

Your Other Genome

Objectives

Students will:

- Examine the human microbiome and the major types of microbes.
- Participate in a simulation that models bacterial antibiotic resistance and what can happen to a person when new microbes are introduced to the human body.
- Measure and compare the number of human cells and bacterial cells in their body.
- Explain how next-generation sequencing can help us learn about the microbiome and improve human health.
- Research human body systems and discover what effect microbes have on how body systems function.
- Create a piece of digital media that can help to inform the public on the importance of understanding the link between the human microbiome and health.

OVERVIEW

In this lesson bundle, students are presented with a curious treatment for a nasty infection called *Clostridium difficile*. . . poop pills! Why would anyone want to take a pill filled with someone else's poop? It enhances your microbiome! Students will learn that they actually have a second genome that is stored in the millions of microbes that call their body home, called the microbiome. Students will be introduced to the emerging field of metagenomics and microgenomics and how scientists are working to sequence the genomes of these microbes to learn valuable information about the types of bacteria living inside us, and how the food and lifestyle decisions we make affect our microbiomes and our health. To discover what a large role the microbiome plays in our overall body function, small student groups will each be assigned a body system, such as the nervous, reproductive, and digestive systems, and will create a piece of digital media that highlights the types of microbes found in that system and what role they play—symbiotic or not—in the function of the body. Groups could choose to make a vlog (video blog), an infographic, or interactive digital poster that can then be shared with the whole group for feedback.

The accompanying presentation was created with PowerPoint so that it can be used in a variety of classrooms. If you are using a laptop with an LCD projector, simply progress through the PowerPoint by clicking to advance. All of the interactive aspects of the presentation are set to occur on click. This includes images, text boxes, and links to outside videos, which will appear in your web browser. If you are using an interactive whiteboard, tap on each slide with your finger or stylus to activate the interactive aspects of the presentation. It does not matter where you tap, but you can make it appear as if you are making certain things happen by tapping them. In the notes for each slide, there will be information for the instructor.

CONTENT AREAS

Genetics, Microbiology, Medicine

ACTIVITY DURATION

4 class sessions (45–50 minutes each)

GRADE LEVEL

Grades 9–12

ESSENTIAL QUESTIONS

- What is a microbiome?
- What types of relationships exist between humans and microbes?
- How are scientists using genetic sequencing to learn more about the human microbiome?
- Why is learning about the microbiome important to human health?
- How can information about research and findings linked to the microbiome be beneficial for people?

MATERIALS

All days:

- Device with the ability to project
- Student 1-1 devices (laptop, iPad)

Day 1:

- Capture Sheet, one per student
- Materials for the C. Diff Conundrum Activity (enough for 6–8 groups)
 - snack-size plastic baggies (2 per group)
 - 8 different types of dried pasta
 - plastic cups (1 per group)
 - plastic eggs (1 per group)
 - dry soup mix
- C. Diff Conundrum Activity Sheet (1 per group)

Day 2:

- Calculators (1 per student)
- MICROBIOME RESEARCH JIGSAW VIDEO NOTES (1 per student)

Day 3:

- MICROBIOME AND HUMAN HEALTH RESEARCH SHEET (1 per student)

Day 4:

- MICROBIOME EXIT TICKET (1 per student)

BACKGROUND

While we have long known about the many microbes that inhabit the bodies of and form relationships with other living things, it is only relatively recently that we have begun to uncover just how deep those relationships go. It seems we have only uncovered the tip of the iceberg in this emerging field, and scientists have found that the trillions of bacteria, fungi, and viruses that make up the human microbiome play important roles in the functions of organs and body systems. Next Generation genomic sequencing has helped us to identify new species that are found in our microbiome and discover the links between microbial diversity and our health. As we continue to learn more about the human microbiome using cutting-edge technology, people will most certainly begin to think much more about the tiny organisms that are taking up residence in their body and perhaps be able to better manage or even prevent some human diseases.

This guide gives educators a collection of resources designed to help students investigate the concept of the human microbiome and what we are learning about its influence on human health. It provides slide-by-slide instructions to ensure educators are prepared to explain, discuss, and facilitate the hands-on content in the presentation. The presentation is designed to cover four class sessions, but it can be flexible depending on the students' needs and the time available. Additional extension ideas are included at the end of the manuscript.

This lesson plan follows an inquiry-driven 5E instructional model: Engage, Explore, Explain, Elaborate, and Evaluate. After an opening story about a troubling illness and perhaps an even more troubling treatment, the lesson begins by introducing the microbiome to students with an interactive quiz or poll to activate previous knowledge of microbes and introduce new and surprising information about the microbiome. Over the course of four class periods, students will work together to understand why the microbiome is a fast-growing area of study in genetics and healthcare, research how much influence we are learning the microbiome has on a person's overall health, and eventually create a piece of digital media that will inform the public on specific ways that microbes affect various body systems and why is important to monitor their own microbiome in the future.

Students will begin to gain an understanding of how the microbiome works through a simulation that models a disruption in gut microbes and why the shocking treatment from the opening story would be successful in treating illness. Next, they will use findings from current research to calculate the number of cells that make up their body based on weight and compare that with the number of microbes that call their body home. They will then look at what next-generation sequencing is and why it is so important to getting a complete emerging

picture of the microbiome, and the secrets it is unlocking about the link between our microbes and our health. Once students understand the importance and scope of continuing to learn more about our microbiomes, they will form groups to create a piece of digital media that could be used in a public health campaign. Each group will be assigned one system of the human body to focus on and will research how microbes found there or in other parts of the body affect the function of that system. Students will then share their digital media with the whole group and finish with a discussion on what they have learned about the microbiome and how this may apply to the health choices they make in their lives.

ENGAGE, Slides 1-2

OVERVIEW

Students will listen to a story about a woman who suffered from an infection of *Clostridium difficile* in her gut, which became a debilitating and hard to cure problem. They will learn that she eventually found a successful treatment that involved the use of other people's poop in her own digestive tract to clear the *C. Diff* infection!

DAY 1, SLIDE 1

- Begin class by asking students to listen as you read a story to them about a woman who contracted a devastating bacterial infection.
- Read the story below to students:

Dina's Story

*I am a 51-year-old housewife who contracted *C. diff* at a hospital where I had treatment for rectal cancer in 2005. Ever since my initial stay at that hospital for a high fever of unknown origin, just as I began my chemo and radiation, I had frequent, uncontrollable diarrhea whenever I ate solid food. This diarrhea was initially thought to be possible *C. diff*, and although I had several false-negative tests for the microbe, it wasn't until a more sensitive toxin-test for *C. diff* came into use that my unexplained diarrhea gained a positive-test result. Through the years with undiagnosed *C. diff*, I was given many drugs to try to control the ever-worsening diarrhea. For 8 years, I was given a diagnosis of "IBS" or "Irritable Bowel Syndrome," which just meant every colonoscopy examination showed normal tissue, yet I had digestive trouble that could not be otherwise diagnosed.*

*After many years of "living by the toilet," I was diagnosed properly to have *Clostridium difficile*. By that time, I was pooping about 20 times a day, every day. I was confined to my home. I went through about two rolls of toilet paper every day. Going out was terrifying. Never knowing if or when I might suddenly have to use*

the toilet became a fear of being stuck in traffic or having to wait in line. After having diarrhea for so many years, your normal bowel function ceases and you cannot wait when you have to "go".

To treat the C. diff, I was given the first line of antibiotic defense: Flagyl. I went from diarrhea 20 times a day to diarrhea 50 times a day. Then I took Vancomycin for 9 months. It helped at first. Each time I stopped it, the diarrhea came back. Then I took the last drug available, Xifaxan, but as soon as I went off it, the diarrhea returned. I kept on taking it, but with each passing week, it was less effective.

- Click and explain to students that she did eventually find a successful treatment, but it might be a little shocking... ask students if they have any guesses as to what Dina's treatment might be. What are some treatments they may have used for an upset stomach?

DAY 1, SLIDE 2

- Click to display the picture of frozen poop pills, giving students a minute to study the picture and ask if they have any idea what is inside these pills.
- Click the "Link" button to play a video clip for students. Show the video from 0:00-0:17 and give students a chance to react to the news that the pills are filled with human fecal matter.
- Continue the video to 1:18 and stop. (Link: <https://youtu.be/DkOyoSeHxN8>)
- Click once to display the next information
- Explain to students that they will take a pause from the video and simulate what is happening in a person's gut that could cause a C diff infection and discover why someone else's poop might be helpful in treating it.

EXPLORE, Slides 3-10

OVERVIEW

Students will be introduced to the microbiome by viewing a video clip and taking notes on a capture sheet. They will then form small groups and participate in a simulation that will allow them to model the human digestive microbiome and learn how pills filled with human fecal material can help a patient with severe C. Diff to overcome the infection.

DAY 1, SLIDE 3

- Introduce students to the term microbiome.
- Click once to project the first half of the problem scenario and read it aloud:
 - Before we model what goes on in the case of a person suffering from C. Diff, we need to first talk about all of the cells in and on your body that aren't yours which make up YOUR MICROBIOME!

- While this may be a disturbing thought initially, you will see quickly that without many of these microbes, we would be in real trouble.
- Distribute a Capture Sheet to each student and explain that this will be used as a place to take notes throughout the upcoming activities. Students will need these notes as they continue to explore the microbiome in this lesson.
- Once the video is finished, ask students to share what they learned about the microbiome with the class.

DAY 1, SLIDE 4

- Students will participate in a modeling activity to help them understand how antibiotics can kill bacteria in a person's gut, leaving room for harmful bacteria to move in, as in the case of C. Diff.
- Ask students to form small groups of 3–4 and have each group get a copy of the activity sheet.
- Students should get all necessary materials and follow the instructions for Part 1 of the activity.
- Once students have completed Part 1, they should stop for the next slide.

DAY 1, SLIDE 5

- Students should make sure that their plastic bags are full.
- Read the information on the slide to the students.
- Use the questions on the slide as discussion questions for the whole class. Students may share their answers with the class.

DAY 1, SLIDE 6

- Read the instructions on the slide to students, remind them that they are to remove only the types of pasta on the slide and they are to do it one piece at a time.
- Click to start the timer, walk around the classroom to ensure that students are following the proper procedure.

DAY 1, SLIDE 7

- Read the information on the slide to the students.
- Use the questions on the slide as discussion questions for the whole class.
- Students may share their answers with the class.

DAY 1, SLIDE 8

- Read the instructions on the slide to students.
- Explain that they should go through their digestive microbiome carefully to discover if they have been afflicted with diarrhea associated with C. Diff.
- More than 5 lentils mean they have diarrhea.

DAY 1, SLIDE 9

- Ask groups to report to the class if they have C. Diff (this can be by a show of hands or individual groups giving their data).
- Inform students that they will now be able to see how pills filled with another person's poop can be a helpful treatment for C. Diff.
- Play the video from 1:18 to the end (Link: <https://youtu.be/DkOyoSeHxN8>).

DAY 1, SLIDE 10

- Read the instructions on the slide to students
- Students should see that they can use their plastic egg to represent the capsule for the pill. They should fill the plastic egg with good absent microbes (that are now in their plastic cup) and transfer them to their microbiome bag to represent new good microbes being introduced to the digestive system through the fecal material.
- Allow students a few minutes at the end of the activity to compare their models with the models of other groups.

DAY 2, SLIDE 11

- Now that students have been introduced to the human microbiome and how it connects to human health, they will further explore about the microbes found in and on our bodies and just how many microbes scientists estimate make up our microbiome
- The following statistics and facts about the human microbiome can be used by the instructor to create a poll using the website www.polleverywhere.com.

(Teachers can create an account for free that will allow them to display poll questions to students and get results in real time. Students can either go to a web address to answer poll questions or by texting answers to a number provided by polleverywhere.com.)

- Students can use their devices to log on to the poll and answer the question. The instructor can display the results to the students as they answer on their laptops, ipads, or mobile devices and reveal the correct answers.
- Poll Questions:
 - 1 TRUE or FALSE: It is estimated that there are more microbes in the human body than there are stars in the Milky Way. (Answer—TRUE)
 - 2 Which of the following is NOT a type of microbe? A) bacteria B) fungi C) viruses D) all are considered microbes (ANSWER—D)

- 3 TRUE or FALSE: Not all types of microbes have genetic material (DNA or RNA)
(ANSWER—FALSE)
- 4 TRUE or FALSE: The same type of microbe that lives on your feet is used to ripen Limburger cheese. (ANSWER—TRUE)
- 5 How many different species of bacteria are estimated to live in the average person's mouth?
A) 11 B) 110 C) 1,100 D) 11,000 (ANSWER—C)
- 6 TRUE or FALSE: Microbes have no effect on how genes are expressed in the human body.
(ANSWER—FALSE)
- 7 Which animal's gut microbiome is the human microbiome most similar to?
A) pigs B) dogs C) mice (ANSWER—B)
- 8 TRUE or FALSE: The number of microbial cells in the human body is greater than human cells.
(ANSWER—TRUE)

DAY 2, SLIDE 12

- The following slides will give students the steps to help them calculate how many cells their body is made up of (estimated) based on their weight. Then they can use that number to calculate how many cells make up their microbiome.
- Students will need a calculator for this activity as they will be making conversions and working with large numbers in the trillions. Knowledge of scientific notation is helpful as well.

DAY 2, SLIDE 13

- Instruct students to get out a calculator and paper and pencil.
 - Ask students to follow the steps to calculate the estimated number of human cells that make up their body.
 - Students can compare their results to check for accuracy and understanding.
- *Note: The 4.286×10^8 factor is a derived number based on the results of the study. It is approximately equal to the estimated number of cells per gram of body mass of the typical human referenced in the study.

DAY 2, SLIDE 14

- Ask students to follow the steps on the slide to calculate the estimated number of microbial cells that are found in and on their body. They will need to use their calculation of the number of human cells that are in their body from the previous slide.
- Students can compare their results to check for accuracy and understanding.

EXPLAIN, Slides 15–18

OVERVIEW

Now that students have learned just how much of their body is inhabited by the cells that make up the microbiome, they will explain why next-generation genetic sequencing is so important in helping scientists learn about the links between our health and the trillions of microbes that call our bodies home. Students will do a video jigsaw, where they will explore some of the research that is being done using genomic sequencing.

DAY 2, SLIDE 15

- Read the instructions on the slide to students.
- Ask students if any of them have heard of gene sequencing? If so, ask them to share any knowledge they have of it with the class.

DAY 2, SLIDE 16

- As students watch the video that introduces next-generation sequencing, ask students to think about why this is such an important tool for scientists who are studying the microbiome.
- Click on the button on the screen to play the video in its entirety.
- Students will surely not understand all of the complicated steps in the video, but the teacher may want to make sure that they understand that one reason that next-generation sequencing is beneficial is because it can scan multiple genomes at one time, unlike earlier sequencing techniques. With trillions of microbe cells in the body, this makes it faster and easier to identify the unique genetic fingerprint of the many types of microbes and discover where they reside.

DAY 2, SLIDE 17

- Read the instructions on the slide to the class.
- Hand out a copy of the MICROBIOME RESEARCH JIGSAW VIDEO NOTES sheet to each student.
- Ask the students to form groups of 4, and assign each person one video from the video jigsaw, A-D.
- Students should watch their video and complete their section of the video notes sheet in preparation for class the next day.

DAY 3, SLIDE 18

- Read the instructions on the slide to the class.
- Students should form their groups and take time to share their notes from their video. All students should complete the jigsaw sheet with information about all 4 videos.

- When all groups are finished, and if time allows, the instructor may ask students for their reactions to the information they learned from the video jigsaw about the value of sequencing and what is being learned about the microbiome.

ELABORATE, Slides 11-14

OVERVIEW

In this culminating activity, students will form small groups that will be part of a public health campaign to inform people about the many ways their microbiome has an impact on their health. Each group will be assigned one of the major body systems and will be tasked with creating a piece of digital media that will highlight some of the types of important microbes found in that system or that have an influence on that system. Students can choose to present their information in the form of a vlog (video blog), digital interactive poster, or an infographic. Each group will present their digital media to the class to view the campaign as a whole.

DAY 3, SLIDE 19

- Explain to students that they will be forming teams that are part of a public health awareness campaign to inform people about the importance of understanding the link between their microbiome and their health.
- Ask students to form small groups and assign (or have student groups draw out a of hat) the body system that they will be focusing on for this project.
- Body systems that may be assigned to groups include:
 - 1 The Nervous System
 - 2 The Urinary System
 - 3 The Reproductive system (can be divided into male and female if necessary)
 - 4 The Immune System
 - 5 The Digestive System
 - 6 The Endocrine system
 - 7 The Cardiovascular System

*For larger classes, teachers may add body systems, such as the integumentary system, the skeletal system, muscular system, and lymphatic system

DAY 3, SLIDE 20

- Read the instructions on the slide to the class.
- Give each group a copy of the MICROBIOME AND HUMAN HEALTH RESEARCH SHEET.
- Allow students the remainder of the class period to work on their research and to choose and begin creating their digital media piece.

DAY 4, SLIDE 21

- Instruct students to rejoin their research groups from Day 3 and explain that they should use the information from their research to finish up the creation of their digital media.
- Review the instructions with the class, and answer questions as needed before allowing student groups to begin working.
- Give students approximately 20 minutes of a 50-minute class period to finish up their digital media piece.

DAY 4, SLIDE 22

- It's time to present the campaign! Reiterate that the goal of this public health campaign is for people to get a complete picture of the human body and what a great influence the microbiome has on it.
- Explain that each group will be given 2–3 minutes to present their digital media piece to the class. There will be an opportunity for questions and feedback after presentations have concluded.

EVALUATE, Slide 23

OVERVIEW

After considering the wide range of research and work that the class has completed over the past four days, each student will complete an exit ticket that allows them to evaluate what they have learned about the human microbiome in this lesson.

DAY 4, SLIDE 23

- Give students a copy of the MICROBIOME EXIT TICKET to complete before they leave the classroom. Encourage students to review their capture sheets, and all notes they have completed throughout this lesson to help them reflect on what they have learned.
- If there is time, compile a list of the major things that students have learned about the microbiome in this lesson to share with the class the next day.

EXTENSION ACTIVITY—MANAGING YOUR MICROBIOME, SLIDE 24

- Ask students to research how people can create and maintain a healthy microbiome through diet and lifestyle choices. They can also research how disease, such as diabetes, can be linked to or affect a person's microbiome.
- Students should then create an informational brochure or infographic that could be distributed in a clinic or uploaded to a medical website that can give information about cultivating a healthy microbiome to the public. (Canva and Piktochart are free online sites that can be used to make digital brochures and infographics)

Here are some links that can be given to students to aid in their research:

- <https://www.forbes.com/sites/quora/2018/12/03/why-you-should-be-paying-more-attention-to-your-gut-microbiome/#23a4e0e17235>
- <https://www.youtube.com/watch?v=Yb5v-6dUjqA>
- <https://learn.genetics.utah.edu/content/microbiome/disease/>
- <https://www.youtube.com/watch?v=VzPD009qTN4&t=193s>

FURTHER EXTENSIONS, SLIDE 25

- If you have additional time and/or would like to further challenge your students, consider the following extension options:
 - Students can explore a virtual human microbiome in a microbiome simulator!
Go to the following website to get started:
<http://learn.genetics.utah.edu/content/microbiome/simulator/>
 - 2. Practice some Next Generation Sequencing techniques in a virtual lab to try to reconstruct the physical appearance of an ancient human
Go the following website to try it out:
<http://www.labster.com/simulations/next-generation-sequencing/>

NEXT GENERATION SCIENCE STANDARDS (NGSS):

HS. Structure and Function

Asking Questions and Defining Problems

Ask questions that arise from examining models or a theory to clarify relationships.

LS1.A: All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

HS. Inheritance and Variation of Traits

Asking Questions and Defining Problems

Ask questions that arise from examining models or a theory to clarify relationships.

LS3.A: Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Common Core State Standards for English Language Arts

Grades 9–10

- CCSS.ELA-LITERACY.RST.9-10.2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- CCSS.ELA-LITERACY.SL.9-10.1.D Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

- CCSS.ELA-LITERACY.SL.9-10.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Grades 11–12

- CCSS.ELA-LITERACY.RST.11-12.2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- CCSS.ELA-LITERACY.SL.11-12.1.D. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.

ITEEA STANDARDS FOR TECHNOLOGICAL LITERACY

Technology and Society, Standard 3: Students will develop an understanding of the relationships among technologies and connections between technology and other fields of study.

J. Technological progress promotes the advancement of science and mathematics.

Technology and Society, Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

I. Making decisions about the use of technology involves weighing the trade-offs between the positive and negative effects.

Directions: Watch the video clip about the human microbiome and take notes in the box below.

Think about the following questions as you take notes:

- What is the microbiome made up of?
- Why is it important to our body functions?
- Why are scientists so interested in learning more about the microbiome?

Materials

- Plastic baggies (snack size)
- 8 different types of dry pasta, including penne, ziti, diatilini, farfalle, pinwheel, shells, macaroni, and fusilli.
- Small plastic cups
- Dried bean soup mix
- Plastic eggs

Part 1: Preparing the Microbiome

- 1 Fill one snack-size plastic bag with a mixture of the 8 different types of dried pasta. Each of the types of pasta represents a different type of microbe found in the human digestive system. The filled bag will represent a healthy microbiome of the human digestive system.
- 2 Next, fill a second snack-sized plastic bag with a mixture of the soup beans. These represent microbes that are out in the environment of a person. Place a few of these environmental microbes into your digestive system microbiome bag to represent that we naturally have some of the foreign microbes in our body.
- 3 Stop and wait for the teacher's instructions on the overhead screen before moving on to Part 2.

Part 2:

- 1 Next you will simulate how taking antibiotics can affect the digestive microbiome. The teacher will set a timer for 1 minute. During this time, you must remove only certain, antibiotic-sensitive, pasta from your bag, 1 piece at a time. This simulates the antibiotics killing certain types of bacteria but showing that other types have a resistance to antibiotics.
- 2 Follow the instructions on the overhead screen to complete part 2.

Part 3:

- 1 Now that there is space in your microbiome, you will simulate microbes from the environment moving in. Take 3 handfuls from your environmental microbes' bag and place them in your digestive system microbiome bag until it is full. Shake up your bag to mix it up!
- 2 Follow the instructions on the overhead screen to continue part 3.
- 3 Empty your digestive microbiome bag and count the number of lentils (that represent C. Diff) that ended up in your bag. More than 5 means you have diarrhea!

Part 4:

- 1 In the final part of this activity, you will come up with a way to model the affect that introducing human fecal material into a person's microbiome can help get rid of C. Diff.
- 2 Use the materials provided to come up with a simple way to model the use of poop pills to help the microbiome.
- 3 Follow the instructions on the overhead screen to conclude this activity.

VIDEO A

Archeology of the Invisible

Link: <https://youtu.be/JTh5baW01Nc>

Question that scientists were asking:

Sequencing techniques used (if given):

Findings from the data:

VIDEO B

Is gut sequencing the future of health testing?

Link: <https://www.youtube.com/watch?v=IWIOSrGOYNc>

Question that scientists were asking:

Sequencing techniques used (if given):

Findings from the data:

VIDEO C

Studying the microbiome could be the next frontier in colon cancer research

Link: <https://www.youtube.com/watch?v=mpfjkHYMMu4>

Question that scientists were asking:

Sequencing techniques used (if given):

Findings from the data:

VIDEO D

Your City Has Its Own Unique Microbiome

Link: <https://www.youtube.com/watch?v=mpfjkHYMMu4>

Question that scientists were asking:

Sequencing techniques used (if given):

Findings from the data:

Directions: Use the space below to record your notes from your internet research. As you perform your research, do your best to find reputable news sources, and focus on quality over quantity! Your notes do not have to be in complete sentences.

1. Website URL 2. Source name	1. What types of microbes are found in or have an influence on your body system? 2. How do these microbes affect a person's health?	3. What are some recent studies that have been done to look at the connection between your body system, the microbiome, and human health?	4. Why is it important for people to know this information? 5. How can they take control of their own microbiome?

