I am an Ecosystem

An Elementary Introduction to Microbes

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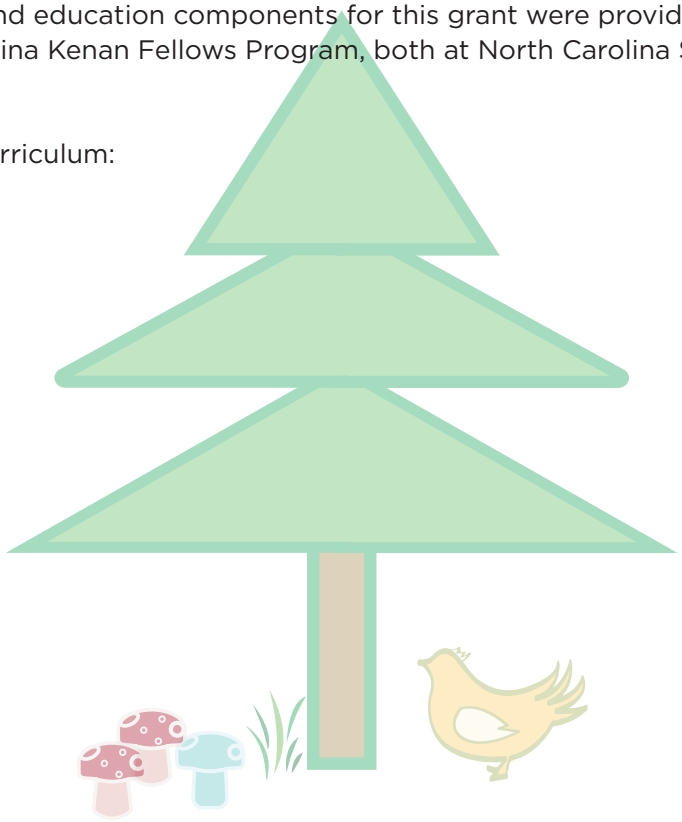


Introduction to "I am an Ecosystem"

"We are not alone."

Historically, this phrase has conjured up images of aliens waiting in space to descend on our unsuspecting planet. However, advances in technology over the years have meant that "we are not alone" applies to our own bodies, our own sense of self in the universe.

It turns out that we are colonial creatures. For every one of our cells that is "us," we also host ten times as many bacterial cells. Our digestive system alone is estimated to contain between 500 and 1,000 different bacterial species. Furthermore, we are learning that these bacteria and other microbes that inhabit our bodies, known collectively as our "microbiome," are essential for our survival. Our microbiome helps to train our immune system to recognize invaders. It also helps us to better process food and nutrients. Some studies even suggest that our microbiome may affect our moods! Without our trillions of hitchhikers, we would be lost.

However, despite our close relationship with our microbiome, not all bacteria are helpful to us. Many bacteria, which are fine outside of our bodies, become disease-causing pathogens once they get inside. Our bodies have many natural defenses against these invaders, including our skin, our mucous membranes, and our immune system. However, some do find their way in. For example, every year, thousands of people become sickened by a bacteria known as Salmonella. Salmonella bacteria cause a disease known as salmonellosis which results in fever, abdominal cramping, and diarrhea. In some cases, salmonellosis can be fatal.

Salmonella bacteria are found normally in the ground, in water, and in poultry and eggs. Proper food safety procedures, including thoroughly washing vegetables, storing food correctly, and cooking all foods to proper temperatures, can help prevent salmonellosis.

In this unit, youth will confront some of the myths and facts surrounding microbes in general and Salmonella in particular. Youth will examine where microbes grow in the environment and under what conditions. They will investigate the roles that microbes play in a healthy ecosystem as well as the roles that microbes play in our own bodies.

Youth will also examine the negative effects of microbes as they investigate a disease outbreak.

Finally, youth will apply their knowledge by designing technologies to help keep people safe from dangerous, food-borne microbes in our world.

Table of Contents

Elementary Microbiology Unit
Scope and Sequence Variations

Teaching Lessons over 5 days for 1 ½-2 hours a day:

DAY	LESSONS
1	Lesson 1: Microbes All Around and Inside Us (Have cantaloupes prepared) Lesson 2: The Role of Microbes in an Ecosystem (begin)
2	Lesson 1: Observe cantaloupes Lesson 2: Completion of activities Lesson 3: The Ecosystems Inside Us
3	Lesson 1: Observe cantaloupes Lesson 3: Complete any activities needed Lesson 4: The Body's Natural Defenses--All Parts (Make sure materials have been collected to complete activity)
4	Lesson 1: Observe cantaloupes Lesson 5: CSI Bacteria- All parts
5	Lesson 1: Observe cantaloupes and finish activities Lesson 6: Engineering a Solution – All parts Wrap-up and conclusions

Teaching Lessons over 3 days: 2-3 hours a day:

DAY	LESSONS
1	Lesson 1: Microbes All Around and Inside Us (Have cantaloupes already prepared—Have some showing the decomposition over certain days for participants to observe) Lesson 3: The Ecosystems Inside Us
2	Lesson 1: Observe cantaloupes Lesson 4: The Body's Natural Defenses Lesson 2: The Role of Microbes in an Ecosystem
3	Lesson 1: Observe cantaloupes and finish activities Lesson 5: CSI Bacteria Lesson 6: Engineering a Solution (Make sure to collect materials to complete activity)

Teaching all lessons in 1 day: 6-7 hours:

DAY	LESSONS
1	**If curriculum is only taught in one day, these are the top 4 suggested lessons to cover: Lesson 3: The Microbes Inside Us Lesson 4: The Body's Natural Defenses Lesson 6: Engineering a Solution (Make sure to have all materials ready for lesson) Lesson 5: CSI Bacteria

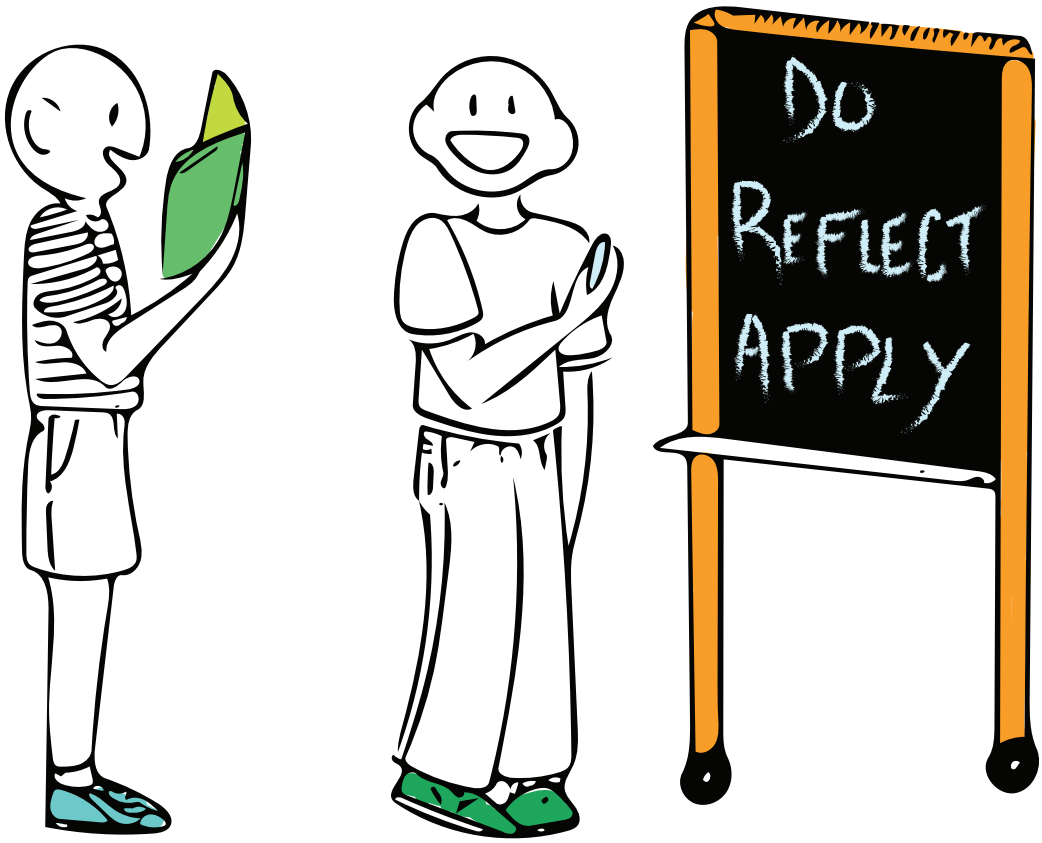
Experiential Learning: A Holistic Approach to Learning

Experiential Learning is student centered. It is an active learning process, which first involves youth in an activity, asks them to reflect on the activity to determine what was useful or important to remember, and then tasks youth with understanding how the information they learned applies to their lives now and in the future. This learning process is holistic and allows youth to consume, apply, and build upon life experiences.

Pfeiffer and Jones' experiential learning model is commonly used in 4-H. However, other pioneers such as Kolb provide a wealth of research that emphasizes the importance of the adult facilitator. According to Kolb, the experiential learning model allows the learner actively participate in what is learned. The facilitator's role is to connect with the student to spark their interest and intrinsic motivation so that the student can gain, revise, or enhance their life skills. The facilitator plays multiple rolls during this process: balancing the attention of the learner, engaging with the subject matter, and creating a safe and holistic learning environment.

Tips to think about when creating a welcoming environment for learning:

- Patience is a virtue. When waiting for youth to respond fully, having patience and allowing time for them to think is important.
- You are not the judge. Accept all responses.
- Experiential questions are open-ended to allow for expression. Make sure that you acknowledge youth who respond to you. Not acknowledging all youth can stop the flow of answers and make youth less likely to respond in the future.
- You are not the young person. Don't answer the question.
- Encourage deep conversation. If a young person gives a short response, provide follow up questions to allow for deeper conversation. Examples could be: "Would you provide an example of what you mean? Can you tell me more about your thoughts?"
- Avoid yes or no questions. These are not open-ended and stop the flow of conversation.
- Don't lead the youth to answers you want to hear.
- Allow the youth to share their responses in pairs rather than with the entire group.



1. Experience: Let's Do It!!!
   Key Reminders to Leader:
- "Sit on Your Hands"
- Observe
- Facilitate to the "bigger picture"

Key Objectives for Discovery:
- To Explore
- To Examine
- To Construct
- To Arrange

2. Share
Key Concept: Respond
Key Question: "What Happened?"

3. Reflect
Key Concept: Analyze Patterns
Key Question: "What's Important?"

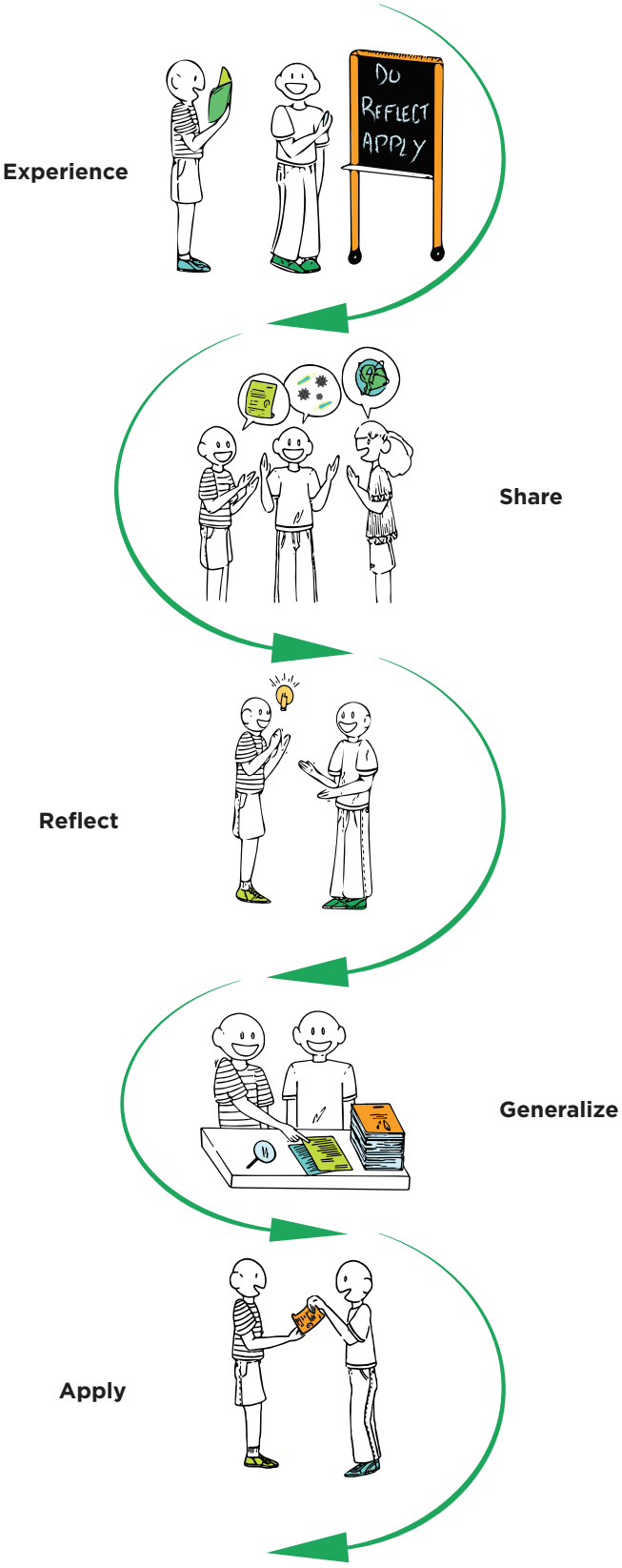
Leader Role
- Allow adequate processing time for sharing.
- Use open-ended questions to stimulate thinking and feeling.
- Encourage "pair share" and large group share.

4. Generalize
Key Concept: Inference
Key Question: "So What?"

5. Apply
Key Concept: Application
Key Question: "Now What?"

Leader Role
- Facilitate youth finding ways to use what they have learned in new situations.
- Guide youth in making connections between the inner meaning of the activity and the broader world.

Share Questions (What Happened?)
What did you like about this activity?
What part of the activity was the hardest to do?
How did you decide what to choose?
What was the most fun about doing the activity?
How did your group work together?
How did you feel about successfully being able to____?
What are some decisions you had to make to carry out this activity?
What steps did you go through before you made your decision?
Why do you think everyone in your group didn't agree about everything?



What was it like to have to make quick decisions?
How did you keep track of everyone's ideas?
Do you think you get more ideas working alone or in a group? Why?
What kind of feelings did you have when group members argued?
What did you observe about the way the groups disagreed (or agreed)?
How did you use your various senses to ___?
What new words did you learn?
Why do you think people have different ideas about what is correct?

Reflect Questions (What's Important?)
What did you learn about yourself by doing this activity?
Why is it important to know___?
How did your group decide ___?
What did you learn as a group that you might not have learned alone?
What were some common themes or thoughts you heard?
How were each person's viewpoints the same? How were they different?
What problems came up over and over?
What would you do if_____ were to happen?
What was easy or difficult about working with a group to____?
What did you do if everyone in the group didn't agree on___?
How did this differ from the way you are usually taught in school?
Give an example of a challenge you had and what you did to solve it.
What works best to get people involved and excited about doing this type of activity?
Why is learning with others sometimes more fun than learning alone?
What suggestions would you have for someone who wanted to____?

Generalize Questions (So What?)
What other situations like this have you experienced?
Why is it important that each person has his/her own view?
When have you had to___ before?
Where can you find resources to help you make some of your decisions about__?
When else have you had fun and learned new things at the same time?
Why is it important to have plenty of information before making decisions?
When do you make decisions that require everyone in the group to agree?
What do you do when you don't agree with the group?
What did you learn about your own skill in making decisions?
What did you learn about your own skill in communicating with others?
Describe five ways in which new ideas can be communicated to you.
In what ways do people help each other learn new things?
What are some ways you like to learn?
What did you learn?

Apply (What was Learned?)
How would you teach someone about this activity or concept?
What did you learn today that you will be able to use in school….at home?
What did you learn by participating in this process that will help you in the future?
Describe a time when you might need the skills/knowledge you learned today.
What are some other situations when you will need to use the skills you learned today?
What would you do differently if you conducted this activity again?

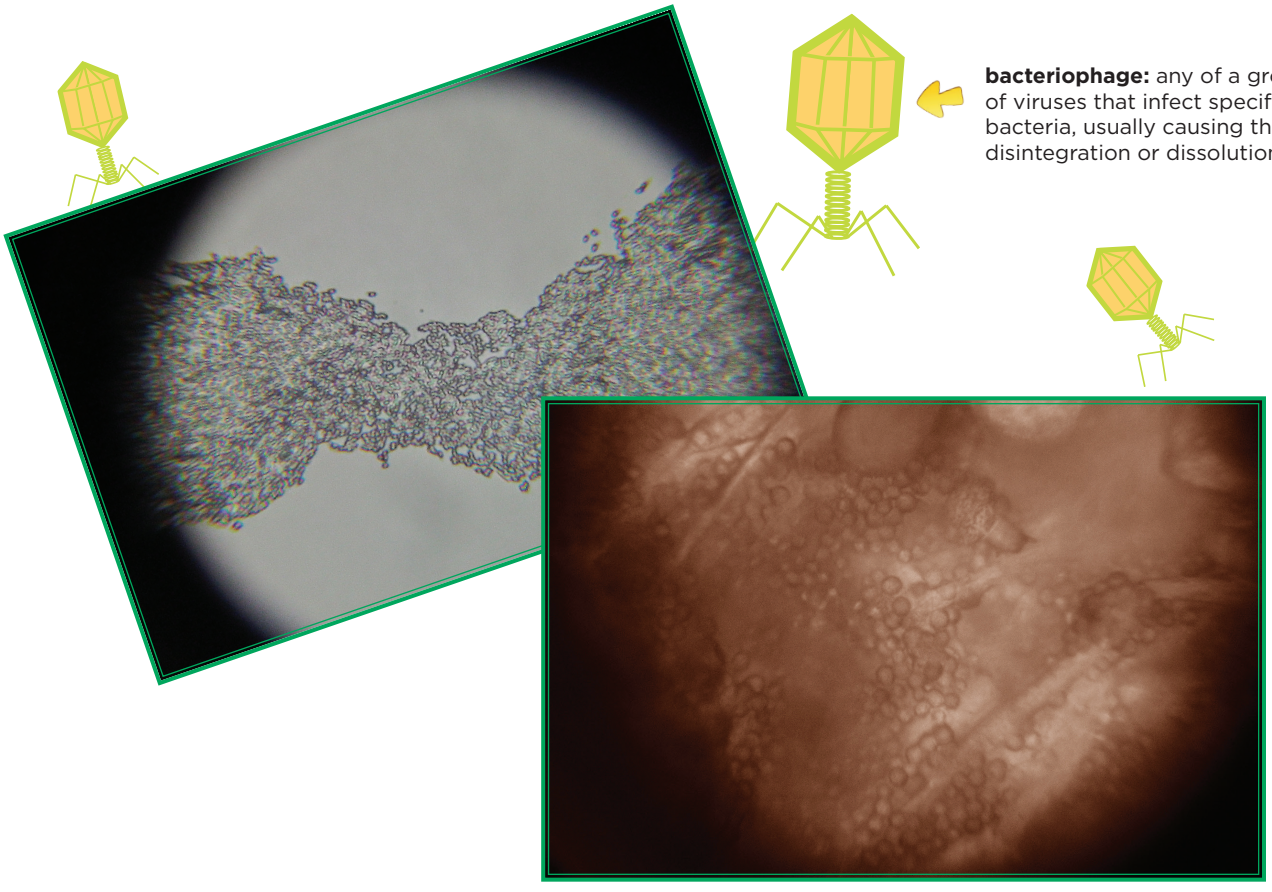
Lesson 1 Microbes All Around and Inside Us

Introduction

Look around you. What types of organisms, or living things, can you see? For example, you might see different grasses, trees, or flowers. You might see ants, spiders, birds, or other humans. The biodiversity, or variety of living species, of our planet is amazing. Even now, new species are discovered every day.

However, what you see with your eyes only tells a tiny piece of the biodiversity story. The world we live in is mostly microscopic. Microorganisms, tiny living things too small to see with our eyes alone, vastly outnumber the organisms we can easily see. An entire world of bacteria, fungi, viruses, protists, and other microscopic organisms exists under (and even inside of) our very noses. Sometimes, the term "microbiodiversity" is used to describe the enormous variety of microorganisms that exist on our planet.

Microorganisms (also called "microbes") can be extremely tiny. For example, a single E. coli bacterium is approximately one micrometer across. A micrometer is one millionth of a meter, or one thousandth of a millimeter, and is written as 0.000001. Compare this to a single grain of sugar, which is about one-half of a millimeter across, or 0.0005m. In other words, 500 E. coli bacteria could easily fit on a grain of sugar. Ten thousand E. coli bacteria could fit on the period at the end of this sentence. In your body alone, 100 trillion different microbes make their home. In an average, healthy adult, these bacteria, fungi, viruses, and protists can weigh as much as five pounds!



bacteriophage: any of a group of viruses that infect specific bacteria, usually causing their disintegration or dissolution.

Lesson 1 Microbes All Around and Inside Us

Key Teaching Points

1. Microbes (organisms too small to see unaided) make up most of the biomass (living matter) on our planet.
2. Scientists use evidence and reasoning to talk about their claims.

Learner Outcomes

- Develop an understanding of bacteria, microbes, biodiversity, and microbiodiversity.
- Make predictions about the growth of microbes on pieces of cantaloupe that have been swiped across different surfaces.
- Predict which surfaces and environments will promote the most and least microbial growth.
- Make observations and draw conclusions while observing the microbial growth throughout the experiment.

Skill Level: Elementary, Beginning

Success Indicators

- Youth will state claims using reasoning from prior knowledge and discussions.
- Youth will make predictions using schema and information shared before the experiment.

Life Skills

Critical Thinking, Keeping Records, Communication, Team Work, Healthy Life-style Choices

Time Needed

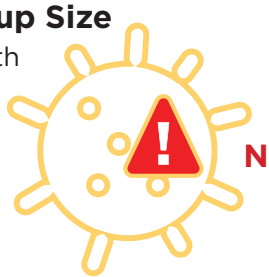
90 minutes or two 45 minute sessions

Space

Classroom or kitchen

Suggested Group Size

Groups of 4-5 youth



No tasting the cantaloupe

Materials List

- 5 pound bag of sugar (this will be used again in Lesson 3)
- A small cup of loose sugar or individual sugar packets
- Sticky Notes
- 1 KWL (poster size)- A graphic organizer used to find out what youth Know, Want to know or questions, and what they Learn
- Microbe Comic (1 per youth)
- Claim-Evidence-Reasoning poster (1 for the class)
- Claim-Evidence-Reasoning chart (1 per youth)
- Cantaloupe Lab packet (1 per group)

For experiment

Facilitator materials

- Clean knife
- Clean cutting surface
- Clean spoon to scoop seeds from cantaloupe
- Clean bowl or container to hold sliced cantaloupe (1 per group)

Youth materials

- Cantaloupe slices (14 slices per group)
- Plastic bags that can be sealed (14 per group)
- Box or other container that blocks light to collect prepared bags of room temperature cantaloupe (1 per group)
- Container to collect prepared bags of refrigerated cantaloupe (1 per group)
- Hand sanitizer
- Soap and water (to wash hands)
- Permanent marker (1 per group to write the surface name on each bag, or stickers)
- Bag Stickers (1 set per group) ** Alternative: provide labels printed on regular paper, scissors, and tape to label the bags.

Lesson 1 Microbes All Around and Inside Us

Background information

Microbes make up most of the life on our planet, but we are only just beginning to understand them. Microbiology is the branch of science that studies microbes, particularly bacteria. For decades, the major focus was on how to eliminate microbes, hoping that doing so would eliminate diseases. Now, microbiologists are discovering that our relationships with microbes are far more complex and complicated than we ever imagined. In fact, our bodies are teeming with microbes, and while some cause us harm, most are essential to our very survival.

Before the Activity

1. Have a 5 pound bag of sugar out.
2. Have a small cup of loose sugar or individual sugar packets out.
3. Print copies of the Claim-Evidence-Reasoning chart for each youth.
4. Print copies of the Claim-Evidence-Reasoning Self-Assessment for each youth.
5. Print copies of the Cantaloupe Experiment lab packet for each group.
6. Print labels for bags of cantaloupe, either on regular paper or on sticker paper.
7. Have sticky notes available for all youth.
8. Label corners of the room with "I agree with Shannon," "I agree with Brad," "I agree with Courtney," and "I agree with Whitney." [Note: Names may be changed to reflect the community in which you teach.]
9. Divide the youth into pairs and groups of 4-5. For easy labeling of materials during the cantaloupe experiment, you may assign each group a name or a number; alternatively, each group can be allowed to choose a name.
10. Have 2 copies of the Microbe Comic for each group of youth to use during the lesson.
11. Make sure that each group has 14 slices of cantaloupe, 14 plastic bags, stickers or labels for the bags, access to hand sanitizer, and access to a sink with soap and water.

To prepare the cantaloupe

1. Wash cantaloupe outer surface with water.
2. Clean and sterilize the working area as much as possible to avoid contaminating the cantaloupe.
3. Cut the cantaloupe in half and remove the seeds. Discard the seeds.
4. Cut the outer rind off the cantaloupe. Dispose of the rind.
5. Cut the cantaloupe into slices. The slices do not have to be exactly the same size or shape, as long as approximately the same amount of surface area is available for most of the slices.
6. Place 14 slices of cantaloupe into a bowl or other clean container for each group.
7. One small to medium cantaloupe can provide enough slices for 2-3 groups.
8. If preparing in advance, cover the bowls or containers with plastic wrap to avoid contamination as much as possible. Do not touch the cantaloupe with the plastic wrap.

Need a photo using ziploc bag as a glove for cantaloupe

Lesson 1 Microbes All Around and Inside Us

PART ONE

Opening Questions

- Have you ever heard of bacteria, fungi, or viruses?
- If so what do you know about them and where have you heard of them before?

Follow-up Questions

- Do you know if all bacteria, fungi, or viruses are good or bad?
- Do you know where bacteria, fungi, and viruses live?
- What do microbes do for humans? Are they helpful or harmful?

Let's Do It!

1. Activate youth's background knowledge by asking the Opening Questions.

2. Give youth sticky notes and a few minutes to record anything that they personally think to be true. Youth should only record one idea on each sticky note. If they have three things to say, they should end up with three sticky notes.

3. Have youth share their work ideas with their group members. Any new ideas that arise during their conversations should also be recorded with one idea per sticky note.

4. Show the youth the class KWL poster. Tell youth that the letters "KWL" stand for "What I Know," "What I Want to Know," and "What I Have Learned." Explain that they will be using this tool to help them record their questions and their learning, and that they will start by placing their sticky notes in the first column.

5. Allow youth to bring their sticky notes to the poster and place them on the Know section.

6. Summarize the group knowledge. If there are conflicting ideas, move those sticky notes to the "W" column. Remind youth that what they know at the start of the lesson may change as they work, and that is simply a sign of learning.

7. Point out the "W" column. Explain to youth that, as they have questions, they are welcome to write their questions down during the course of their work and add those sticky notes to the W section.

8. Inform the youth that bacteria, fungi, and viruses are actually types of organisms known as microbes. Write the following terms on the board: "microbes," "biodiversity," "organisms," "microorganisms," and "microbiodiversity." Ask youth what they know about these words. Break down each of the words to find out if the youth know what the parts of the words mean:
    a. bio- means "life"
    b. micro- means "small"
    c. diversity means "variety"
    d. organism means "living thing"

9. Give the youth time to collaboratively discuss these words to develop an understanding. Possible questions to support this discussion:

    a. What is an organism? If an organism is a living thing, then what is a microorganism or a microbe? What does micro- mean?
    b. What does the word biodiversity mean? Do you know what the root bio- means? What is diversity? Do you have any connections to either words or have you heard of biodiversity before?

10. Now that you have an understanding of what a microorganism is, what do you think microbiodiversity is?

11. Ask youth to estimate the amount of microbes in their bodies. Have youth write down their estimates and line up in order based on the number they chose. Reveal that there are over one trillion bacterial cells in our bodies, and that bacterial cells outnumber human cells by a 10:1 ratio. In other words, for every human cell, there are ten bacterial cells.

12. Pass the 5 pound bag of sugar to the youth and let them pass it around. Explain that approximately 5 pounds of microbes inhabit our bodies.
    [Note: This bag of sugar will be used again in Lesson 3.]

13. Pour a small amount of sugar in a cup or pass out individual sugar packets. Have youth each try to pick up a single granule of sugar. Ask youth to estimate the size of the granule. Again, youth can rearrange themselves based on their estimates.

14. Inform youth that a single grain of sugar is approximately 0.5 mm, whereas a single E. coli bacterium is 0.001 mm (one micrometer, or one millionth of a meter). Explain that microbes are so small that they cannot be seen without a microscope. If we see bacteria with our eyes alone, then we are actually looking at colonies of bacteria.

15. Introduce the Microbes Comic to the youth and let them know that they will be working in groups to learn more about microbes and how they interact with our bodies. Ask youth to work with 1-2 partners to read the booklet. They should use sticky notes to record at least five facts that they learn and at least three questions they have. After youth navigate through this resource, have them place their sticky notes on the KWL poster. Summarize the information on the KWL chart for the group.

[for 45 minute classes, this is a good breaking point]

PART TWO

1. If a second class period has begun, review the KWL chart from the previous lesson.
2. Ask the Share question.
   - Before learning about microbes, what did you think a microbe was?
   - Where did you think they lived?
3. Ask the first Reflect question.
   - How did your thinking change as you read about microbes?
4. Introduce the Claim-Evidence-Reasoning poster to the youth. Inform youth that they will be using the Claim-Evidence-Reasoning framework in order to craft a scientific argument.
5. As a class, you will be modeling how to use the Claim-Evidence-Reasoning format. Share with youth the following Microbe Probe question. You may change the names to names that are representative of the community in which you teach:

   Four friends were talking about microbes and where they would grow best.

   Shannon said, "I think that microbes would grow best on counters."

   Brad said, "I think that microbes would grow best in the refrigerator."

   Courtney said, "I think that microbes would grow best on our hands."

   Whitney said, "I think that microbes would grow best somewhere else."

   With which friend do you most agree? Why?
6. Use a Four-Corners activity for youth to share their ideas. Designate one corner as "I agree with Shannon," one corner as "I agree with Brad," one corner as, "I agree with Courtney," and one corner as "I agree with Whitney." Youth move to the corner that most closely matches their ideas. Allow one or two youth to defend their position.
7. Randomly choose one of the corners to use as the model claim. Model how to complete the "Claim" section by writing, "Bacteria will grow best on [the surface] because [use a reason from one or two of the youth in that corner]." Explain that a claim is a complete sentence that stands alone and includes at least one supporting reason. "I agree with Courtney" is not an example of a claim.
8. Pass out the Claim-Evidence-Reasoning charts to each youth. Provide a few minutes for youth to record their individual claims.

9. Tell youth that they will be testing their claims by collecting microbes from a variety of locations. They will use cantaloupe slices in order to determine which environments have the most microbes and to determine what makes bacteria grow faster in certain environments. Pass out the Cantaloupe Experiment sheet. Read the Procedure with youth to ensure that they know the expectations.

10. Review lab observation and safety procedures, especially procedures for tasting food in the lab. After the lab has been completed, youth will not directly touch or smell the cantaloupe again. The bags will remain sealed. Youth will observe the experiment by visual inspection.

- **Seeing: youth will use their sense of sight to make visual observations of the cantaloupe experiment once it has been set up.**
- **Tasting: youth are to eat in the lab only when directly instructed to do so by the teacher. Otherwise, there should not be anything to eat or drink in the lab setting.**
- **Touching: youth will not directly touch the cantaloupe again after the experiment has been set up.**
- **Smelling: youth will not observe the cantaloupe by smelling again after the experiment has been set up.**
- **Hearing: this sense is not applicable to this experiment.**

11. Youth will use their cantaloupe slices to gather microbes from each of the following locations- single human contact, multiple human contact, two different surface areas, hands that have been cleaned with hand sanitizer, hands that have been washed with soap and water, and one pair of slices that has not been used to swipe a surface (controls for room temperature and refrigerator). They will need to swipe each surface with two pieces of cantaloupe because one will be placed in a refrigerated environment and the other will remain in a room temperature environment.

12. Tell youth to take two pieces of cantaloupe, place them in sealed bags, and label the bags. One bag should be labeled “Control: Room Temperature,” while the other bag should be labeled “Control: Refrigerator.” Model how to use the bags as gloves to pick up the cantaloupe.

13. Instruct each group to select one member to be the “Single Human Contact” member of their group.

14. Have the Single Human Contact group member swipe two cantaloupe pieces across his/her hands and put into sealed bags. One bag should be labeled “Single Human Contact: Room Temperature” and the other should be labeled “Single Human Contact: Refrigerator.”

15. Have youth pass two pieces of cantaloupe around in their group so that every person touches each piece. Put these pieces in sealed bags labeled “Multiple Human Contact: Room Temperature” and “Multiple Human Contact: Refrigerator.”

16. Tell youth to wash their hands.

17. Have the Single Human Contact group member for each group swipe their freshly-washed hands with the cantaloupe. Place the pieces in sealed, labeled bags.

18. The Single Human Contact group members now wash their hands again.

19. Have the Single Human Contact group member for each group clean their hands with hand sanitizer. Swipe their hands with the cantaloupe and place the pieces in sealed, labeled bags.

20. The Single Human Contact group members now wash their hands again.

21. Have youth choose two different surfaces in the room that they would like to swipe with cantaloupe. Have them swipe the first surface with two pieces of cantaloupe and put them in sealed, labeled bags. Repeat for the second surface. Youth should use the bag-as-glove method demonstrated earlier in the lab.

22. Tell youth that they will revisit the cantaloupe throughout the course of the unit to observe what might start growing.

23. Ask the second Reflect question.

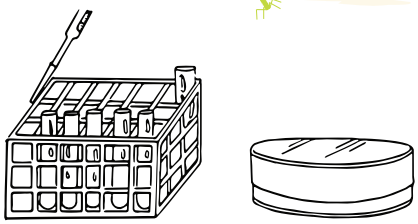
    - Did your thinking about where bacteria might grow best change throughout the experiment preparation?

24. Ask the Generalize questions.

    - After setting up the cantaloupe experiment, which cantaloupe slices do you think will show the greatest and least microbial growth?
    - Why do you think this? Do you think that each of the cantaloupe slices will look the same throughout the experiment? Why and in what ways?

25. Ask the Apply questions.

    - Using the predictions that you made today about the growth of microbes in different environments, where do you think microbes tend to grow best inside of our bodies? What do microbes do to our bodies?
    - Are they harmful or helpful?



Term and Concept Discovery

Bacteria: a type of single-celled organism. Bacteria are classified as prokaryotic organisms, as they do not have membrane-enclosed nuclei or other similar structures (organelles). Bacteria are the most abundant life forms on our planet. Singular: bacterium

Microbe: any one of a number of organisms too small to be seen without a microscope. Bacteria, viruses, and many fungi are all considered microbes.

Fungi: Fungi are eukaryotic, since their cells do contain a nucleus. Mushrooms are fungi, as are microorganisms such as yeasts and molds. Singular: fungus

Viruses: a microbe that replicates itself by taking over cells in a host organism. At this time, there is debate among scientists as to whether viruses are actually considered to be living organisms. Unlike pathogenic bacteria, viruses cannot be killed using antibiotic medicines.

Microbiodiversity: the variety of microbes that inhabit an ecosystem.

Talk It Over

Share 1	Reflect 2
Before learning about microbes, what did you think a microbe was? Where did you think they lived?	How did your thinking change as you read about microbes? Did your thinking about where bacteria might grow best change throughout the experiment preparation?
Generalize 3	**Apply 4**
After setting up the cantaloupe experiment, which cantaloupe slice do you think will show the greatest and least microbial growth? Why do you think this? Do you think that each of the cantaloupe slices will look the same throughout the experiment? Why and in what ways?	Using the predictions that you made today about the growth of microbes in different environments, where do you think microbes tend to grow best inside of our bodies? What do microbes do to our bodies? Are they harmful or helpful?

Variations

- Demonstrate how to write the number "one trillion" in US standard form (1,000,000,000,000) and scientific form (1.0×10^{12}). Have youth represent the size of a E. coli bacterium using a decimal, a fraction, and scientific notation (0.000001; 1/1,000,000; 1.0×10^{-6}).

- You can provide the youth with different kinds of fruits or vegetables so that they can observe the differences of microbial growth on a variety of produce. Potatoes and sugar pumpkins are possible alternatives if cantaloupe is not available.

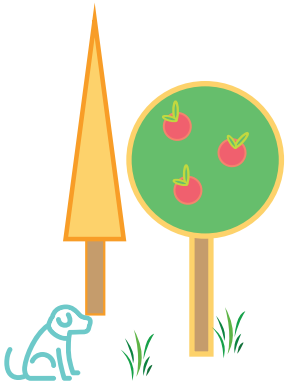
- You may choose to use electronic versions of the Claim-Evidence-Reasoning chart and Cantaloupe Experiment lab packet. Youth can digitally photograph any changes in their cantaloupe over the course of the experiment and share their findings through Edmodo or other locally-approved platforms.

Take It Home!

With an adult, take a walk in your neighborhood.

Draw pictures in your notebook or take photographs to document the biodiversity in your neighborhood.

How many different types of organisms can you find?



Education Standard(s)

5.L.2.3- Infer the effects that may result from the interconnected relationship of plants and animals to their ecosystem.
Youth know that all of the organisms in an ecosystem have interconnected relationships. Youth know that because of this, factors that impact one population within an ecosystem may impact other populations within that ecosystems.
5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
Variation: 5.NBT.1 -Recognize that in a multi-digit number, a digit in one place represents 10 times as much as it represents in the place to its right and 1/10 of what it represents in the place to its left.
Variation: 5.NBT.2 - Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.

Tags

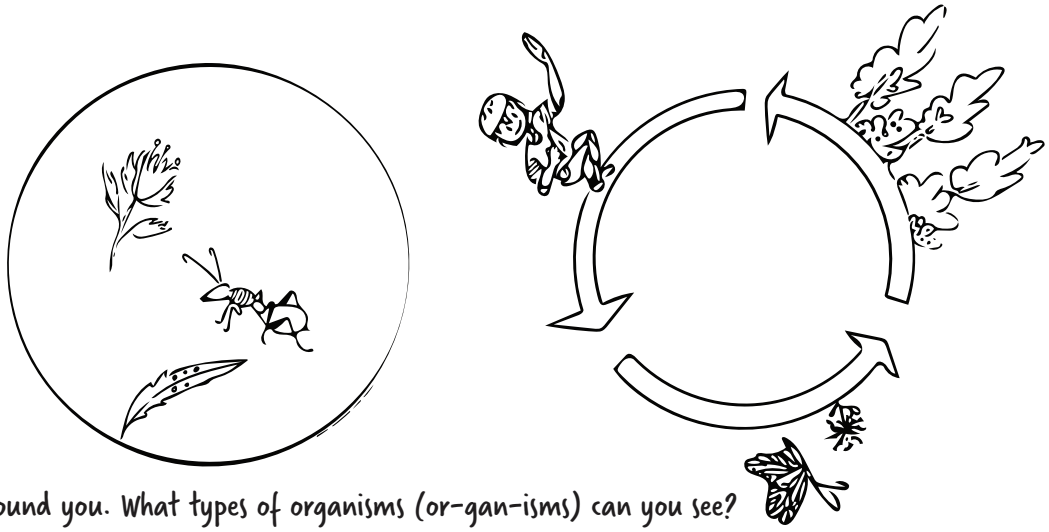
Microbes, Microorganisms, bacteria, fungi, viruses, biodiversity, microbiome, microbiodiversity

Lesson 1 Print Materials

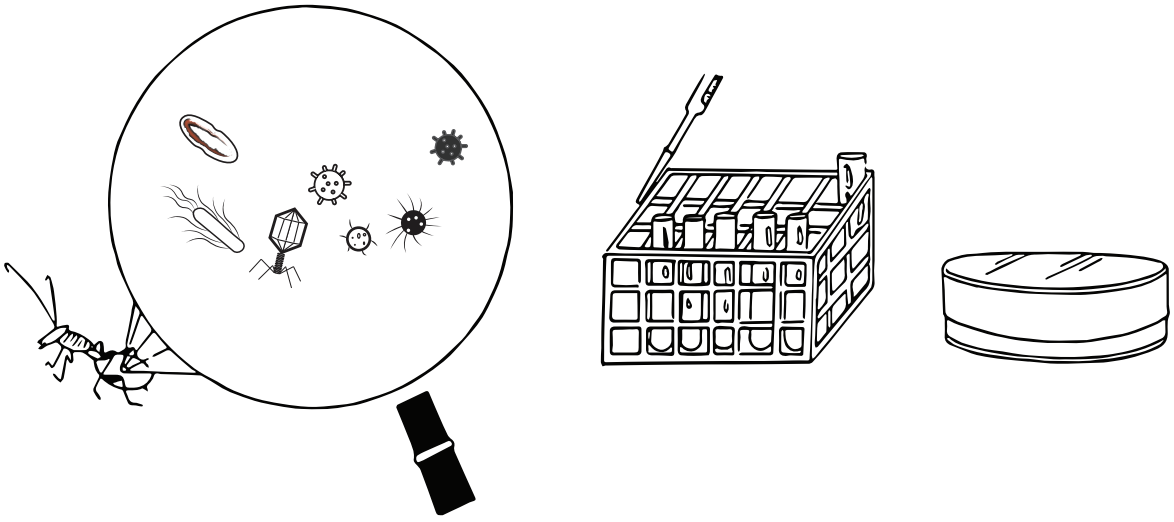
Facilitator
KWL poster
(one large scale poster per class)
Claim-Evidence-Reasoning poster (one large scale poster per class)

Group Handouts
Cantaloupe Lab packet
Bag stickers or labels

Youth Handouts
Microbe Comic
Claim-Evidence-Reasoning chart
Claim-Evidence-Reasoning Self-Assessment



Look around you. What types of organisms (or-gan-isms) can you see?
Do you see different grasses or flowers?
Ants, spiders, birds, and people?
The list of living things makes up the biodiversity (bio-di-ver-si-ty) of our world.



Because we can't see microbes, scientists who specialize in microbiology (mi-cro-bi-ol-ogy) do experiments to show the existence of microorganisms (mi-cro-or-gan-isms) and their interactions with us.
In this lesson, you will learn more about microbes.