

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*.

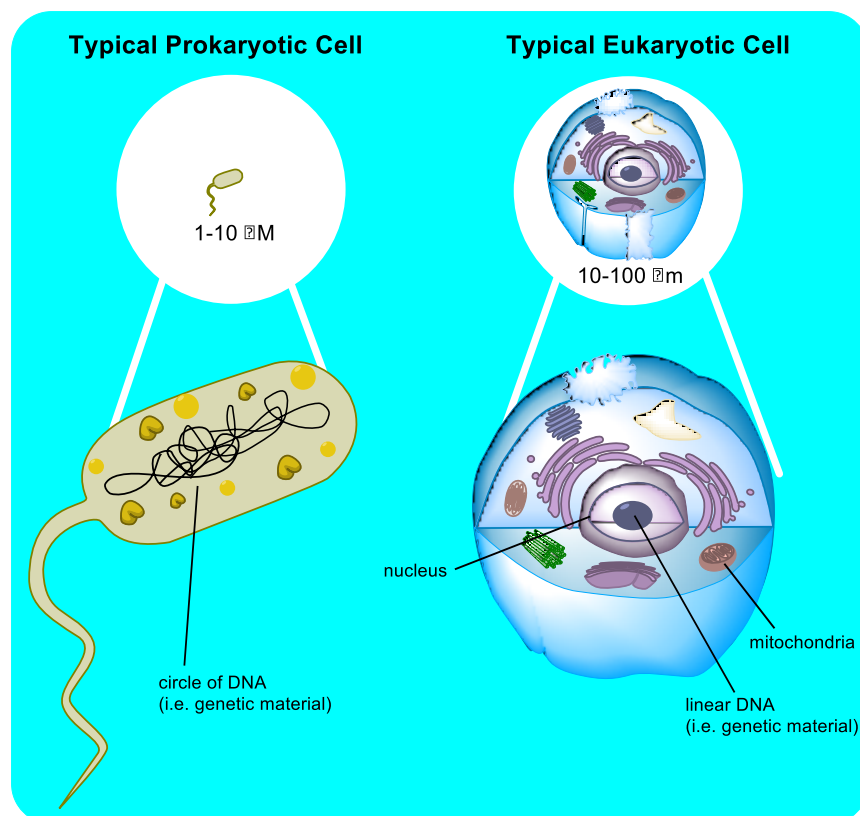


Figure 14.1. A comparison of prokaryotic and eukaryotic cells (μm is the abbreviation for micrometers or 1 billionth of a meter).

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*.

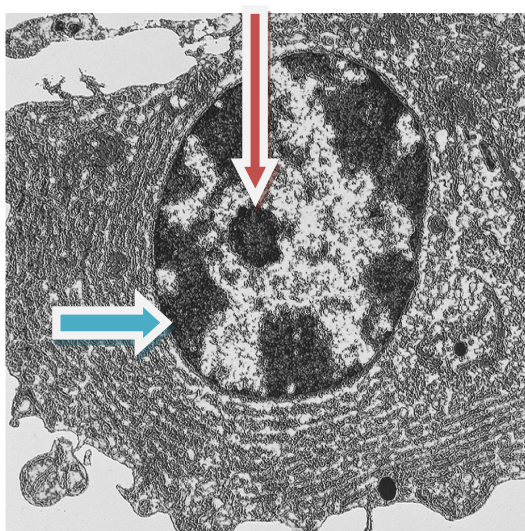


Figure 14.2. A powerful microscope image of a *eukaryotic* cell from an animal. The red arrow is pointing to the *nucleus*, while the blue arrow is pointing to the *cell membrane*.

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

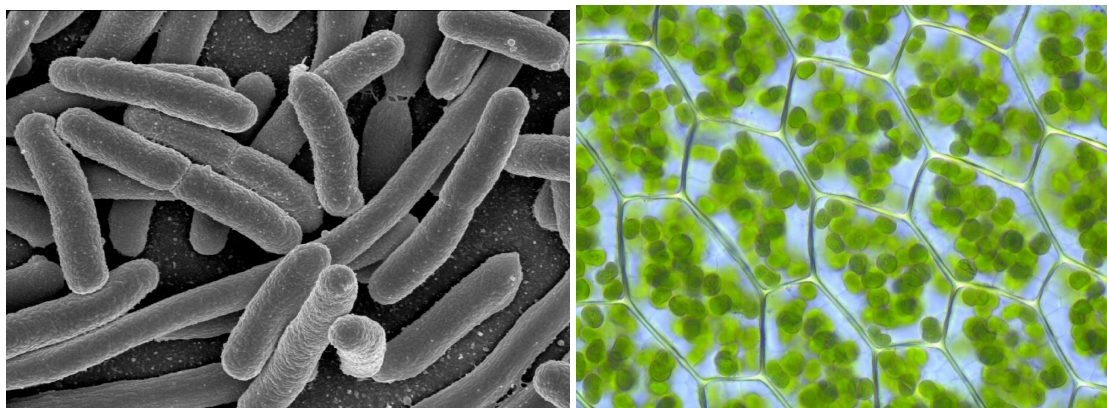
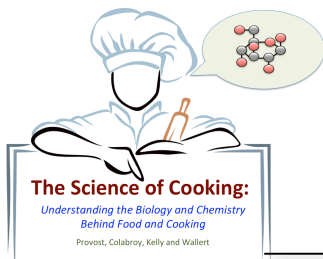


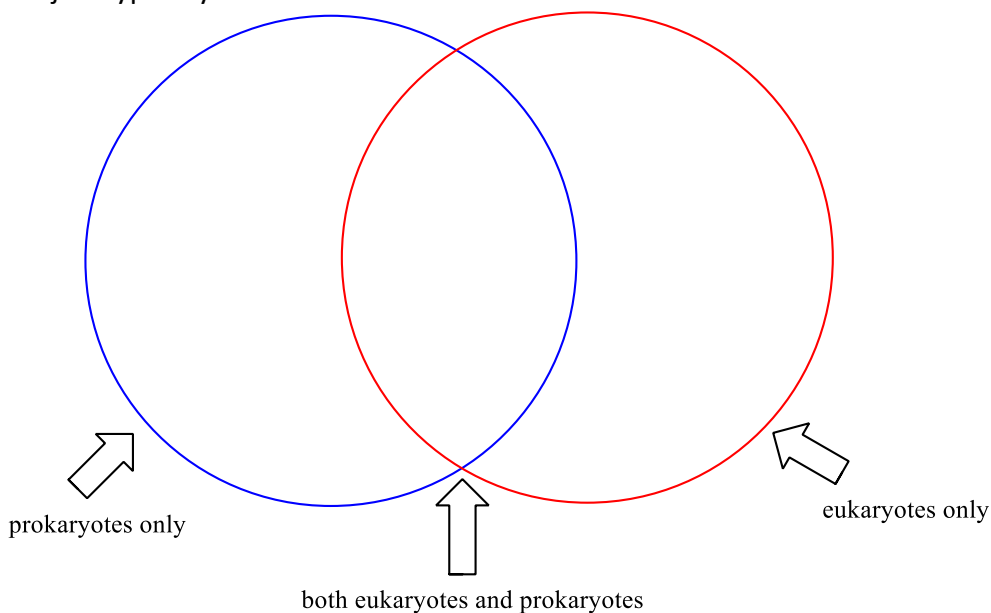
Figure 14.3. A) A cluster of *prokaryotic* bacteria, specifically *E. coli* cells. [Public domain] (B) The *eukaryotic* cells of a leaf²

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

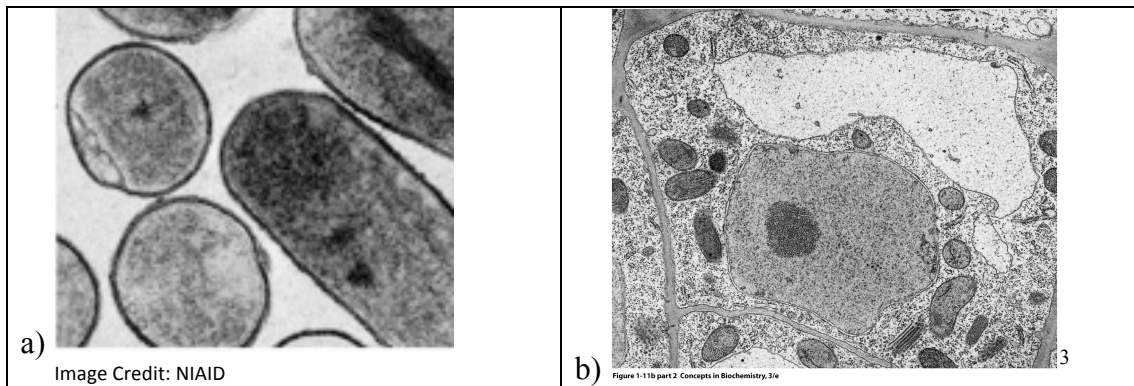
² "Plagiomnium affine laminazellen" by Kristian Peters – Fabelfroeh. Licensed under CC BY-SA 3.0 via Wikimedia Commons



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



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



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

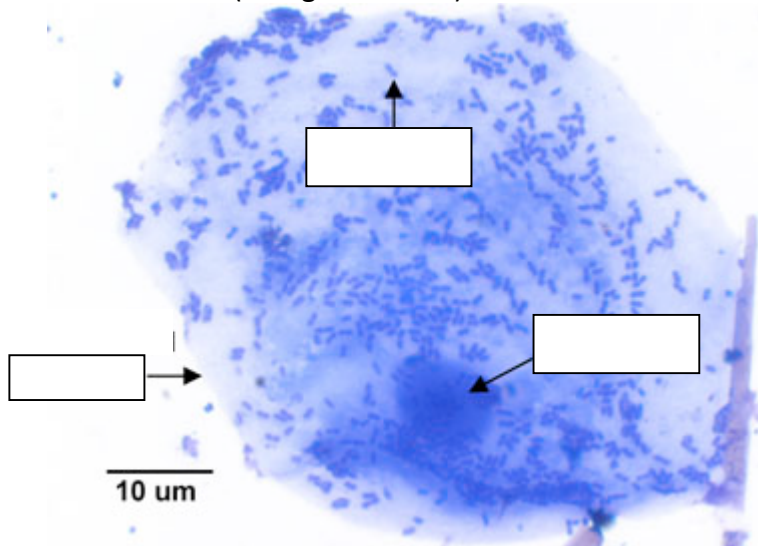


Image courtesy of Dr. Gary E. Kaiser, Professor of Microbiology, Community College of Baltimore County

How did you decide which was which?

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 – yeast⁴. 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.

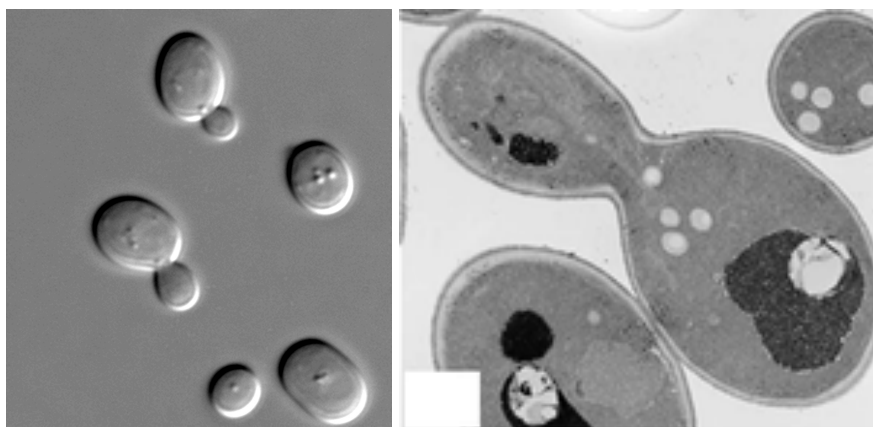


Figure 14.4. (a) Several *S. cerevisiae* cells visualized under a microscope. [public domain] (b) a powerful microscope image showing the inside of yeast cells (*S. cerevisiae*)⁵.

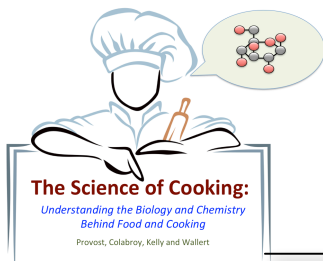
When your group reaches this point, see the instructor for the following materials:

Table 14.1 Materials and procedure for yeast experiment

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

⁴ Pasteur, L. *Studies on Fermentation*. London: Macmillan, 18714

⁵ © The Royal Society of Chemistry 2008



Observations:

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.
5. Is yeast **prokaryotic** or **eukaryotic**? How did you make this final decision?
6. Explain the observations of your mini-experiment.
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.*