

## Lesson Plan: Teaching about Microbial Life and Climate Change

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As an **undergraduate-level Biological Sciences** teacher, you can use this set of computer-based tools to help you in teaching topics such as **microbes, microbial growth, the role of microbes in the climate system, and the effects of global climate change on microbial growth and survival.**

The lesson plan allows students to learn about the relationship between microbes, the environment, and climate. The activity will explore the specific roles played by various microbes in the climate system.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in the Biological Sciences.

Use this lesson plan to help your students find answers to:

- *What are microbes?*
- *What are the factors that influence microbial growth?*
- *What is the relationship between microbes and climate?*
- *How might climate change affect microbial growth and survival?*

### About the Lesson Plan

**Grade Level**

High school, Undergraduate

<b>Discipline</b>	Biological Sciences
<b>Topic(s) in Discipline</b>	Microbes, Gas Cycling, Environment, Bacterial Growth and Adaptation, Greenhouse Gases
<b>Climate Topic</b>	Climate and the Biosphere
<b>Location</b>	Global
<b>Access</b>	Online (some material can be downloaded for use in offline mode)
<b>Language(s)</b>	English
<b>Approximate Time Required</b>	120 – 150 min

## 1 Contents

- 1. Video (~3 min)**

A micro-lecture that provides an overview of microbes, their classification, and their importance in the biosphere.

<https://www.rmit.edu.au/media-objects/multimedia/video/seh/how-stuff-works/what-are-microbes>
- 2. Animation/Video (~3 min)**

An animation/video that describes the environmental factors required for microbial growth and explains the effects of changing environmental conditions on microbial growth by using temperature as an example.

[http://highered.mheducation.com/sites/0072501855/student\\_view0/chapter16/animation\\_quiz\\_1.html](http://highered.mheducation.com/sites/0072501855/student_view0/chapter16/animation_quiz_1.html)

**3. Reading (~50 min)**

A reading that introduces the relationship between microbes and climate change while describing microbial diversity in different environments.

<http://microbiologyonline.org/file/561774836e6880dd93a63f9eb466b06d.pdf>

**4. Classroom activity (~60 min)**

A classroom activity to identify the relationship between a specific microbe and climate.

[https://www.mbari.org/wp-content/uploads/2016/01/Microbe-climate\\_student.pdf](https://www.mbari.org/wp-content/uploads/2016/01/Microbe-climate_student.pdf)

**5. Suggested questions/assignments for learning evaluation**

- *What are microbes?*
- *What are the factors that influence microbial growth?*
- *What is the relationship between microbes and climate?*
- *How might climate change affect microbial growth and survival?*

## 2 Step-by-step User Guide



Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

**1. Introduce the topic through videos**

When teaching the topic of microbes, discuss the relationship between microbial life and climate. As climate change alters the environment, microorganisms respond, adapt, and evolve in their surroundings. Microorganisms have generation times that may be as short as a few hours; therefore, they respond to environmental and climate-related changes at a faster rate than most other organisms. Thus, microbes are ideal systems for understanding the effects of climate change on biological systems.

- Play the micro-lecture (approx. 3 min) "[What Are Microbes?](#)" to provide an overview of microbes,

their classification, and their role in the biosphere.

The micro-lecture “What Are Microbes?”, provided by RMIT University and contributed by Dr. Taghrid Istivan, is available at <https://www.rmit.edu.au/media-objects/multimedia/video/seh/how-stuff-works/what-are-microbes>.

- Discuss the significant role of microbes in sustaining life on earth.
- Now, play the animation/video (approx. 3 min) “[Food Pathogens and Temperature](#)” to illustrate how microbial growth depends on various environmental factors. Use the graphs in the animation to explain the effect of changing temperature on microbial growth. Proceed to explain how global warming may affect microbial growth and establish a relationship between the environment and microbes.

The animation/video “Food Pathogens and Temperature” is provided by McGraw Hill and is available at

[http://highered.mheducation.com/sites/0072501855/student\\_view0/chapter16/animation\\_quiz\\_1.html](http://highered.mheducation.com/sites/0072501855/student_view0/chapter16/animation_quiz_1.html).

Note: This tool requires a Flash player, and therefore, may not play in some browsers. Please enable the Flash player or use a browser (such as Firefox) that supports the playback of Flash content.

## 2. Discuss the topic further through a reading activity

Now, use the handout in the reading “[Microbes and Climate Change](#)” to explain the crucial role of microbes in the environment. Discuss the role of microbes in gas cycling, the consumption and production of greenhouse gases by microbes, and the resulting effects on climate.

This reading discusses the role of microbes in ecological systems and their role in the biogeochemical

cycling of elements such as carbon and nitrogen.

This handout and reading is provided by the Microbiology Society and is available at <https://microbiologysociety.org/uploads/assets/uploaded/f4c5c7a3-3386-427b-a5cafc7d2102806c.pdf>.

Note: More information on the relationship between microbes and climate/climate change can be found in the Additional Resources section.

### 3. Conduct a classroom activity

Next, help students explore this topic further in an engaging manner through a classroom activity “[Microbes and Climate](#)”. In this activity, students can use online resources to identify the relationship between a specific marine microbe and the climate system. They will then present their findings.

The classroom activity “Microbes and Climate”, created through the Educational and Research Testing Hypotheses program from Monterey Bay Aquarium and Research Institute, is available at [https://www.mbari.org/wp-content/uploads/2016/01/Microbe-climate\\_student.pdf](https://www.mbari.org/wp-content/uploads/2016/01/Microbe-climate_student.pdf).

### 4. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- *What are microbes?*
- *What are the factors that influence microbial growth?*
- *What is the relationship between microbes and climate?*
- *How might climate change affect microbial growth and survival?*

## 3 Learning Outcomes

The tools in this lesson plan will enable students to:

- describe the relationship between microbes, the environment, and climate
- describe microbial growth and its phases, and the key factors affecting microbial growth
- discuss the possible impacts of climate change on microbes

## 4 Additional Resources



If you or your students would like to explore the topic further, these additional resources will be useful.

### 1. Reading

A reading, “Is Climate Change Putting World’s Microbiomes at Risk?” by Jim Robbins on YaleEnvironment360, that briefly describes the impact of climate change on microbial growth.  
[https://e360.yale.edu/features/is\\_climate\\_change\\_putting\\_world\\_microbiomes\\_at\\_risk](https://e360.yale.edu/features/is_climate_change_putting_world_microbiomes_at_risk)

### 2. Laboratory Activity

A laboratory activity, “Effect of pH on Growth Rate” from Prof. John Blamire and hosted on the Brooklyn College website, that will help students to analyze the effect of changing pH on microbial growth and survival.

<http://www.brooklyn.cuny.edu/bc/ahp/CellBio/Growth/MGpH.html>

**3. Reading**

The reading resources, “Carbon cycle” and “Nitrogen cycle” from the Microbiology Society, describe how microbes interact with the environment through the carbon and nitrogen cycle.

<http://microbiologyonline.org/about-microbiology/microbes-and-the-outdoors/carbon-cycle>

<http://microbiologyonline.org/about-microbiology/microbes-and-the-outdoors/nitrogen-cycle>

**4. Reading**

A reading, “Climate Change Could Impact Vital Functions of Microbes” from the American Society for Microbiology and available on ScienceDaily, to learn about the impact of climate on microbes.

<http://www.sciencedaily.com/releases/2008/06/080603085922.htm>

**5. Reading**

A reading resource, “Other Environmental Conditions that Affect Growth” from OpenStax on LibreTexts, to learn more about the environmental factors affecting microbial growth (see modules 9.3, 9.4, and 9.5 for relevant material).

[https://bio.libretexts.org/TextMaps/Microbiology/Book%3A\\_Microbiology\\_\(OpenStax\)/09%3A\\_Microbial\\_Growth/9.5%3A\\_Other\\_Environmental\\_Conditions\\_that\\_Affect\\_Growth](https://bio.libretexts.org/TextMaps/Microbiology/Book%3A_Microbiology_(OpenStax)/09%3A_Microbial_Growth/9.5%3A_Other_Environmental_Conditions_that_Affect_Growth)

## 5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and ownership details for each tool by following the individual links provided.

We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

**1. Video/Micro-lecture, “What Are Microbes?”**

[RMIT University](#); Dr. Taghrid Istivan

2. Video (animation), "**Food Pathogens and Temperature**" [McGraw Hill Education](#)
3. Reading, "**Microbes and Climate Change**" [The Microbiology Society](#)
4. Classroom Activity, "**Microbes and Climate**"  
Joan Matsuzaki, Katie Lodes, Michelle Garcia, Liz Kumabe, Beth Marass, Linda McIntosh;  
Educational and Research Testing Hypotheses program from [Monterey Bay Aquarium and Research Institute](#)
5. Additional Resources  
Jim Robbins on [YaleEnvironment360](#);  
Prof. John Blamire, hosted on the [Brooklyn College](#) website;  
[The Microbiology Society](#);  
The American Society for Microbiology, available on [ScienceDaily](#);  
[OpenStax](#), [LibreTexts](#)