Unit Activities:	Setting the Stage, Objectives, Carousel Survey, Graph Data
Instructional Events:	Gain Attention, Inform Learners of the Objectives, Stimulate Recall of Prior Knowledge
Materials:	Graph paper, rulers, markers, colored pencils, Carousel headings
Student Handouts:	Graphing Self-Assessment (pg.102).

Learning Objectives:	Students will be able to: 1. Develop and organize a simple data set generated from a class survey. 2. Construct graphical representations of the class data set.
PA Standards:	2.5.8B

Activities:

Setting the Stage (8 minutes)

Purpose: To capture attention and prepare students to learn and participate

Learner Level: All

- Write the following question on the board or overhead: **Describe what we mean when we say a human grows.**
  - 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:
    - How much have you grown over the last year?
    - What makes a human grow?
    - What has to happen for any organism to grow? (cell division**)**

Inform the Learner of the Objectives (2 minutes)

Purpose: To help students understand what they are responsible for learning

- Tell students: **This week we are going to study the difference in growth of humans and growth of bacteria. Our first activity is going to determine how likely bacteria is to grow in your kitchen at home.**

Activities:

Carousel Activity (30 minutes)

Purpose: To familiarize students with new words, activate prior knowledge, and provide a guide to the concepts they will learn in this lesson.

Learner Level: All

- Before beginning this activity, download and print each question from **the Carousel Activity** from our website. www.handsonclassrooms.org
- Post each page in a different place around the room
- Divide students into 10 groups and send each group to a different page.
- Give students 1-2 minutes to read the question on their page and then tally their response in the appropriate box in the answer grid.
- Rotate student groups to a new page every 2-3 minutes until each group has answered every question.
- Discuss each question with the class, noting the various answers. Discuss the best answer choice(s) for each question.

Graphing Data (20 minutes)

Learner Level: All

- Assign each group of students one of the question pages from the Carousel Activity above.
- Each group should use the data (student response tallies) from their assigned question to create a bar graph reflecting student responses.
- To save time, provide students with a pre-drawn graph master.
- Have students color in the bar representing the correct answer.
- Have students calculate the mean and mode responses.
- When students are finished, display each graph.
- Encourage students to make observations and identify questions indicating an area needing improvement (due to low numbers of correct responses).
- Student should complete the **Graphing Self-Assessment Rubric.**

Unit Activities:	Review, Understanding Scale
Instructional Events:	Present the Stimulus
Materials:	Rulers, calculators, dice, construction paper, tape
Student Handouts:	Understanding Scale Worksheet (pg.105).

Learning Objectives:	Students will be able to: 1. Apply use of scale to create 3-D scale models of a 6-sided die. 2. Recognize the impact of magnifying an object by 4x, 10x, and 40x.
PA Standards:	2.3.8G

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday we took surveys to determine how safe your kitchen is and graphed the results. Did any of you suggest changes to your parents last night during dinner? Today we are going to learn about scale and try to get an idea of how big a bacterium is.**

Understanding Scale (50 minutes)

- Ask students: In science class you are conducting an experiment to grow bacteria. How big is a bacterium?
- Allow students to guess.
- Explain to students that bacteria are microscopic, which means they can only be seen using a microscope.
- Tell students that later in the week they will use a microscope to look at bacteria. The microscope will allow them to see the bacteria at 4x, 10x, and 40x its actual size.
- To demonstrate this scale, have students complete the Understanding Scale worksheet.
- Optional: Allow students to go outside and, using a measuring stick, mark off their heights at 4x, 10x, and 40x.

Activities:
Understanding Scale (continued)

- Students should construct a die at actual size (1x), 4x, and 10x:

  a) Have students measure a standard six-sided die (1.5 cm)

  b) Using a ruler and construction paper, have students measure out six 1.5 cm squares. Students should then cut out the squares and construct a die. This die represents the actual size or 1x.

  c) Have students determine the dimensions of a 4x die (1.5 cm x 4=6cm)

  d) Using a ruler and construction paper, have students measure out six 6 cm squares. Students should then cut out each square and construct a die. This die represents the actual size or 4x.

  e) Have students determine the dimensions of a 10x die (1.5 cm x 10=15cm).

  f) Using a ruler and construction paper, have students measure out six 15 cm squares. Students should then cut out each square and construct a die. This die represents the actual size or 10x.

  g) While students are constructing their dice, draw examples of a 1x, 4x, 10x, and 40x (60cm) squares on the board for students to use as a comparison.

- Explain to students that when they look at their bacteria in the microscope these are the powers of magnification they will use.

- Encourage students to draw connections between the actual size of the die versus the 40x.

Unit Activities:	Review, Understanding Bacterial Growth, Bacterial Growth Demonstration
Instructional Events:	Present the Stimulus, Provide Learner Guidance
Materials:	Modeling Clay
Student Handouts:	Understanding Bacterial Growth Worksheet (pg.108).

Learning Objectives:	Students will be able to: 1. Recognize bacterial growth as an example of exponential growth. 2. Use given formulas to calculate the growth of bacteria over a given time period.
PA Standards:	2.5.8B, 2.7.8B

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday we learned about scale and the size of bacteria. What surprised you most about what you learned yesterday? Today we are going to continue learning about scale and the size of bacteria.**

Understanding Bacterial Growth (15 minutes)

Learner Level: Average-High

- Display the following definition on the board: **Bacterial growth means an orderly increase in the number of bacteria.**
- Have students compare and contrast bacterial growth with growth in animals and plants.
- Allow students to brainstorm ideas and record these differences on the board and in their notebooks.
- Lead a discussion on students' ideas.

Learner Level: Low-Average

- Distribute a copy of **Understanding Bacterial Growth** to each student.
- Lead students through completing each section.
- Ask students to share ideas from the Venn diagram with the class.

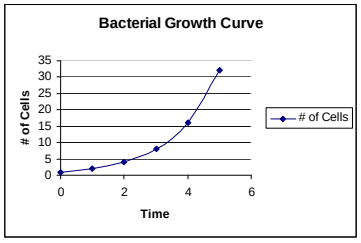
Activities:

Bacterial Growth Demonstration (15 minutes)

Purpose: To facilitate the transfer of new knowledge to long-term retention by providing a concrete demonstration of an abstract concept.

Learner Level: All

- Divide the class into groups of four.
- Give each group a fist-sized piece of clay that represents a single bacterium.
- Every 30 seconds, have each group divide its "bacteria": first two, then four, then eight, then 16, then 32 to demonstrate bacterial growth.
- Track the bacterial growth on the class graph sheet to show what an exponential growth curve looks like.



- Ask students to consider how their model bacteria are different from real life. (*Size, structure, dividing bacteria do not get smaller and smaller with each generation and growth rates are not limitless.)*

Unit Activities:

Review, Application of Knowledge, Is It Safe to Eat?

Instructional Events:

Elicit Performance, Provide Feedback

Student Handouts:

Applying Bacterial Growth Rates Worksheet (pg. 111).
Is It Safe To Eat? Worksheet (pg. 113).

Learning Objectives:

Students will be able to:

1. Use given formula to calculate the growth of bacteria over a given time period.
2. Solve problems involving unit rates

PA Standards:

2.4.8F, 2.7.8B

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday we learned that bacteria grow by multiplying. How is that different from how humans grow? Today you are going to solve some problems to determine if foods in certain situations are safe to eat.**

Application of Knowledge (20 minutes)

Purpose: To allow the learner to practice the new knowledge. The repetition further increases the likelihood of retention of the new information.

Learner Level: All

- Give each student a copy of **Applying Bacterial Growth Rates.**
- Explain that bacteria, including strains that make us sick like E. coli, can divide as often as every 20 minutes under optimal conditions.
- That means that one E. coli cell could multiply to 128 (enough to make you sick) cells in less than 2 and ½ hours.
- Ask students to calculate how many bacteria there would be after three hours and four hours at this fission rate.
- Then, have students graph an exponential multiplication rate with a specified time period and rate at which that number doubles, and then doubles again and again.
    - Example: if an organism doubles every twenty minutes, how much time must pass for there to be over one million cells? (6 hours, 40 minutes)

Activities:

Is it Safe to Eat? (20 minutes)

Purpose: To assess and facilitate further student learning.

Learner Level: All

- The purpose of this activity is to provide real-world applications of bacterial growth.
- Give each student a copy of **Is it Safe to Eat?**
- Walk students through the example problem and then let students complete the remaining problems.
- It is important to remind students that these are only examples and should not be used as a guide for whether food is safe.
- Remind students that in real life they would not know the number of pathogenic cells contaminating their food.

Unit Activities: Review, Student Reflection, Analyzing Data

Instructional Events: Assessing Performance, Enhance Retention & Transfer

Materials: Construction paper

Student Handouts: Analyzing Data worksheet (pg.116)

Learning Objectives:

Students will be able to:

1. Use mean, median, mode, and range to analyze a data set.
2. Use statistical analysis to compare treatments in a data set.
3. Create graphical representations of data.

PA Standards: 2.6.8A, 2.6.8B, 2.6.8C, 2.6.8.E

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday you solved some problems to determine if foods in certain situations are safe to eat. Today we are going to analyze the results of your bacterial growth labs from science class. What predictions do you have as to which treatment was the most effective in getting rid of bacteria?**

Student Reflection (15-20 minutes)

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

Learner Level: All

- Ask students to reflect on the math concepts they've learned so far (bacterial growth and scale).
- Allow students to work in pairs and provide each pair with a piece of construction paper.
- Each pair should write one "really good" multiple-choice test question that covers the math concepts they've learned so far in this lesson.
- Post each pairs question on the front board and, as a class, try to answer each question correctly.

Activities:

Analyzing Bacterial Growth Data (30 minutes)

Purpose: To allow students to develop expertise with the new information and create a construct for transferring knowledge to long-term retention.

Learner Level: All

- Using the raw data collected in the science follow-up lab, have students complete the **Analyzing Data** worksheet.
- Students may work individually or in pairs.
- Once they have finished, have students complete the **Analyzing Data Self-Assessment.**
- Modifications for lower level students include: completing the exercise as a group and reducing the number of problems.

Unit Activities:	Review, Analyzing Data, Self-Assessment
Instructional Events:	Enhance Retention & Transfer
Student Handouts:	Analyzing Data Worksheet (pg.116). Analyzing Data Self-Assessment (pg.119).

Learning Objectives:	Students will be able to: 1. Use mean, median, mode, and range to analyze a data set. 2. Use statistical analysis to compare treatments in a data set. 3. Create graphical representations of data.
PA Standards:	2.6.8A, 2.6.8B, 2.6.8C, 2.6.8.E

Activities:

Review (5 minutes)

Daily Review Question: **Yesterday we began analyzing the results of the bacterial growth labs from science class. What trends did you see you analyzed this data? Today we are going to finish our analysis.**

Analyzing Data (30 minutes)

Purpose: To allow students to develop expertise with the new information and create a construct for transferring knowledge to long-term retention.

Learner Level: All

- Using the raw data collected in the science follow-up lab, have students complete the **Analyzing Data** worksheet.
- Students may work individually or in pairs.
- Once they have finished, have students complete the **Analyzing Data Self-Assessment.**
- Modifications for lower level students include: completing the exercise as a group and reducing the number of problems.

Self Assessment (5 minutes)

- Students should complete the **Analyzing Data Self-Assessment**