A Guide to Developing Literacy Practices in Science

Focusing on Key Ideas with an Anticipation Guide: The Human Microbiome

Strategy Guide

The Learning Design Group

THE LAWRENCE HALL OF SCIENCE

Earth Science

Grades 6–8

Overview

What's in this guide? This strategy guide introduces an approach for teaching students to focus on key ideas by using an anticipation guide. With an anticipation guide, students learn how to activate their background knowledge, focus their reading, and support statements with evidence from text. This guide includes a plan for using an anticipation guide with the article *The Human Microbiome: A World Inside You*, which introduces students to the scale of living things by discussing the trillions of bacteria that live on and in the human body.

Why use an anticipation guide to help students focus on key ideas? Even students who are strong readers can have difficulty finding key ideas in science texts. By using an anticipation guide to help them engage with and reflect upon key ideas before, during, and after reading, students gain valuable practice obtaining, evaluating, and communicating essential information gained from text.

How This Fits Into Your Science Curriculum

Reading *The Human Microbiome: The World Inside You* provides an opportunity to help build students' understanding of the crosscutting concept of scale as they are presented with the astonishing fact that the human body is home for trillions of microorganisms. The article also introduces the concept that all organisms, from humans to tiny bacteria, are made of cells. The session presented in this strategy guide can be used at the beginning of a life science unit on cells, the human body, or microorganisms. The session can also work well paired with firsthand investigations in which students use microscopes to investigate things that are not visible to the naked eye.

Addressing Standards

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas

LS1.A: Structure and Function: All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular).

Crosscutting Concepts

Scale, Proportion, and Quantity: Phenomena that can be observed at one scale may not be observable at another scale.

Science Practices

Obtaining, Evaluating, and Communicating Information: Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).

COMMON CORE STATE STANDARDS FOR ELA/LITERACY

Reading Standards for LIteracy in Science and Technical Subjects 6–12

RST.6–8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

College and Career Readiness Anchor Standards for Speaking and Listening

SL #1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Science Background

The human body is host to around 100 trillion **microorganisms**, which collectively are referred to as the human **microbiome**. Most of the organisms in the microbiome are **bacteria**. Recent research suggests that up to 10,000 different species of bacteria can colonize humans, and a single person can provide a home for up to 10% of these species. Though bacteria live just about everywhere on and in our bodies—on our hair and skin, inside our mouths, noses, and lungs—by far the greatest number and diversity of bacteria are found in the human gut. We provide these bacteria with food and shelter, and they provide us with numerous benefits. Due to the recent research that has uncovered the importance of the microbiome to many aspects of the health of the human body, researchers are studying how the use of **antibiotics** may have unintended consequences on the human microbiome.

Getting Ready

1. Make one copy of *The Human Microbiome: The World Inside You* and one copy of the Anticipation Guide copymaster for each student.

Activating Background Knowledge (10 minutes)

1. **Introduce the session.** Explain that students will read a text about the human body and that they might discover some surprising information.
2. **Highlight focusing on key ideas.** Point out that, as students probably know, informational texts they read in science class are meant to convey important ideas. Explain that today, students will think carefully about key ideas before they read, while they are reading, and after they read. In this way, they will learn some of the thinking strategies that expert readers of science texts use in order to help them understand the key ideas of what they are reading.
3. **Explain what to do before reading.** Explain that expert readers of science texts identify, before they read, what they already know and what they think they might learn. Let students know that before they read, they will respond to some statements related to the text to help them identify what they already know and what they think about the ideas they might learn.
4. **Explain the anticipation guide.** Distribute one copy of the Anticipation Guide student sheet to each student. Have students read each statement carefully and record whether they agree or disagree with it. Be sure students understand that some of the statements are true, and some are false.
5. **Emphasize reasoning.** Direct students to think about the reasons why they agree or disagree, based on what they currently know. Allow a few minutes for students to complete the anticipation guide independently.
6. **Partners discuss ideas.** After students have completed the anticipation guide, have them work in pairs to discuss their initial thoughts for each statement. Circulate to listen for comments to which you can refer back during a whole-class discussion. If needed, prompt students to deepen their reasoning and their explanations.
7. **Debrief.** Gain students' attention and briefly discuss each statement. Encourage students to explain why they agreed or disagreed with each statement. Emphasize that it is more important at this point to discuss different possible views and reasons for those views than it is to find correct answers.

Reading and Discussing Evidence from Text (20 minutes)

1. **Explain what to do during reading.** Explain that students will continue to think about the statements in the anticipation guide. As they read, they will look for evidence to support or refute their ideas. In particular, they should make note of ideas that were surprising or those that challenged their initial thoughts.
2. **Students read and annotate.** Distribute one copy of the article to each student. Have students read the article independently or with a partner, making notes as they read. Remind students to refer back to the anticipation guide statements as they read in order to keep their focus on those key ideas.

Supporting English Language Learners

Modeling reading with a small group of ELLs provides a supportive environment for learning how to focus on key ideas in a text. Read a few sentences from *The Human Microbiome* aloud, then think aloud as you connect what you read in the text with one statement from the anticipation guide. Ask students to tell you if what you read from the text supports or refutes the statement. Model writing a note about this on the article as an annotation. Continue reading the text in this manner, stopping to make connections to the anticipation guide statement and then writing annotations on the article. Then, have students continue reading the text and thinking about another statement from the anticipation guide. Encourage pairs to discuss what they are reading and thinking in order to help clarify their understanding.

3. **Revisit the anticipation guide.** After students read and annotate, prompt them to return to the anticipation guide to see if their thinking about any of the statements has changed. Have students reread each statement and circle any statement for which they changed their thinking.
4. **Prompt student discussion.** Have pairs discuss the statements in light of what they read in the text. Ask them to discuss surprising ideas and the evidence that supported or refuted the statements or caused them to change their thinking. Listen for comments to which you can refer back during the whole-class discussion. If needed, prompt students to deepen their reasoning and their explanations.

Synthesizing Ideas (15 minutes)

1. **Facilitate a whole-class discussion.** Prompt students to share which ideas were most surprising and why. Let students know that three of the statements in the anticipation guide are false. Ask students to point out which statements they think are false and why. Throughout the discussion, prompt students to explain their thinking and to cite evidence from the text.
2. **Revising false statements.** Ask students to provide suggestions for how to restate the three false statements in more accurate ways. On the board, track suggestions and prompt discussion about which is the strongest statement, based on the evidence. Following are some ways that the incorrect statements could be revised.
   - There are millions of tiny organisms that live on and in your body.

     Revised: There are about 100 trillion tiny organisms that live on and in your body.
   - Bacteria are always harmful to humans.

     Revised: Some types of bacteria are harmful, but other types of bacteria are harmless. Many bacteria live in the human gut and help people stay healthy.
   - Antibiotics (medicine we take for infections) kill only harmful bacteria in the human body.

     Revised: Antibiotics can kill both helpful and harmful bacteria.
3. **Record revised statements.** Once the class has come to consensus on wording, have students record on their anticipation guides the revised statements under the false statements.
4. **Students respond in writing to one statement.** Direct students to choose one statement that was most interesting to them. In the space provided on the bottom of the anticipation guide, have them write about the evidence from the text that supports the statement.

Connecting to Standards

Focusing on key ideas by using an anticipation guide capitalizes on the overlap between the science practices in the Next Generation Science Standards (NGSS) and the Common Core State Standards (CCSS) for English Language Arts. As students are prompted to discuss ideas and support or refute them with evidence from the text, they will be motivated to obtain, evaluate, and communicate key science ideas (NGSS Science Practice 8: Obtaining, Evaluating, and Communicating Information). The statements in the anticipation guide also provide a reason for students to cite specific evidence to support their analyses of the text (CCSS.ELA-Literacy.RST6–8.1) and to determine its central ideas (CCSS.ELA-Literacy.RST6–8.2). In addition, anticipation guides capitalize on interesting content and peer interactions in order to help students build on one another's ideas and express their own ideas more clearly (CCSS Anchor Standard 1 for Speaking and Listening).

Generalizing This Practice

Anticipation guides can be used throughout your science curriculum with a variety of texts and topics. A benefit of having students work with peers as they anticipate and revise ideas based on text evidence is that this approach makes identifying key ideas in science text a student-centered rather than a teacher-driven experience, allowing students' genuine understandings, misunderstandings, and questions about the text to emerge and to prompt further discussion of science ideas. It also provides an initial hook to engage students as they learn general strategies for accessing complex texts. Use the following steps when utilizing an anticipation guide with other science texts.

1. **Choose a text and goals.** This approach is most effective when used with science texts that present new or surprising ideas. Identify important concepts in the text that you would like students to discuss and learn about from reading.
2. **Write statements.** To create the anticipation guide, write between four and eight statements. Following are some tips for writing statements for an anticipation guide.
    - Focus on information you want students to better understand as a result of reading the text.
    - Look for ideas that may be surprising or interesting for students and/or that address misconceptions.
    - Make sure that the statements are accessible enough for students to discuss before they have read the text.
    - Include a mix of true and false statements.
    - Be sure that students can find supporting or refuting evidence in the text.
3. **Introduce the text and explain anticipation guides.** Point out how thinking about key ideas before, during, and after reading will help students practice strategies that expert readers of science text employ. Explain the anticipation guide and let students know that using an anticipation guide will help them think about key ideas.
4. **Pairs discuss ideas.** After students complete the anticipation guide independently, have pairs discuss their initial thoughts.
5. **Debrief.** Regain students' attention and briefly discuss each statement from the anticipation guide. Encourage students to explain why they agreed or disagreed with each statement.
6. **Students identify evidence while reading.** Explain that scientists look for evidence to support or refute their ideas. Let students know that they should make note of possible evidence as they read by writing annotations on the article.
7. **Students revisit anticipation guides after reading.** In pairs or small groups, have students share what they were surprised by in the text and what ideas they read about that may have caused them to change their thinking.
8. **Facilitate discussion of revised ideas.** Ask a few students to share surprising ideas they read about, to share the statements for which they revised their thinking, and to cite the evidence from the text that prompted them to change their thinking.
9. **Summarize key ideas.** To help students synthesize core concepts, have them rewrite false statements as true statements, based on the evidence in the text. Make sure that the class arrives at a consensus about which statements are true and which are false, based on the text.
10. **Extend learning.** Have students record the evidence from the text that supports one or more of the ideas from the anticipation guide. Alternatively, have students respond to a question that requires them to apply core ideas they learned from reading the text. This could be a group discussion or a writing assignment.

Name: _____ **Date:** _____

Anticipation Guide

1. Before reading *The Human Microbiome: A World Inside You*, read the statements below. If you agree with a statement, write an "A" in front of it. If you disagree with a statement, write a "D" in front of it.
2. After you read the article, circle any statements for which you changed your thinking. Be ready to explain your ideas and to give evidence from the text that caused you to agree or disagree.
3. Select one statement that was most interesting to you. On the bottom of the page, record the evidence from the text to support your thinking.

_____ There are millions of tiny organisms that live on and in your body.

_____ Bacteria are always harmful to humans.

_____ People get sick if there are no bacteria in their guts.

_____ Even though they are only made of one tiny cell, bacteria have the same basic needs as other living things.

_____ Antibiotics (medicine we take for infections) kill only harmful bacteria in the human body.

The Human Microbiome: A World Inside You

There's a world filled with strange creatures. The creatures of this world are invisible, and they're not human. Aliens sometimes threaten to invade the world these creatures call home. . . .

This world is not a far-off planet: it's your body! The creatures are called microorganisms, and your body is home to more than 100 trillion of them. Microorganisms live on your skin, in your gut, in your nose and mouth, and pretty much everywhere else on and in your body.

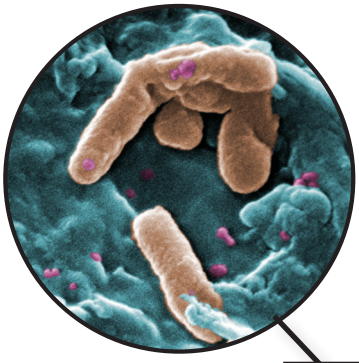
CDC/Dr. Holdeman

Wikimedia/ Arnold Reinhold

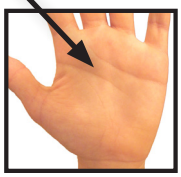
Your tongue is covered with bacteria like the ones in this photo (above), taken through a microscope.

Your Body: Home Sweet Home for Bacteria

The microorganisms living in and on your body range from fungus to eyelash mites, but most of them are bacteria. Bacteria are among the smallest microorganisms on Earth. Each one is made of a single cell—that's the tiny structure that makes up all living things. However, bacteria are not all the same. They come in different shapes, use different things as food, and live in different places. Thousands of different kinds of bacteria live in your body.



CDC/ Janice Haney Carr



Wikimedia/ Sal Elder

This microscope photo shows some bacteria in their natural environment: human skin.

Even though they are so tiny, bacteria are living things with the same basic needs that all living things share, such as food, warmth, and living space. The human body provides bacteria with all these things, and that's what makes our bodies such a good environment for bacteria. Another word for organisms living in an environment is *biome*, so we call the bacteria living in and on the human body "the human microbiome." All together, the bacteria living in an average human's microbiome weigh about 2–5 pounds. The number of bacteria in the microbiome of one human is millions of times greater than the number of people living on Earth!

Wikimedia/Peter Zoon

NASA

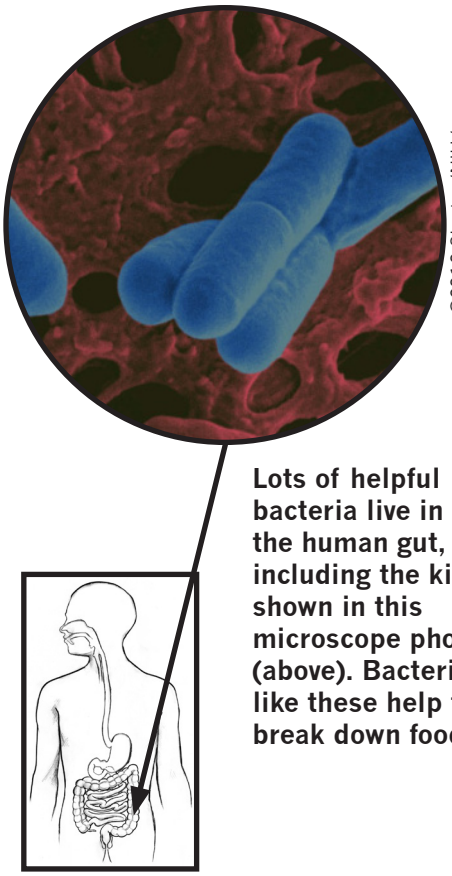
People living on Earth: about 7 billion.

Bacteria living on one human: about 100 TRILLION!

Helpful Bacteria and Alien Invaders

Most bacteria in the human microbiome are harmless. In fact, many bacteria do important jobs for the human body. For example, bacteria living in your gut (the stomach and intestines) help to break down food that your body can't digest on its own. Other bacteria help protect your body from infection. In exchange for food and shelter, the bacteria of your microbiome do their part to keep you healthy. You depend on these bacteria, and they depend on you.

Unfortunately, not all bacteria are helpful. Harmful bacteria can invade the human microbiome through cuts, spoiled food, and even the air we breathe. An invasion of harmful bacteria is called an infection, and infections can make people very sick.



©2010 Sleator/NIH/ Open-i Image Library

NIH/ NIDDK Image Library

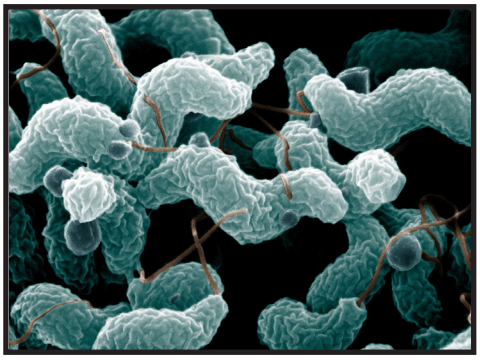
Lots of helpful bacteria live in the human gut, including the kind shown in this microscope photo (above). Bacteria like these help to break down food.

Antibiotics and the Microbiome

Often, doctors treat infections with antibiotics, medicines that kill bacteria. Antibiotics can stop dangerous infections, and they save millions of lives every year. However, antibiotics don't just kill harmful bacteria—they kill helpful bacteria, too! A person who has just taken antibiotics has fewer bacteria than normal. Helpful bacteria will grow back in time, but often the bacteria that return are different from the ones that were there before. Taking antibiotics changes a person's microbiome.

Your Own Little World

Your body is the whole world to the bacteria of your microbiome. It's their home and the environment that provides everything they need. What you do affects them, and they affect you, too. Your body is a world in miniature—a microbiome.



De Wood, Pooley, USDA, ARS, EMU

What people call "food poisoning" isn't caused by poison; it's usually an infection with harmful bacteria such as the ones shown in this microscope photo.

About Disciplinary Literacy

Literacy is an integral part of science. Practicing scientists read, write, and talk, using specialized language as they conduct research, explain findings, connect to the work of other scientists, and communicate ideas to a variety of audiences. Thus, the Next Generation Science Standards (NGSS) and the Common Core State Standards (CCSS) alike call for engaging students in these authentic practices of science. Through analyzing data, evaluating evidence, making arguments, constructing explanations, and similar work, students engage in the same communicative practices that scientists employ in their profession. Through supporting and engaging students in science-focused literacy and inquiry activities that parallel those of scientists, students master discipline-specific ways of thinking and communicating—the disciplinary literacy of science. Strategy guides are intended to help teachers integrate these disciplinary literacy strategies into the science classroom.

About Us

The Learning Design Group, led by Jacqueline Barber, is a curriculum design and research project at the Lawrence Hall of Science at the University of California, Berkeley. Our mission is to create high-quality, next-generation science curriculum with explicit emphasis on disciplinary literacy and to bring these programs to schools nationwide. Our collaborative team includes researchers, curriculum designers, and former teachers as well as science, literacy, and assessment experts.

The Learning Design Group

These materials are based upon work partially supported by the following:
Bill & Melinda Gates Foundation under grant number OPPCR060
Carnegie Corporation of New York under grant number B 8780
National Science Foundation under grant numbers DRL-0822119 and DRL-1119584