Unit Activities:

Setting the Stage, Objectives, Bacteria Lab

Inquiry Learning:

1. Engage 2. Explore

Materials:

Supplies: Petri plates, parafilm, hand sanitizer, hand soap, sharpie markers

Student Handouts:

-Bacterial Growth Experiment: Set Up (pg. 11)

Learning Objectives:

Students will be able to:

1. Apply Scientific Method to conduct an investigation
2. Identify the variable and control in a scientific investigation
3. Follow appropriate lab rules and safety procedures

Virginia Standards:

LS.1-B, D, F, G, J

Activities:

Setting the Stage (10 minutes)

Purpose: To help students make connections between past and present learning experiences, lay the organizational ground work for the activities ahead and stimulate their involvement in the anticipation of these activities.

Displayed on board as students enter the room: **On a scale of 1-10, how clean do you think your hands are right now? (1=dirtiest, 10=cleanest). Make a list of 10 things you have touched since you last washed your hands.**

- Ask students to write down their response to the question. Allow 3-5 minutes for students to do so.
- Allow students to share their responses with the class.
- Pose questions for discussion
    - After considering the things you've touched, do any of you think you gave yourself too high a score?

Inform Learners of the Objectives (3 minutes)

Tell students**: Today we are going to conduct a lab to learn about bacteria, where it grows, and how you can avoid getting sick from bacteria.**

Activities:

Bacteria Growth Lab: Set-up (40 minutes)

Purpose: To provide students with an opportunity to get directly involved with the scientific materials and develop a base of experience with new concepts.

- Follow the procedures of **Bacterial Growth Experiment: Set-Up** (pg. 11) sheet
- Provide each student with a lab sheet handout.
- Students should record their procedures as they set up the experiment.
- Remind students that there are 3 variables in their treatments:
  - Temperature of water
  - Length of time
  - Presence/absence of soap
- Ask each student (or lab group) to brainstorm a hypothesis for this experiment.
- Students will observe their Petri plates for two days and record their observations on their lab sheet.
- Refer to **Bacterial Colony Growth Descriptors** (pg.14) to help students describe their observations.
- Be sure to review **SAFETY Procedures** for Science Laboratories and Materials on **page 8.**

Safety Procedures for Science Laboratories and Materials

- *Bacterial Growth Lab: Set-up* (pg. 11)
    - Petri plates should be sealed with Parafilm, then placed upside down in a secure location and not touched until observations are made on Day 2 and 3.
    - Anytime students touch the Petri plates, they should wear gloves and, once they are finished, immediately wash their hands for 20 seconds with warm water and soap.

- *Preparing and Staining Wet Mount Slides* (pg. 38)
    - Adequate adult supervision is the key to student safety.
    - Students should wash their hands and put on gloves.
    - Remind students that all laboratory safety rules apply, especially: no food or drink, and no horseplay.
    - Encourage students to not touch clothes, face, hair, etc.
    - A teacher/helper should open and hold the Petri plates while students use their loops to remove bacterial colonies.
    - Petri plates should be closed immediately after use.
    - Loops should be thrown away immediately after use.
    - Wet mount slides should be allowed to air dry completely in a secure location since bacterial cells may still be alive.
    - Crystal Violet stain is permanent, so students should be reminded frequently to be careful when applying drops to their slides. The staining procedure should kill bacteria cells.
    - After removing gloves, students should wash their hands thoroughly.

- **Disposal and Disinfection: Must be handled by teacher only.**
    - Using the spray bottle and bleach provided in the science kit, create a 50% bleach solution (1 part bleach: 10 parts water).
    - Petri Plates: Open plate and spray 2-3 sprays of 50% Bleach Solution, close plate, and place in Ziploc bags.
    - Microscope slides: Place all slides in a Ziploc bag and spray with a generous (~5 sprays) amount of 50% Bleach Solution.
    - Loops and Gloves: Dispose into a regular trash bag along with Ziploc bags of Petri plates and microscope slides and spray with a generous (~10 sprays) amount of 50% Bleach Solution.
    - Countertops and Equipment (i.e microscopes, pencils, etc.): Use sanitizing wipes and/or 50% bleach solution spray with paper towels to clean all surfaces used and/or touched during the lab activity.
    - Sanitize student desks each day after handling the Petri plates or performing the lab activities.

Teacher's Copy

Bacterial Growth Experiment: Set Up

Materials:
1 pre-poured SMA plate per student
Hand soap
Hand sanitizer
Secure location for plate incubation
1 Sharpie Marker per student
Parafilm

Procedures: (What did you do to set up this experiment?)

1. Have each student shake hands with at least 5 other students.
2. Have each student draw a line to divide the Petri plate in to two halves. Label one side of the Petri plate along the edge of the bottom of plate (side with printed writing) using small letters with the following information:
   Name
   Date
   Teacher's Name
   Hands Unwashed

3. Have each student label the second side of the Petri plate with the following information:
   Their treatment

4. Have students touch the surface of the Petri plate with all five fingers like they were being fingerprinted.
5. Divide students into groups of three. Give each group member a different condition:
   a. wash hands in cold water with no soap for 5 seconds
   b. wash hands in warm water with soap for 20 seconds
   c. use a hand sanitizer with no water or soap
6. Allow time for students to execute their treatment. Then have them touch the surface of their second Petri plate with all five fingers.
7. Wrap plates in Para film and incubate the plates upside down at room temperature for 48 hours.

Each day, students will record observations of their Petri plates. It is important to remind students not to open the lids of the Petri plates.

Hypothesis: (What do you think is going to happen in this experiment?)

Possible hypotheses include:

A lot of bacteria will grow on the plates with unwashed hands.
The plates with just cold water will have more bacteria than those with warm water and soap for 20 seconds.
The plates with hand sanitizer will not have any bacteria.

Day 2: Observations

Colony count:

Explain to students that each "clump" of growth represents one **colony forming unit** (cfu). Ask students to count the number of colonies growing on each of their plates. If the number is too large to count have students divide the plate in quarters and count only one section. If they do this, it is important that they mark their plates to show which quarter they counted so they can count the same section on the following day.

Describe colonies:

Provide students with a list of words commonly used to describe bacterial colonies such as:

- Size. Pinpoint, small, medium, or large, based on the relative differences between the largest and smallest colonies seen.
- Shape and margins. Round, regular or irregular.
- Elevation. Flat, rounded, craterlike (with depressed center).
- Consistency. Shiny or rough.
- Color. Describe the color as accurately as possible, distinguishing between different types of gray or white, yellows, and red.

****Do NOT touch colonies growing on your plate. Once you have finished recording your observation, wash your hands thoroughly with soap and warm water.****

Day 3: Observations

Colony count:

Students should recount each entire plate (or quarter plate) to ensure they account for all new growth.

Describe colonies:

Display the list of descriptive words for bacterial colonies

****Do NOT touch colonies growing on your plate. Once you have finished recording your observation, wash your hands thoroughly with soap and warm water.****

Bacterial Growth Experiment: SET UP

Materials:
1 pre-poured SMA plate per student
Hand soap
Hand sanitizer
Sharpie Marker
Secure location for plate incubation
Parafilm

Procedures: (What did you do to set up this experiment?)

Hypothesis: (What do you think is going to happen in this experiment?)

Day 2: Observations

Colony count: Control: Treatment:

Describe colonies:

****Do NOT touch colonies growing on your plate. Once you have finished recording your observation, wash your hands thoroughly with soap and warm water.****

Day 3: Observations

Colony count: Control: Treatment:

Describe colonies:

****Do NOT touch colonies growing on your plate. Once you have finished recording your observation, wash your hands thoroughly with soap and warm water.****

Unit Activities: Review, Collect Data, Bacteria Brainstorm, Bacteria Lecture

Inquiry Learning: 3. Explain

Materials: Supplies: Gloves, Introduction to Bacteria PP, computer

Student Handouts: -Bacterial Growth Experiment: Set Up (pg.11)
-Bacteria Concept Map (pg.21)

Learning Objectives:

Students will be able to:

1. Accurately collect data in a scientific investigation
2. Connect prior knowledge to new concepts about bacteria
3. Understand basic differences between bacteria cells and plant and animal cells

Virginia Standards: LS.1-B
LS.2-D
LS.9-A, D

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday we set up a bacterial growth experiment. What do you think the bacteria will look like when you look at your Petri plates today? Today we are going to observe and collect data from your experiments and we are going to learn about bacteria.**

Collect Data (10 minutes)

- Have students put on gloves and observe Petri plates. Students should write down observations of plates on Bacterial Growth Experiment worksheet.

Brainstorming About Bacteria (10 minutes)

- On a large piece of drawing paper (or the board) write the word: **Bacteria** large enough that all students can see it.
- Ask students to volunteer any information they know about bacteria.
- Record student responses in the format of a concept map on the drawing paper.
- At this stage, the focus is not on correct answers, merely on brainstorming to assess prior knowledge of the concept.
- Student knowledge will vary depending on how much prior learning they've had on bacteria.

Activities:

Introduction to Bacteria Presentation (20 minutes)

Purpose: To help students begin to understand, in greater depth, the materials and concepts they explored in the previous activities.

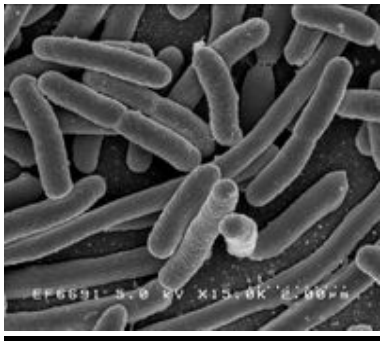
Learner Level: Average-High

- Use the PowerPoint presentation *Introduction to Bacteria*
- Students should complete the graphic organizer **Bacteria Concept Map** during the presentation.
- Be sure to allow time for students to fill in their concept map throughout the presentation.

Learner Level: Low-Average

- Use the PowerPoint presentation *Introduction to Bacteria*
- Divide students into small groups of 2-3
- Assign each group one main heading from the **Bacteria Concept Map** graphic organizer
- Each group should listen carefully for all information related to their heading and fill in only their section during the presentation.
- After the presentation, have each group share what they recorded with the rest of the class so that each group has a complete concept map.

Bacterial Colony Growth Descriptors



- **Size**
  - o pinpoint
  - o small
  - o medium
  - o large

- **Shape and Margins**
  - o round
  - o regular or irregular
  - o flat, rounded, craterlike (with depressed center).

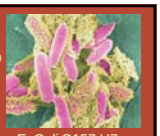
- **Consistency**
  - o Shiny or rough.

- **Color**.
  - o Describe the color or shades accurately
  - o gray
  - o white
  - o yellows
  - o red

Introduction to Bacteria

What are bacteria?

- Single celled organisms
- Very small
- Need a microscope to see
- Can be found on most materials and surfaces
  - Billions on and in your body right now



E. Coli O157:H7 can make you very sick.

Streptococcus can cause strep throat.

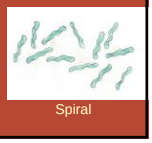
This *E. coli* helps you digest food.

What do they look like?

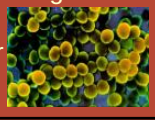
- Three basic shapes
  - Rod shaped called bacilli (buh-sill-eye)
  - Round shaped called cocci (cox-eye)
  - Spiral shaped
- Some exist as single cells, others cluster together

Bacilli

Cocci

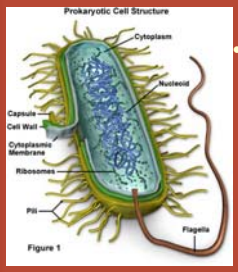


Spiral



Cluster of cocci

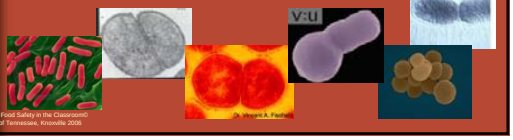
Bacteria are ALIVE!



- What does it mean to be alive?
  - They reproduce (make more of themselves)
  - They need to eat

How do bacteria reproduce?

- Grow in number not in size
  - Humans grow in size from child to adult
- Make copies of themselves by dividing in half
  - Human parents create a child



How do bacteria eat?

- Some make their own food from sunlight—like plants
- Some are scavengers
  - Share the environment around them
    - Example: The bacteria in your stomach are now eating what you ate for breakfast
- Some are warriors (pathogens)
  - They attack other living things
    - Example: The bacteria on your face can attack skin causing infection and acne

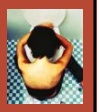
Photosynthetic bacteria

Harmless bacteria on the stomach lining

E. Coli O157:H7 is a pathogen

What is a pathogen?

- Bacteria that make you sick
  - Why do they make you sick?
    - To get food they need to survive and reproduce



  - How do they make you sick?

    - They produce poisons (toxins) that result in fever, headache, vomiting, and diarrhea and destroy body tissue

Where do you get a pathogen?

Indirect contact

- Contact with people who are sick
  - Direct or indirect
- Food, Water, or other Surfaces that are contaminated

Foods that could be contaminated

Direct contact

A Closer Look – Where do you get a pathogen

Indirect Contact

Direct Contact

Foods and water may be contaminated

Are all bacteria pathogens?

- No, most are harmless
- Some are even helpful
  - Examples of helpful bacteria:
    - *Lactobacillus*: makes cheese, yogurt, & buttermilk and produces vitamins in your intestine
    - *Leuconostoc*: makes pickles & sauerkraut
    - *Pediococcus*: makes pepperoni, salami, & summer sausage





A Closer Look – Helpful Bacteria

www.bioweb.usu.edu


Pediococcus - used in production of fermented meats


Lactobacillus casei – found in human intestines and mouth to improve digestion

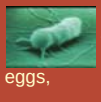

Leuconostoc cremoris – *used in the production of buttermilk and sour cream*

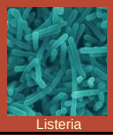

Lactobacillus bulgaricus – *used in the production of yogurt*

What are some common pathogens?


E. coli O157:H7

- Pathogenic *E. coli* (like O157:H7)
  - Found in ground beef, contaminated fruits and vegetables
- *Salmonella*
  - Found in raw meats, poultry, eggs, sprouts, fruit and vegetables
- *Listeria*
  - Found in deli foods, lunch meats, smoked fish and vegetables


Salmonella


Listeria

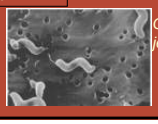
Examples of Pathogens

Salmonella

E. coli O157:H7

What shape are these bacteria?
Cocci, bacilli, or spiral?

Staphylococcus aureus



Campylobacter jejuni

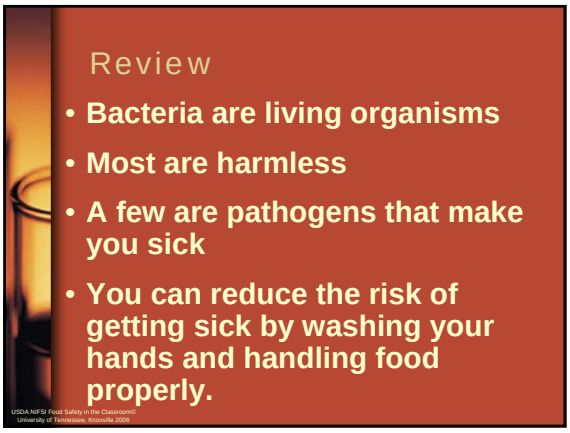
How can I avoid pathogens?

- Wash your hands often so you won't transfer bacteria to your mouth or food
  - Warm water with soap for 20 seconds, rub hard between fingers and nails

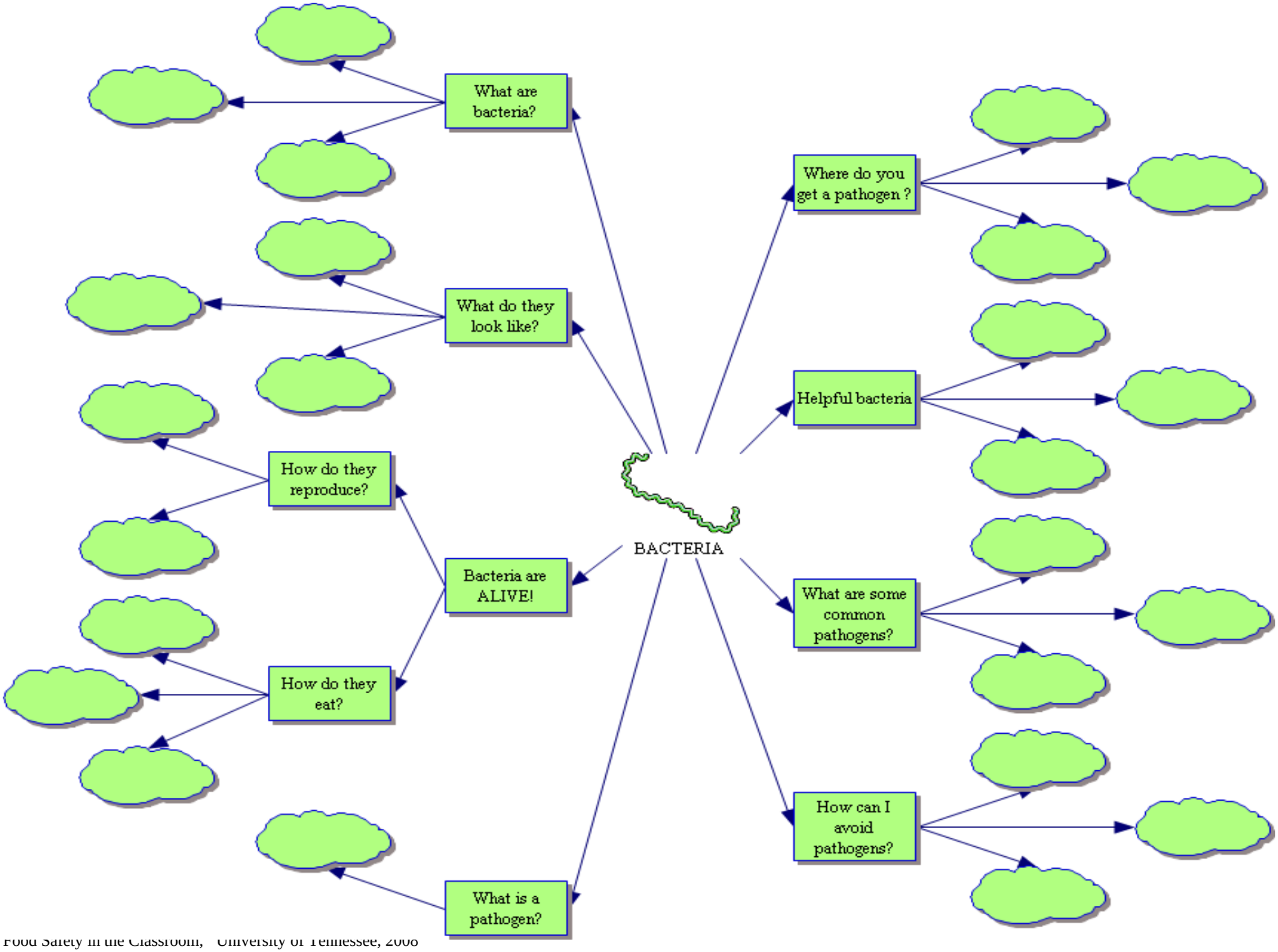
How can I avoid pathogens?

- Cook food thoroughly to kill any pathogens that may be in your food

- Store food properly to limit pathogen growth
  - Cold temperatures (40°F)


Review
• Bacteria are living organisms
• Most are harmless
• A few are pathogens that make you sick
• You can reduce the risk of getting sick by washing your hands and handling food properly.
USDA NIFSI Food Safety in the Classroom©
University of Tennessee, Knoxville 2006

Bacteria Concept Map



Unit Activities:	Review, Collect Data, Complete Lecture, RAFT
Inquiry Learning:	4. Elaborate
Materials:	Gloves, Markers, Construction Paper
Student Handouts:	Bacterial Growth Experiment: Set Up (pg.11)

Learning Objectives:	Students will be able to: 1. Accurately collect data 2. Synthesize information about pathogens and helpful bacteria into a product that clearly communicates an understanding of bacterial growth
Virginia Standards:	LS.1-B, J

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday we learned about bacteria. What did you learn yesterday that you did not know before? Today you are going to use your imaginations to share what you've learned about bacteria with others.**

Collect Data (10 minutes)

Have students put on gloves and observe Petri plates. Students should write down observations of plates on Bacterial Growth Experiment worksheet.

Complete Lecture (10 minutes)

- Finish discussing information from day before
- Make sure students have concept maps filled out
- Add to brainstorming chart about Bacteria from previous day

RAFT Activity (20 minutes)

Purpose: To provide opportunities for students to expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them.

- Display the RAFT chart on the overhead or board (page 23).
- Assign each student (or pairs) one of the roles. You may allow students to choose groups and assignments or make assignments based on ability levels and learning styles.
- Students will then assume the role of their assignment and create the prescribed product.
- Once the products have been completed, students should present their work to the class.

Example: Students will write as though they are a helpful bacteria writing to a group of teenagers. The writing will take the form of a rap song on the topic of "Can I help U?"

Bacteria RAFT

Role	Audience	Format	Topic
Helpful bacteria	Teenagers	Rap song	"Can I help U?"

Points to include:	• Examples of helpful bacteria	• Foods made with helpful bacteria	• Other interesting information about helpful bacteria

Role	Audience	Format	Topic
Bacteriologist	Patients in a doctor's waiting room	Most Wanted Poster of foodborne pathogens	"Wanted: Dead or Alive"

Points to include:	• What is a pathogen? • Describe how you might come in contact with a pathogen.	• What is the best way to avoid getting sick from pathogens?	• Description • Aliases • Known Associates

Unit Activities:

Review, RAFT, Aggregating Data

Inquiry Learning:

4. Elaborate

Materials:

Gloves, sharpie markers, student Petri plates

Student Handouts:

-Bacterial Growth Experiment: Aggregating Data (pg. 27).

Learning Objectives:

Students will be able to:

1. Interpret data collected from scientific investigation
2. Recognize sources of error and bias
3. Draw conclusions from data from a scientific investigation

Virginia Standards:

LS.1-A, B, E, F, I, J

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday you started creating your RAFT assignments to share with your new knowledge of bacteria. Was it hard pretending to be bacteria? What was the hardest part of this assignment? Today you are going to present your RAFT products to the class and we are going to complete the lab experiment that you started on Monday.**

Complete RAFT activity (20 minutes)

- Have students finish and present RAFT activity from previous day

Aggregating Data (30 minutes)

- Aggregate the class data by recording student plate counts by treatment.
    - To save class time, consider passing around a form for students to record their plate counts on one day and presenting them with a completed data set when you begin this activity.
- Total and average the amount of growth in each treatment.
- Ask students to consider explanations for the trends and discrepancies they notice in the data.
- Pose questions for discussion:
    - Why are plate counts so different even in the same treatments? (washed for different amounts of time, touched doors after washing hands, pressed harder on Petri plates, etc.)
    - What surprises you about the results?
    - Do you think our data is accurate?
    - What could we do to make our results more reliable?
    - Were your hypotheses correct?
- Students should then draw conclusions based on the experiment results and answer **Questions for Consideration.**
- Be sure to review **SAFETY Procedures** for Science Laboratories and Materials **(pg. 8).**

Teacher's Copy

Bacterial Growth Experiment: Aggregating Data

Class Data

Record the number of colonies grown on each plate for each student on the board. Students should record totals on their lab worksheet. (Example shown below)

Treatment 1:

Unwashed	Cold Water/No Soap
15	10
36	30
18	19
20	5
24	22

Totals: 113/86

Treatment 2:

Unwashed	Warm Water/Soap
16	5
18	2
29	10
7	5
22	15

92/37

Treatment 3:

Unwashed	Hand Sanitizer
14	2
38	10
62	5
23	8
16	2

153/27

*To save class time, consider gathering this data from students the day before and preparing a completed data set to give to students when you conduct this activity.

This can be done with any of the following modifications:

- Passing around a form for students to fill in their plate totals and running copies
- Entering student data into a spreadsheet and running copies
- Entering student data into an excel graph and giving a copy to each student

Totals: Determine the total for each column in each treatment.

Averages: Average the totals for all unwashed and for each of the other treatments.

Example: Unwashed: 23.86 Cold Water/No Soap: 17.2 Warm Water/Soap: 7.4 Hand Sanitizer: 5.4

Class Data Observations:

After recording each student's plate counts, encourage students to make observations about the data. What trends do they notice? How do they explain discrepancies?

Do these trends hold true when the counts are totaled? When they are averaged?

Conclusions:

Based on the results of the data, have students generate conclusions. Were they able to answer their hypothesis?

Bacterial Growth Experiment: Aggregating Data

Questions for Consideration: Answer each of the following questions.

1. Did the amount of time spent washing your hands and the use of soap or sanitizer affect the amount of growth on the plates? If so, how?

Students should answer this question based on the class data collected. Results will vary from class to class.

2. It is common for children to get sick more often once they start school. Why do you think this happens? How could a school child avoid getting sick more often?

Possible answers include: Children are around more people at school than they were at home, and germs are easily spread from person to person by contact with toys, books, each other, etc. They could avoid getting sick by washing their hands regularly.

3. Why is it important to wash your hands before handling food?

Possible answers include: The bacteria on your hands can be easily transferred to your food and make you sick.

Bacterial Growth Experiment: Aggregating Data

Class Data

Treatment 1:

Unwashed	Cold H_2O 5 Seconds

Treatment 2:

Unwashed	Warm H_2O Soap 20 Sec

Treatment 3:

Unwashed	Hand Sanitizer

Totals:
Averages:

Class Data Observations: What trends do you notice in the data?

Conclusions: Based on the data, what is the answer to your hypothesis?

Questions for Consideration: Answer each of the following questions.

1. What could have happened in the Lab Set Up that led to unexpected outcomes in your data?

2. Did the amount of time spent washing your hands and the use of soap or sanitizer affect the amount of growth on the plates? If so, how?

3. It is common for children to get sick more often once they start school. Why do you think this happens? How could a school child avoid getting sick more often?

4. Why is it important to wash your hands before handling food?

Unit Activities:	Review, Researchable Question, Microscope Introduction
Inquiry Learning:	4. Elaborate
Materials:	Microscopes, slides, dropper bottles with water, toothpicks, iodine solution
Student Handouts:	-Generating a Researchable Question (pg.30) -Microscope Lab Handout (pg. 32).

Learning Objectives:	Students will be able to: 1. Design a scientific investigation 2. Demonstrate understanding of controls and variables in a scientific investigation 3. Select appropriate tools and methods for a scientific investigation 4. Recognize basic parts of a compound microscope 5. Demonstrate appropriate care and use of compound light microscopes
Virginia Standards:	LS.1-I, J

Activities:

Review (5 minutes)

- Daily Review Question: **Yesterday we gathered class data from your bacterial growth experiment. Were you surprised by the number of bacteria on your hands? Did any of you find yourselves washing your hands more often after class yesterday? Today you are going to work in groups to design a new experiment, and we are going to learn how to use a microscope.**

Generating a Researchable Question (30 minutes)

- Allow students to work in small groups to complete **Generating a Researchable Question (pg.30).** Examples and possible answers for all lab follow-up activities are included on the Teacher's Copy of the **Bacterial Growth Lab: Generating a Researchable Question sheet (pg. 29**).
- Encourage students to share their researchable questions and experiment design with the class.
- Students should complete the **Bacterial Growth Lab Self-Assessment (pg.31)** once these activities are completed.

Microscope Introduction (20 minutes)

- The purpose of this activity is to familiarize students with the microscope before they view bacterial cells in a later lesson.
- Students should follow the procedures outlined on the Microscope Lab handout.
- Encourage students to pay close attention to detail when drawing their observations in the data sections.

Teacher's Copy

Bacterial Growth Experiment: Generating a Researchable Question

Generating a Researchable Question:

1. As a group, brainstorm three things you would like to know more about as a result of this experiment or its results.

a.

b.

c.

Possible ideas could include: changing only on variable in the treatment (temperature of water, length of time, presence/absence of soap), transfer of bacteria to food, various growth conditions of bacteria (temperature, light, application of chemicals), bacteria found on surfaces throughout the classroom and school, cleanliness of cafeteria/food handlers, etc.

Try to steer students away from the obvious change of washing hands for 40 seconds, 90 seconds, etc.

2. Choose one of your ideas from above and reword it as a researchable question.

(Example: What would happen if we stored our bacterial growth plates under a heat lamp instead of at room temperature?)

Researchable Question:

3. Design a simple experiment to test your researchable question: (What steps would you take to get an answer to your question?)

There is no right or wrong way to design an experiment to test their researchable question, however, the experiment design should be reasonable, logical, well thought out, and have a reasonable chance of successfully addressing their question.

4. As a group, brainstorm a hypothesis for your researchable question. (What do you think would happen if you did the experiment you outlined above?)

Hypotheses will vary widely, but they should be directly related to the researchable question and experiment design.

Bacterial Growth Experiment:
Generating a Researchable Question

1. As a group, brainstorm three things you would like to know more about as a result of this experiment or its results.

   a.

   b.

   c.

2. Choose one of your ideas from above and reword it as a researchable question.

(Example: What would happen if we stored our bacterial growth plates under a heat lamp instead of at room temperature?)

Researchable Question:

3. Design a simple experiment to test your researchable question: (What steps would you take to get an answer to your question?)

4. As a group, brainstorm a hypothesis for your researchable question. (What do you think would happen if you did the experiment you outlined above?)

Bacteria Growth Lab Self-Assessment

0	1	2	3	4	5	I followed all lab procedures and safety rules.
0	1	2	3	4	5	I recorded observations from each of my Petri plates for two days.
0	1	2	3	4	5	I completed each of the questions found on my lab sheet.
0	1	2	3	4	5	I participated in the collection and analysis of class data.
0	1	2	3	4	5	My group produced at least one researchable question.
0	1	2	3	4	5	My group designed an experiment to test our researchable question.

_____

TOTAL: /30 points

Bacterial Growth Lab Self-Assessment

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0	1	2	3	4	5	I recorded observations from each of my Petri plates for two days.
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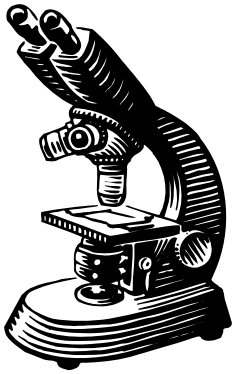
0	1	2	3	4	5	I participated in the collection and analysis of class data.
0	1	2	3	4	5	My group produced at least one researchable question.
0	1	2	3	4	5	My group designed an experiment to test our researchable question.

_____

TOTAL: /30

Microscope Lab



Objectives:

- → To learn the parts of a microscope.
- → To find specimens using low and high power.
- → To make a wet mount slide.
- → To view your own human check cells under the microscope.

Part 1 Procedure: Letter "e"

1. Cut out the letter "e" from the word "Microscope" above and place it face up on the slide.
2. Add a drop of water to the slide.
3. Place the cover slip on top of the "e" and drop of water at a 45-degree angle and lower. Draw what is on the slide in **FIGURE 1**.
4. Place the slide on the stage and view in low power (4x). Center the "e" in your field of view. Draw what you see in **FIGURE 2**.
5. Move the slide to the left; what happens? Move the slide to the right; what happens? Up? Down?
6. View the specimen in high power (10x). Use the fine adjustment **only** to focus. Draw what you see in **FIGURE 3**.

Data:

FIGURE 1: **FIGURE 2:** **FIGURE 3:**

Microscope Lab

Analysis:

1. How does the letter "e" as seen through the microscope differ from the way an "e" normally looks?

2. When you move the slide to the left, in what direction does the letter "e" appear to move? When you move it to the right? Up? Down?

3. How does the ink appear under the microscope compared to normal view?

4. Why does a specimen placed under the microscope have to be thin?

Part 2 Procedure: Cheek Cells

1. Place a small drop of iodine solution onto a clean slide.
2. Using a toothpick, gently scrape the inside of your cheek.
3. Place the toothpick tip into the iodine and mix. The iodine stains the cells so you can see them.
4. Place the slide under low power (4x). Draw what you see in **FIGURE 4**.
5. Switch to high power (10x or 40x). Draw 2 cells in **FIGURE 5**. Label the nucleus, cell membrane, and cytoplasm.

Data:

FIGURE 4: **FIGURE 5:**

Analysis:

1. Why was it important to add iodine to your cheek cells?

2. What part (structure) in the cheek cell was stained the darkest? Why do you think this is?

3. Is your cheek cell an animal, plant, or bacteria cell?

Unit Activities:	Review, Complete Microscope Introduction, Edible Cells
Inquiry Learning:	4. Elaborate
Materials:	Edible Cell materials (see pgs. 35-36)
Student Handouts:	Microscope Lab Handout (pg.32), Edible Cells Handout (pgs. 35-36).

Learning Objectives:	Students will be able to: 1. Recognize basic parts of a compound microscope 2. Demonstrate appropriate care and use of compound microscopes 3. Recognize and understand major organelles in bacterial cells 4. Compare and contrast bacteria cells with plant and animal cells. 5. Apply safe food handling behaviors
Virginia Standards:	LS.1-D, J LS.2-A

Activities:

Review (5 minutes)

Daily Review Question: **Last week we learned a lot about bacteria, how it can help us, and how it can make us sick. Today we are going to build a model of a bacterial cell using food. What are some important safe food handling rules that we need to follow?**

Complete Microscope Introduction (10 minutes)

Purpose: To familiarize students with the microscope before they view bacterial cells in a later lesson.

- Students should follow the procedures outlined on the **Microscope Lab** handout.
- Encourage students to pay close attention to detail when drawing their observations in the data sections.

Edible Cells (40 minutes)

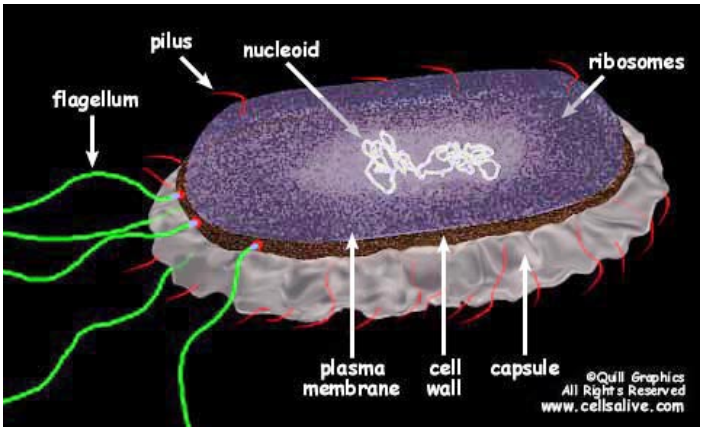
Purpose: To familiarize students with the structure of a bacterial cell while allowing them an opportunity to practice safe food handling.

- Decide which version of the **Bacteria Cell Model** activity you will use. Give each student a copy of the **Bacterial Cell Model** handout.
- Remind students to wash their hands thoroughly before beginning this activity and before eating.
- Use sanitizing wipes to clean and disinfect students' desks and other surfaces used in this activity before you begin.
- Lead students through the construction of their cell models.
- Explain each cell "component" as students are constructing their models.

Bacterial Cell Model: Edible Cell Model

Ingredients:

Paper plates
Sugar Cookies
Frosting
Chocolate chips
Twizzler bites
M&Ms
Shredded coconut
Gummy worms



Parts of a bacterial cell:

The **cell capsule** lets some things in and keeps other things out. It includes a cell wall and plasma membrane. This layer protects the bacterial cell and is often associated with pathogenic bacteria because it serves as a barrier against phagocytosis by white blood cells.

The **cytoplasm** is the liquid material inside the cell where the functions for cell growth, metabolism, and replication are carried out.

The **ribosomes** make proteins. Ribosomes give the cytoplasm of bacteria a granular appearance in electron micrographs. Though smaller than the ribosomes in eukaryotic cells, these inclusions have a similar function in translating the genetic message in messenger RNA into the production of proteins.

Flagella—The purpose of flagella (sing., flagellum) is to move the cell around. Flagella are long appendages which rotate by means of a "motor" located just under the cytoplasmic membrane. Bacteria may have one, few, or many flagella in different positions on the cell.

Pili are hair-like structures on the surface of a cell that connect the bacterium to another of its species and build a bridge between the cytoplasm of either cell so that plasmids can be exchanged.

Nucleoid—DNA in the bacterial cell is generally confined to this central region. Though it isn't bound by a membrane, it is visibly distinct (by transmission microscopy) from the rest of the cell interior.

Plasmids—Along with chromosomal DNA, most bacteria also contain small independent pieces of DNA called plasmids that often encode for traits that are advantageous but not essential to their bacterial host.

Instructions for building a cell model:

Your sugar cookie is the **cell capsule**. Lay it flat on the plate.

Cover the top of the cookie with frosting. This is the **cytoplasm**!

Add a twizzler bite. This is the **nucleoid** (DNA).

Cover with a few pieces of M&Ms. They are the **plasmids**.

Attach the **flagella** by placing a gummy worm on the edge of the cell.

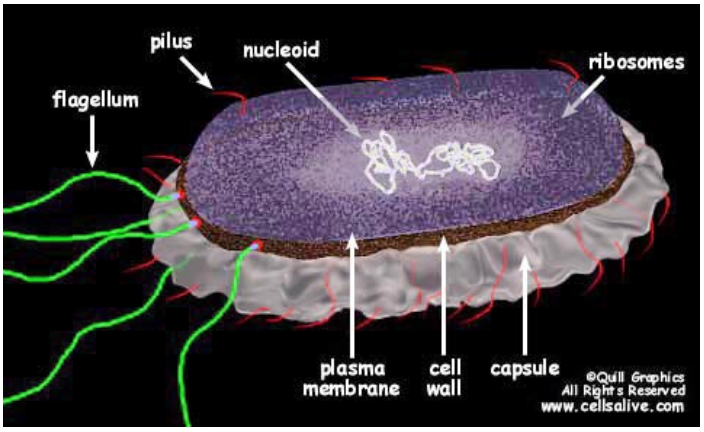
Add **pili** by sprinkling shredded coconut around the edges of the cookie.

Add the **ribosomes** or chocolate chips throughout the cell.

You're ready to eat your cell model! Enjoy!

Bacterial Cell Model: Tortilla Cell

Ingredients:
Paper plates
A large flour tortilla
Pizza Sauce
Shredded cheddar cheese
Pepperoni
Canned sliced olives
Canned sliced mushrooms



Parts of a bacterial cell:

The **cell capsule** lets some things in and keeps other things out. It includes a cell wall and plasma membrane. This layer protects the bacterial cell and is often associated with pathogenic bacteria because it serves as a barrier against phagocytosis by white blood cells.

The **cytoplasm** is the liquid material inside the cell where the functions for cell growth, metabolism, and replication are carried out.

The **ribosomes** make proteins. Ribosomes give the cytoplasm of bacteria a granular appearance in electron micrographs. Though smaller than the ribosomes in eukaryotic cells, these inclusions have a similar function in translating the genetic message in messenger RNA into the production of proteins.

Flagella—The purpose of flagella (sing., flagellum) is to move the cell around. Flagella are long appendages which rotate by means of a "motor" located just under the cytoplasmic membrane. Bacteria may have one, few, or many flagella in different positions on the cell.

Pili are hair-like structures on the surface of a cell that connect the bacterium to another of its species and build a bridge between the cytoplasm of either cell so that plasmids can be exchanged.

Nucleoid—DNA in the bacterial cell is generally confined to this central region. Though it isn't bound by a membrane, it is visibly distinct (by transmission microscopy) from the rest of the cell interior.

Plasmids—Along with chromosomal DNA, most bacteria also contain small independent pieces of DNA called plasmids that often encode for traits that are advantageous but not essential to their bacterial host.

Instructions for building a cell model:

Your tortilla is the **cell capsule**. Lay it flat.

Spread the pizza sauce on it. This is the **cytoplasm**!

Add the **ribosomes** or sliced mushrooms throughout the cell.

Add the **flagella** and **pilli** by sprinkling shredded cheddar cheese on the tortilla.

Add a sliced olive. This is the **nucleoid**.

Cover with a few pieces of **pepperoni**. These are the plasmids.

You're ready to eat your tortilla cell! Enjoy! (Optional: Heat the tortilla cell to melt cheese.)

Unit Activities: Review, Staining Slides, Reflection Writing

Inquiry Learning: 4. Elaborate 5.Evaluate

Materials: Slides, clothes pins, loops, gloves, sharpie markers, student Petri plates, dropper bottles with stain, dropper bottles with water, sanitizing wipes, paper towels, bleach disinfectant

Student Handouts: -Preparing and Staining Slides (pg. 38).

Learning Objectives: Students will be able to:

1. Evaluate size and shape of a bacteria cell as seen under a compound light microscope
2. Demonstrate an ability to accurately follow lab protocol
3. Clearly communicate a scientific understanding of cell shape and size through descriptions and sketches
4. Apply lab safety rules and procedures

Virginia Standards: LS.1-D, J

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday we built edible models of bacterial cells. What were some of the cellular structures that were in your "cells"? Today we are going to prepare and stain slides of the bacteria you grew in Petri plates earlier last week. What do you expect to see on the slides?**

Preparing and Staining Slides (40 minutes)

- Before beginning this activity, give some thought to the arrangement and traffic patterns of your classroom.
  - Consider setting up 4-7 work stations for students where they will complete all steps. This reduces traffic flow around the room and allows you to guide all students through the activity at once.
- Give each student a copy of **Preparing and Staining Slides.**
- Provide a complete demonstration of slide staining to familiarize students with the procedure.
- Remind students that they should not touch the colonies growing on their Petri plates with their fingers…only the loops. Petri plates should be closed immediately after use.
- Once students have observed their slides, they should answer the questions found on the bottom of the procedure handout.
- Be sure to review **SAFETY Procedures** for Science Laboratories and Materials on **page 8**.

Reflection Writing (10 minutes)

Purpose: To determine if students are successfully meeting the learning objectives for this lesson.

- Ask students to consider all they've learned about bacteria
- Have students write a paragraph response to the following:
  - **Imagine you have a sister in 1st grade. In language she can understand, explain to her what bacteria are, how it can make you sick, and how you can avoid getting sick from bacteria.**
- Encourage students to share their responses with the class

PREPARING AND STAINING SLIDES

Materials:

Plastic loop (1 per student)
Glass slides (1 per student)
Clothes pin (1 per student)
Petri plates with bacterial growth
Sharpie marker (1 per group)
Crystal Violet stain
Disposable gloves (Nitrile)
Paper towels
Microscope (1 per group)
Sterilized water

Procedure:

1. Make sure you have all of the supplies listed above.
2. Wash your hands with soap and warm water for at least 20 seconds and put on gloves.
3. Using a Sharpie, label one side of the glass slide with your initials.
4. Apply a drop of water to the slide.
5. Touch the large end of your plastic loop to one colony of bacteria on your Petri plate.
6. The loop should then be touched to the glass slide (on the same side as your initials) on the drop of water.
7. Mix bacteria with water and smear across the length of the slide.
8. Allow to air dry for 3 minutes.
9. Attach the clothes pin to one end of the slide.
10. Hold the clothes pin while you pass the slide over high heat (or allow to air dry for 10 minutes) until no water is visible on the slide. This will heat fix the bacteria on your slide so they will not wash off when you stain them.
11. Allow the slide to cool and then add five drops of Crystal Violet stain.
12. Allow the stain to sit for 60 seconds.
13. Turn your slide upside down and rinse with water until the water runs clear (15-30 sec).
14. Use a paper towel to lightly pat (Don't Rub!) the slide dry.
15. Place the slide on the stage of the microscope and slowly focus in until you are able to see bacteria.

Answer the following questions:

To what magnification did you have to adjust the microscope in order to see bacteria?

Sketch your observations:

Describe the bacteria cells.
(Shape, color, clusters, chains, etc.)