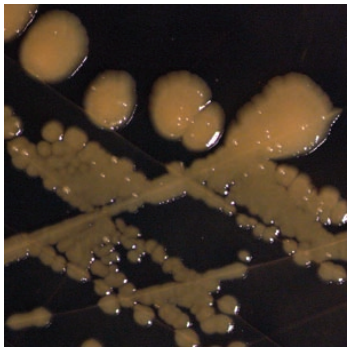
Margus Pedaste and Tago Sarapuu
46 Vanemuise St., 51014 Tartu, Estonia

How to grow bacteria?

Worksheet accompanying the inquiry model "The Growth of Bacteria"

Introduction



When talking about the growth of organisms, we usually mean the increase in the dimensions of an individual. The growth of macro-organisms is visible and easily measurable, but it is not so for micro-organisms. For example, bacteria are such tiny organisms with a diameter of 0.1 to 25 µm only, and it is rather complicated to measure the growth of one cell, even under a microscope. Scientists describe the growth of bacteria by generation time – the time it takes for the number of bacteria to double. This is actually a characteristic of the reproduction of bacteria but it describes their growth as well. In optimal living conditions, some bacteria can reproduce every 20 to 30 minutes and form visible colonies on a Petri dish. Therefore, the growth of bacteria can also be described by the increase in the size of their colonies.

In this lesson, you will have an opportunity to be a young scientist. You have to investigate how different environmental factors influence the growth of bacteria. The results of this study are applicable in every day life when you want to increase or decrease the growth of these organisms – in making yoghurt or in protecting food products against undesirable bacteria.

Formulating hypotheses

Please open the model "The Growth of Bacteria" by clicking on the icon of the program. Read the instruction carefully at the bottom of the model's window and list all the environmental factors that can be modified:

- _____
- _____
- _____

Next, try to guess what influences these factors have on the growth of bacteria. Complete the sentences (hypotheses).

- If _____, then the growth of bacteria will _____
- If _____, then the growth of bacteria will _____
- If _____, then the growth of bacteria will _____

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Planning the studies

You have to carry out three experiments to check your hypotheses. Please describe how you plan to do this and list the equipment needed for each study when carrying them out in a real laboratory.

- For proving the first hypothesis I plan to _____

  _____

  The equipment I need for carrying out this study: _____
- For proving the second hypothesis I plan to _____

  _____

  The equipment I need for carrying out this study: _____
- For proving the third hypothesis I plan to _____

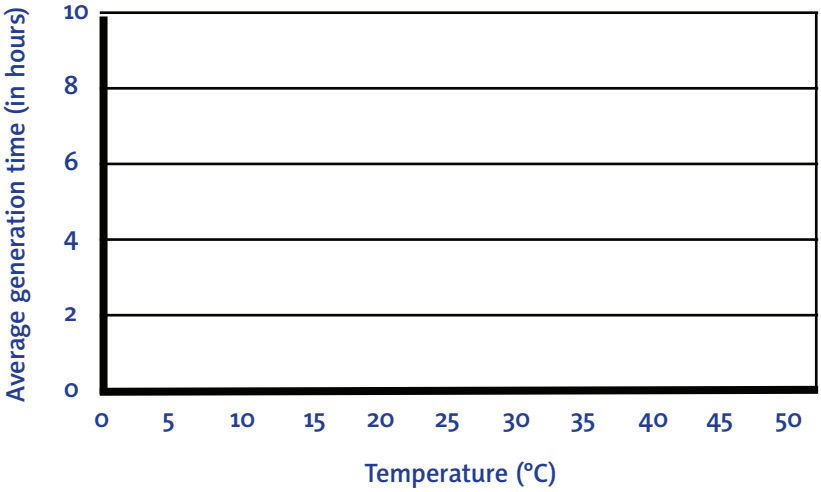
  _____

  The equipment I need for carrying out this study: _____

Study 1: The influence of temperature on the growth of bacteria

Use the model "The Growth of Bacteria" and fill in the following table.

Temperature °C	Humidity %	Antibiotics yes / no	Time for doubling the number of bacteria (in hours)			Average generation time (in hours)
			1st time of doubling	2nd time of doubling	3rd time of doubling	
10	60	no				
25	60	no				
50	60	no				



Plot a graph of the results and answer the questions below.

- In which conditions is the growth of bacteria most intensive?

  _____

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In which conditions is the growth of bacteria most suppressed?

- Make a conclusion: what influence does temperature have on the growth of bacteria?

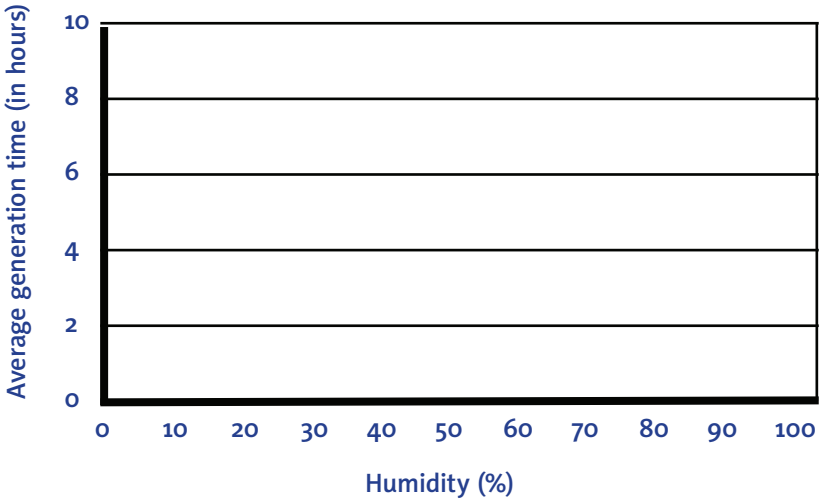
Study 2: The influence of humidity on the growth of bacteria

Use the model "The Growth of Bacteria" and fill in the following table. Please select an appropriate temperature.

Temperature °C	Humidity %	Antibiotics yes / no	Time for doubling the number of bacteria (in hours)			Average generation time (in hours)
			1st time of doubling	2nd time of doubling	3rd time of doubling	
	20	no				
	60	no				
	100	no				

- Explain why you selected the temperature for your experiments.

Plot a graph of the results and answer the questions below.



- In which conditions is the growth of bacteria most intensive?

In which conditions is the growth of bacteria most suppressed?

- Make a conclusion: what influence does humidity have on the growth of bacteria?

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Study 3: The influence of antibiotics on the growth of bacteria

Use the model "The Growth of Bacteria" and fill in the following table. Please select an appropriate temperature and humidity as well.

Temperature °C	Humidity %	Antibiotics yes / no	Time for doubling the number of bacteria (in hours)			Average generation time (in hours)
			1st time of doubling	2nd time of doubling	3rd time of doubling	
		yes				
		no				

- Explain why you selected this temperature and humidity for your experiments.

- What changes are observable in your experiment?

- Make a conclusion: what influence do antibiotics have on the growth of bacteria?

Generalization

You have studied the growth of bacteria. Please explain what has to be done in the following situations on the basis of your results.

- Mike and Jenny were making yoghurt. They mixed a little of milk with a spoonfull of yoghurt. Next, they put their vessel into a freezer. They waited for two days but nothing happened. What was wrong? WHAT should they have done differently and WHY?

- Anna and Rolf investigated the bacteria in the air of their home. First, they made some nutrient agar and put it in some Petri dishes. Next, the Petri dishes were left on a window sill of the bathroom. A week later the kids brought their Petri dishes for study to school but they were completely useless – all the Petri dishes were covered with the colonies of bacteria and mould. What went wrong? WHAT should they have done differently and WHY?

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