Microbe Math

Grade Level: 3-5

Professions: Laboratory Technician

References: www.healthyhands.com

All HOTT lesson plans are designed with the purpose of increasing students' awareness of the variety of health careers that are available to them. If possible, invite the corresponding health professional into your classroom to discuss his/her occupation. If this is not an option, use the attached sheet(s) to share this/these career(s) with your students.

Purpose: Students will use clay to illustrate bacterial multiplication rates while calculating the enormous astronomical potential reproductive growth of just one bacterial growth, learn about the exponential speed at which bacteria can multiply, learn about the role of bacteria in promoting decay.

Materials needed: Modeling clay, one or two colors, ½ inch grid chart paper, graph sheets (one per student), magnified images of common germs (either one sheet per student or transfer onto an overhead transparency)

Duration: 50 minutes

Instructions:

- Prior to the start of the activity divide clay into a fist-sized piece for each group of four students.
- Ask students for examples of decay they have seen, such as food left in the refrigerator too long or a dead animal in the yard. Explain that bacteria and fungi cause most of the decay.
- Go through the Vocabulary words:

1. **Antibiotic** - agent that destroys bacteria
2. **Antibodies** - protein that fights infections
3. **Bacteria** – microscopic life form
4. **Exponential growth** - growth that increases at an ever accelerating rate.
5. **Fungi** – a single-celled or multicellular organism without chlorophyll that reproduces by spores and lives by absorbing nutrients from organic matter. Fungi include mildews, molds, mushrooms, rusts, smuts, and yeasts.
6. **Microbe -** a microscopic organism, especially one that transmits a disease
7. **Microorganism** -any organism (animal or plant) of microscopic size
8. **Optical microscope** – a magnifying instrument that uses transmitted or reflected light to obtain an image.

- Explain that an individual bacterium is far too small to be seen by our eyes alone; most are about 1/1000 of a millimeter in diameter. Pass out copies of common germs sheet (or show transparency) and review the magnified images of germs. (NOTE: These images have been taken from a variety of sources and do not necessarily reflect what a student would see looking through an optical microscope.)

- Divide the class into groups of four. Give each group a fist-sized piece of clay that represents a single bacterium. Every 30 to 60 seconds, have each group divide its "bacteria": first two, then four, then eight, then 16, then 32. Track the bacterial growth on the class graph sheet. (Example attached)
- Explain that real bacteria — including strains that make us sick — divide every 20 minutes under optimal conditions. The real bacterium would have gone from one to 32 in 100 minutes. Now ask them to calculate how many bacteria there would be after two hours, three hours and four hours at this fission rate.
- Ask them to consider why such unchecked growth does not actually happen. *[Finite food supply, limits of suitable living space, propensity for crowded bacteria to poison themselves with their own waste, antibiotics that are created by competing fungi, ability of humans and many animals to produce antibodies.*]
- **Interesting Fact** In just 12 hours, one bacterium could multiply to over 8.5 billion under perfect conditions. After three days, with no bacteria dying, there would be enough of them to cover the entire earth.

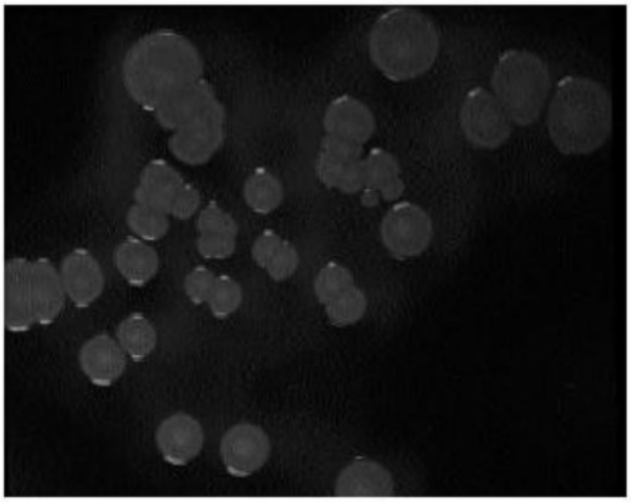
Check for Understanding:

- Have students graph an exponential multiplication rate with a specified time period and rate at which that number doubles, and then redoubles again and again. Example: if an organism doubles every hour, how many hours must pass for there to be over one million of them? [*20*]
- Ask students 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*.]

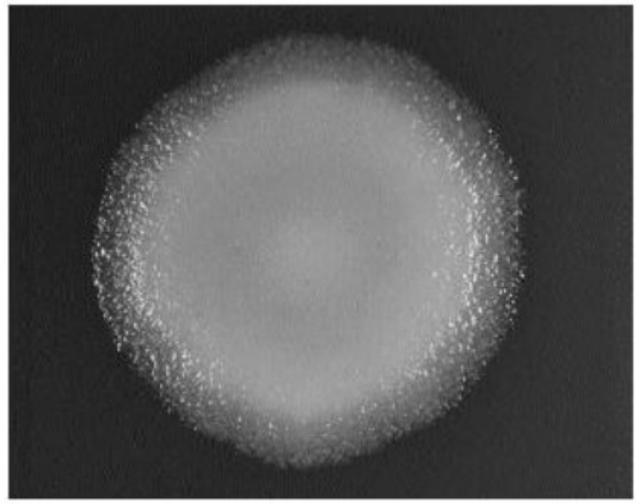
In essay form, have students answer the following questions:

- What are other examples of rapid species growth in the natural world?
- Does this sort of growth apply to humans?
- What sort of environmental and biological factors limit that growth?

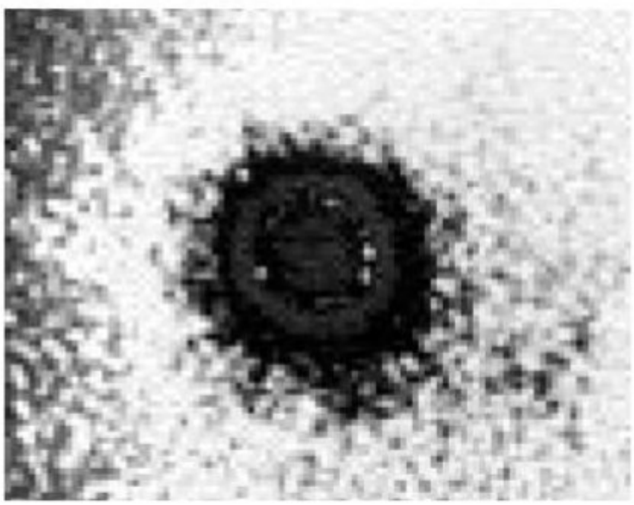
Magnified Images of Common Germs



Staphylococcus aureus (bacteria)

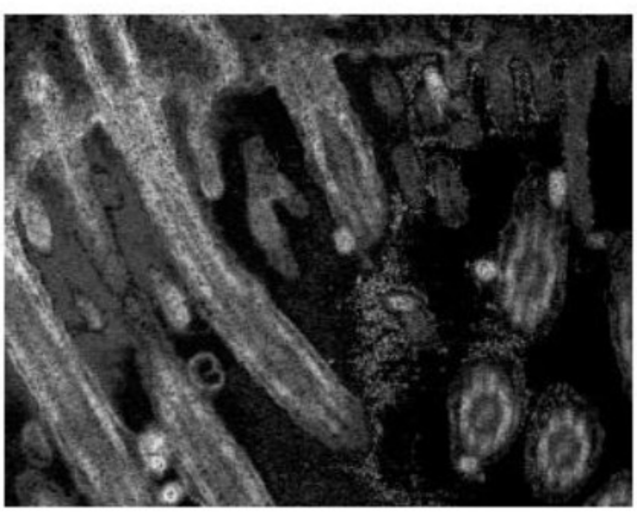


Bacillus cereus (bacteria)

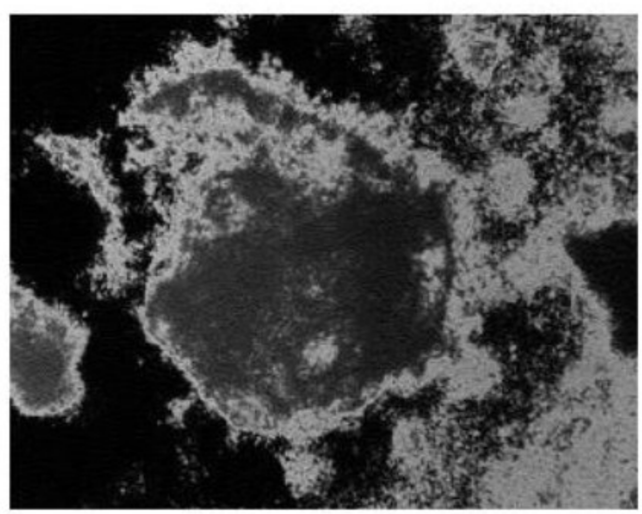


Rhinovirus (Type 1A)

Bacteriophage T4 (virus)



Influenza A virus



Rubella virus

Example of Bacteria Growth Graph