

Topic 02

Prokaryotic and Eukaryotic Cells

Learning Objectives

At the end of this module, students will be able to:

- Recognize two different cell types.
- Compare and contrast prokaryote & eukaryote cells.
- Recognize several key words used in other modules.
- Generally identify size comparisons of various cells.
- Recognize the evolutionary relationship of these two major cell types.

Outline

- a. Examine several key words for recognition.
- b. Make a "scale model" illustrating size differences of several small things.
- c. Discuss two diagrams illustrating the evolutionary relationship of prokaryotes and eukaryotes.

Definition

Prokaryote
[prō'kerē,ōt]

A microscopic single-celled organism that has neither a distinct nucleus with a membrane nor other specialized organelles. Prokaryotes include the bacteria and cyanobacteria.

Definition

Eukaryote [prō'kerē,ōt]

An organism consisting of a cell or cells in which the genetic material is DNA in the form of chromosomes contained within a distinct nucleus. Eukaryotes include all living organisms other than the eubacteria and archaeobacteria.

02.a

Examine Several Key Words

The word **prokaryote** comes from the Greek πρό (**pro**, 'before') and κάρυον (karyon, 'nut' or 'kernel').

The word **eukaryote** comes from the Greek **eu**, "well," and karyon, "nut or kernel," which is a common scientific word-forming element that's used to talk about the nuclei of cells.

<https://en.wikipedia.org>

02.a

Examine Several Key Words

prokaryote - before true nucleus

eukaryote - with true nucleus

02.a

Examine Several Key Words

prokaryote - before true nucleus

eukaryote - with **true** nucleus

02.a Examine Several Key Words

Overview

Prokaryotes are unicellular organisms that lack organelles or other internal membrane-bound structures.

Prokaryotic cells preceded eukaryotic cells on the evolutionary timeline.

Eukaryotes are organisms whose cells have a nucleus enclosed within membranes.

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02.a Examine Several Key Words

Unicellular Organism
Organelles
Membranes
Nucleus

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Organelles
Membranes
Nucleus

About Two Organelles

Mitochondria and chloroplasts have striking similarities to bacteria cells.

They have their own DNA, which is separate from the DNA found in the nucleus of the cell. And both organelles use their DNA to produce many proteins and enzymes required for their function.

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02.a Examine Several Key Words

Unicellular Organism
Organelles
Membranes
Nucleus
Mitochondria
Chloroplasts
DNA

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02.a Examine Several Key Words

Don't memorize these ... just recognize them.

Unicellular
Organism
Organelles
Membranes
Nucleus
Mitochondria
Chloroplasts
DNA

02.a Examine Several Key Words

Don't memorize these ... just recognize them.

Unicellular

"Uni" means one.
Some organisms are only one cell.

All prokaryotes are one cell.
Some eukaryotes are one cell.

02.a Examine Several Key Words

Don't memorize these ... just recognize them.

Organism

Some organisms are only one cell (unicellular). Others are multicellular.

Organisms are living things.
Cells are the basic units of structure and function in living things.

02.a Examine Several Key Words

Don't memorize these ... just recognize them.

Organelles

All living things are composed of cells ... eukaryotic cells are made up of organelles.

Organelles are "subunits" of a eukaryotic cell. An organelle is a specialized part of a cell that has a specific function.

02.a Examine Several Key Words

Don't memorize these ... just recognize them.

These are examples of organelles. This is not a complete list.

Chloroplasts are only in plant cells. The nucleus, a cell membrane and mitochondria are in plant and animal cells.

Membranes
Nucleus
Mitochondria
Chloroplasts

02.a Examine Several Key Words

Don't memorize these ... just recognize them.

Most people have heard of DNA. The initials stand for deoxyribonucleic acid.

A, C, G and T. adenine cytosine guanine and thymine.

DNA is a complicated molecule that appears somewhat like a twisted ladder (double helix).

DNA

02.a Examine Several Key Words

Unicellular Organism
Organelles
Membranes
Nucleus
Mitochondria
Chloroplasts
DNA

Prokaryote

Eukaryote

02.b Relative Size Differences

Size Comparisons

10⁻³ 1 mm
10⁻⁴
10⁻⁵
10⁻⁶ 1 μm
10⁻⁷
10⁻⁸
10⁻⁹ 1 nm
10⁻¹⁰

meters

10⁻³ is one thousand times SMALLER than a millimeter

Each of these are 10 times smaller than the number above it.

One millimeter (mm) is the small mark on a meter stick.

Eukaryotes
Prokaryotes
Viruses
Proteins
Small molecules
Atoms

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02.b **Relative Size Differences**

Eukaryotes

Biggest —————
 Medium ———
 Smallest ·

Prokaryotes

Biggest ·
 Medium Big 10x smaller than a "big" prokaryote
 Medium Small 100x smaller than a "big" prokaryote
 Smallest 1,000 smaller than a "big" prokaryote

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02.b **Relative Size Differences**

Use a yard stick or meter stick.

Measure off 10 units of the stick (probably in a hallway – or, outside)

Let that represent the "biggest" eukaryotic cells. Examine the comparison of 1/10 and 1/100 of that length for medium and small eukaryotes.

02.c **Evolutionary Relationship**

Evolutionary Relationship Among Domains

Domain Domain Domain
 Bacteria Archaea Eukarya

Common Ancestor

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02.c **Evolutionary Relationship**

Timeline of evolutionary events (Billions of years before present):

- 1.5: origin of life
- 4.0: archaeobacteria, eubacteria
- 2.0: eukaryotes
- 1.0: plants, fungi, invertebrates
- present: vertebrates, amphibians, birds, reptiles, mammals

<https://home.cc.umanitoba.ca/>

Check

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