

Learning Across the Curriculum:

Aboriginal and Torres Strait Islander histories and cultures 	Ethical understanding 	Personal and social capability 
Asia and Australia's engagement with Asia 	Information and communication technology capability 	Civics and citizenship 
Sustainability 	Intercultural understanding 	Difference and diversity 
Critical and creative thinking 	Numeracy 	Work and enterprise 

Outcomes:

A student:

- investigates by posing questions, including testable questions, making predictions and gathering data to draw evidence-based conclusions and develop explanations
ST3-4WS
- describes how structural features and other adaptations of living things help them to survive in their environment ST3-10LW
- describes some physical conditions of the environment and how these affect the growth and survival of living things ST3-11LW

Topic Description:

Micro-organisms affect everyone. Some are helpful, while others are harmful. Pathogenic micro-organisms can cause diseases like sore throats, influenza, tuberculosis, and AIDS. Decomposer micro-organisms decay rotting plant and animal matter, returning important nutrients back into the soil. Food spoilage micro-organisms like mould ruin stored food. Other bacteria and yeasts are vital to the production of food and drinks like yoghurt and bread, and beer and wine and cheese.

This unit provides opportunities for students to develop an understanding of the role of micro-organisms in food and medicine. Students investigate the conditions micro-organisms need to grow, learn about yeast and the bread-making process, and research the development of penicillin.

Content

Living things have structural features and adaptations that help them to survive in their environment. (ACSSU043)

Students:

- present ideas and explanations about how the structural features and behaviour of some bacteria, fungus, and other microorganisms help them to survive in their environment
- research the conditions needed for a particular plant to grow and survive in its environment

The growth and survival of living things are affected by the physical conditions of their environment. (ACSSU094)

Students:

- make predictions about how changing the physical conditions of the environment impacts on the growth and survival of living things, e.g. different amounts of light or water on plant growth or the effect of different temperatures on the growth of yeast or bread mould
- use gathered data to develop explanations about how changing the physical conditions of the environment affects the growth and survival of living things

Teaching & Learning Activities

Lesson 1: Introduction to Microorganisms

Take home message: Micro-organisms exist and can be found pretty much everywhere on Earth.

Ask students what they think microorganisms/microbes are. At the end of the lesson after students know more about the topic, establish a definition of microorganisms - ***Microbes are small living forms of life that cannot be seen without the help of a microscope. As a result, these tiny one-celled organisms are known as microorganisms. Microorganisms are as real and alive as you are. They eat and grow; they reproduce and die.***

Ask students to brainstorm a list of places where microbes can be found. Ask them where they think microbes would not be able to be found. At the end of the lesson, students might be surprised to find out about some of the places where microbes inhabit - ***Microbes can be found everywhere. They live in almost all natural conditions where moisture is found. They may be found in fresh water ponds, soil, salty water, hot springs, or snow drifts. They are even found in the most unlikely of places, such as inside a volcano, down a salt mine, inside the vents at the bottom of the ocean, and on Antarctica! They are present on animals, people, and even in the air we breathe.***

<http://www.slideshare.net/edulff/microorganisms-40401299> - Quick presentation with an overview of microorganisms.

Fun and simple explanation of microorganisms - <https://www.youtube.com/watch?v=JZjzQhFG6Ec>

Note: It is important to point out to students that 99% of microorganisms that exist are neutral and don't affect us. This could lead into a discussion about not always needing to use anti-bacterial cleaners as we are essentially wiping out neutral bacteria. There are certainly times when it is necessary to properly clean and remove bacteria (e.g. when dealing with raw chicken on a kitchen counter as to avoid contaminating the surface and causing sickness), but overuse of anti-bacterial cleaners can create a bacteria that is resistant to anti-bacterials, which is not good news for humans.

Resources	Differentiation	Assessment	Register/Evaluation
Notebook file - KWL chart (What I KNOW , What I WANT to know) discuss students' prior knowledge of microbes Computer/SmartBoard - YouTube - Slideshare		KWL chart	

Lesson 2: Categories of microorganisms

Take home message: microorganisms can be classified into different categories, All the things that microorganisms make for us

The Variety and Roles of Microbes

Sorting activity – source: <http://www.bioedonline.org/lessons-and-more/lessons-by-topic/microorganisms/microbes/the-variety-and-roles-of-microbes/>

1. Ask students, *What are some different kinds of microorganisms? Do microorganisms have different kinds of roles? What are some examples?* Discuss students' ideas. Tell students they will be looking at specific examples of materials and resources that involve microbes.
2. Give each student group one bag of cards. Have students remove the set of 20 smaller cards, which describe roles performed by certain microbes. Instruct student groups to read, discuss and decide the best way to sort the cards into categories. Have groups make notes about how they made their decisions. Then, have a spokesperson from each group explain its rationale for sorting and discuss as a class.
3. If students did not organize the cards by "role in food production," "role in causing disease," and "role in ecosystem/environment," have them sort the cards into these new categories.
4. Tell students that the cards also may be sorted by "kind of microbe" involved in each process. Instruct groups to take the four large cards ("Viruses," "Fungi," "Protists," "Bacteria") from the bag and read each card. Discuss the information and ask questions, such as, *Which microbe group does not have members with cells? (viruses) Which groups have multi-celled members? (protists, fungi)* Mention that all roles described on the small Microbe Examples cards are carried out by one or more members of the four groups described on the large cards.
5. Have students place their large Microbe Group cards on the table. Starting with the cards related to food production, have students use the clues on each small card to assign it to one or more Microbe Group cards. Students may notice that some roles are fulfilled by microbes belonging to two groups (e.g., cacao seeds are fermented by bacteria and fungi).
6. Discuss as a class. Point out that microbes related to food production are found in either the bacteria or fungi group. Ask, *Are you surprised by this? What can we now say about microbes?* Explain that most microbes are not harmful, and many are helpful. But some microbes, called pathogens, cause diseases in humans, animals, plants and other organisms. Ask, *What do you know about disease?* Instruct groups to select the small cards related to disease and place each one by the appropriate Microbe Group card.
7. Ask students, *What are the differences and similarities between the microbes involved in food production and the microbes that cause disease? What general statement could we make about microbes?* (Microbes have many roles. Some are helpful; some are harmful.) *Is it possible for the same microbe to be both helpful and harmful to humans or to another organism?* (yes)
8. Repeat the sorting activity with the last group of small Microbe Examples cards: ecosystems. Discuss students' groupings. Mention that while microbes often are invisible members of ecosystems, they play important roles in decomposition and in soils, and are important members of food webs.
9. Ask, *Why should we care about microbes?* Discuss as a group. Have students add any new ideas to their concept maps.
10. Have students sort and place the cards back in the plastic bags.

Add the following words to your word wall: (Useful (symbiotic), harmful (parasitic), and neutral (commensal) micro-organisms)

Resources	Differentiation	Assessment	Register/Evaluation
'Variety and Roles of Microbes' (one per group) Optional: Bring to class examples of the foods used in this activity. Or have students bring different foods produced by using microbes and/or recipes that use microbe-produced foods. Have students investigate other common foods produced with the aid of microbes, such as root beer (yeast), vinegar (bacteria), pickles (bacteria) or cheese (bacteria, and sometimes fungi).	Mixed ability groupings	Work sample	

Lesson 3: Helpful microorganisms

Take home message: helpful microorganisms can keep us healthy, good bacteria are our friends

<https://www.youtube.com/watch?v=1X8p0vhsWRE> – YouTube clip explaining how microorganisms can keep us healthy.

Medicine – Antibiotics

<http://www.abc.net.au/btn/story/s3714613.htm> - BTN Behind the News report on Antibiotics.

After viewing the BTN report, discuss antibiotics with students. You may like to have students record their understanding of the topic in the workbook.

Discussion questions:

1. What do antibiotics do?
2. What impact have antibiotics had on controlling disease?
3. Who discovered penicillin?
4. Describe how he discovered penicillin by accident.
5. What Australian scientist helped turn this discovery into an antibiotic?
6. In Australia how many antibiotic prescriptions are filled each year? a. 2 thousand b. 2 million c. 22 million
7. Antibiotic resistant superbugs might soon become a serious medical problem. True or false?
8. When taking antibiotics it is important that you.....
9. Can you think of any other scientific inventions that have directly affected people's lives?

<http://www.abc.net.au/btn/story/s4000822.htm> - BTN Behind the News report on antibiotic resistance and super bugs.

Discussion questions:

1. Discuss the issues raised in the Antibiotics story with another student.
2. Antibiotics are used to fight bacteria. True or false?
3. Finish the following sentence: Antibiotics won't work on...
4. What is antibiotic resistance?
5. What is the World Health Organisation concerned about?
6. No new antibiotics have been discovered for _____ years.
7. How can you slow down antibiotic resistance?
8. When taking antibiotics it is important that you.....
9. What do you understand more clearly since watching the BtN Antibiotics story?

Activity: word jumble – 'BTN Antibiotics Activity 1' worksheet.

Optional extra: Fecal transplants: <http://bioedonline.org/news/blog/newsflash-fecal-transplant-pill-may-bring-balance-to-microbiomes/> - information about a new type of medicine that could be highly beneficial for future generations.

Resources	Differentiation	Assessment	Register/Evaluation
'BTN Antibiotics Activity 1' worksheet (1 per student) Computer/SmartBoard BTN reports (links provided)	Support: pair or group work	Work sample	

Lesson 4: Helpful microorganisms

Take home message: helpful microorganisms – bread, cheese (bacteria, mould), beer and wine are not possible without microorganisms

Explain to students that although some microbes are harmful, some can be beneficial. Ask the students whether they know of any foods/drinks that are produced with the help of microbes. Beer, wine, cheese, yoghurt and pro-biotic drinks.

Explain to students we are going to be watching a short video clip showing how microbes are used in the production cheese. Students should take note of what they are viewing as they are going to be creating a flowchart about how microbes are used in the cheese making process.

The Cheese-making process: <http://www.foodafactoflife.org.uk/VideoActivity.aspx?siteId=15§ionId=66&contentId=163&titleId=171> – video and steps detailing the cheese-making process

<http://kidcyber.com.au/tag/facts-about-cheese-for-kids/> - Link with information about how cheese is made and why it is a good product for consumption.

<https://www.youtube.com/watch?v=y9wLhRrj5Ug> – 5 minute video on the cheese-making process.

Microorganisms Make Cheese Flowchart activity – products like cheese are not possible without microorganisms. After viewing the aforementioned videos, have students create a flowchart of the cheese making process. The cheese making flowchart can be used as a scaffold to guide students. It is important to note the role of microorganisms in the cheese making process, rather than focus entirely how cheese is made.

Resources	Differentiation	Assessment	Register/Evaluation
<ul style="list-style-type: none">Cheese making flow chart templateWorkbook/paper for students to make their own flowchart	Support: Cheese-making process template with subheadings and keywords	Work sample	

Lesson 5: practical experiment with yeast

Take home message: using the Scientific Method to see if yeast can inflate a balloon

Yeast Feast – (Primary Connections)

Teacher background information

The yeast used in bread-making is a micro-organism that requires food and the right temperature and conditions in which to grow. Yeast is activated by liquids, such as milk and water. It breaks down sugars for energy and produces carbon dioxide gas and alcohol as waste products. Yeast can also use enzymes to break down complex carbohydrates, for example, starch (like the starches found in flour) into sugars, ready for it to be used as an energy source. This is why sugar doesn't have to be added when making bread, though it sometimes is because it makes the process faster.

Carbon dioxide gets trapped in the dough, creating pockets of gas which make the bread rise. When the dough is heated during baking, the heat causes the pockets of gas to expand, making large spaces in the bread. The bread rises and becomes lighter.

The alcohol is evaporated or burnt off during baking, which is why people don't get tipsy after eating a sandwich.

Preparation:

- Set up a 'safety zone' where you can prepare warm water. The water needs to be neither hot nor cold, about 37°C. Work out a safety procedure for students to collect warm water.
- Find a warm area to place the mixture of yeast, sugar and water. A sunny window is fine, but cool weather might mean setting up a blow heater in a corner of the classroom. An overhead projector, a lamp or a heat pad might be other sources of warmth.
- Purchase active dry yeast from the supermarket.

Note: Yeast is available in boxes that usually contain 7 g or 8 g sachets, or in a 280 g bulk container. The 7 g sachets yield four to five ½ teaspoons. You will need two to three sachets per team for this.

Lesson:

1. Review students' understanding of micro-organisms and the fact that yeast is a living micro-organism. Discuss what students think yeast needs if it is to stay alive. Ask students to record their ideas in their science journals.
2. Explain that students will be working in collaborative learning teams to investigate what happens when yeast is mixed with other substances, including sugar and water. Read through an enlarged copy of 'What happens when yeast is mixed with sugar and water?' (Resource sheet 3). Discuss the purpose and features of procedural texts.
3. Discuss all the different combinations that are listed for the bottles, asking why such a variety is needed. Introduce the idea of a fair test and the need for a control. Explain that when you want to test what happens in the bottle with yeast, water and sugar you need something to compare it to, such as a bottle without yeast, a bottle without water and a bottle without sugar. Draw students' attention to the fact that they are using the same-sized bottles and the same amount of ingredients in each bottle. Discuss why this is important to ensure a fair test.
4. After teams have set up their investigations, set a timer for one hour. When students have written their predictions in their science journals, discuss and record them in the class science journal.
5. After an hour, check the bottles and balloons. Discuss the inflation of the balloon on bottle 2. Ask students whether they know what has inflated the balloon. Explain that it is a gas called carbon dioxide and discuss what students might already know about carbon dioxide, for example, humans breathe out carbon dioxide.

Optional: Leave the experiment overnight (if you are conducting the experiment in the afternoon session) and record results again in the morning.

Resources	Differentiation	Assessment	Register/Evaluation
<ul style="list-style-type: none"> • 1 thermometer • 1 kettle • 3 x ½ tsp measure • 3 x ¼ cup measure • 3 x ½ cup measure • Water • 1 funnel • 1 jug • 1 timer • Camera to record findings <p>For each group:</p> <ul style="list-style-type: none"> • 1 copy of 'What happens when yeast is mixed with sugar and water?' (Resource sheet 3 – Primary Connections) • 4 small plastic bottles (350 – 400ml), all the same size • 4 balloons • 1 funnel • Self-adhesive tape • Marking pen • 3 x 1/2tsp rapid rise active dry yeast • 3 x ¼ cup sugar • 3 x ½ cup warm water (37°C) 	<p>Mixed ability groupings</p>	<p>Experiment results</p>	

Lesson 6: Harmful microorganisms

Take home lesson: Harmful microorganisms that cause diseases (ringworm – fungal, flu – viral, tonsillitis – bacteria)

Talk to students about the history of disease. People used to think the causes of diseases were things like sleeping outside under the influence of the stars (influenza) and curses. Tell students about Robert Koch who discovered germs in the 19th century. He took samples from sick victims, stained them so the germs showed better, and looked at them under a microscope. He proved that germs caused diseases by finding the killer germs, growing them in a culture plate, then injecting them into healthy animals and observing as they fell sick.

http://www.bbc.co.uk/bitesize/ks3/science/organisms_behaviour_health/disease/activity/ - Interactive on how diseases are caused and what we can do to avoid them. Quiz at the end.

<http://www.bbc.co.uk/bitesize/quiz/q46363343> - Online quiz for students to complete individually, or could be printed to use as a hard copy.

<http://ngm.nationalgeographic.com/2013/01/125-microbes/oeggerli-photography> - Photographs of microbes.

Microbes and Disease

Source: <http://www.bioedonline.org/lessons-and-more/lessons-by-topic/microorganisms/microbes/microbes-and-disease/>

1. Ask students, *Do you think diseases have changed history? Do any diseases affect society today?* Tell students that they will be learning about diseases that have had impacts worldwide.
2. Provide each group with a set of "Disease Information" sheets for a single disease. Each student should receive his or her own copy of the sheet.
3. Instruct each student to read the information on his or her sheet. Depending on students' reading levels, you may need to provide assistance with the readings.
4. Have students within each group jointly create a concept map to summarize the important ideas from the group's "Disease Information" sheet. (At this point, students should be familiar with concept maps.) Then, have each group use its newly-created concept map to prepare a presentation about its assigned disease.
5. Distribute six copies of the "3-2-1" sheet to each group.
6. Have each group present its overview to the class. After each presentation, allow all groups, including the one that just presented, five to six minutes to complete a "3-2-1" sheet on the presentation. Repeat the process until all student groups have made their presentations.
7. As an assessment, have each group work collectively to create a piece of art that illustrates one of the diseases covered, and then write a paragraph explaining how the artwork represents the chosen disease(s).
8. Ask a student representative from each group to present the group's artwork in class, along with related information from the readings or other sources.

Optional Activity:

Infectious Disease Case Study

Source: <http://www.bioedonline.org/lessons-and-more/lessons-by-topic/microorganisms/microbes/infectious-disease-case-study/>

1. Begin a class discussion of disease by asking questions such as, *How do you know when you are sick? What are some common diseases? Are all diseases alike? Are all diseases caused by a kind of microbe? Do some diseases have similar symptoms?*
2. Tell your students that in this class session, they will be acting as medical personnel trying to diagnose a patient. Give each group a copy of the "What is Wrong with Allison?" sheet. Have one student read the case to the group, and then have groups discuss it. The reporter should record each group's ideas about what might be wrong with Allison.
3. Have each student group list four possible questions that a doctor might ask a patient like Allison. Write these questions on the board and discuss with the class.
4. Have groups identify three possible diseases that Allison may have, based on the story, class discussion and their own experiences.
5. Give each student a copy of the "Disorders and Symptoms" sheet and briefly introduce the four illnesses to the entire class. Compare these illnesses to the ones that students suggested. Ask, *Are there any similarities?* Have students follow the instructions on the sheet to complete the exercise.

6. Give each group of students a set of envelopes. Warn students not to open the envelopes until they are instructed to do so. Tell students that each envelope contains information that a medical doctor might need about a patient. All information is important to the diagnosis, but only certain information will help to distinguish among the four possible respiratory disorders. Instruct students that their task is to decide which envelopes contain information that will help them determine Allison’s illness. Once a group has agreed on question choices, it may open as many envelopes—one at a time—as needed. The challenge is to use as few envelopes as possible to diagnose Allison’s illness. Each group should keep a tally of the number of envelopes opened. Remind students that in real life, a physician would conduct a complete examination and gather all possible information before making a diagnosis.
7. Allow time for groups to work. Provide assistance to students who may not understand the information contained in the envelopes. If the medicine and body temperature envelopes have been opened, make sure students understand that some medications, like Tylenol™, will mask the presence of mild fevers.
8. Have each group present its diagnosis and the reasoning used to arrive at its decision. (Allison’s disease is a common cold. If students have arrived at other conclusions, discuss the evidence they used. Mention the challenges of diagnosing respiratory diseases.)
9. Expand the discussion to address the importance of not taking antibiotics for viral diseases. Ask, *Since Allison has a cold, should her doctor prescribe antibiotics? Would it be okay to take leftover antibiotics?* Help students understand that antibiotics are effective for bacterial infections, but do not help against viral infections like colds.

Also, mention that if antibiotics are prescribed for a bacterial infection, it is important to follow the doctor’s instructions and to take all the medication, even if symptoms start to improve before the medicine is gone. Otherwise, the disease may reoccur. Taking antibiotics incorrectly, or using them inappropriately (such as taking leftover medicine without a doctor’s guidance) can contribute to the development of antibiotic resistant forms of bacteria, which cannot be killed by existing antibiotics.

10. Have student groups add information to their concept maps.

Optional activity:

Students complete ‘Microbes and illness’ worksheet. After reading the information about how pathogens enter the body, students label a diagram of the human body with the various pathogen entry points.

<https://www.youtube.com/watch?v=YBGsoimPXZg> – How germs spread, plus tips on limiting the spread of germs.

<https://www.youtube.com/watch?v=Rpj0emEGShQ> – How a virus infects your body.

<http://pandemic3.com/> - An online game where students create a disease and attempt to infect the world with it!

<http://www.infectiousdisease.cam.ac.uk/schoolzone/games> - More online games about microorganisms.

<https://educators.brainpop.com/bp-game/microbes/> - Microbes is the first level of Caduceus, a puzzle adventure game from Generation Cures at Children’s Hospital Boston that casts players in the role of young medical apprentices. The game challenges students to isolate a single microorganism and identify a disease marker that is causing a plague in mythical Alterica. The game screen shows a microscopic view of a slide teeming with dozens of colorful amoeba-like microbes that move randomly. Each single-cell microbe can be identified by four attributes: nucleus shape and color, cytoplasm pattern, and cell membrane color. The challenge is to click on matching pairs of microbes. Each click marks the microbe with a special dye. Matched pairs disappear until the disease marker is isolated. This game supports lessons on scientific inquiry and the life sciences.

Resources	Differentiation	Assessment	Register/Evaluation
‘Microbes and illness’ worksheet Optional – ‘Infectious Disease case studies’	Mixed ability groupings	Work sample	

Lesson 7: practical experiment with mould

Take home message: food safety, mould and food, spores

A Nightmare in my Lunch Box – Mould (Primary Connections)

Teacher background information

The term 'mould' is used to refer to several kinds of fungi that grow on various surfaces. Moulds reproduce by producing spores. Mould spores are commonly found in the air and soil, but will grow into mould only when they land somewhere with the right conditions for growth. Spores are very small and don't contain a supply of food to help them begin to grow like seeds do. They use whatever they land on as food.

Moulds grow best away from direct sunlight in moist, cool-to-warm conditions where there is plenty of plant and animal (organic) matter for them to use as an energy source. A soggy sandwich left in a lunch box over the summer holidays is a mould's delight. Moulds love bathrooms and sweaty old shoes. They will even grow on books and papers that have not been stored in the right conditions. Direct ultraviolet light (including sunlight) tends to kill moulds and they don't grow well in dry environments, or in very cold or hot conditions.

When mould spores 'germinate' they produce long thin strands called 'hyphae', which give moulds their fluffy appearance. Moulds play an important role in the ecosystem, helping decompose and recycle dead organic materials.

Preparation:

Prepare samples of mould using bread products, or fruits, such as a lemon or a strawberry as follows:

- Purchase bread or fruit 7 to 10 days before you begin the lesson.
- Cut open the fruit or lay out the slices of bread, and leave in the open air overnight so that mould spores can land on the bread or fruit.

Note: Some people are allergic to moulds and therefore careful preparation of the mould sample is required.

- Prepare half a slice of mouldy bread or a piece of fruit for each team by lightly moistening each piece with water. Seal the bread or fruit inside one plastic bag, leaving some air in the bag.
- Tape the top of the bag with self-adhesive tape.
- Place this bagged bread inside a second plastic bag and seal the bag by taping the top of the bag. This is referred to as double bagging.
- Store in a warm place. Mould should begin to grow in about four to seven days, depending on your location and the temperature.

Lesson:

1. Tell students that you have found a nightmare in your lunch box. Show them a sealed bag of mouldy food that has been double bagged and ask them if they know what it is and how it might have happened. Discuss students' experiences with mould and ask them what they know about mould, recording responses in the class science journal.
2. Explain that mould is a fungus micro-organism and that students will be working in collaborative learning teams to investigate moulds and that they will be growing mould on food sealed using the double bag method. Emphasise that the plastic bags are not to be opened after they have been sealed because some people are allergic to moulds.
3. Explain that in the first part of the investigation, students are going to observe mouldy food and describe what it looks like in their science journals. This includes making a drawing of the sample. Show students how to draw a labelled diagram. Discuss the purpose and features of such a diagram.
4. Demonstrate how to use a magnifying glass to look closely at the mouldy food sealed inside the double bags. *Optional: Moulds look great when viewed under a binocular microscope or video microscope connected to a TV or a computer.*
5. When teams have recorded their observations, collect the mould samples and place them in a large plastic or paper bag ready for disposal.
6. Bring the teams together and discuss questions, such as:
What did the mould look like?
What colours did you see in the mould?
7. Tell students that they are going to read some information about mould. You might like to explain that the information is in the form of an information report, and

discuss the purpose and features of an information report before reading the text. Alternatively, you might like to share the text with students and, after reading, discuss the type of text, its purpose and features. For example, 'Was it a procedure? A narrative? How do you know? What were the clues in the text?'

Provide each student with a copy of 'Moulds' (Resource sheet 5 – Primary Connections) and a highlighter. Explain that as the class reads the text, they will highlight to mark any new or unfamiliar technical terms. Discuss the highlighted vocabulary and explain the words by referring to students' earlier work in the unit. Review the fact that mould is a micro-organism.

Resources	Differentiation	Assessment	Register/Evaluation
<ul style="list-style-type: none"> • SmartBoard • Digital microscope connected to computer and Smartboard <p>For each team:</p> <ul style="list-style-type: none"> • 1 copy of 'Moulds' (Resource sheet 5 – Primary Connections) for each student • 1 highlighter per student • 1 sample of mouldy bread or fruit in 2 clear, sealed plastic bags (double bagged with tape) • 1 magnifying glass 	Mixed ability groupings	Experiment results	

Lesson 8: Milestones in Microbiology / Antibiotics

Take home message: Antibiotics are able to kill bacteria, but they have no effect on viruses or fungus, so that's why getting antibiotics when you have the flu isn't going to help you. If bacteria is the cause of your sickness, then you should get antibiotics. Before antibiotics were invented, many people were killed by bacteria (the plague).

Milestones in Microbiology

Source: <http://www.bioedonline.org/lessons-and-more/lessons-by-topic/microorganisms/microbes/milestones-in-microbiology/>

1. Ask students a question about how one discovery or invention can lead to another, such as, *Which came first, the wheel or the cart? Or, Would a light bulb be of any value if ways to utilize electricity had not been invented?* Discuss students' responses.
2. Distribute the Discovery Readings sets to each group. Tell students that they will use clues from each reading to figure out the historical order in which events described in the articles occurred. Have each student select a highlighter and one article from the group's set. Instruct students to highlight words that provide clues related to the order of events.
3. When a student finishes an article, he or she should pass it to another group member until all members have read and marked all of the articles. If a word or phrase already has been highlighted and the next reader agrees with the marking, that reader should draw a line with his or her highlighter above the mark.
4. Next, have each group discuss and determine the most likely order of events and discoveries.
5. At the bottom of each reading, have each group list major clues that might help others recreate the order of events.
6. Distribute the "Timeline" sheets. Have groups cut out the sections and tape the timeline together.
7. Tell students to paper clip (not tape) the articles in order along the top of the timeline. Have each group share its results with the class. Discuss any differences among the groups' timelines. If there is a disagreement, let students present their cases. Lead the class toward consensus. Ask, *Why do all of the groups have the same article first on the timeline?* (microscope) *What is the most logical second event?* (agar plates) Ask, *Why is the development of this technique important?* (It provided a reliable way to grow bacteria for study.)
8. Based on the readings, it will be difficult for students to decide whether "The Discovery of Penicillin" or "Contagious Living Fluid" came first. Ask, *What additional information might help us to make a decision?* You may want to ask students to research these topics on their own.
9. Finally, have groups calculate the number of years between events and discuss the possible reasons for the varying time intervals between discoveries. You may wish to discuss why related discoveries sometimes occur close together in history.
10. Allow students time to add this information to their concept maps.

Antibiotics

https://www.youtube.com/watch?v=1pFww_EaLiY&list=PLHn7w59M2ZeR0IILM-cSusm4BBJdfrit1 – Mythbusters Bathroom Hygiene Myth: Adam and Jamie conduct a hygiene test on 3 different ways of washing your hands after going to the toilet – no washing, washing with water, washing with water and soap.

<https://www.youtube.com/watch?v=2g4fWaegoDk> – Paper Towel vs Hand Dryer: which is more hygienic?

<https://www.youtube.com/watch?v=znnp-lvj2ek> – Antibiotic resistance, how it is caused.

Resources	Differentiation	Assessment	Register/Evaluation
Computer/SmartBoard - YouTube 'Milestones in Microbiology' Timeline Activity (enough copies for each group)		Group timelines Work samples	

Lesson 9: practical experiment using microscopes

Take home message: using microscopes to examine microorganisms

Teacher uses digital microscope and SmartBoard to show entire class different microorganisms. Students form teams and use regular microscopes and slides to examine different types of microorganism samples. Ask students to note the differences between the microorganisms that they can see.

Source: <http://www.bioedonline.org/lessons-and-more/lessons-by-topic/microorganisms/microbes/observing-different-microbes/>

1. Ask students, *Have you ever seen a microbe? What do you think different kinds of microbes might look like?* Tell students that they will have opportunities to observe and compare different kinds of microbes: bacteria in yogurt, yeast cultures, and paramecia (or other pond organisms).
2. First, students will prepare and examine a slide to observe bacteria in yogurt. If necessary, demonstrate how to make a slide before having groups of students make their own. Students should follow the instructions on the Bacteria card to prepare and observe their slides. Have students draw what they observe. (Students will not be able to see any parts inside the bacterial cells, which will appear as tiny rods.) Be sure students record on their drawings the magnification at which they made their observations.
3. Ask, *Were you able to see cells or groups of cells?* Explain that students observed tiny rod-shaped bacteria, called *Lactobacillus*, that live on milk sugar (lactose).
4. Have students follow the procedures on the Yeast card to observe and draw yeast cells. Students will be able to observe many round yeast cells, some of which may be reproducing by budding. Ask, *Were the yeast cells larger or smaller than the bacteria? (larger) What other differences did you notice?*
5. Finally, have students observe the paramecium culture (or pond water, which may or may not contain paramecia).

If you are using pond water that includes a variety of organisms, you may want students to examine the water with a hand lens before using a microscope. Students should follow the directions on the Paramecia card to prepare their slides.

Have students draw one paramecium (or other pond organism). These organisms may be large enough for students to observe and label the cell nucleus and cell membrane. Students also may be able to see the cilia around the edge of each paramecium.

Tip: A tiny drop of glycerin on slides with pond water will slow the movement of microorganisms so that they are easier to observe.

6. Conduct a class discussion or have each student group create a table that summarizes the similarities and differences observed among the three kinds of microorganisms. Allow time for groups to add new information to their concept maps.

Have students research or discuss other types of bacteria, fungi, and protists.

Resources	Differentiation	Assessment	Register/Evaluation
Digital microscope Microscopes (1 per group) Slides of microorganisms		Experiment results	

Lesson 10: Assessment

Review the unit. Use the accompanying 'Microorganisms Assessment' to see how students' understanding of the topic has developed.

Complete the 'L' section of the KWL chart from Lesson 1.

Resources	Register/Evaluation
<p>'Microorganisms Assessment'</p> <ul style="list-style-type: none">- Multiple choice questions, short answer questions, and examples of possible situations involving a variety of microorganisms to assess students' understanding of the topic and their practical application of this understanding. Questions covered all key ideas within the Science unit.	

Teacher background information – Primary Connections

Introduction to micro-organisms

Micro-organisms are organisms (living things) so small that as individual cells they are impossible to see with the naked eye. They are much simpler than larger organisms, such as animals and plants. Many micro-organisms, for example, bacteria and yeast, are made up of only a single living cell. When individual cells grow and multiply in number they can be seen as bacterial or yeast colonies which contain millions of cells.

While they are simple, micro-organisms are incredibly successful survivors. They live and thrive in virtually every environment on Earth, including deep oceans, steaming-hot geysers, the freezing poles and the driest deserts. Micro-organisms even live inside larger creatures, including humans, where they often carry out important functions for their host, for example, aiding digestion. However, some micro-organisms can also cause illness and disease in their hosts. Such organisms are known as pathogens.

Like larger organisms, micro-organisms feed, grow and reproduce. Most micro-organisms reproduce asexually, that is, without sex. One way they do this is by doubling everything in the cell and then splitting equally into two genetically identical 'daughter cells'. Both bacteria and yeasts (which are a kind of single-celled fungus) reproduce this way. Other kinds of fungus can reproduce asexually by producing spores which grow when they land in an environment with a food supply and the right levels of warmth and moisture.

Humans have used micro-organisms for thousands of years in food production. Foods that are made using micro-organisms include bread, yoghurt, cheese, sauerkraut, pickles, salami, beer, wine and spirits. Baker's yeast, for example, is used to make bread rise and to give it flavour. Yeast breaks down sugars for

energy and produces carbon dioxide gas and alcohol as waste products. The carbon dioxide is trapped in the dough and makes it rise; the alcohol is burnt off in the baking process but contributes to the flavour of the final loaf.

While they are important to food production, micro-organisms are also responsible for making food decay or 'go off'. Mould, which grows on bread and other foods, is a kind of fungus. Bacteria can grow on and in meat that is improperly stored or handled, causing it to spoil and become unfit to eat. Bacteria can also spoil milk, causing it to curdle and become sour by making it more acidic. Sometimes micro-organisms growing undetected in food give us food infections or food poisoning. This is one reason why we cook food or wash it before eating it.

Micro-organisms are very important in medicine. Many diseases in humans are caused by micro-organisms (for example, bacteria cause cholera, tetanus, tuberculosis and food poisoning, while fungi cause ringworm and tinea). However, micro-organisms are also useful in treating diseases. Penicillin, the first antibiotic, is produced naturally by the *Penicillium* mould. Before antibiotics were discovered, people died from bacterial infections of wounds and from food infections.

In 1928 British researcher Dr Alexander Fleming observed that *Penicillium* mould contaminated a bacterial culture he was studying and inhibited the bacterial growth. Penicillin was developed into a usable drug by Australian Dr Howard Florey and his co-worker, Dr Ernst Chain, in the 1940s. In 1945 Howard Florey, Alexander Fleming and Ernst Chain were awarded the Nobel Prize in Medicine in recognition of their discovery.