University — Faculty of Sciences

1st Year (L1) — Module: Cell Biology

Tutorial Sheet No. 1: Cell Types

Prokaryotic Cell — Eukaryotic Cell — Acaryotic Particle

Objectives

- Distinguish the three major categories of cellular organization: prokaryotic, eukaryotic, and acaryotic.
- Identify the structural and functional criteria underlying this classification.
- Be able to place an organism or particle (virus) within the classification based on observations.
- Argue and justify an answer using appropriate scientific vocabulary.

Course Summary

The cell is the structural and functional unit of life. Two major types of cellular organization are classically distinguished, along with a special category of biological entities lacking cellular structure:

- Prokaryotic cell: simple organization, no individualized nucleus; the genetic material (circular DNA) is located in a region called the nucleoid, which is not delimited by a membrane. No membrane-bound organelles. Examples: bacteria, archaea.
- Eukaryotic cell: complex organization, presence of a true nucleus delimited by a nuclear envelope (double membrane), cytoplasmic compartmentalization into membrane-bound organelles (mitochondria, endoplasmic reticulum, Golgi apparatus, etc.). Examples: animal, plant, fungal, and protist cells.
- Acaryotic structure: an entity lacking both a nucleus AND any true autonomous cellular organization (no metabolism of its own). Viruses are the prime example: they have no cytoplasm, no organelles, and no protein-synthesis machinery of their own, and are obligate intracellular parasites. (Note: some authors also use "acaryotic" for cells that have lost their nucleus during differentiation, such as mature red blood cells or cork cells; this distinction is clarified in the answer key.)

The table below summarizes the main comparison criteria:

Criterion	Prokaryote	Eukaryote	Acaryote (virus)
True nucleus	Absent	Present	Absent
Genetic material	Circular DNA, nucleoid	Linear DNA, chromosomes	DNA or RNA (never both)
Membrane-bound organelles	Absent	Present	Absent
Average size	1 to 10 µm	10 to 100 µm	20 to 300 nm
Own metabolism	Yes	Yes	No (obligate parasite)
Ribosomes	70S	80S (cytoplasmic)	Absent
Examples	Bacteria, archaea	Yeasts, animal/plant cells	HIV, bacteriophages, influenza virus

Exercise 1 — Multiple Choice Questions (MCQ)

For each question, only one answer is correct. Circle or highlight the correct answer.

1. The main difference between a prokaryotic cell and a eukaryotic cell lies in:

   a) the presence of a cell wall

   b) the presence of a nucleus delimited by a nuclear envelope

   c) cell size alone

   d) the presence of ribosomes

2. Viruses are described as acaryotic because:

   a) they have a reduced nucleus

   b) they have no nucleus, no cytoplasm, and no organelles

   c) they are too small to be observed

   d) they contain no genetic material

3. The nucleoid is a structure characteristic of:

   a) eukaryotic cells only

   b) viruses

   c) prokaryotic cells

   d) mitochondria

4. Which of the following organisms is made up of eukaryotic cells?

   a) Escherichia coli

   b) Saccharomyces cerevisiae (baker's yeast)

   c) A thermophilic archaeon

   d) Bacteriophage T4

5. The ribosomes of prokaryotic cells have a sedimentation coefficient of:

   a) 40S

   b) 60S

   c) 70S

   d) 80S

Exercise 2 — True or False (justification required)

State whether each statement is true (T) or false (F), then briefly justify your answer, especially when the statement is false.

6. All cells possess an individualized nucleus.
7. Bacteria possess membrane-bound organelles such as mitochondria.
8. A virus can replicate autonomously, without a host cell.
9. Eukaryotic cells are generally larger than prokaryotic cells.
10. Prokaryotic DNA is usually circular and located in the cytoplasm.
11. Archaea are eukaryotic organisms.

Exercise 3 — Comparative Table to Complete

Complete the table below by indicating, for each type of organization, whether the structure or property is present (+), absent (–), or by providing the requested information.

Characteristic	Prokaryote	Eukaryote	Acaryote
Plasma membrane			
Nuclear envelope			
Mitochondria			
Endoplasmic reticulum			
Cell wall (in some)			
Protein capsid			
Capacity for autonomous division			
Presence of both DNA and RNA			

Exercise 4 — Classifying Organisms

Classify each of the following biological elements into the appropriate category (prokaryote / eukaryote / acaryote), justifying your answer in one sentence:

- Escherichia coli (intestinal bacterium)
- A human neuron
- Hepatitis B virus
- Paramecium (ciliated protozoan)
- A methanogenic archaeon

- Bacteriophage lambda
- A fungal cell (yeast)
- Tobacco mosaic virus (TMV)

Exercise 5 — Reflection / Short Essay Questions

12. Explain why viruses pose a classification problem within the living world. Are they considered living beings in the full sense? Argue your answer in about ten lines, drawing on the criteria of life (metabolism, reproduction, cellular organization).
13. A researcher discovers a new unicellular organism. Electron microscopy reveals the absence of a nuclear envelope but the presence of a rigid cell wall and 70S ribosomes. What type of cell does this organism most likely belong to? Justify your answer.
14. Some differentiated eukaryotic cells, such as mature red blood cells (erythrocytes) in humans, lose their nucleus during maturation. Can these cells therefore be described as "acaryotic" in the same sense as a virus? Discuss the fundamental difference between these two situations.