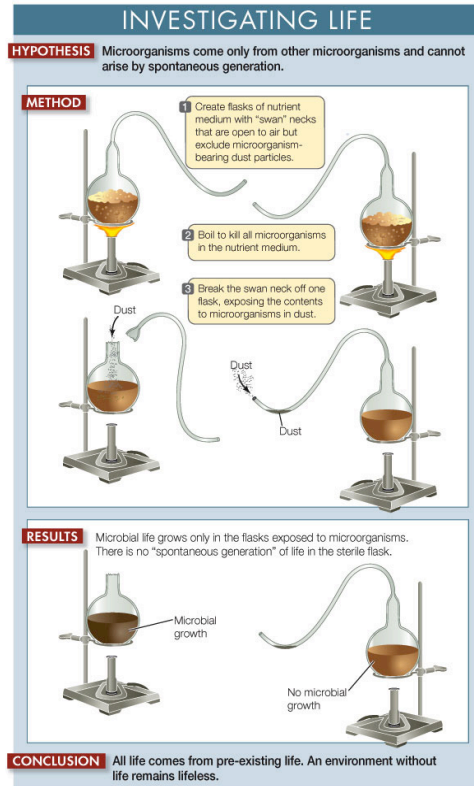


## Working with Data

### Disproving the Spontaneous Generation of Life (Textbook Figure 4.7)

#### Introduction

To disprove the theory of spontaneous generation, Louis Pasteur devised a way to flask that allowed oxygen in, but prevented dust from entering. The broth did not show signs of life until he broke off the neck of the flask allowing dust, and therefore microbes, to enter. Through this experiment, Pasteur demonstrated that life arises from existing life. This experiment laid the foundation for the development of pasteurization, a process of heating food for the purpose of destroying harmful human pathogens. Pasteur discovered that the destruction of bacteria can be accomplished by exposing them to a specific minimum temperature for specific minimum amount of time. Unlike sterilization, however, pasteurization does not kill all microorganisms. Rather, pasteurization results in a reduction in the number of viable microorganisms. Proper refrigeration of food helps to prevent further growth and spoilage.



#### Original Paper

Pasteur gave a talk on the background of spontaneous generation and his research at the "Sorbonne Scientific Soirée" on April 7, 1864. This talk was published and has been translated into English:

Pasteur, L.: On Spontaneous Generation  
<http://shell.cas.usf.edu/~alevine/pasteur.pdf>

## Links

*Access Excellence: The Slow Death of Spontaneous Generation (1668–1859)*

[http://www.accessexcellence.org/RC/AB/BC/Spontaneous\\_Generation.html](http://www.accessexcellence.org/RC/AB/BC/Spontaneous_Generation.html)

*Science & Society Picture Library: Pasteur's experiments on spontaneous generation, c 1857*

<http://www.scienceandsociety.co.uk/results.asp?image=10288629>

*Founders of Biological and Medical Science: Louis Pasteur*

<http://www.foundersofscience.net/>

*USDA: National Agriculture Library: Food Safety Research Information Office: Food Processing and Technology: Pasteurization*

[http://fsrio.nal.usda.gov/document\\_reslist.php?product\\_id=142](http://fsrio.nal.usda.gov/document_reslist.php?product_id=142)

## Analyze the Data

In his lecture, Pasteur described how, in Experiment 1, “the infusion will, two or three days later, be seen to contain animalcules and mold.” He described growth versus no growth, but did not quantitate the microbial growth he observed. A convenient way to accomplish this is to measure turbidity, the cloudiness that Pasteur observed. This is readily done by taking samples from the flasks and counting cells under the microscope. When Pasteur’s experiment was repeated and samples were taken from Experiments 1 and 2, the following data were obtained:

**Table 1**

<b>Time (hr)</b>	<b>Cells/ml Experiment 1</b>	<b>Cells/ml Experiment 2</b>
Initial	0	0
6	0	0
12	$10^3$	0
14	$10^4$	0
18	$10^6$	0
22	$10^8$	0

### Question 1

Plot log cell number versus time for both experiments. What do you conclude?

### Question 2

The data in Table 1 can be used to calculate the growth rate (generation time for cell reproduction) of the “animalcules” (mostly bacteria and fungi) that were in the flask. If cells are growing by division, there is a logarithmic progression:

$$C_2 = C_1 \times 2^n$$

where  $C_1$  and  $C_2$  are the initial and final cell concentrations, and  $n$  is the number of doubling times (generations). Also:

$$G = t/n$$

Where  $G$  is the generation time and  $t$  is the time in minutes.  
Combining the two equations:

$$G = \frac{t}{3.3 \log C_2 C_1}$$

Using the data in the Table 1 for 14 and 18 hr, calculate  $G$ .