

**Section 16-1 Spontaneous Generation**

(pages 339-342)

**SECTION REVIEW**

In this section you examined the hypothesis of spontaneous generation. Spontaneous generation refers to the idea that life regularly arises from nonlife, or nonliving things. You looked into the experiments of Francesco Redi and Lazzaro Spallanzani, which attempted to disprove the spontaneous generation

hypothesis. You also examined the experiments of John Needham, which tried to prove that the spontaneous generation hypothesis was correct. Finally, you studied the experiments of Louis Pasteur, which showed conclusively that the spontaneous generation hypothesis was incorrect.

**Spontaneous Generation: Relating Facts**

Describe in your own words the experiments of each of the following scientists and whether the experiment proved or disproved the spontaneous generation hypothesis.

Francesco Redi: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Lazzaro Spallanzani: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

John Needham: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Louis Pasteur: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

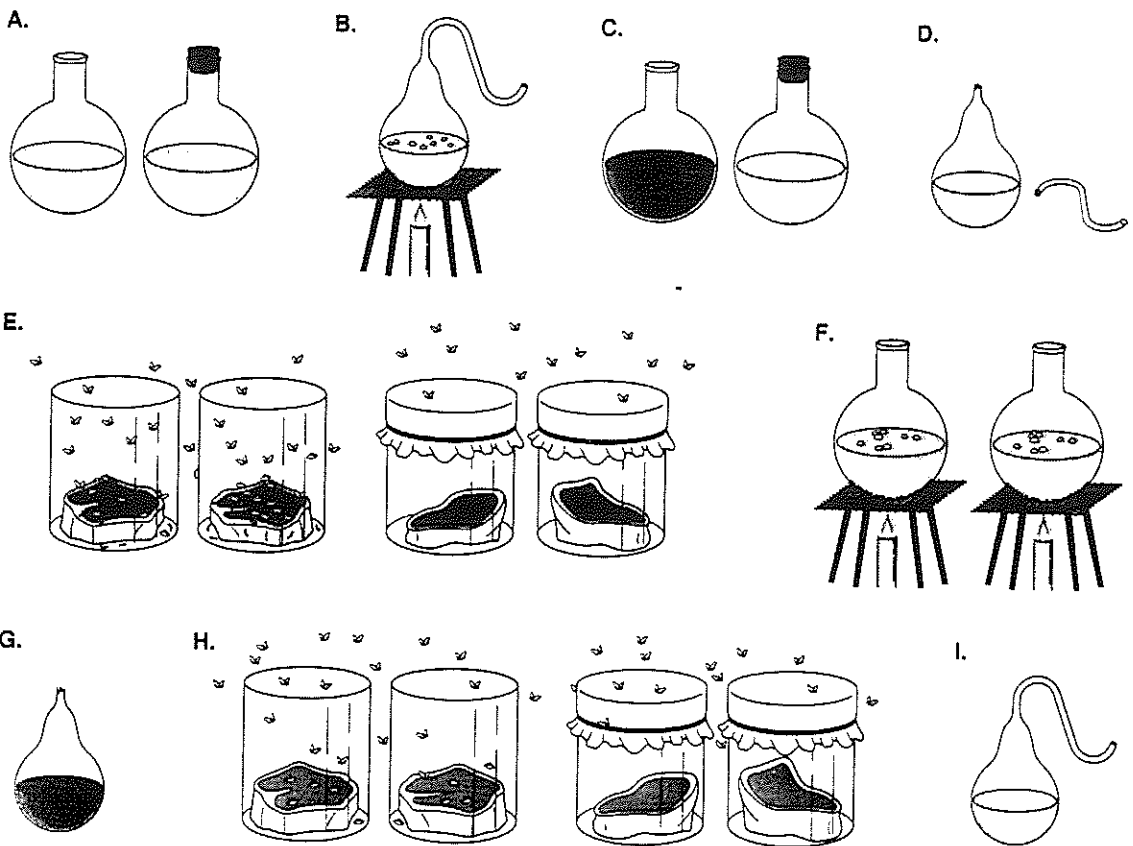
### Scrambled Experiments: Finding the Main Ideas

The illustrations below show the steps in the experiments of Redi, Spallanzani, and Pasteur. Unfortunately, they are scrambled and out of order. Unscramble the steps. Then place the correct order of steps beside the names of each of the scientists listed below. Use the letter key beside each step to mark the correct order.

Redi: \_\_\_\_\_

Spallanzani: \_\_\_\_\_

Pasteur: \_\_\_\_\_



### Concept Mapping

The construction of and theory behind concept mapping are discussed on pages vii-ix in the front of this Study Guide. Read those pages carefully. Then consider the concepts presented in Section 16-1 and how you would organize them into a concept map. Now look at the concept map for Chapter 16 on page 160. Notice that the concept map has been started for you. Add the key facts and concepts you feel are important for Section 16-1. When you have finished the chapter, you will have a completed concept map.

**Section 16-2 The First Signs of Life**

*(pages 342-346)*

**SECTION REVIEW**

In this section you looked into some of the theories as to how life arose on Earth. You discovered that organic molecules such as amino acids, lipids, and carbohydrates will form spontaneously during laboratory experiments in which conditions on ancient Earth are simulated.

Scientists have found microfossils that have been dated back to 3.5 billion years ago. The microfossils provide the outlines of an-

cient cells and show that these first cells were heterotrophic prokaryotes similar to bacteria alive today.

Over time, cells that could perform an ancient form of photosynthesis evolved. These cells were autotrophic because they could produce their own food. The first autotrophs were extremely successful and were commonplace some 3.4 billion years ago.

**Early Cells: Relating the Main Ideas**

Place a Y next to each of the following characteristics that relate to the first ancient cells. Place an N next to each characteristic that does not relate to the first cells. In each case, explain your response.

1. Contain a nucleus: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. Aerobic: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. Multicellular: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. Photosynthetic: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
5. Prokaryotic: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Concept Mapping**

The construction of and theory behind concept mapping are discussed on pages vii-ix in the front of this Study Guide. Read those pages carefully. Then consider the concepts presented in Section 16-2 and how you would organize them into a concept map. Now look at the concept map for Chapter 16 on page 160. Notice that the concept map has been started for you. Add the key facts and concepts you feel are important for Section 16-2. When you have finished the chapter, you will have a completed concept map.

**Section  
16-3**

**The Road to Modern Organisms**

**(pages 347-349)**

**SECTION REVIEW**

In this section you looked into the evolution of life after photosynthetic organisms appeared. You learned that the oxygen released during photosynthesis dramatically changed the composition of the atmosphere and led to our modern atmosphere, which is about one-fifth oxygen. The addition of oxygen to the atmosphere had several important effects. First, it banished anaerobic organisms to parts of the Earth where oxygen can no longer reach. Second, it formed an ozone layer in the upper atmosphere that acts as a shield from the damaging ultraviolet rays of

the sun. Third, it allowed the evolution of metabolic pathways that utilize oxygen (aerobic metabolism).

You also discovered that eukaryotic cells evolved around 1.4 billion years ago. Eukaryotic cells contain a nucleus and membrane-bound organelles (mitochondria and chloroplasts, for example). Finally you looked into the evolution of sexual reproduction—which allows for much more genetic variety than asexual reproduction—and the eventual evolution of multicellular life.

**Compare and Contrast: Finding the Main Ideas**

For each of the following pairs of characteristics, underline the characteristic that evolved first. Then explain the reason for your selection.

1. Autotroph, heterotroph: \_\_\_\_\_  
\_\_\_\_\_
2. Prokaryotic, eukaryotic: \_\_\_\_\_  
\_\_\_\_\_
3. Aerobic metabolism, anaerobic metabolism: \_\_\_\_\_  
\_\_\_\_\_
4. Sexual reproduction, asexual reproduction: \_\_\_\_\_  
\_\_\_\_\_
5. Unicellular, multicellular: \_\_\_\_\_  
\_\_\_\_\_

**Concept Mapping**

The construction of and theory behind concept mapping are discussed on pages vii-ix in the front of this Study Guide. Read those pages carefully. Then consider the concepts presented in Section 16-3 and how you would organize them into a concept map. Now look at the concept map for Chapter 16 on page 160. Notice that the concept map has been started for you. Add the key facts and concepts you feel are important for Section 16-3. When you have finished the chapter, you will have a completed concept map.

## ***Evaluating a Theory About Cells***

Some biologists believe that eukaryotes descended from prokaryotes. The origin of the nucleus, however, remains unknown, and there is little data upon which to construct a convincing theory as to how it arose.

There is evidence, however, that suggests an origin for chloroplasts and mitochondria, which are found only in eukaryotic cells. Biologists have proposed that these organelles are descendants of free-living prokaryotic cells. This theory was developed in its modern form by Dr. Lynn Margulis and is called the endosymbiont theory.

Dr. Margulis suggests that chloroplasts descended from blue-green bacteria (prokaryotes) and mitochondria descended from aerobic bacteria (prokaryotes). According to the theory, more than a half billion years ago these prokaryotes invaded the cytoplasm of certain eukaryotic cells. Instead of harming the eukaryotes, the bacteria established a symbiotic, or mutually beneficial, relationship with them. The blue-green algae provided the eukaryotes with energy-rich sugars that they produced through photosynthesis. The eukaryotes provided the blue-green bacteria with protection and certain nutrients. The aerobic bacteria, which used oxygen in respiration, provided their host with a more efficient means of extracting energy from food. In return, these bacteria received food and protection. Eventually, the characteristics that had allowed these organisms to survive independently faded, and a single organism—the modern eukaryote—emerged.

The endosymbiont theory cannot be verified by a few direct experiments. The following table, however, summarizes evidence that supports it.

<b>Characteristics</b>	<b>Chloroplasts</b>	<b>Mitochondria</b>
Resembles some blue-green bacteria	X	
Resembles some aerobic bacteria		X
Contains DNA	X	X
Ribosomes synthesize some proteins	X	X
Circular DNA resembling that found in aerobic bacteria	X	X
Ribosomes of organelles differ from those found in cytoplasm of eukaryotic cells	X	X
Chloroplast ribosomes are similar to ribosomes of prokaryotes	X	X

1. What features of chloroplasts and mitochondria could be used to support the notion that symbiosis provided a foothold for their development? Why?

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2. Compare chloroplasts and mitochondria to modern prokaryotic organisms. What is the significance of this comparison regarding the endosymbiont theory?

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3. What evidence might indicate relationships that might be the result of coincidence?

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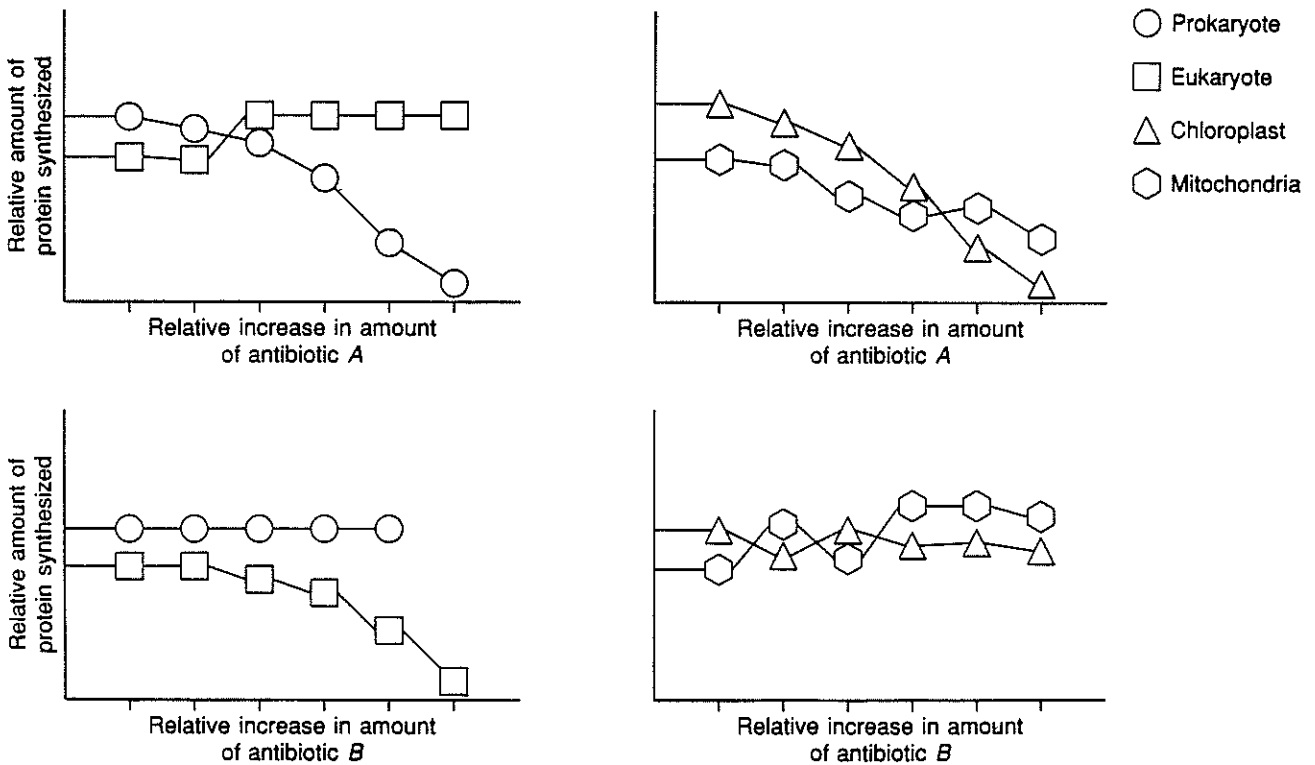


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Both eukaryotes and prokaryotes carry on similar basic life functions. However, eukaryotes carry on a greater range of functions. They contain a variety of substances and their control centers are more complex than those of prokaryotes.

The following data were collected based on experiments with cells and organelles. Figure 1 shows the effect of two antibiotic drugs on prokaryotic cells, eukaryotic cells, chloroplasts, and mitochondria.

**Figure 1** Responses of Cell and Organelle Protein Synthesis with Antibiotic Exposure



Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

4. How do the data displayed in the graph relate to the endosymbiont theory?

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5. Form an opinion as to why either one of the antibiotics could be of potential harm to human beings. Explain your answer.

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