An introduction to cells and metabolism

Model 1. The smallest unit able to sustain life is called a *cell*. A *cell* can be simply defined as a container of small and large molecules that are essential for the survival of an organism. Unicellular organisms are called *prokaryotes* (pronounced PRO-CARRY-OATS), and they contain all that is necessary for their survival within a single cell – bacteria are examples of *prokaryotes*. When cells evolved to live as a collection or group, some organisms became, by definition, *multicellular*; these *eukaryotes* (pronounced YOU-CARRY-OATS) contain many individual cells that have distinct functions – animals and plants are examples of complex organisms comprised of *eukaryotic cells*.

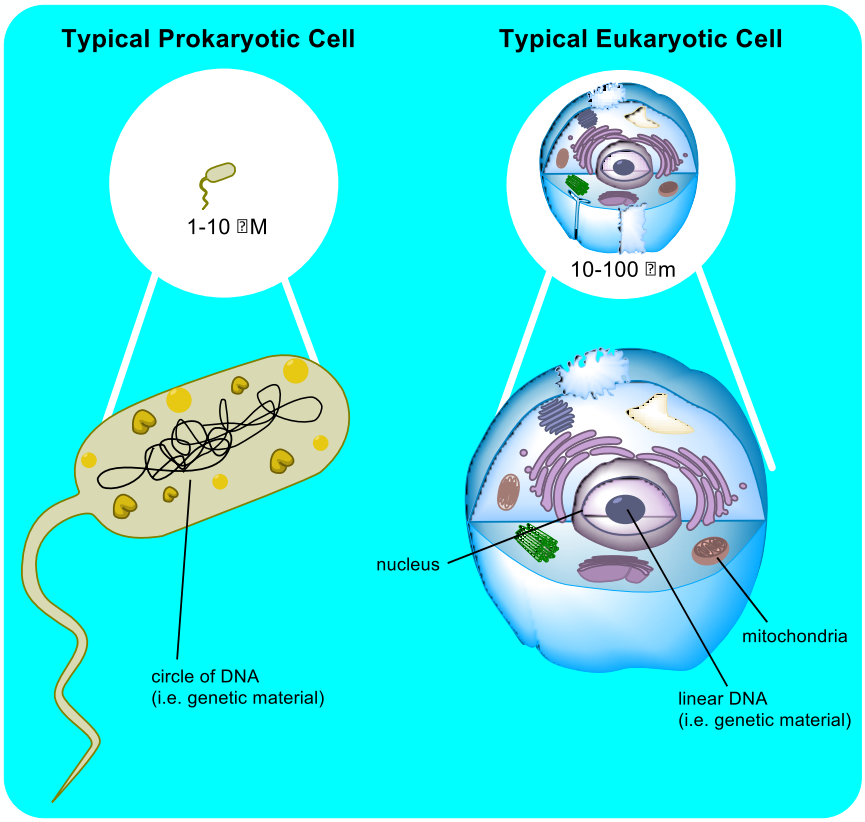


Figure 14.1. A comparison of prokaryotic and eukaryotic cells (µm is the abbreviation for micrometers or 1 billionth of a meter).

Although *prokaryotes* and *eukaryotes* are very different, several characteristics are common among all types of cells: 1) Every cell needs a barrier, called a *cell membrane* or

a *cell wall*, that controls the flow of molecules into or out of the cell; 2) Inside the cell, a range of molecules including carbohydrates and 20,000 to 30,000 different proteins, play a key roles cell function; and finally, 3) each cell contains *DNA*[1] - the genetic blueprint or hereditary information which is passed from cell to cell during cell division. Specialized compartments called *organelles* are found in *eukaryotic* cells; *chloroplasts* and *mitochondria* are examples of *organelles*.

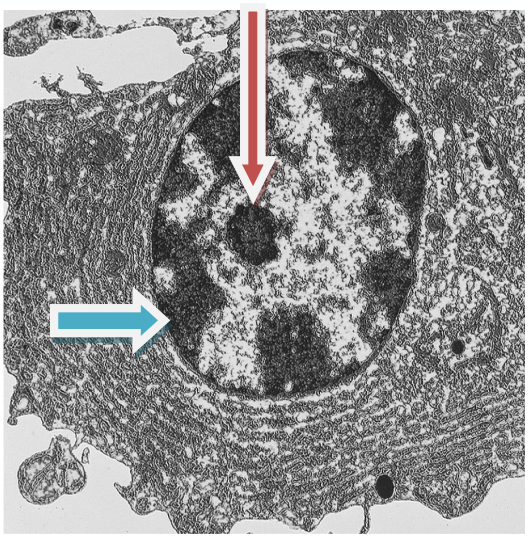


Figure 1-11a part 2 Concepts in Biochemistry, 3/e

Figure 14.2. A powerful microscope image of a *eukaryotic* cell from an animal. The red arrow is pointing to the *nucleus*, while the blue arrow is pointing to the *cell membrane.*

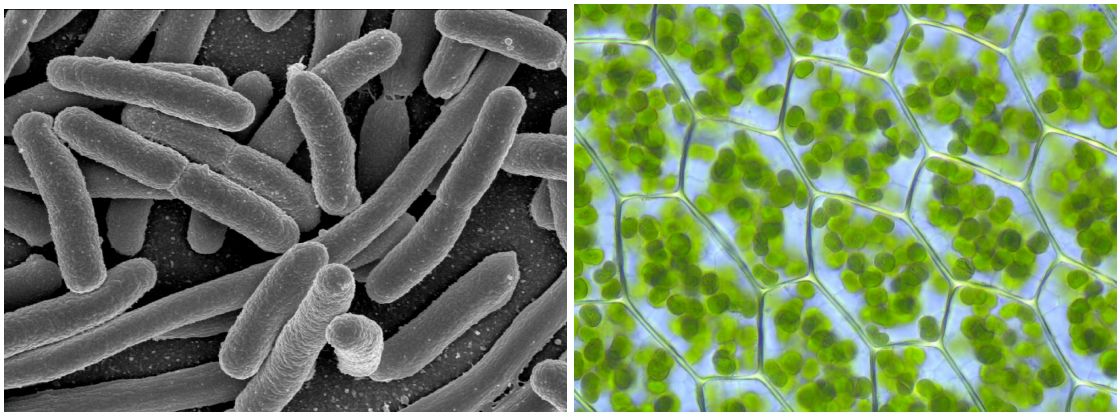
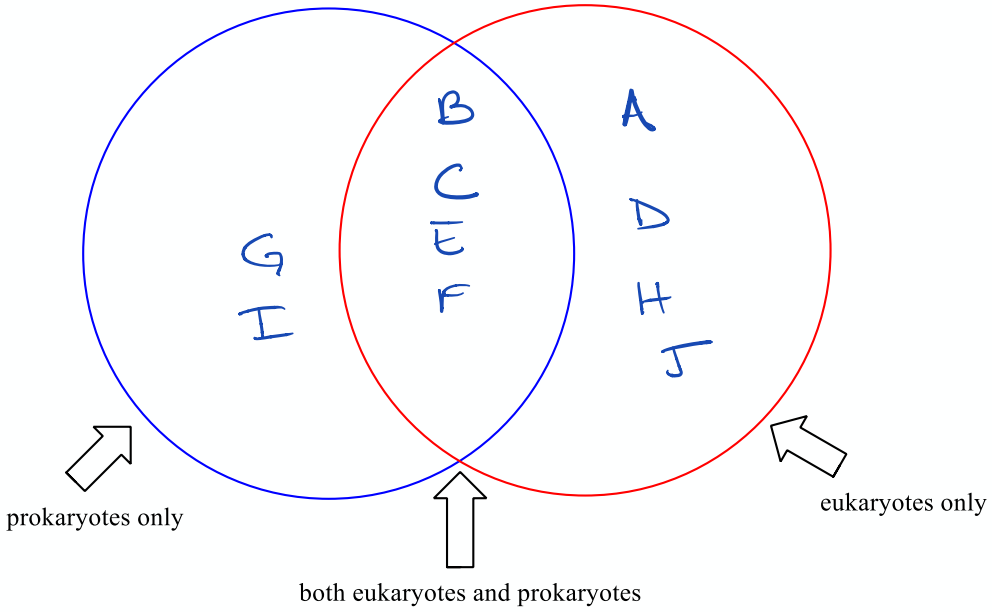


Figure 14.3. A) A cluster of *prokaryotic* bacteria, specifically *E.coli* cells.[Public domain] (B) The *eukaryotic* cells of a leaf [2]

[1] DNA is the abbreviation for DeoxyriboNucleic Acid – the chemical name for the type of molecule that makes up genetic information.

[2] "Plagiomnium affine laminazellen" by Kristian Peters – Fabelfroh. Licensed under CC BY-SA 3.0 via Wikimedia Commons

1. Using the information in Model 1. Complete the Venn Diagram below by placing the following words in the appropriate area:
    a. Nucleus
    b. Cell membrane/cell wall
    c. DNA
    d. Organelles (e.g. mitochondria or chloroplasts)
    e. carbohydrates
    f. proteins
    g. bacteria
    h. An animal or plant
    i. Unicellular
    j. Typically *multicellular*



2. Using the information provided in Model 1, identify the microscope images below as either *prokaryotic* or *eukaryotic* cells. Explain your reasoning.

A = prokaryotic ⇓ no organelles

B = eukaryotic ⇓ can see organelles

a)

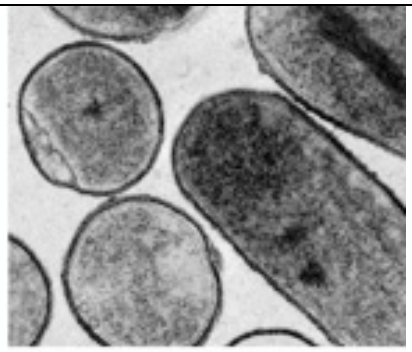


Image Credit: NIAID

b)

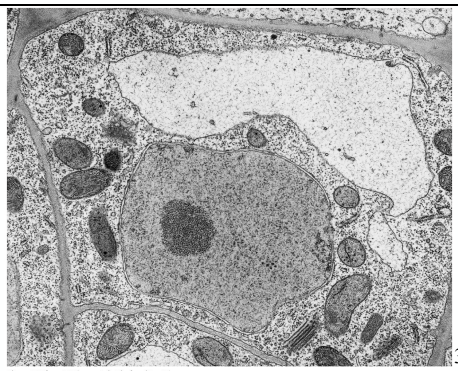


Figure 1-11b part 2 Concepts in Biochemistry, 3/e

[3]

3. In the image below, please place the following labels in the correct box.
   a. Skin cell
   b. Nucleus
   c. Bacterium (a single *bacteria*)

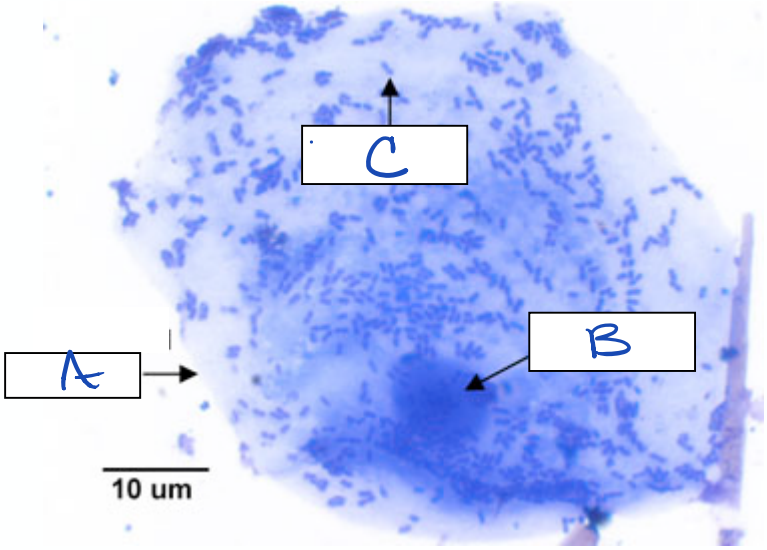


Image courtesy of Dr. Gary E. Kaiser, Professor of Microbiology, Community College of Baltimore County

How did you decide which was which?

Bacterium => very small
Nucleus => dark organelle (medium size)
Skin cell => largest

[3] This image from Boyer's concepts in Biochemistry

Model 2. In the late 19th century, the French chemist Louis Pasteur demonstrated that fermented beverages – such as beer and wine - result from the action of a living organism – yeast[4]. In yeast breads, that same living yeast is what causing the bread to "rise". Yeast are small, *unicellular* organisms. The scientific name for baker's or brewer's yeast is *Saccharomyces cerevisiae*. The *Saccharomyces* is the genus name, while *cerevisiae* is the species name. Another related organism *Saccharomyces bayanus* is used in the production of wine and cider.

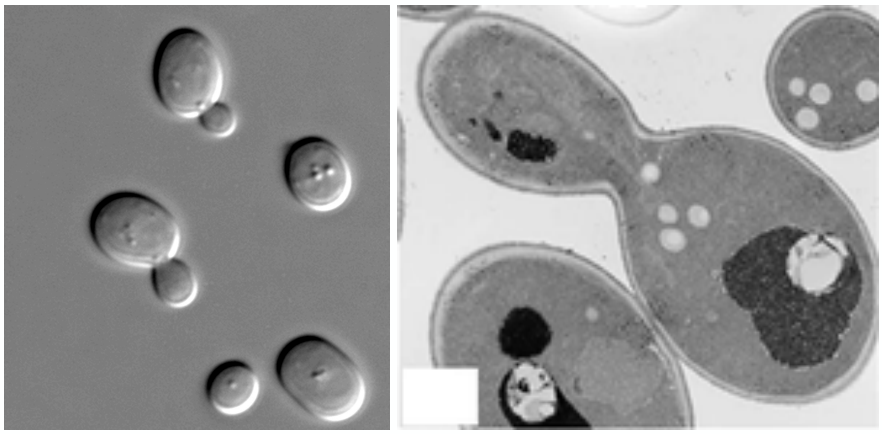


Figure 14.4. (a) Several *S. cerevisiae* cells visualized under a microscope. [public domain] (b) a powerful microscope image showing the inside of yeast cells (*S. cerevisiae*)[5].

When your group reaches this point, see the instructor for the following materials:

Table 14.1 Materials and procedure for yeast experiment

Materials	Set up the three glass cylinders as follows: 1. 1 Tbsp warm water + ¼ tsp yeast 2. 1 Tbsp warm water + ¼ tsp sugar 3. 1 Tbsp warm water + ¼ tsp sugar + ¼ tsp yeast. *Wait for 10 minutes, then record what you see for each of the three conditions.*
Pack of active dry yeast	
Glass cylinders, x3	
Plastic wrap	
Rubber band	
sugar	
Warm water	

[4] Pasteur, L. Studies on Fermentation. London: Macmillan, 18714
[5] © The Royal Society of Chemistry 2008

Observations:

Skip

4. After study the above figures and accompanying information of Model 2, in what ways is baker's yeast like a human or plant cell (*eukaryotic*) and in what ways is it like an *E. coli* cell (*prokaryotic*)? Please explain.

eukaryotic → has nucleus
prokaryotic → small + unicellular

5. Is yeast **prokaryotic** or **eukaryotic**? How did you make this final decision?

It's own group because has features of both.

6. Explain the observations of your mini-experiment.

Skip

7. How might the information you've learned explain the following instructions within a bread recipe: *Use warm water to dissolve the yeast, do not use boiling water*.

Yeast is alive and boiling water would kill it.