TOPIC 1.4

What interactions occur between humans and micro-organisms?

Key Concepts

- A micro-organism is an organism that can only be seen with a microscope.
- Humans have both negative and positive interactions with micro-organisms.

Curricular Competencies

- Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal interest.
- Experience and interpret the local environment.
- Seek patterns and connections in data from your own investigations and secondary sources.
- Exercise a healthy, informed skepticism and use scientific knowledge and findings for your own investigations to evaluate claims in secondary sources.
- Transfer and apply learning to new situations.

An ecosystem is any place where living things interact with each other and with their environment. Have you ever thought about your mouth as an ecosystem? About 700 species of bacteria live there. They live on the surface of the tongue and the roof of the mouth, and they coat the teeth and gums. (You may have heard your dentist refer to this coating as biofilm.) Some of these bacteria can cause tooth decay and gum disease. Some have been linked to diseases in other parts of the body, including the heart and pancreas. Other kinds of bacteria help to keep your mouth healthy by outcompeting populations of disease-causing bacteria, which keeps their numbers down.

Starting Points

Choose one, some, or all of the following to start your exploration of this topic.

1. **Identifying Preconceptions** Microscopic organisms are a part of daily life in many ways. Some of these ways are helpful, and some are harmful. Brainstorm as many examples as you can of helpful and harmful microscopic organisms in your life.
2. **Questioning** Your mouth is not the only part of your body that is home to bacteria and other microscopic organisms. Where else do you think bacteria live in and on your body? How do you know, or what makes you think so?
3. **Applying** The photo below shows a microscopic animal called a tardigrade. It is found in places as diverse as hot springs, deep ocean trenches, and beds of moss. (One of its common names is moss piglet.) Does it surprise you to read that animals can be microscopic? Why or why not? Do you find yourself questioning or rethinking ideas about living things that you have had up to now? Why or why not?

Key Terms

Three key terms are highlighted in bold type in this Topic:

- micro-organisms
- microbes
- pathogens

Flip through the pages of this Topic to find these terms. Add them to your class Word Wall along with their meaning. Add other terms that you think are important and want to remember.

CONCEPT 1

A micro-organism is an organism that can only be seen with a microscope.

Activity

Reflecting on Micro-organisms

Each of the living things in **Figure 1.15** is a micro-organism. Record at least five observations and five questions that occur to you as you compare these photos.

One thing that the organisms in **Figure 1.15** have in common is that they are too small to see with the unaided eye. Anything that is smaller than 1 mm requires technology such as a microscope to see clearly. **Micro-organisms** are all smaller than 1 mm, so they can only be seen with a microscope. For example, each bacterium in **Figure 1.15** has a length of about 1 μm. This means that thousands of them could fit in an area the size of the period at the end of this sentence. The phytoplankton are even smaller, with a length of only 0.1 μm. The *Euglena* is a bit larger, with a length of about 10 μm.

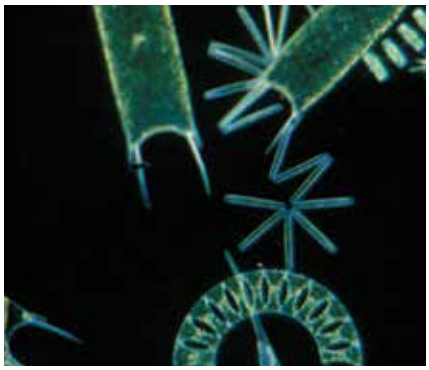
micro-organisms any organisms small enough to need a microscope to be seen

Micro-organisms, or **microbes** for short, live in every place you can possibly imagine. They live inside and on other living things. Many live freely in the air, in large and small bodies of water, and even in small puddles. No matter where you travel in the world—along sandy beaches, in coastal and inland forests, into the mountains, across prairie grasslands, in the freezing Arctic, and in dry, hot deserts—there are microbes.

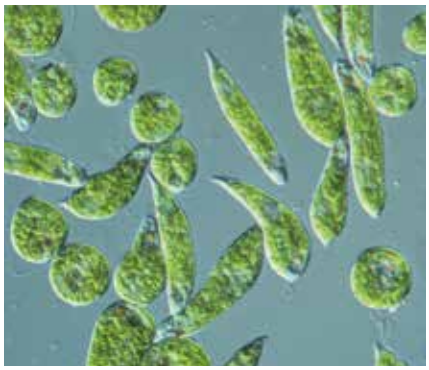
microbes common-language short form for micro-organisms

Figure 1.15 These single-celled organisms are found in various ecosystems, some on land and some in the water.

Spirillum volutans; Bacteria; LM Magnification: 1000x



Various Species of Phytoplankton; Magnification: Unknown



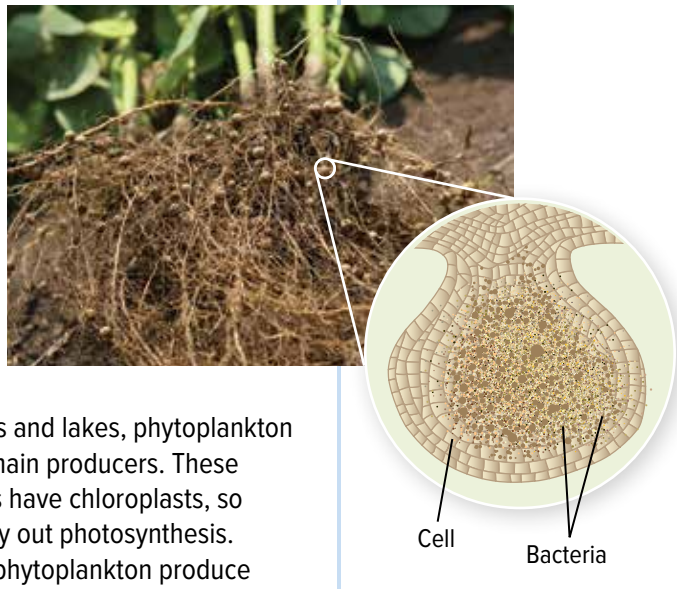
Euglena gracilis; Protist; LM Magnification: 200x

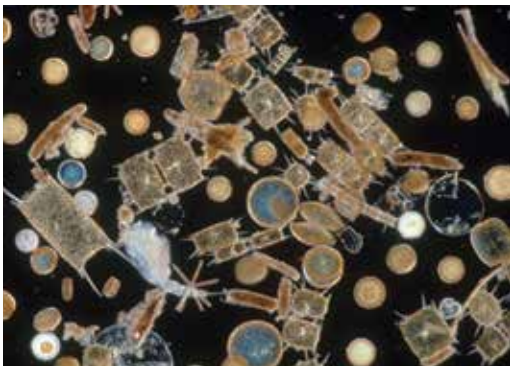
The Importance of Microbes

Microbes have important roles in ecosystems. **Figure 1.16** shows how bacteria and phytoplankton are important to other living things in an ecosystem.

Many types of bacteria are decomposers. They break down (decompose) dead or waste materials such as rotting wood, dead animals, and animal wastes. The action of decomposers returns nutrients to the soil. Plants and other organisms use these nutrients to grow and carry out their life processes.

For example, nitrogen is a nutrient that plants and other organisms need. Nitrogen gas makes up about 78 percent of the atmosphere, but it is in a form that plants cannot use. Certain kinds of bacteria make nitrogen available to plants. The bacteria live and grow on the roots of plants such as peas, beans, and alfalfa. As part of their own life processes, the bacteria change nitrogen into a form that the plants are able to use. This usable nitrogen is transferred to other organisms when they eat the plants.





In oceans and lakes, phytoplankton are the main producers. These microbes have chloroplasts, so they carry out photosynthesis. As well, phytoplankton produce about 50 percent of the oxygen in the atmosphere.

Figure 1.16 Forests and other environments could not function without the action of decomposer microbes.

Before you leave this page . . .

1. Explain why a microscope is needed to see micro-organisms.
2. You read about roles that bacteria and phytoplankton play in ecosystems. Suggest two other roles that you think microbes play in ecosystems.

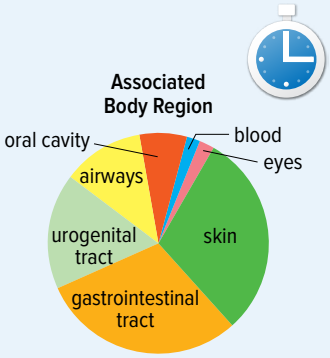
CONCEPT 2

Humans have both negative and positive interactions with microbes.

Activity

Microbes on the Move

The pie chart shows results of an experiment in which microbe samples were collected from surfaces in the New York City subway system. The pie chart shows the sources of the microbes collected. What questions do you have about these data? What would be your next step in the process of scientific inquiry?



Negative Interactions with Microbes

Under favourable conditions, phytoplankton can reproduce very quickly. They form huge, colourful masses called red tides. The red-tide microbes produce toxins that make shellfish such as clams poisonous. First Peoples know to observe the behaviour of coastal animals during red tides. Animals avoiding clams is a sign that they are unsafe to eat. Elders along the coast observe that red tide is becoming more common now than in the past (**Figure 1.17**).

Red-tide microbes are examples of **pathogens**—microbes that can make people sick. You may have heard of bacteria such as *E. Coli*, *Listeria*, and *Botulism*. These pathogens can cause food poisoning, which can lead to vomiting, diarrhea, and fever.

pathogens micro-organisms that can cause disease

Causing sickness is not our only negative interaction with microbes. For example, bacteria and other microbes such as mould cause food to spoil. Mould can also cause wood to rot, which can affect the structural stability of homes and other buildings that are made with wood.

Figure 1.17 First Peoples along the Pacific coast have created clam gardens for millenia. These beach-extending structures are a sustainable source of food and have served as places for Elders to share knowledge and teach skills to the young.

Positive Interactions with Microbes

There are more than 400 types of bacteria in your intestine right now, but they are not making you sick. These bacteria help keep you healthy and are a natural part of your digestive system. Some help you digest food, and some help prevent infection. Certain bacteria in your large intestine help you absorb the nutrient vitamin K, which helps your blood clot properly. Table 1.3 lists more examples of the positive interactions humans have with microbes.

Table 1.3 Some Positive Interactions With Microbes

Interaction	Examples	
Food production	Bacteria are used to make foods such as cheese, yogurt, pickles, soy sauce, and chocolate.	
Medicine production	Bacteria are used to make antibiotics and the insulin that people with diabetes need.	
Agricultural production	Bacteria are used to genetically modify crops so that they are better protected against insects or disease. Scientists also continue to study the importance of bacteria in soil and for the health of crops.	
Waste management	More than 300 species of bacteria are used in water treatment plants to decompose wastes.	
Disaster recovery	Bacteria can be used to help clean up oil spills and areas contaminated by chemical spills or radioactive waste.	

Before you leave this page . . .

1. Make a T-chart to list the positive and negative interactions between humans and microbes.
2. Some medicines people take to treat an infection also kill bacteria that are naturally found in the intestines. Why is this a concern?

Biology Connections

Artificial Life Programmer

Environmental Technologist

Immunologist

Science Writer

Virologist

What kinds of jobs are there for people who investigate cells and life processes?

Microbiologist

The next treatments for a damaging disease with antibiotic resistance could be lurking in caves. Want to explore? Microbiologists think big while investigating the very small.

Limnologist

Fresh water makes up 10% of British Columbia's total area, but most people consider it precious beyond compare. Limnologists help keep it that way by studying microbes and other factors that could harm it.

Food Science Technician

Some people protect food from microbes, but food science technicians rely on microbes for the products that form the basis of many delicious and nutritious meals.

Questions

1. What other jobs and careers do you know or can you think of that involve the study of cells, living things, or micro-organisms?
2. Research a job or career related to Unit 1 that interests you. What attracts you to it? What kinds of things do you have to know, do, and understand for this job or career?

Check Your Understanding of Topic 1.4

QP Questioning and Predicting PC Planning and Conducting PA Processing and Analyzing E Evaluating
AI Applying and Innovating C Communicating

Understanding Key Ideas

1. Are bacteria a type of microbe? Why? PA
2. Name two places where microbes can live. PA
3. Describe three characteristics that microbes share with other living things. PA AI
4. A student says that microbes include bacteria and viruses. Another student argues that viruses should not be called microbes. Which student do you agree with? Provide one or two statements that support your position. PA C
5. Bacteria can consume some chemicals that would make humans very ill. This makes them very useful for waste management and disaster recovery. Describe the role bacteria play in addressing these two issues. PA C
6. Create a rap, rhyme, or song that could be used to teach younger students about positive and negative interactions that humans have with microbes. Include at least three positive and three negative interactions. PA AI C
7. The statements below are related to handling food safely. Explain the reason behind each statement. PA AI
   a) Frozen meat should be thawed in the refrigerator, not on a counter at room temperature.
   b) Cutting boards and dishcloths need to be disinfected after each use.
   c) People should wash their hands before and after handling and preparing food.

Connecting Ideas

8. Scientists estimate that about 2000 blue whales journey along the British Columbia coast each year. Blue whales are the largest living things on Earth. However, they are unlikely to survive without some of the smallest living things on the planet: microbes. Provide two reasons why this is the case. PA AI E C

Making New Connections

9. The graph shows how a population of bacteria increased in a bowl of broth over a period of time. QP PA AI C
   a) Interpret what is happening to the population between 0 and 100 min; and between 100 and 160 min.
   b) Infer what is happening to the population after 160 min, and give your reasoning.
   c) Assume the temperature of the broth was 60°C. Predict what the graph would look like if the temperature of the broth were 4°C. Explain your prediction.