structured (built)**: All membranes are made of two layers of phospholipids molecules, with imbedded protein molecules (that is, protein blobs stuck in between the phospholipids). The protein molecules act like doorways.
8. **Why the phospholipids ALWAYS line up in two layers:**
   - the phospholipids heads are polar – attracted to polar water
   - the phospholipids tails are nonpolar – repel from polar water
   - the polar phospho heads turn to face the water outside and inside the cell
   - the nonpolar lipid tails are protected inside the membrane, away from the water

9. **Membranes have many functions (jobs):**
   A. All membranes are selectively permeable, which means the membrane selects which chemicals can pass through the membrane. Small chemicals can sneak through between the phospholipids. Large chemicals must go through the protein doors.
   B. Membranes act like walls, creating separate “rooms” or areas inside the cell. Each area has a special job that requires certain chemicals. The membrane keeps in the needed chemicals, and keeps out chemicals that could interfere with the special job.
   C. Membrane often serves as “work surface”, like a factory floor. To get more working space into a small area, the membrane is often folded.
   D. Membrane serves as a “multipurpose packaging material.” Small pieces of membrane may pinch off of an organelle as a wrapping around a chemical. When the chemical moves to its next organelle, the membrane “wrapping” is added to this organelle, allowing the chemical to enter.

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**ORGANELLE NOTES**

1. **Cell Membrane**
   - Is a flexible, outer protective layer
   - Like all membranes, is made of 2 layers of phospholipid molecules with imbedded protein molecules.
   - Is selectively permeable – selects which chemicals can enter and leave the cell.

   **Jobs:**
   - protects the cell
   - keeps the good chemicals inside, the bad chemicals outside
   - selects which chemicals go into and out of the cell

2. **Cytoplasm**
   - watery, jello-like “soup” inside the cell that contains organelles and dissolved chemicals like sugars and proteins.
   - is in constant motion, so chemicals can touch and react.

   **Job:** provides a place for life’s chemical reactions to occur

3. **Nucleus:** contains DNA and nucleoplasm. Nucleoplasm is watery and jello-like, similar to cytoplasm, but contains different chemicals.

   **Job:** is the "brain center" of the cell that directs and controls cell activities by using DNA information

4. **Nuclear Envelope**
   - is a membrane around nucleus, made of two phospholipid layers + proteins
   - is selectively permeable - selects what goes in and out through the nuclear pores (protein openings in the nuclear envelope)
Jobs:
• protects the nucleus and DNA
• keeps the good chemicals inside, the bad chemicals outside
• selects which chemicals go into and out of the nucleus

5. Nucleolus: a mass of DNA, RNA and proteins, found in the nucleus.
   Job: makes ribosomes

6. Chromatin: a strand (single string) of DNA; a strand of genetic material. Genetic material is a fancy way of saying “DNA.”
   Job: The DNA provides genetic information (operating instructions) for the cell.

7. Chromosomes
   • made of “coiled up” chromatin (DNA) and protein
   • Appears only when cell getting ready to divide (reproduce). Since DNA is a long molecule, it could get damaged when the cell splits. The DNA wraps around protein “spools” to protect the DNA from damage while the cell splits.
   Job: Protect the DNA from damage during cell division (cell reproduction)

8. Mitochondrion (plural is mitochondria)
   • Is the “powerhouse” of the cell – provides energy for the cell
   • Respiration centers of the cell. “Respiration” means burning food and releasing the energy for cell use. Thus, the mitochondrion is the organelle where food is burned and energy released for cell use
   • recharges ATP ("rechargeable battery" molecule that captures the energy released by respiration & takes the energy to where energy is needed)
   • has its own DNA and is made from 2 membranes - one folded inside, one on outside
   • membrane is folded to cram more work space into a small area; mitochondria needs a lot of work space!
   Job: performs respiration, and provides energy for the cell

9. Lysosome
   • A membrane sac that uses enzymes to digest and recycle waste, bacteria, and worn out organelles
   • Also stores wastes
   Job: the cell's "waste handlers" - stores and recycles wastes

10. Ribosomes
    • Small, round bodies of made of protein & RNA (no membrane)
    • Ribosomes found in the cytoplasm, many are attached to rough ER
    Job: Ribosomes read the RNA recipe, then make the protein

11. Rough ER
    • Folded membrane covered with ribosomes
    • Connected to nuclear envelope – RNA recipe leaves nucleus through nuclear pores, goes into ER, where the ribosomes read the RNA recipe and assemble the protein
• Membrane is folded to get more “work space” crammed into a small space inside the cell.

**Job:** provides a place where proteins are made

12. **Golgi Apparatus:** Flat membrane sacs (look like deflated basketballs stacked up), always found near rough ER

**Job:** finish, package and ship proteins into the cell or body.

13. **Flagellum** (plural flagella)

• Long, whip-like tail, sticks out from surface of cell
• Cell uses its flagellum to swim or move
• Rarely found in plant cells

**Job:** Helps cell move (sperm cells have these)

14. **Cytoskeleton:** A web of protein fibers found just under the cell membrane.

**Jobs:**

• Helps shape and support the cell
• Acts like highway along which organelles move

15. **Cilia**

• Small, hairlike structures that stick out from surface of cell
• Lung cells use cilia to move mucus and junk out of lungs
• *Paramecium* is a unicellular critter that uses cilia to swim
• *Vorticella* is a unicellular critter that uses cilia to sweep food into its “mouth”

**Job:** Cilia move the cell, food, or mucus

16. **Vacuole**:

• A membrane sac that provides temporary storage of food, enzymes, wastes and water.

• In plant cells, the **central vacuole** stores water for future use & can occupy up to 90% of the volume of a plant cell. A full vacuole helps hold up the plant the same way an inner tube full of air holds up a tire. If the vacuole is empty, the plant wilts (just like a flat tire!).

**Jobs:**

• Provides temporary storage of food, enzymes, wastes and water.
• Stores water for a plant
• Helps a plant stand up when full.

The organelles listed above are found in both plant and animal cells. The following organelles are found only in plant cells.

17. **Chloroplast**

• Round green body where photosynthesis occurs
• Chlorophyll is the chemical that makes chloroplasts green
• Like mitochondria, chloroplasts are made of two membranes, and contain their own DNA

**Job:** makes food (sugars) through photosynthesis
18. **Cell Wall**: Made of cellulose, is a “hard box” outside of the cell membrane that gives a plant cell a geometric appearance (box-like).

   **Jobs**:
   - Protects and shapes the cell
   - Gives a plant strength and rigidity (stiffness) so the plant stands up

19. **Plastid**: A membrane sac that stores starches or lipids.

   **Job**: store starches or lipids

**CELL PROJECT INSTRUCTIONS**

Must do 12 organelles x 3 pts each = 36 pts

Neatness and overall appearance = 10 pts

Total = 46pts

For full credit:
- 1pt for a picture that represents the **job** of the organelle
- 2 pts for an explanation: explain the organelle’s **job** (1 pt) and explain why the picture represents the job (1 pt)

**Full credit explanations**:

A guard protects a building, the same way a cell membrane protects the cell.

A door lets some people in, and keeps other people out, the same way the cell membrane selects what goes in and out of a cell.

**Lousy explanations – not full credit**:

A guard protects a building the same way a cell membrane does.

A door works the same way a cell membrane, letting some chemicals into the cell but keeping other chemicals out.

**No credit picture**:
- jello (for the cytoplasm) – what is jello’s **JOB**? Does that match cytoplasm’s **JOB**?
- Spaghetti (for chromatin) – what is spaghetti’s **JOB**? Does that match chromatin’s **JOB**?

**Extra credit**: do more than 12 organelles – up to 2 pts per extra organelle AND extra credit if you're extra creative!