And the Bacteria Ran Away with the Petri Dish

Summary

Students will learn about germs, their infectious behavior and their treatment.

Materials

Per Small Group or per Student:

- *Antibiotics: The Cure All?*
  (Overhead)
  Plastic comb
  Small magnet
  Plastic baggie #1 (31 small vinyl-coated paperclips, each with one end bent upward, and 1 normal, unbent paperclip)
  Plastic baggie #2 (30 (unbent) vinyl-coated paperclips and one plastic paperclip)
  Plastic baggie #3 (31 plastic paperclips)

Whole Class

  Hot plate
  Beef bouillon cubes
  Unflavored gelatin
  Petri dishes
  Sterile swabs (Q-tips work)
  One tablespoon
  One cup

- *What? There are How Many?*
- Mold: It is Lovely to Behold, but not to Hold
- Bread Mold Data Sheet
- Directions for Making a Mini Lab Booklet

Additional Resources

Books

- *Bill Nye the Science Guy's--Great Big Book of Tiny Germs*
  , by Bill Nye; ISBN 0786805439
- *The Demon in the Freezer*
  , by Richard Preston; ISBN 0345466632
- *Germ Killers--Fighting Disease*
  , by Sally Morgan; ISBN 1588106993
- *Germs Make Me Sick!*
  by Melvin Berger; ISBN 0060242507
- *Guide to Microlife*
  , by Kenneth G. Rainis; ISBN 0531112667
- *Gross But True Germs--A Scientific Inquiry Into The Exciting World of Viruses, Fungi, and Bacteria*
  , by Luann Colombo; ISBN 068981495
- *The Hot Zone*
  , by Richard Preston; ISBN 0385479565
- *Intimate Strangers- Unseen Life on Earth*
  , By Needham, C.; Hoagland, M.; McPherson, K.; Dobson, B.; ISBN 1555811639

- *Invisible Allies- Microbes That Shape Our Lives*
  , by Jeanette Farrell; ISBN 0374336083
- *Kingfisher Knowledge--Microscopic Life*
  , by Richard Walker; ISBN 0753457784
- *Microbes*
  By Kids Discover; ISBN 1054-2868
- *Micro Monsters--Life Under the Microscope*
  , by Christopher Maynard; ISBN 0789447568
- *Mysterious Microbes--Microscopic Monsters and Vile Monsters!*
  by Steve Parker; ISBN 0811423441
- *The Smallest Life Around Us--Exploring The Invisible World of Microbes with Eight Easy At-Home Experiments*
  , by Lucia Anderson; ISBN 0517532271

Videos

- *Body Story Out of Control*
  , by Discovery Channel Video, VHS#763813

Articles

Evolution of Antibiotic Resistance, by Alan Gubanich, Science News
Before the Next Epidemic Strikes, By L.W. Winik, Parade Magazine

Organizations

Centers for Disease Control and Prevention
1600 Clifton Road
Atlanta, GA 30333
(404) 639-3534
(800) 311-3435
http://www.cdc.gov
National Immunization Hotlines
(800) 232-2522 (English)
(800) 232-0233 (Spanish)

Background for Teachers

Bacteria are so small that about 1,000 could fit on the head of a pin. Bacteria are classified into three groups according to their shape: round (cocci), spiral (spirilla), and rod (bacilli) shape. Some round shape bacteria can cause infections in people. Some spiral shape bacteria are used to make cheese. Some rod shaped bacteria have been known to cause food poisoning.

There are more than 10,000 kinds of bacteria and an unknown number still waiting to be discovered. The human body has more bacteria than it has cells. An unborn baby is completely free of bacteria, but the instant they are born they acquire billions of bacteria. Bacteria are essential for a healthy body.

All bacteria have similar characteristics. They are made up of a single cell with a cell wall and do not have a nucleus. Some bacteria can make their own food, but a large majority feed on other organisms. In addition, most bacteria need oxygen to survive.

When people become sick, they go to the doctor's office expecting a miracle cure. Most often, the best advice often times is to go home, drink lots of fluids and rest. Many people are unsatisfied with that response and demand something to end their suffering. So many of these complaints are viral, yet there is no medication available to combat a viral infection. Doctors may prescribe antibiotics, but it cannot treat the illness at hand. As a result, antibiotics can become overprescribed and misused. Over time, the microbes will become resistant and the antibiotics will become ineffective.

Intended Learning Outcomes

1. Use Science Process and Thinking Skills.

Instructional Procedures

Invitation to Learn

Display on the overhead *Antibiotics: The Cure All?* Read aloud, and then have the students think, pair, and share their ideas to these questions for three minutes. Share as a class, the key ideas students talked about.

We are going to simulate bacteria infecting a human and how the treatment of antibiotics effects the bacterial infections.

Pass out the materials: three small baggies labeled #1, #2, and #3, a small magnet, and a plastic comb, with every other tooth removed. One set is needed for each partner group or small group of students.

Take out the contents in Baggie #1. This is a model of a population of infectious bacteria that is making a human very sick.

Hold up one "bacterium" (paper clip) and discuss the plural and singular form of bacteria. Go on to discuss the growth process. Bacteria reproduce by binary fission: one bacterium divides in half to produce two new bacteria, each one is genetically identical to each other. They are clones, unless a mutation occurs. Have the students model the growth of the bacteria with the paperclips. For example, start with one and it reproduces two bacteria and then those two reproduce to make four. How many times has it reproduced when you get to 32? Record on the board. For example: 1 bacterium= 2 bacteria, 2 bacteria = 4, and so on. Save chart for a later extension activity.

The comb represents an antibiotic that has been given to the patient. Move the comb through the bacteria population, hooking the bacteria on its teeth, until no more bacteria can be destroyed. This represents the drug treatment to cure the patient. How many times did you have to use the antibiotic to destroy the bacteria? Are there any bacteria left after the treatment? There is a single bacterium left. It has something in its biological make-up that enables it to resist Antibiotic A. This might be a mutation, although other mechanisms are known by which antibiotic resistance can develop.

This lone bacterium begins to reproduce. Take out Baggie #2 and remove the contents. Again discuss how the bacteria reproduce. Have the students discuss binary fission again, if needed. Pass the comb over this new generation of bacteria. What effect does the antibiotic have now? If Antibiotic A is no longer effective, try a new antibiotic (the magnet, which is Antibiotic B). Pass the magnet over the population of bacteria several times until no more bacteria are destroyed. How many times did you have to use the antibiotic to destroy the bacteria? What is left? Again, there is one survivor of the antibiotic treatment--it is resistant to Antibiotic A and Antibiotic B.

Baggie #3 now represents the new offspring. Empty the contents on the table. Try to kill these bacteria with both Antibiotic A and Antibiotic B. What happens?

Discussion: This brief activity illustrates how antibiotic resistance evolves in a population. Due to this evolutionary process, many strains of bacteria have become resistant to one or in some cases several of the antibiotics that formerly used to control them. How will this affect future generations?

Instructional Procedures

Day One:

Model how to make a cheap and easy Culture Medium: Makes six Petri dishes. Adjust the recipe to fit the size of your classroom.

RECIPE: Use a hot plate to heat water. Stir one tablespoon of plain, unflavored gelatin and one

beef bouillon cube into one cup boiling water. Stir constantly until the gelatin and cube dissolve completely. Pour a thin layer of the liquid in each Petri dish. Cover each Petri dish quickly to avoid contamination. Wait until gelatin sets before adding bacteria.
Make enough for each student to have one set aside for Day two's lesson.
Brainstorm in science journal of all the places that bacteria can be found.
Have a class discussion about the numerous places that bacteria could be found. Tell the students that we are going to conduct an investigation on bacteria. We are going to focus on two different locations and compare the bacteria growth in these locations. Each student must come up with a different location to test. Model an idea for the students. For example, test your hand and a student's hand. Write the question on the board: Which will cause more bacterial growth: the teacher's hands or the student's? Write a hypothesis: I hypothesize that a teacher's will have more then the bacteria growth because of the numerous people and objects she comes in contact with everyday and she only gets a break to wash her hands at lunchtime.
Record ideas on the whiteboard. Examples of ideas: bathroom door handle, light switches in different aged classes, class computer versus lab computer, and different aged classes' desks. Be ready with ideas. Give the students think time to come up with creative ideas. It is fun to compare classes and grade levels.
After recording all the ideas on the whiteboard. Develop a question and a hypothesis as a class for one of the student's ideas. Then, students will write their own question and hypothesis in their science journal. Model repeatedly if needed. Have the groups review over their questions and hypotheses for improvements and clarifications.
Take Home Assignment: Students need to take home their science journal and discuss their question and hypothesis with their parents. Together, the student and the parent can write predictions.

Day Two:

Discuss the at-home assignment and the questions and hypotheses.
Pass out Petri Dishes and have the students divide the Petri Dishes into two parts and then label them with student name and locations of samples to be taken.
Demonstrate the procedure to swab the Petri Dishes. Choose two different playground balls: soccer and basketball. Swab them with a Q-tip in about a two-inch square area and open the Petri Dish and gently make streaks on the plate's surface. Use firm, but gentle pressure and do not retrace your previous streaks. Discard the Q-tip. Repeat the same procedure with the other ball and swab on the other side of the Petri Dish. Completely seal the Petri dish with four pieces of clear tape. Store the Petri Dish in a dark, warm, and dry place.
Have the students complete their experiments. Store the Petri Dishes with the other modeled Petri dish. A copy paper box is a great holder.

Day Three to Eight:

Each day for five days, take about 15 minutes to have the students record their data. See handout for recording. It turns into a great mini-booklet. Students record observations. Which streaks have more microbes? Do you see a pattern? How do your result compare to other results? How can you describe your findings accurately, with a ruler, comparing to another object, or by color and shape.
Have the students create a mini-poster of their findings.

Extensions

Curriculum Extensions/Adaptations/Integration

Research the development of antibiotics.
Invite a doctor or science specialist to give a presentation.
Mathematics Story Problem: Complete *What? There are How Many?*

Family Connections

Discuss possible experiments and precautions to take prior to sending the activity home. Grow mold samples at home. See handout *Mold: It is Lovely to Behold, but Not to Hold.*

Send home the *Bread Mold Data Sheet* for the students to share information with family while they're performing their experiments.

Assessment Plan

Make a mini-poster.

Completing a five day observation journal of Petri Dishes.

Active participation in class discussions.

Bibliography

Eick, Charles J. (2002). Science curriculum in practice: Student teachers' use of hands-on activities in high-stakes testing schools. *NASSP Bulletin*, Volume 86, pp. 72-85.
"Hands-on, minds on" teaching methods develop a deeper understanding of science concepts and processes. Studies found that limiting instruction to facts and skills and eliminating hands-on inquiry can place already at-risk students at a greater risk of failure on high-stakes testing. Teachers that used investigative inquiry prompted high-order thinking and questioning, and thus obtained higher test scores. The researchers emphasized an integrated curriculum that incorporated testing objectives into courses of study.
Office of Educational Research and Improvement. (1993) *Transforming ideas for teaching and learning science: A guide for elementary science education*. [Guide]. Washington, DC: Siversten, M.L.
Science education reform is a must. Science education must focus on the big ideas and be taught on a daily basis to all students. The researchers stress that hands-on inquiry based learning and experimentation are extremely effective teaching strategies. Instruction should focus on the essential key concepts or ideas, not the memorization of facts and theories. Teachers should be facilitators of student learning by engaging them in active learning projects.

Authors

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