Name:_____ Date:_____ Class:_____

Student Worksheet

How Quickly Do Bacteria Grow?

Safety

Wear gloves to ensure that no bacteria are transferred from your fingertips to the swab sample. The bacteria collected today will be no more pathogenic than what you are exposed to everyday, but do not touch your mouth, nose, ears or eyes during this lab activity.

Recently, scientists have found bacteria that measure 20–400 nanometers in size. Originally thought to be viruses, these nanobacteria—also called *nanobes*—may be the smallest living organisms on Earth! These super-small bacteria resemble the fossilized structures found on meteorites that originated on Mars. So, not only do we find bacteria everywhere here on Earth, but maybe even in the vast distances in space!

Materials

- sterile Petri dishes with nutrient agar
- sterile cotton-tipped applicators or swabs
- disposable gloves
- scotch tape
- permanent fine-tipped ink marker
- metric ruler
- paper, pencils, graph paper
- incubator *(optional)*
- digital camera *(optional)*

Question Out of all the things you touch everyday, where would you find the most bacteria? Why?

Make a Prediction

_____

_____

_____

_____

_____

Procedure

1. Decide with your group where you will collect your bacteria sample.
2. Take the *packaged* cotton swab and *closed* Petri dish to where you will collect the sample.
3. Rub the tip of the cotton swab across the area you are sampling. Twist the swab as you swipe it along the surface to help collect a good amount of bacteria onto the swab.

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4. Open the Petri dish just enough to fit the tip of the swab into it. Gently rub and twist the swab at the center of your dish.
5. Immediately close the dish, seal it along the perimeter (edge of the lid) with clear tape.
6. Label the tape with your name, date, time, and what you sampled. Throw the cotton swab into the trash.
7. Place your dish where instructed by the teacher to be stored until the next class. (One option is to place the dish in an incubator (such as, a styrofoam cooler with a lamp).

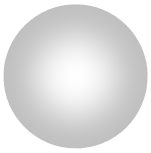
Record Your Observations

At the beginning of the next three classes, use a metric ruler to measure the size of the bacterial growth in the dish. Then, fill out the data table below for each observation.

#	**Date & Time**	**Observations** (drawing or picture)	**Size of Growth** (measure and describe)
1			
2			
3			

Analyze the Results

1. Write the equation for the radius of a circle (radius of a circle = *r*). _____
2. Draw a line on the circle below to indicate the radius of a circle.



3. Write the number for π (pi). π = _____
4. Write the equation for the surface area of a circle. _____
5. Write the equation for the circumference of a circle. _____
6. Calculate the surface area of bacterial growth using data from your data table.

Calculation of Bacterial Surface Area Growth

Hours of Growth	Calculate the surface area of bacterial growth. Show your calculations. Explain your work.

7. Calculate the bacteria and nanobe populations. First, convert bacterial surface areas from cm^2 to μm^2 or to nm^2. Remember:

$$1\ cm^2 = 10{,}000\ \mu m^2 = 10{,}000{,}000\ nm^2$$

$$\text{surface area of a bacterium} \sim 9\ \mu m^2$$

$$\text{surface area of a nanobe} \sim 400\ nm^2$$

Calculation of Bacteria and Nanobe Populations

Hours of Growth	Surface Area of Growth	Bacteria Population
Hours of Growth	**Surface Area of Growth**	**Nanobe Population**

8. Using your results from the previous page, graph the growth of the bacteria versus time. Determine the best scale to use for graphing by looking at the ranges of your growth data.

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Draw Conclusions

1. When might it be useful to know how fast bacteria can grow at certain temperatures?

2. Describe your graph. Did anything surprise you? Explain.

3. As more time goes by, more bacteria grow. What kind of function is this?

4. Nanobacteria are so small they cannot be seen with a light microscope. Knowing that doctors identify what type of bacterial infection a patient has and what kind of medicine a patient needs by looking at the bacteria through a light microscope, what problems might doctors have if nanobacteria were to also cause infection?

Going Further Look at your graph.

a. How many bacteria do you think will be in your dish in 200 hours? Write your prediction.

b. What could you do to test and see if you are right?

c. If you let your bacterial population grow for 1 month, how would the bacterial growth in the Petri dish differ from growth in the location you took your sample from?

Extra Credit Follow the steps you outlined in answer "b" above. If time allows, test to see whether your prediction in answer "c" is accurate.