**Name**_____

**Microbes: The Good**

Objectives:

1. To describe the beneficial roles of microorganism to humans.
2. To learn how to collect novel microbes and study them.
3. To observe research scientists collecting and analyzing data related to beneficial microbes.

PART 1: What do you know about beneficial microbes?

1. Make a list of ways microbes are beneficial to humans (at least 5 but you can include more). For each suggest where the microbes would be obtained and how they would be collected.

| Way microbe is beneficial | Where would they be collected | How would they be collected |
|---|---|---|
| | | |
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2. Ask at least 10 friends/family members "How do microbes benefit humans?". Make a list of their responses – you do not need to repeat answers.

PART 2: Collecting Microbes – A Virtual Field Trip

3. Take a field trip with Dr. John Fitzpatrick by clicking on this link: http://player.vimeo.com/video/78237963?title=0&byline=0&portrait=0. Answer the following questions while watching the video:
    a. What is in the sand and mud at the bottom of the ocean?
    b. What is the deep biosphere?
    c. How is sediment collected from the deep sea floor?
    d. What does each layer of sediment represent?
    e. What is pyrite? What does it look like in sediment? Why was it formed?

f. How do the lab materials get transported from the University to the research site?
g. How is the DNA removed from the microbes?
h. What happens to the DNA that is removed from the cells?
i. Are these techniques just used for marine microbiology research?

PART 3: Investigating Microbial Ecology

4. Watch Part 2 of Dr. Brandi Reese's presentation, "The Biogeography of the Deep Biosphere" by clicking on this link: http://player.vimeo.com/video/78264216. Answer the following questions while watching the video:
    a. What is ecology?
    b. What is the average depth of the ocean?
    c. What portion of the ocean are we most familiar with?
    d. How does the deep sub-surface sediments serve as a record of past climate?
    e. How can an understanding of past climate benefit us today?
    f. How can methane be used to benefit humans?
    g. How is methane produce?
    h. Why do microbes in the sub-sea floor produce antibiotics?
    i. Do they produce antibiotic resistant genes?
    j. How can the antibiotics and antibiotic resistance genes of the sub-seafloor microbes benefit humans?
5. Optional: You can watch Parts 1 and 3 of Dr. Brandi Reese's presentation by clicking on these links: Part 1 - http://player.vimeo.com/video/78264216 and Part 3 - http://player.vimeo.com/video/78268179

6. How does this relate to my life in health careers?
    Read the article, Compound Discovered at Sea Show Potency against Anthrax https://scripps.ucsd.edu/news/anthracimycin-compound-shows-promise-anthrax and Going Deep for Drug Discovery: An Ocean to Bedside Approach to Explore Sub-Seafloor Microbes for the Next Generation of Antibiotics http://www.rimed.org/medhealthri/2012-09/2012-09-292.pdf.

    a. After reading both articles, write a summary of them. Include where the microbes are found, examples of the types of microbes found that produce antibiotics, which pathogens they may target, some of the challenges of working with deep sea microbes.

PART 4: Ask the Scientist

Now that you have investigated how sub-sea floor microbes are collected and how they can benefit humans, list at least 3 good questions you would like to ask a Marine Biologist working in this field.

**TOOLKIT CREDITS:**
Developed by Rebecca Kapley, (Cuyahoga Community College, OH), with support by the rest of the C-DEBI Collaborative Toolkit Team.

**WEBSITE:**
http://www.coexploration.org/C-DEBI/toolkits_biology.html