STAGE 1 – DESIRED RESULTS

Unit Title: Microbiota

Grade: 2nd grade

Time: 3 lessons (lesson 1 – 1 hour, lesson 2 – 45 minutes, lesson 3 – 30 minutes)

Overview: This interdisciplinary unit consists of 3 lessons. Students will learn about the microbes all around them and on and inside their bodies as well as some of what they do through a read aloud with the book, *Tiny Creatures: The World of Microbes*, by Nicola Davies. They will take samples of microbes from habitats on their bodies (e.g., head, forearm, armpit, belly button, hands) and from their classroom environment (e.g., computer keyboard, doorknob), which then will be plated and incubated. Students will observe the colonies from their samples and record their observations in their Microbiota Lab Notes, which they will use when sharing their findings and any patterns they noticed with the class. On the last day, students will create an art project that represents a microbe of their choice, using what they have learned about microbes and their own creativity. This illustrates the diversity of microbial communities and makes the "invisible" visible and tangible.

Learning Goals/Understandings:

The specific purpose of this unit was for second grade students to (a) develop an understanding of microbes (tiny organisms too small to see without a microscope) and colonies, (b) describe characteristics (shapes, colors, & textures) of microbes and colonies (visible collection of the same microbes), (c) understand that microbes live in communities everywhere, even on our bodies, and (d) dispel the false impressions that all microbes are bad "germs," because most microbes are beneficial to our health and wellness. Most important is fostering a sense of curiosity and excitement about this amazing part of our world.

Essential Question: Are all microbial communities the same?

- What kinds of microbes live on, in, and around us?
  - What are the shapes, colors, and textures of their colonies?
  - Where can we find microbes on our bodies?
  - What are some kinds of microbes?
  - What kinds of jobs do microbes perform?

Students will know:	**Students will be able to:**
• What microbes and colonies are • Characteristics of microbes and colonies (there is a diversity in shapes and sizes of microbes, which varies according to location)	• Ask and answer questions. • Engage in discussions with peers and teacher. • Complete observation notes about the different types of colonies and describe characteristics of these colonies. • Create microbe artwork.

STAGE 2 – ASSESSMENT EVIDENCE

Students will be formatively assessed based on the following:
-KWL Chart
-Microbiota Lab Notes
-Participation in read aloud discussions
-Microbiota art project and associated discussions about their microbes
-Responses to teachers' and peers' questions throughout lessons and during closure

STAGE 3 – LEARNING PLAN

Summary of Learning Activities:

***** Day 1: Building Background Information and Experiment *****

1) Introduction
    a. **Lesson Preparation:** Set up microscope with a slide of microbes. Commercially available, ready-made slides or a fresh slide with baker's yeast are appropriate. Dry baker's yeast from the grocery store can be re-hydrated for these observations. Students will go to the microscope station in groups during the experimental part of this lesson. Alternatively, a video of live cells can be used (https://www.youtube.com/watch?v=iyWtp_L0Kzc).
    b. **Activating Background Knowledge:** Draw a KWL Chart.

What you **K**now? (K)	What do you **W**ant to know? (W)	What did you **L**earn? (L)

    c. Ask students what they think microbes are? What do they do? Write their answers in the K column.
        - Scaffold with questions like "What does *micro* mean?" (small, tiny) "What other words sound like microbe?" (microscope)
    d. Ask students what they want to know. Prompts can guide students to think about how they grow, move, eat, and communicate.
    e. Confirm that microbes are tiny living things (organisms) that are so small we need a microscope to see them. Even though they are tiny, they are extremely important to our world and to our health. Consider using anchor charts and word walls, with sketches next to these new words to assist with vocabulary. Introduce the book *Tiny Creatures: The World of Microbes* by Nicola Davies.
    f. **Building Background Knowledge:** *Tiny Creatures: The World of Microbes* Read Aloud.

- When reading, pause to emphasize three pages and the visuals, to assist with visualization of microbes and collaborative discussions about microbes and microbiota, allowing students to construct knowledge and associate vocabulary with these concepts.
    1. The Paramecium – point out the cilia and explain how these help the microbe move
    2. The characteristics page – highlight the "wiggling tails" and explain that these are flagella that propel the microbe forward. Also highlight the amoeba and explain they move by slowly extending out.
    3. The doubling page – ask students if it is easier to see the 1 microbe, or the 2 pages of microbes. Explain that all of the similar microbes together is called a colony, which can be added to the anchor chart. This is important when they prepare their plates – they need to understand they are picking up single microbes that will grow into visible colonies. Emphasize this distinction.

g. After reading the book, ask students what they learned and fill this column out in the K-W-L chart. With students, summarize the ways in which microbes move, what they eat, where they live, and what they do.

h. Make connections to what students learned about habitat and community. Ask questions such as the following:
    - What is a habitat?
    - What is a community?
    - Do microbes live in a community?
    - What types of jobs do they have in a community? (breaking down food and extracting nutrients; helping plants grow by providing nutrients they can't make, generate natural pesticides so spraying crops is less important; making bread/cheese/yogurt; breaking down rocks; helping clean the environment by using oil for food; helping fight off "bad" microbes (germs) to fight infections; priming our immune system to make us more able to fight infection helping to make snowflakes, etc.)
    - Have they ever thought of their heads or arm pits as habitats?
    - Would our head habitat support the same community of microbes as our arm pit habitat? What are some differences and similarities? (arm pits are dark and more moist than our head)

2) Experiment

a. Students will engage in scientific practices by growing microbial communities from different habitats. Assign volunteers to groups of students. Within the groups:
    a. Take one group of students at a time to view yeast cells with the microscope.
    b. Students should think of two habitats on their bodies or in the classroom that they would like to sample.
        1. Help students develop hypotheses. Some questions to ask to support students with developing their hypotheses include:
            a. Is the white board the same material as the carpet?
            b. Do the same things come in contact with the floor as the door knob? (hands versus feet walking)

c. Why do your feet smell different from your armpits?
d. Does your hair/head get washed as frequently as your hands?
e. Which is more moist – head or armpit?
f. Which gets more light, head or foot?

2. Lead students through labeling their plates.
3. They need to write their initials on the bottom of the plate and the name of the habitat they are swabbing. It is easiest to guide them one plate at a time and discuss why it is important to label their plates this way.
4. Show the students how to open the swabs and take one out. Lead them through opening their swab packet.
    a. Demonstrate swabbing your own head or arm.
    b. Demonstrate rubbing the swab on the plate. Explain that it is like painting. Do not push too hard. Rub the swab all around the plate.

b. Collect the plates and explain that for the microbes to grow into colonies, they need to be kept warm. Put the plates in an incubator, or warm spot in the classroom.

3) Ask if there is anything they would like to add to the KWL chart or if there are any final questions.

*****Day 2: Observations of Agar Plates (at least one week later)*****

2) Summarize Previous Lesson
    a. Review what students know/have learned about microbes.
        i. Microbes are tiny and can only be seen with a microscope
        ii. Microbes live in communities, are found in every habitat, and have specific jobs to do.
        iii. Some microbes can move using a flagella, cilia or move like an amoeba.
        iv. A group of the same microbes is called a colony.
        v. Microbial communities (microbiota) consist of many different types of microbes.
    b. Review the experiments they set up last week.
        i. Revisit essential question: What question is this experiment answering? (Are all microbial communities the same? Do the same microbial communities live in different habitats?)
        ii. What procedure did they follow? (swabbed microbial habitats and put those microbes on the plates that contain nutrients).
        iii. Emphasize that each colony started with one, invisible microbe. Connect back to *Tiny Creatures: The World of Microbes*– 1 doubles to 2, 4, 8, 16 . . . (Have students skip count.)
3) Observations
    a. Hand out students' plates.
        i. Give each student blank Microbiota Lab Notes and remind them that scientists must record their observations so they can be shared with other people. These observations need to be very detailed, so that someone who did not see the

experiment can understand it. Read and discuss directions as a class. Offer scaffolding questions and prompts as needed.
    ii. Students write their name on the tops of pages 1 and 2 and then rip off page 1; this is their word bank.
    iii. Help students complete the chart on page 2, using their sense of sight (and smell) and the word banks on page 1. They may take the lids off to get better views.
    iv. Using their chart and their plates, they then complete pages 3 and 4. They may use their crayons/colored pencils/markers for the drawing portion.
4) Closure: When their lab notes are complete, engage the class with a wrap up.
    a. Ask students to share the colors, shapes, textures, and sizes of microbes they observed. Note if some students saw any of the same characteristics.

*****Day 3: Microbiota Art Project*****

1) Activate Background Knowledge and Reinforce Learning
    a. Ask students to think back to *Tiny Creatures: The World of Microbes* and think about microbes and the different shapes, sizes, and colors that microbes can be.
    b. The following questions can be used to assess and reinforce learning in this unit.
        i. What is a microbe?
        ii. What do you call a whole bunch of microbes living together?
        iii. Where do microbes live?
        iv. How do good microbes help us?
        v. What do bad microbes do?
        vi. Remember when you looked at your microbe plates? What did you observe about the colonies – what did they look like? What were some textures or colors that you noticed?
        vii. What else did you learn about microbes?
        viii. Do you have any other questions about microbes? This question could lead to some follow-up activities in the class.
    c. Have students revisit their Microbiota Lab Notes and show students different pictures of microbes to engage in a discussion with students.
        i. Highlight the different features, including flagella and cilia.
2) Art Project
    a. Tell students that they are going to use their imaginations, as artists and scientists do, along with their knowledge of microbes to create their own microbe, using open-ended art supplies (crayons/colored pencils/markers, scissors, yarn, buttons, glitter glue, pipe cleaners, googly eyes, puzzle pieces, pompoms, stickers, streamers, pipe cleaners, stickers). The supplies will allow 2-D or 3-D creations.
    b. Spread the art bins with art supplies around the room. Provide each student a piece of construction paper.
    c. While they are working, wander the room and ask students to explain their microbe to you and any stories they have about their microbe. For instance, students might share how their microbe has cilia to help it move.
3) Closure
    a. Assemble all microbes together on a table or on the floor to create the "class microbiota." You can hang artwork on display or do a gallery walk as well.
    b. Engage in a whole class discussion about students' microbial artwork.

i. Tell us about your microbe.
    1. Where does it live?
    2. How does it move?
    3. How does it communicate?
    4. What is its job in the community?

ii. Foster connections about what they learned about microbes to their microbe artwork and the art supplies they used. Note the diversity of the class microbiota and how that mirrors the diversity within microbial communities that are in, on and around us.

iii. Revisit KWL chart to discuss what students have learned.

4) Opportunities for Unit Extension
    a. More sophisticated scientific knowledge about microbial movement can be introduced for older students). Flagella (singular, flagellum = "whip") are whip-like appendages found on bacteria such as *Escherichia coli*, part of human microbiota. The flagellum rotates like a propeller to move the organism. Paramecia are covered in cilia (singular, cilium = "eyelash"), hair-like structures that beat in unison to move the organism. Amoeba move via pseudopodia, meaning "false feet," temporary projections that extend the cell to "crawl" forward.
    b. Ask students to write a story about their art microbes. Encourage them to think about the class microbiota and the job their microbe has in that community.
    c. Students may perform a microbiota dance. Review the ways microbes move and communicate and ask students to be a microbe and select a movement that represents their microbe. The class then performs their dances/movements simultaneously. As one "microbe" nears another, it might change its behavior.

Materials:

- *Tiny Creatures: The World of Microbes* by Nicola Davies
- Microscope and power supply
- Yeast (live yeast or dry baker's yeast from the grocery store)
- If a microscope is unavailable, there are good videos of live yeast under the microscope available online (e.g. https://www.youtube.com/watch?v=iyWtp_L0Kzc) or amoeba and paramecia (e.g., https://www.youtube.com/watch?v=4XlzCe5gDu0)
- Chart paper and markers
- Agar plates – either Luria-Bertani broth or beef broth/beef bouillon (e.g. https://www.madaboutscience.com.au/shop/free-experiments/post/grow-bacteria-on-homemade-agar-plates/)
- Agar
- Sterile swabs
- Microbiota Lab Notes
- Art supplies and construction paper