

**Title: Cholera Catastrophe**

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**Abstract:** The purpose of this action research project is to investigate how implementing a biotechnology/pathology lab will influence a 6<sup>th</sup> grade student's interest in a STEM career path. Companies are reporting a shortage of qualified STEM employees (WorkNet Pinellas, 2013). The Pinellas County School district has pledged to expand career programs in every middle and high school and is currently providing programs to expose younger students, mainly minority and female students, to STEM (Lim, 2013). The goal of these types of outreach programs, such as *Lets Go STEM* and *STEM TEC*, is to peak student interest in STEM careers.

**Rationale:** The current unemployment rate in Florida is nearing 11% (The Academies of Pinellas). Giving our children an educational advantage before they even graduate high school will prepare them for high-demand, high-skill and high-wage career choices (The Academies of Pinellas). Research shows that students enrolled in career and themed programs have a higher success rate in school (The Academies of Pinellas). The district has developed a five-year strategic plan that sets a goal for 50 percent of Pinellas County high school students to be enrolled in a career academy, magnet or themed program and 35 percent of high school students to earn at least one industry certification by 2017 (Dawson, 2013). Middle school students should be provided with relevant, academic coursework so they may be better prepared to choose which high school career academy or magnet program they want to follow.

This Cholera lab will be used during the exploration phase of a 6<sup>th</sup> grade unit investigating infectious diseases. By engaging students in a relevant lab procedure, they will experience a scientific practice that is commonly used in a STEM career. Students will be exposed to biotechnology and Arc mapping to gain an understanding of how STEM can be applied to a meaningful career choice, and will hopefully spark interest in a career they may have never considered before.

**Student Outcomes:**

- Students will identify, compare, and/or contrast the types of infectious agents that affect the human body.

**Standards:**

- SC.6.L.14.6 Compare and contrast types of infectious agents that may infect the human body, including viruses, bacteria, fungi, and parasites.
- SC.6.N.1.1: Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.
- SC.6.N.2.3: Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals.

**Lessons (5E Model) and Timeline Overview (4 instructional days):**

- **Day 1 Engage:**  
\* *Antibiotics Probe* - The purpose of this diagnostic assessment probe is to elicit students' ideas about infectious diseases. The probe is designed to reveal whether students recognize that antibiotics only work on bacterial infections, not viral infections.
- **Day 1 Explore:**  
\* *Meet the Menacing Microbes* from ICORE
- **Day 2 and 3 Explore:**  
\* *Cholera Conundrum* lab from ICORE  
\* Differentiation for Advanced students: *Dot Blot Simulation*
- **Day 4 Elaborate:**  
\* *STEM careers* relating to life science/pathology/disease – *Cholera video clips* will be used as a springboard for discussion on careers related to this field of science. An anecdotal story of my trip to U of F this summer and the experiences I had will be shared at this time. I will also give students information about which magnet high schools and career academies focus on biotechnology/pathogen careers.
- **Daily Bell Work Assignment (10 minutes):**  
\* *Text Rendering/Academic Dialogue (Socratic Method)* – Students will read a current article about infectious disease, highlight unknown vocabulary, number the paragraphs, summarize the text (outline, graphic organizer, one sentence summaries, etc.), create three higher-level thinking questions, then use the questions to drive academic dialogue using evidence from the text to support their answers. Article titled [Cholera Outbreak in Haiti](#)

#### **Data Collection Techniques:**

- Career surveys given at the beginning of the year, midyear, and end of the year to monitor increasing or decreasing interest in STEM careers.
- Student work as demonstrated in:
  - \* Artistic representations
  - \* Bell work
  - \* Text summaries
  - \* Higher order questions
  - \* Dialogue
- Lab worksheet

#### **Connections to ICORE Summer Institute:**

- Dot Blot
- Waterborne Pathogens
- Cholera

#### **Improvement on Traditional Teaching Techniques:**

This will be the first time I have incorporated career awareness strategies into my lesson plan. The goal for the coming year is to specifically identify STEM careers that relate to each 6<sup>th</sup> grade integrated science unit. If students are exposed to relevant scientific investigations, then they will be better prepared to choose the most appropriate career academy or high school magnet program, based on their interests in STEM.

## Budget and Budget Justification

Item	Cost and Rationale	Vendor
Fisherbrand* Snap-Cap* Microcentrifuge Tubes: Flat Top 500/pack	*CPET will provide Cholera Conundrum Lab	Fischer Scientific
M1095350007 from Fisher, colorpHast* Strips	*CPET will provide Cholera Conundrum Lab	Fischer Scientific
Buffer Solution SB116	*CPET will provide Cholera Conundrum Lab	Fischer Scientific
500 pH 3 buffer, too: SB97-500	*CPET will provide Cholera Conundrum Lab	Fischer Scientific
GIANTmicrobes(R) Original (5-7" plush doll) common cold	\$8.95 Meet the Menacing Microbes	<a href="http://www.giantmicrobes.com">http://www.giantmicrobes.com</a>
GIANTmicrobes(R) Original (5-7" plush doll) Flu	\$8.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) Penicillin	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) Cholera	\$8.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) Tick	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) Red Tide	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) e. coli	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) Salmonella	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) white blood cell	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) mosquito	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) west Nile	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) Lyme disease	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) Staph	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) pneumonia	\$8.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) chicken pox	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll) MRSA	\$9.95 Meet the Menacing Microbes	
GIANTmicrobes(R) Original (5-7" plush doll)	\$8.95 Meet the Menacing Microbes	
Fisher Science Education* 4-Way Microtube Racks 174 x 95 x 52mm; Assorted pack of 5	*CPET will provide Cholera Conundrum Lab	Fischer Scientific
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	<b>Total = \$164.15</b>	
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**Literature Cited**

WorkNet Pinellas. (2013, March 12). Tampa bay businesses investing in stem education. *Tampa Bay Newswire*. Retrieved from <http://www.tampabaynewswire.com/2013/03/12/tampa-bay-businesses-investing-in-stem-education-8891>

Dawson, A. (2013, June 11). Pinellas expanding oversight of career academies. *The Tampa Tribune*. Retrieved from <http://www.tampatrib.com/pinellas-county/pinellas-expanding-oversight-of-career-academies-20130611/>

The Academies of Pinellas. Pinellas County Schools, Pinellas County Council. (n.d.). Transforming teaching and learning in pinellas county schools. Retrieved from Pinellas Education Foundation website: [http://www.pinellaseducation.org/applications/Assets/pef\\_academies\\_insert\\_10\\_21\\_11.pdf](http://www.pinellaseducation.org/applications/Assets/pef_academies_insert_10_21_11.pdf)

Lim, S. (2013, May 31). Pinellas program aims to grow interest in stem. *Tampa Bay Times*. Retrieved from <http://www.tampabay.com/news/education/k12/pinellas-program-aims-to-grow-interest-in-stem/2123890>

**2013 Palm Harbor Middle School  
Gradual Release Lesson Plan**

**Teacher: Maher**

**Week of: 11/18/2013**

**Course: Science**

**Grade Level: 6<sup>th</sup> Advanced and Average**

**Lesson Planning**

**Objective- What will I Learn Today?**

**Lesson(s):** Cholera Conundrum

**Benchmark(s)/NGSS Standard(s):** *What is the next benchmark(s) on my course curriculum guide or FCIM calendar? .*

- **SC.6.L.14.6:** Compare and contrast types of infectious agents that may infect the human body, including viruses, bacteria, fungi, and parasites.
- **SC.6.N.1.1:** Define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.
- **SC.6.N.2.3:** Recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals.

**Objective(s):** *What specific part(s) of the benchmark will the students be able to know at the end of the lesson?*

- Students will identify, compare, and/or contrast the types of infectious agents that affect the human body.
- Students will define a problem from the sixth grade curriculum, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigation of various types, such as systematic observations or experiments, identify variables, collect and organize data, interpret data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.
- Students will recognize that scientists who make contributions to scientific knowledge come from all kinds of backgrounds and possess varied talents, interests, and goals.

**Essential Question(s):** *How will I reword the lesson objective(s) into a question(s) using student friendly terms?(Post this on the Common Board Configuration)*

- How are certain pathogens transmitted to humans through drinking water?

- What types of scientists study infectious agents?
- What types of careers focus on the detection and treatment of infectious agents?
- Which career academies/magnet programs through Pinellas County Schools focus on these types of careers?

**Activator/Hook:** *What anticipatory activity will you do to engage the student? (Videos, Protocols, WICR, etc...)*

I will access the learners' prior knowledge and help them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity will make connections between past and present learning experiences, expose prior conceptions, and organize students' thinking toward the learning outcomes of current activities.

**Materials/Resources:** *What do I have or need to have in order to teach this lesson objective(s)?*

All resources are attached below.

**Lesson Agenda:** *How will I deliver this lesson to help my students answer the essential question(s)?*

- **Day 1 Engage:**  
\* *Antibiotics Probe* - The purpose of this diagnostic assessment probe is to elicit students' ideas about infectious diseases. The probe is designed to reveal whether students recognize that antibiotics only work on bacterial infections, not viral infections.
- **Day 1 Explore:**  
\* *Meet the Menacing Microbes* adapted from ICORE
- **Day 2 and 3 Explore:**  
\* *Cholera Conundrum* lab from ICORE  
\* Differentiation for Advanced students: *Dot Blot Simulation*
- **Day 4 Elaborate:**  
\* *STEM careers* relating to life science/pathology/disease – *Cholera video clips* will be used as a springboard for discussion on careers related to this field of science. An anecdotal story of my trip to U of F this summer and the experiences I had will be shared at this time. I will also give students information about which magnet high schools and career academies focus on biotechnology/pathogen careers. The *Viral Quest* lesson will allow students to explore careers in biotechnology.

## Process/Activities- How Will I Learn It?

**Strategies include:** (Double click the square to "x" all that apply)

Marzano High Yield Strategy: [Click here to enter text.](#)

- |  |  |  |  |  |
|--|--|--|--|--|
| <input checked="" type="checkbox"/> Reading on the Spot    | <input type="checkbox"/> Selective Highlighting        | <input checked="" type="checkbox"/> K-W-L  | <input type="checkbox"/> Read & Say Something        | <input checked="" type="checkbox"/> Venn Diagram       |
| <input checked="" type="checkbox"/> Concept Map            | <input checked="" type="checkbox"/> Frayer Model       | <input checked="" type="checkbox"/> Paired Reading                                       | <input checked="" type="checkbox"/> Read/Think aloud | <input checked="" type="checkbox"/> Quick Write        |
| <input checked="" type="checkbox"/> Cornell (Column) Notes | <input checked="" type="checkbox"/> Anticipation Guide | <input checked="" type="checkbox"/> Think-pair-share                                     | <input checked="" type="checkbox"/> Writing Prompt   |  |
| <input checked="" type="checkbox"/> Questioning            | <input type="checkbox"/> PAS                           | <input checked="" type="checkbox"/> Technology <a href="#">Click here to enter text.</a> |  | <b>Other</b> <a href="#">Click here to enter text.</a> |

**Explicit Instruction with Vocabulary Acquisition Strategy:** *How will I focus my students on what they need to learn? Which important vocabulary will I introduce/review to keep an active word wall?*

\* 5E Process: Students will learn Science standards through Engagement, Exploration, Explanation, Elaboration, and Evaluation

**Modeled Instruction:** *How will you show your students what they are expected to do to answer the essential question(s)? (Copy me teaching, Video tutor, etc..the students are only watching at this time)*

- \* Explicit instruction
- \* Demonstrate labs to verify processes
- \* Provide examples of projects
- \* Teacher Think-Alouds/Read-Alouds
- \* Provide templates for graphic organizers

**Guided Practice with Collaborative Structure:** *How will my students practice answering the essential question(s)? (How will I incorporate Teacher-Led Question and Answer, Student Accountable Talk, Collaborative Structures, and Checks for Understanding? Kagan strategies or collaborative protocols work well here)*

- \* Word Sorts
- \* Chalk Talk
- \* Think/Write/Pair/Share
- \* Reciprocal Teaching
- \* Text Rendering
- \* Jigsaw
- \* Numbered Heads Together
- \* Vocab. Games
- \* Frayer Models
- \* Quick Labs
- \* Inside/Outside Circles
- \* Peer Review w/ Rubrics
- \* 3-2-1
- \* Approved student blogging forums to support educational dialogue between students

**Independent Practice:** *How will my students practice answering the essential question(s) individually?*

- \* Cornell Notes
- \* Concept Maps
- \* Venn Diagrams
- \* Lab Write-ups/Conclusions/Reflections
- \* Worksheets from textbook
- \* Homework/Projects
- \* Literacy in Science: Claims and Evidence/Cause & Effect

**Lesson Summarization:** *How will your students summarize or reflect on what they learned today?(Ticket out the door, Plus/Delta, Cornell Notes Summary, Quick Write, etc...)*

- \* Exit Ticket
- \* KWL
- \* Cornell Notes Summary
- \* Text Rendering Summary

**Home Learning:** How will my students practice what they learned in class at home to reinforce learning and facilitate mastery of the objective(s)?

- \* Worksheets from the textbook
- \* Projects supporting workshop content
- \* Study Guides & Vocabulary Words posted on Portal at all times to support study skills
- \* Homework & Project directions/rubrics posted on Portal for easy access
- \* Technology assignments using Fusion and approved Internet Interactives
- \* Power Points

**Assessment- How Will I Know I Learned It?** *How will I know if my students can answer the essential question(s)?*

- \* Pretest before each unit (Earth/Life/Science)
- \* Benchmark assessments after each workshop
- \* Post-test after each unit (Earth/Life/Science)
- \* Informal evaluations (Thumbs-up/Thumbs down; Exit ticket; Fist of Five)

**Relevance/ Application-How and Where Will I Use It?** How will my students apply their knowledge (Real-world relevance/application beyond assessments)

- \* Weekly Science Current Events
- \* Technology Extensions

**FCIMs:** \* Text Rendering/Academic Dialogue (Socratic Method) – Students will read a current article about infectious disease, highlight unknown vocabulary, number the paragraphs, summarize the text (outline, graphic organizer, one sentence summaries, etc.), create three higher-level thinking questions, then use the questions to drive academic dialogue using evidence from the text to support their answers. Article titled [Cholera in Haiti](#)

**ESE/ 504 Accommodations:**

- Read aloud directions



- Extended Time
- Note-Taking Assistance
- Short Answer/Oral Test
- Repeat/Clarify Directions
- Preferential seating
- Hard Copy
- Verbal Encouragement/Cue to Task
- Break Reduce Written

## Day 1 Explore: *Meet the Menacing Microbes* adapted from ICORE

### Meet the Menacing Microbes

**KEY QUESTION(S):** What is a microorganism? What is a pathogen? When are microorganisms considered pathogens?

**SCIENCE SUBJECT:** Biology, Anatomy and Physiology

**OVERALL TIME ESTIMATE:**

- Advanced Preparation: 10 Minutes
- Student Procedure: 35 Minutes

**LEARNING STYLES:** Visual, Auditory, and Kinesthetic

**VOCABULARY:**

- **Microbiology:** The study of microorganisms.
- **Microorganism:** Microscopic organisms that are invisible to the naked eye. Bacteria, protozoans, viruses, microscopic algae and some types of fungi are all microorganisms.
- **Pathogen:** Disease causing agents.

**LESSON SUMMARY:** The “Meet the Menacing Microbes Activity” is a discussion activity that serves as a basic introduction to pathogenic microorganisms and evidences their intricate connection with humans.

**STUDENT LEARNING OBJECTIVES:**

The student will be able to...

1. Define pathogen.
2. Explain how microorganisms impact human health.
3. Discuss how microorganisms are beneficial to humans.

**MATERIALS:**

- Microbe Questions and Answers ( 1 Question or Answer per Student)
  - ❖ Two different sets of questions and answers exist.
    - Set 1: Blue Paper- Corresponds to the giant microbes in Set# 1
    - Set 2: Orange Paper- Corresponds to the giant microbes in Set# 2
- “Meet the Menacing Microbes” Student Worksheet ( 1 per Student)
- 15 Giant Microbes (1 per Student Pair):

**Corresponding to Question Set # 1:**

1. The Common Cold (Rhinovirus)
2. Sore Throat (Streptococcus)
3. Cough (*Bordetella pertussis*)
4. Flu (Orthomyxovirus)
5. Ear Ache (*Streptococcus pneumoniae*)
6. Stomach Ache (Shigella)
7. Black Death (*Yersinia pestis*)
8. E. Coli (*Escherichia coli*)
9. Ebola (Ebolavirus)



10. Flesh Eating (*Streptococcus pyogenes*)
11. H.I.V (Human Immunodeficiency Virus) AIDS
12. Malaria (*Plasmodium flaciparum*)
13. Staph (*Staphylococcus aureas*)
14. TB, Tuberculosis (*Myobacterium tuberculosis*)
15. MRSA, Multiple- (Resistant *Staphylococcus aureus*)

#### Corresponding to Question Set # 2

1. West Nile (West Nile Virus)
2. Swine Flu, Influenza A virus H1N1
3. Bird Flu, Influenza A virus H5N1
4. Pnemonia (*Streptococcus pneumonia*)
5. Polio (Poliovirus)
6. Pox, Syphilis (*Treponema pallidum*)
7. Measles, Morbillivirus
8. Listeria (*Listeria monocytogenes*)
9. Rubella (Rubella virus)
10. Leishmania (Leishmania tropica)
11. Lyme Disease(*Borrelia burgdorferi*)
12. C. Diff (*Clostridium difficile*)
13. Gangrene (*Clostridium perfringens*)
14. Giardia (*Giardia lamblia*)
15. Typhoid Fever (*Salmonella typhi*)

#### BACKGROUND INFORMATION:

**Microbiology** is the study of microorganisms or microbes. **Microorganisms** are organisms that are invisible to the naked eye. These organisms are very diverse and include bacteria, protozoans, viruses, microscopic algae and some types of fungi. Despite their small size, microbes play an essential role in sustaining life on earth and have for approximately 3.8 billion years. Some microbes, however, are **pathogenic** or disease causing. Pathogenic microbes have the potential to be extremely harmful and/ or fatal to living organisms.

#### ADVANCE PREPARATION:

Prior to implementing the lesson the instructor must:

- Print and Cut “Microbe Questions and Answers”. Questions and answers must be on separate pieces of paper (1 question or answer per student).
  - ❖ There are two different sets of microbe question and answers. Ensure that the giant microbes you distribute in the classroom correspond to the correct questions given to the students. (Set 1- Blue paper; Set 2- Orange paper).
- Make Copies of the “Meet the Menacing Microbes Worksheet” (1 per student).
- Disperse giant microbes around the classroom or place all the microbes in a container in the center of the room.

#### PROCEDURE AND DISCUSSION QUESTIONS:

1. **Bell Ringer Activity (5 Minutes):** Write or post the following question on the board and call on students to respond.

- **Question:** What is a microorganism? What is a pathogen? How are they related?  
(Answer:
  - i. Microscopic organisms that are invisible to the naked eye. Bacteria, protozoans, viruses, microscopic algae and some types of fungi are all microorganisms.
  - ii. Pathogens are disease causing agents.
  - iii. Disease carrying and harmful microorganisms are considered pathogenic.  
Approximately 30% of all bacteria are pathogenic.)

**2. Meet the Microbes Activity (30 Minutes):** Tell the students they are going to participate in an activity to learn more about pathogenic microbes and how they impact human health.

A. Explain Activity Procedure:

- (2 Minutes) Each student will be given a piece of paper with a question or answer relating to a microbe on it. The object of the activity is to find the person that has the answer to your question or the question for your answer.
- (13 Minutes) Once each student finds their microbe partner they must find their giant microbe in the classroom and complete “Part I” of their student worksheet.
- (15 Minutes) The students will introduce their microbe to the class by reading their question and answer aloud. As the students present their microbes make sure they complete “Part II” on the “Meet the Menacing Microbes” worksheet.
  - Students can be called to present their microbe in numerical order. Each giant microbe question is numbered.
- Briefly discuss question #8 on worksheet with students.
- Question #8: We learned a great deal about the negative impacts of microbes. However, not all microbes are harmful to humans. Discuss at least one of the beneficial roles of microbes.
  - (Possible responses: Penicillin, nitrogen- fixing bacteria, decomposers, yeast, bacteria in food- yogurt, cheese, etc.)

**ASSESSMENT SUGGESTIONS:**

Students will complete the “Meet the Microbes Activity Sheet”.

Questions from worksheet addressing objectives:

1. What is a pathogen?
2. Explain the symptoms that an individual infected by your microbe displays.
3. We learned a lot about the negative impacts of microbes. However, not all microbes are harmful to humans. Discuss at least one beneficial role of microbes.

**EXTENSIONS:**

**Modifications:**

- This lesson can also serve as a classroom icebreaker activity. Have the students not only learn about the microbes, but also about their partner. Prior to presenting information on their microbe have the students introduce their partner.

**RESOURCES/REFERENCES:**

**Giant Microbes available for purchase at:**

- <http://www.giantmicrobes.com/>

**Internet Resources:**

1. Science Daily: Microbe News-  
[http://www.sciencedaily.com/news/plants\\_animals/microbes\\_and\\_more/](http://www.sciencedaily.com/news/plants_animals/microbes_and_more/)
- Students can visit this website to find current research, images, and information on microbes.
2. Microbes Info:  
<http://www.microbes.info/index.html>
- This website provides a variety links to find information on microbes.

**Microbe Question and Answer Card References:**

- About.com (2010)
- Centers for Disease Control and Prevention (2010) Division of Healthcare Quality Promotion (DHQP)
- Centers for Disease Control and Prevention (2008) Division of Foodborne, Bacterial, and Mycotic Diseases
- Centers for Disease Control and Prevention (2010) Global Health
- Centers for Disease Control and Prevention (2009) National Center for Immunization and Respiratory Diseases
- Centers for Disease Control and Prevention (2009) National Center for Zoonotic, Vector-Borne, and Enteric Diseases
- Gerace, James. (2008) MedicineNet, Inc.
- MedicineNet, Inc. (2010) eMedicine.com
- Oliver, Drew. (2009) Giant Microbes, Inc
- U.S. National Library of Medicine (2010)
- Watkins, David I. (2008) The Big Challenge. *Scientific American*, 299, 5.
- WebMD (2009) Healthwise, Inc
- Zimmerman, Barry E.; Zimmerman, David J. (1996) Killer Germs. *Contemporary Books*, 90.

## Microbe Questions and Answers Game SET# 1

### 1. The Common Cold (Rhinovirus)

1. Q: You have caught the common cold! Symptoms of your illness include a runny nose, sneezing, sore throat, and coughing. Antibiotics cannot cure you because the common cold is caused by a virus not bacteria. What is the name of the virus that is responsible for causing the common cold?

A: Extremely active during the fall and winter months, the Rhinovirus is responsible for causing the common cold. Rhinoviruses are responsible for almost 35% of colds. The common cold is the most frequently occurring illness in the world, and it is a leading cause of doctor visits and missed days from school and work. Children in preschool and elementary school usually have three to 12 colds per year while adolescents and adults typically have two to four colds per year.

### 2. Sore Throat (Streptococcus):

2. Q: These bacteria are spread through direct contact with mucus from the nose or throat of an infected person. Symptoms caused by this bacterium are a sore throat, sudden fever, cough, swollen glands, diarrhea, watery eyes, and a runny nose. Most infections are relatively mild; however, these bacteria cause severe and even life-threatening diseases if untreated. What is the name of this bacterium?

A: Streptococcus bacteria cause about 15% of sore throats. Strep throat cannot be diagnosed by looking in the throat – a lab test must also be done. Strep throat can be easily cured by taking antibiotics, such as penicillin. It is important for doctors to test for and treat strep throat because if it is mistreated as a viral sore throat or left untreated, it can develop into a more serious disease, such as rheumatic fever. If the test results show strep throat, the infected patient should stay home from work, school, or day care until 24 hours after starting an antibiotic to ensure they are no longer contagious.

### 3. Cough (*Bordetella pertussis*):

3. Q: Caused by a highly contagious bacterium, this disease is characterized by severe coughing, “whooping”, and vomiting. Serious symptoms can persist for as long as six weeks and in some cases may prove fatal. This disease results in high morbidity and mortality in many countries every year. Vaccination for this disease is available and most deaths from this disease occur among unvaccinated children or children too young to be vaccinated. What is the common name of this dangerous disease and the bacterium that causes it?

A: “Whooping cough” is caused by the bacterium *Bordetella pertussis*. Fortunately, the DPT (diphtheria, tetanus, pertussis) vaccines have hugely reduced incidents of this bacterium. *Bordetella pertussis* causes coughing spells, up to 40 a day, that can last over a minute and end with a “whoop” of gasped air. Young children can suffer from oxygen deprivation and turn blue. If you think you have whooping cough, ask your doctor: antibiotics can help you “whoop” it.

4. Flu (Orthomyxovirus)

4. Q: This virus can cause mild to severe illness, and at times can lead to death. Young children, pregnant women, older people, and individuals with existing health conditions (such as asthma, diabetes, or heart disease) are at increased risk for contracting this illness. The best way to prevent this illness is by getting a seasonal vaccination. The vaccine should be taken during the fall because it can take several weeks for it to become fully effective. What is the name of this virus and what does it cause?

A: "Influenza", or the flu, is caused by strains of Orthomyxovirus. Every year, 5-40% of the population gets the flu. However, most people fully recover in a couple of weeks. Since there are only about a dozen different types of flu viruses, vaccines have been developed that can be up to 90% effective in preventing the infection in the first place. The single best way to prevent seasonal flu is to get a seasonal flu vaccination each year. However, since eggs are used in the vaccine, people who are allergic to eggs should not get the shots.

5. Ear ache (*Streptococcus pneumoniae*)

5. Q: This bacterium causes acute otitis media. Symptoms include ear pain, redness, and fever. This bacterium is responsible for causing the most common health ailment in young children. Nearly every child gets this health ailment at least once and most get it several times. This health ailment is the number one cause of emergency room admission each year and is also responsible for more antibiotic prescriptions than any other condition. What is this bacterium and what is the common name for this illness?

A: *Streptococcus pneumoniae* causes ear aches (otitis media). Ear aches are more commonly found in children because of their high susceptibility to upper-respiratory infections. Also, children's ear tubes are shorter and straighter than adult ear tubes, which provides bacteria with easier access. Although there is an antibiotic for ear aches, *S. pneumoniae* is beginning to adapt.

6. Stomach ache (Shigella)

6. Q: This microbe causes an intestinal tract infection that produces abdominal cramps, fever, and diarrhea. It is extremely contagious. In fact, it is so contagious that if even 10 individual bacteria get into your system, you can become infected! What is the name of this bacterium and what does it cause?

A: Shigella is an extremely contagious microbe that causes stomach aches. Over 140 million people are infected by Shigella every year. It is responsible for 10 to 20% of the cases of diarrhea worldwide. If you are infected, it is important to stay hydrated. Currently, there is no vaccine available to prevent shigellosis. The best way to prevent being infected is to wash your hands frequently.

7. Black Death (*Yersinia pestis*)

7. Q: This microbe has caused numerous deaths in history. This microbe began affecting Sicily in October of 1347 and, by 1352, killed 25 million people – or a third of Europe’s population. This microbe caused its victims to bleed beneath the skin, blackening their bodies. The epic ailment caused by this microbe was also characterized by gangrene of the fingers, toes, and nose. What is the name of this microbe?

A: *Yersinia pestis* caused the outbreak of the Black Death in the 1300’s. Although some scientists have speculated that the Black Death was caused by other agents (including anthrax, typhus, and Ebola virus), DNA tests on 600-year-old teeth from victims of the Black Death have confirmed that *Yersinia pestis* was indeed the cause of the Black Death. Today, outbreaks are few and isolated as antibiotics have kept this microbe at bay.

8. *E. Coli* (*Escherichia coli*)

8. Q: Multiple strains of this bacterium exist. Most are harmless and are present in large numbers in the human and animal gut; however, some can make you sick. This bacterium can twirl its flagella around, propelling it forward at the bacterial-equivalent speed of a torpedo. Under ideal conditions, these bacteria can divide every 20 minutes; a single cell can become over a billion in less than 10 hours! What is the name of this bacterium?

A: Most strains of *E. coli* (*Escherichia coli*) are harmless. However, certain strains of this fast moving bacterium can cause food poisoning. Contamination typically occurs at the slaughterhouse, when cattle’s internal bacteria are inadvertently brought into contact with the beef’s surface. Because *E. coli* contamination requires very few bacteria, contaminated meat looks and smells normal.

9. Ebola (Ebola virus)

9. Q: This virus was first recognized in 1976 near a river in the Congo in Africa. The onset of illness is abrupt and is characterized by fever, headache, joint and muscle aches, sore throat, and weakness, followed by diarrhea, vomiting, and stomach pain. A rash, red eyes, hiccups and internal and external bleeding may be seen in some patients. What is the name of this virus?

A: Named after a river in the Congo, where it was first found, the Ebola virus is a potentially fatal disease. Approximately 50-90% of infections result in death. The initial symptoms of Ebola mimic those of many diseases; making it very difficult to diagnose correctly. Outbreaks have been limited to a few hundred cases – many of which have been the result of nosocomial transmission (transmission in a health-care setting). No cases of the disease in humans has ever been reported in the United States



10. Flesh Eating (*Streptococcus pyogenes*)

10. Q: This bacterium causes one of the fastest-spreading infections known. It is very rare, and because its initial symptoms are similar to the flu, more often than not its diagnosis is tragically delayed. This bacterium is passed from person to person through physical contact. If a person has a skin injury- as small as a pinprick or scratch- this bacteria can enter. The infection can destroy skin, fat, and the tissue covering the muscles. Without immediate medical care, toxic shock sets in. What is the name of this bacterium?

A: *Streptococcus pyogenes*, commonly known as “flesh eating disease,” refers to a rare infection that leads to the destruction of the “fibrous tissues.” Typically, originating from a skin injury, the bacterium causes great pain and discomfort within 24 hours of infection. Approximately 50% of the people who contract this disease are in good health prior to infection; nonetheless, about 1 in 4 people die from it.

11. H.I.V. (Human Immunodeficiency Virus) AIDS

11. Q: This virus is most commonly transmitted by sexual contact with an infected person. The symptoms of this virus are separated into three stages. The first stage which occurs within weeks of infection is characterized by “flu” like symptoms. The next stage is asymptomatic or has no symptoms and can last eight - ten years. The final stage of infection is called the Acquired Immunodeficiency Syndrome (AIDS). Symptoms of AIDS include unusual infections or cancers, severe loss of weight, and intellectual deterioration. What is the name of this virus?

A: Human Immunodeficiency Virus (H.I.V) is most responsible for causing Acquired Immuno-Deficiency Syndrome (AIDS) in an infected person once their immune system is compromised. To date, a cure for HIV has not been discovered; however, drug therapies have been successful in suppressing replication of the virus and Highly Active Antiretroviral Therapy, or HAART, has prolonged life and health in countless infected individuals.

12. Malaria (*Plasmodium falciparum*)

12. Q: This microbe was once found throughout the tropics and subtropics. It is passed from person to person by the Anopheles mosquito. Infection results in a wide variety of symptoms, ranging from very mild to severe disease and even death. The microbe affects the liver first. Toxins are then released that cause a fever and chills. Up to half a billion people a year, worldwide develop this disease. What is the name of this microbe?

A: Malaria, *Plasmodium falciparum*, is spread by the Anopheles mosquito. More than a million people, mostly African children, die each year from Malaria. About 1,500 cases of malaria are diagnosed in the United States each year. The vast majority of cases in the United States are in travelers and immigrants returning from parts of the world where malaria transmission occurs, including sub-Saharan Africa and South Asia. Past attempts at eradication have been unsuccessful. New efforts are now underway.

13. Staph (*Staphylococcus aureus*)

13. Q: This bacterium can often be found living harmlessly on human skin. If it gets into your bloodstream, however, it can cause a variety of infections that range from a simple boil to flesh-eating infections. The difference in the severity of infection is dependent on how deep it goes, how fast it spreads, and how resistant it is antibiotic treatment. Patients undergoing surgery are at significantly increased risk for infection, because their skin-barrier is compromised and their immune systems are typically suppressed. What is the name of this bacterium?

A: Staph bacterium, *Staphylococcus aureus*, causes a slew of common infections that are commonly acquired by patients undergoing surgery. Antibiotics are used to treat staph infections. But there has been a gradual change in how well these antibiotics work. While most staph infections used to be treatable with penicillin, that changed in the 1980s and stronger antibiotics are now used. In about 50% of cases, however, resistance is seen to even these stronger antibiotics. These cases are not just happening in hospitals -- as once was true -- but now are occurring in the general community.

14. TB, Tuberculosis (*Mycobacterium tuberculosis*)

14. Q: This bacterium can infect any part of the body, but typically targets the lungs and throat. Symptoms include: a bad cough lasting more than two weeks, coughing up blood or sputum, chest pain, fever, fatigue/weakness, chills, weight loss, loss of appetite, and night sweats. Individuals may be unaware of their infection because these bacteria can remain in a latent or inactive state within the human body. What is the name of this bacterium and what does it cause?

A: TB or Tuberculosis is caused by *Mycobacterium tuberculosis*. Tuberculosis can remain in a latent (inactive) or active state within the body. If TB is suspected, a skin test in which tuberculin is injected under the skin is administered. A hard, inflamed red bump at the injection site indicates TB. This harmful disease has killed more people in the United States than any other disease during the late nineteenth century. It presently infects about 2 billion people in the world, and kills 3 million of those each year. It remains the largest cause of death from a single pathogen in the world.

15. MRSA, Multiple-Resistant *Staphylococcus aureus*

15. Q: Originally responsive to penicillin, antibiotic-resistant strands of this bacterium soon emerged. The antibiotic resistance of this bacterium has continued to improve: some strains of this "superbug" are now resistant to virtually all known treatments. While the immune system in a healthy individual can usually ward off infection from this bacterium without the aid of antibiotics, infection in an individual with a suppressed immune system can be life-threatening. What is the name of this bacterium and what does it cause?

A: MRSA, Multiple-Resistant *Staphylococcus aureus*, has been a traditional problem in healthcare facilities. This highly resistant strain of *Staphylococcus aureus* commonly enters the body through surgical wounds, nasal passages, urinary tracts, and insertion-points for catheters and feeding tubes. Now, MRSA is beginning to spread to the general population and typically is found in groups with pre-existing medical conditions or where a high degree of skin-to-skin contact is customary, such as prison populations, athletic teams, and military recruits.

## Microbe Questions and Answers Game Set# 2

### 1. West Nile (West Nile Virus)

1. Q: This mosquito-borne illness is primarily found in Africa, West Asia, and the Middle East. While outbreaks regularly attract a flood of media attention, about 80% of infected people experience no symptoms at all. Most of the rest experience flu-like symptoms, often accompanied by skin rashes. In less than 1% of cases, this virus penetrates the tissue in or around the brain and spinal cord, causing encephalitis and meningitis. In these rare instances, the virus can cause paralysis, convulsions, coma, and even death. What is the name of this virus?

A: The West Nile virus which is transmitted by mosquitoes is notorious for its harmful potential, however, the majority of the individuals infected experience no symptoms. Overall, the West Nile Virus is still a potentially serious illness which should be avoided. The easiest and best way to do this is by taking the proper precautionary measures to prevent mosquito bites.

### 2. Swine Flu, Influenza A virus H1N1

2. Q: Previously, this strain of the influenza virus only affected pigs. As this flu became more virulent, it began to spread faster and mutate. One such mutation made the species-jump and infected humans. The stigma of this virus's name caused the industry associated with this animal to suffer economically. Fortunately, this flu virus is generally fragile, and in most cases basic health precautions (such as hand-washing) significantly reduce the chance of infection. What is the name of this virus and what were the risks of the species-jump?

A: Swine Flu, Influenza A virus H1N1, is a respiratory infection. Initially, the fear of infection caused a global panic. This is because a viral species-jump poses substantial health risks for the new species. In the original host-population, some immunity generally exists against the original strain and which are at least partially effective against new mutations. In a new host, however, there may be no natural immunity. So the virus can spread rapidly in the new host-population. While Swine Flu may be avoided with proper precautions, the dangers of future mutations and infections will continue to abound until, well, pigs fly.

### 3. Bird Flu, Influenza A virus H5N1

3. Q: Of the few viruses that have crossed the species barrier to infect humans, this influenza virus has caused the largest number of detected cases of severe disease and death in humans. Most cases have occurred in previously healthy children and young adults and have resulted from direct or close contact with infected animals or contaminated surfaces. In general, this influenza remains a very rare disease in people. This virus does not infect humans easily, and if a person is infected, it is very difficult for the virus to spread to another person. What is the name of this virus?

A: Bird Flu, Influenza A virus H5N1, is a virus subtype that occurs mainly in birds, is highly contagious among birds, and can be deadly to them. This virus has now crossed the species barrier and has been responsible for severe infections in humans. Symptoms of avian influenza in humans have ranged from typical human influenza-like symptoms (e.g., fever, cough, sore throat, and muscle aches) to eye infections, pneumonia, severe respiratory diseases (such as acute respiratory distress), and other severe and life-threatening complications.

4. Pneumonia, (*Streptococcus pneumonia*)

4. Q: This bacterium comes in pairs and is the leading cause of bacterial inflammations. The infection commonly causes the inflammation of one or both lungs. Inflammations caused by this bacterium ranks among the top 10 causes of death in the United States and is the #1 cause of death in children under 5 that is preventable by a vaccine. Children and the elderly are at the greatest risk; however, adults may also become infected as well. What is the name of this bacterial infection and the bacterium that causes it?

A: *Streptococcus pneumonia* is the paired bacterium responsible for most bacterial pneumonia infections, which inflame one or both lungs. Signs of this infection can include coughing, fever, fatigue, nausea, vomiting, rapid breathing or shortness of breath, chills, or chest pain. Serious pneumococcal disease caused by *Streptococcus pneumonia* includes pneumonia, meningitis and sepsis. The World Health Organization estimates that more than 800,000 children under 5 die each year of pneumococcal disease. Over 90% of these deaths occur in developing countries.

5. Polio (Poliovirus)

5. Q: Up to 95% of persons infected with this virus will have no symptoms. About four to eight percent of infected persons have minor symptoms such as fever, fatigue, nausea, headache, flu-like symptoms, stiffness in the neck and back, and pain in the limbs which often resolves completely. Less than one percent of these cases result in permanent paralysis of the limbs (usually the legs). Of those paralyzed, 5-10% die when the paralysis strikes the respiratory muscles. What is the name of this viral disease?

A: Poliomyelitis (polio) is a highly infectious disease caused by a virus that invades the nervous system. Only 5% of those that are infected display symptoms. Poliovirus is transmitted through contact with an infected person. There are two types of vaccine that can prevent polio: inactivated polio vaccine (IPV) and oral polio vaccine (OPV). IPV has been used in the United States since 2000; however OPV is still used throughout much of the world.

6. Pox, Syphilis, (*Treponema pallidum*)

6. Q: This is a highly contagious disease spread primarily by sexual activity. Although this disease is spread from sores, the vast majority of these sores go unrecognized. The infected person is often unaware of the disease and unknowingly passes it on to their sexual partner. If left untreated, this disease can cause serious and permanent problems such as dementia, blindness, or death. What is the name of this disease and the bacterium that causes it?

A: Syphilis is caused by the bacteria *Treponema pallidum*. This sexually transmitted disease was once a major public health threat, commonly causing serious long-term health problems. Syphilis infection occurs in 3 distinct stages. If the infection goes untreated, it may then progress to the third stage, which is characterized by severe problems with the heart, brain, and nerves that can result in paralysis, blindness, dementia, deafness, impotence, and even death if it's not treated. Syphilis defied effective treatment until the late 1940s, when the antibiotic penicillin was first developed.

7. Measles (Morbillivirus)

7. Q: This highly contagious respiratory disease is caused by a virus and can be spread through air. Also known as rubeola, this virus normally grows in the cells that line the back of the throat and lungs. It causes fever, runny nose, cough, and a rash all over the body. About one out of ten children with this virus also gets an ear infection, and up to one out of 20 gets pneumonia. What is the name of this disease and the virus that causes it?

A: Measles are caused by the morbillivirus. Measles spreads through the air by breathing, coughing or sneezing. It is so contagious that any child who is exposed to it and is not immune will probably get the disease. While measles is almost nonexistent in the United States because most children are vaccinated, it still kills nearly 200,000 people each year around the world. Measles can even cause pregnant woman to miscarry or give birth prematurely.

8. Listeria, *Listeria monocytogenes*

8. Q: This serious infection has recently been recognized as an important public health problem in the United States. The infection can be caused by eating fresh meats and vegetables that have been exposed to a certain bacterium. Elderly people, pregnant women, newborns, and adults with weakened immune systems are most susceptible to contamination. Symptoms of infection include fever, muscle aches, nausea, or diarrhea. If infection continues to spread headache, stiff neck, confusion, loss of balance, or convulsions may occur. What is this infection and what bacterium causes it?

A: Listeriosis is caused by the bacterium *Listeria (Listeria monocytogenes)*. This bacterium is commonly found on vegetables grown in soil that has been fertilized with manure. Animals can also carry *Listeria monocytogenes* without appearing ill and can contaminate foods of animal origin such as meats and dairy products. To reduce risk of infection, thoroughly cook raw food from animal sources, such as beef, pork, or poultry; wash raw vegetables thoroughly before eating; avoid unpasteurized (raw) milk or foods made from unpasteurized milk; and wash hands, knives, and cutting boards after handling uncooked foods. In the United States, an estimated 2,500 persons become seriously ill with listeriosis each year. Of these, 500 die.

9. Rubella (Rubella virus)

9. Q: This is an acute viral disease that causes fever and rash for two to three days. It is a mild disease in adults and children that does not usually cause long-term health problems. If acquired by a pregnant woman, however, this disease can cause birth defects. The disease is spread by contact with an infected person, through coughing and sneezing. What is the name of this viral disease?

A: Rubella virus can be prevented with the Measles, Mumps, and Rubella (MMR) vaccine. Although the disease is mild, children are recommended to receive two dose vaccinations. Rubella vaccination is also particularly important for non-immune women who may become pregnant because of the risk for serious birth defects if they acquire the disease during pregnancy.

10. Leishmania, (*Leishmania tropica*)

10. Q: This is a parasitic disease that is found in parts of the tropics, subtropics, and southern Europe. This disease is most often spread by the bite of infected sand flies. Several different forms of this disease impact humans. The most common of the forms cause skin sores and affect internal organs. It is thought that about 1.5 million new cases of the cutaneous (skin-afflicting) form and 500,000 of the visceral (internal-organ-afflicting) form occur each year. Almost all of the people in the United States who have this disease became infected while traveling or living in other countries. What is the name of this parasitic disease and the parasite that causes it?

A: Leishmaniasis (LEASH-ma-NIGH-a-sis) is caused by infection of Leishmania parasites, *Leishmania tropica*. People who have cutaneous leishmaniasis have one or more sores on their skin. The sores can be painful and lead to swollen glands near the sores. People who have visceral leishmaniasis usually have fever, weight loss, and an enlarged spleen and liver, and some abnormal blood tests. For example, patients usually have low blood counts, including a low red blood cell count (anemia), low white blood cell count, and low platelet count. People of all ages are at risk for infection if they live or travel where leishmaniasis is found.

11. Lyme Disease (*Borrelia burgdorferi*)

11. Q: This disease is spread by an arthropod. It was the first pest-borne epidemic of the post-World War II era in the United States. Between 1982 and 1993, more than fifty-three thousand cases were reported nationwide. The disease consists of three stages: (1) rash and flu-like symptoms, (2) heart and nervous system disorders, (3) arthritis. What is the name of this disease and the name of the arthropod that has helped spread it?

A: Lyme disease (*Borrelia burgdorferi*) is transmitted to humans by the bite of infected blacklegged ticks. This disease first appeared in Lyme, Connecticut, in October 1975. It was discovered when several people complained to their doctor of feeling fatigued, having pain in their joints, and noticing an unusual rash on their body. Lyme disease is diagnosed based on symptoms, physical findings (e.g., rash), and the possibility of exposure to infected ticks. Most cases of Lyme disease can be treated successfully with a few weeks of antibiotics.

12. C. Diff (*Clostridium difficile*)

12. Q: This bacterium causes diarrhea and serious intestinal conditions such as colitis. The elderly and individuals with preexisting health conditions that require the prolonged use of antibiotics are at a greater risk of acquiring this disease. These bacteria are commonly found in the feces and spread through the contact of infected surfaces. Healthcare workers can spread these bacteria to other patients or contaminate surfaces through hand contact. What is the name of this bacterium?

A: *Clostridium difficile* is a bacterium that can cause colitis, more serious intestinal conditions, sepsis, and rarely death. The infection is most common in people who are taking antibiotics while in the hospital. The large intestine normally contains many good bacteria that keep it healthy and do not cause disease. Antibiotics taken to kill bacteria that do cause disease also kill the good bacteria. This may allow *C. difficile* bacteria to grow in the large intestine and release harmful substances called toxins. Hand-washing and hygienic restrooms help prevent infection and spread of this bacterium

13. Gangrene (*Clostridium perfringens*)

13. Q: These bacteria produce internal gas bubbles that can severely damage body tissues. Under low-oxygen (anaerobic) conditions, the bacteria produce toxins that cause tissue death and related symptoms. This bacterial ailment generally occurs at the site of trauma or a recent surgical wound. The onset is sudden and dramatic. About 1 in 5 cases occur without an irritating event. What is the name of this bacterium and the ailment it causes?

A: *Clostridium perfringens* is a bacterium that commonly causes gangrene infection. Gangrene is a term that describes dead or dying body tissue that occurs because the local blood supply to the tissue is either lost or is inadequate. The site of infection is very painful; the tissue is inflamed, and turns a pale to brownish-red color. The edges of the infected area expand so quickly that changes can be seen over a few minutes and the involved tissue may be completely destroyed. If the condition is not treated, the person can develop shock with decreased blood pressure, kidney failure, coma, and finally death. The person will need to have surgery quickly to remove dead, damaged, and infected tissue.

14. Giardia (*Giardia lamblia*)

14. Q: This illness is an infection of the intestines caused by a parasite and is most often a problem in undeveloped countries where tap water is not safe. After a person is exposed to the parasite, it usually takes 7 to 10 days for the infection to develop. This parasite can be passed to others during the entire period of infection. Symptoms include bloating, nausea, vomiting, and fatigue. You may be infected for months, even if you don't have symptoms. What is the name of this parasitic disease?

A: Giardia is caused by the parasite, *Giardia lamblia*. You may become infected with giardia if you eat food or drink water that is tainted with human or animal waste. This infection is most common in developing nations; however, in the United States you can get giardia by drinking untreated water from wells, streams, rivers, and lakes. This is true even in mountain lakes and streams where the water may seem very pure.

15. Typhoid Fever (*Salmonella typhi*)

15. Q: Persons with this illness carry the bacteria in their bloodstream and intestinal tract. In addition, a small number of people, called carriers, recover from the illness but continue to carry the bacteria. Both ill persons and carriers shed bacteria in their feces. Once these bacteria are consumed, they multiply and spread into the bloodstream. Symptoms associated with this infection include fever, diarrhea, weight loss, sore throat, rash, exhaustion, and a distended abdomen. What is the name of this bacterial illness?

A: Typhoid fever is a life-threatening illness caused by the bacterium *Salmonella typhi*. You can get typhoid fever if you eat food or drink beverages that have been handled by a person who is shedding the bacterium or if sewage contaminated with *S. typhi* bacteria gets into the water you use for drinking or washing food. Therefore, typhoid fever is more common in areas of the world where hand-washing is less frequent and water is likely to be contaminated with sewage.

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Meet the Menacing Microbes Activity

**Part I.** *Directions:* Answer questions # 1-5 with your partner once you have found your microbe.

1. What is a pathogen?

\_\_\_\_\_

2. What microbe do you have?

\_\_\_\_\_

3. What type of microbe do you have? (Ex: virus, bacterium, etc.)

\_\_\_\_\_

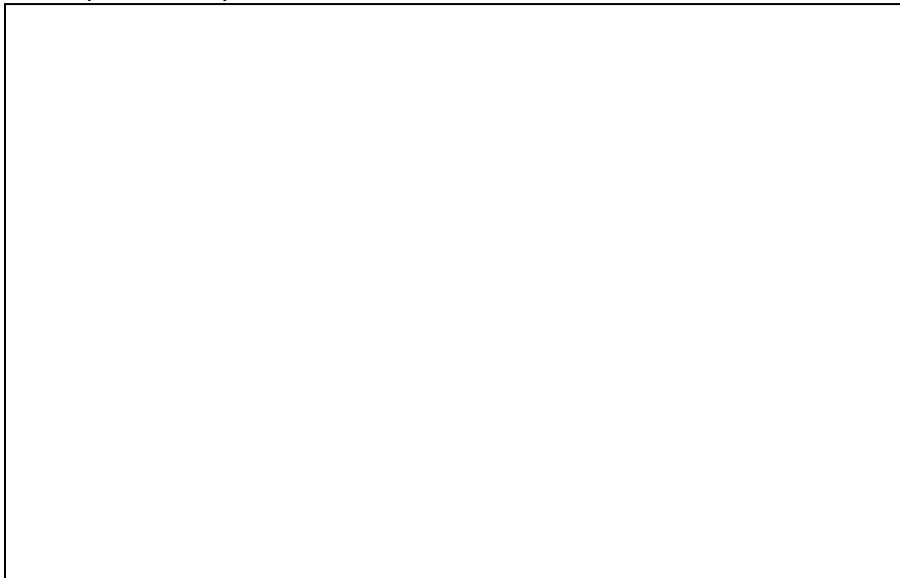
4. Explain the symptoms that an individual infected by your microbe displays.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. Draw a picture of your microbe in the box below.





**Part II.** *Directions:* Answer questions #6– 8 as you learn more about the microbes your classmates present.

6. Complete the table below. List a bacterium, virus, and parasite you learned about and indicate its impact on humans

	<b>How does this microbe impact humans?</b>
<b>Bacterium:</b>  _____	
<b>Virus:</b>  _____	
<b>Parasite:</b>  _____	

7. Which microbe was the most frightening to you? Why?

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8. We learned a great deal about the negative impacts of microbes. However, not all microbes are harmful to humans. Discuss at least one of the beneficial roles of microbes.

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**Day 2 and 3 Explore:**  
**\* Cholera Conundrum lab from ICORE**  
**\* Differentiation for Advanced students: *Dot Blot Simulation***

**Power-point Link:** [Cholera PPT.pptx](#)

## **Cholera Conundrum**

*This activity was adapted heavily from the Science Take Out/University of Rochester Medical School activity, “Medical Mystery of Epidemic Proportions”, to reflect real-world scenarios in Haiti, as well as use more inquiry-based techniques. Written by Drew Joseph, with content expertise and ArcMap assistance by Thomas A. Weppleman*

### **Part 1:**

#### **Materials:**

- Strips of 4 pad pH indicator testing as the cholera dipsticks
- Tubes of “positive” for cholera samples using a pH 10 buffer, and “negative” for cholera using an acidic buffer (pH 4).
- Print out 1 copy of the “Cholera Conundrum Camps” Student spreadsheet, cutting out a set of camp names to be assigned to each student group
- Although this activity is designed for 10 student groups, you can easily modify for more or fewer groups by giving each group fewer or more camps.
- The camps used are based on WFP Emergency Preparedness and Response Branch (ODEP)’s map of Port-au-Prince IDP (Internally displaced people) Camps and Main Distribution Sites, adjusted – *available on accompanying PowerPoint*
- Column G on the “Cholera Conundrum Camps” Teacher Key spreadsheet indicates which camps should test positive for cholera in the well water

Port-au-Prince map:

Print a large copy of the camp map (available on accompanying PowerPoint), and put up on a corkboard (for using pushpins), or a wall (for using sticky tabs). Alternatively, you can project this map onto a whiteboard, and have students mark the locations with whiteboard markers or sticky tabs, although the resolution may be too poor when projected to read the camp names.

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## Part 2:

### Materials:

- Print out antibody-antigen test circles on overhead sheets, 1 per group/camp
- Use 2 colorless chemicals (saturated sodium bicarbonate solution – baking soda, and calcium chloride are two such chemicals) that will create a precipitate when combined (just a few drops), place one (that won't react with water) in tubes labeled "O1 antibody", and the other in a tube labeled "positive control". In tubes labeled with the camp names or numbers, put either water or the precipitating solution, depending on whether it should test positive for the O1 antigen (with precipitate) or negative (water). Column H on the "Cholera Conundrum Camps" Teacher Key spreadsheet indicates which camps should test positive for O1 type cholera

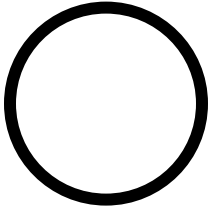
### Extensions:

After completion of this activity, many students will likely wonder how cholera can be prevented in the first place. The difficulty is that countries vulnerable to cholera epidemics have poor water and sanitation, and public health systems are lacking. To show students the extent of this problem, you can have them complete individual or group research projects on the nature of cholera epidemics. Possible topics include:

- Map out cholera outbreaks in the past 50-100 years, globally. Indicate the per capita income in each country, as well as the status of their sanitation and public health systems.
- Artistic representations of the sanitation and public health systems in countries that have recently experienced cholera outbreaks. This includes drawings, paintings, audio, and video (ex. public service announcements).
- Research CDC and/or WHO data on cholera outbreaks, particularly the recent outbreak in Haiti. Projects could include a public service announcement on preventative measures to help prevent the spread of cholera.
- *Any of these projects should ask students to consider how the preventative measures might be difficult for citizens to implement due to cost, i.e. why adding bleach in water or boiling water might be too expensive for many Haitians*

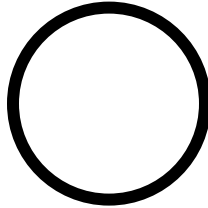
Antibody Test: print 1 per group/camp on overhead sheets for Part 2

O1



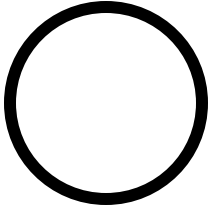
Positive control

O1



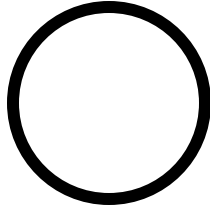
*Vibrio cholerae*  
sample from  
patient

O1



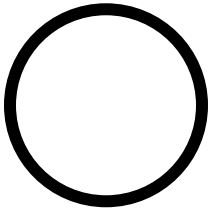
Positive control

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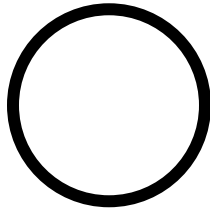
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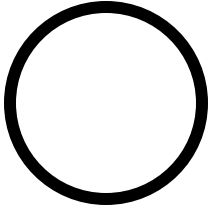
Positive control

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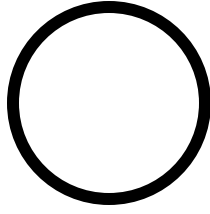
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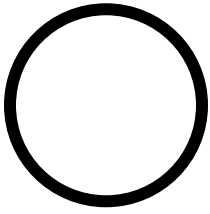
Positive control

O1



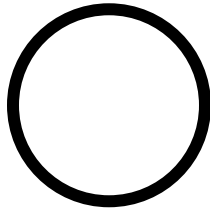
*Vibrio cholerae*  
sample from  
patient

O1



Positive control

O1



*Vibrio cholerae*  
sample from  
patient

## Cholera Conundrum Student Handout

Port-au-Prince, Haiti

**Part 1:** I returned to Haiti last week for the first time since early 2010. I came immediately after the earthquake in January 2010 to assist in Oxfam's efforts to provide clean drinking water for people in Port-au-Prince. Although it was difficult work, I found it immensely rewarding. I made the decision to come back to Haiti to see how we could improve our efforts to control the cholera outbreak, and I'm just stunned. There are hundreds of new cases every day, and the devastation is overwhelming. This tiny bacterium, *Vibrio cholerae*, does so much damage with the potent toxin that it produces. It's amazing that this protein toxin causes such large amounts of watery diarrhea. Cholera can cause such quick death because of the rapid dehydration in patients. One of the reasons it's become such a problem in Haiti is because cholera is usually transmitted in water and food that has been contaminated by infected feces, as well as by person-to-person contact. Even though many infected individuals don't actually show symptoms, they still shed the bacteria for 14 days after infection. This fact makes it so important for us to keep the food and water supplies clean and uncontaminated.

To make sure that you understand the basics of what we're dealing with, answer the following questions:

1. How is cholera transmitted?

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2. Is cholera a bacteria or a virus?

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3. What pathogen causes cholera?

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4. How does the pathogen that causes cholera work?

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5. How long are people with cholera infectious?

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6. How does cholera cause death?

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7. Why do you think cholera has become an epidemic in Haiti?

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This recent upsurge in cholera cases in Port-au-Prince has me concerned. More and more people in this devastated community have turned to us for help in treating this terrible disease, but we can barely keep up. Patients require antibiotics to kill the bacteria, but replacing fluids and electrolytes orally is just as important, in order to alleviate their dehydration. We recently received a shipment of a new diagnostic tester that uses Rapid-Test dipsticks, similar to our old diagnostic tools, but much more reliable. Right now we need a set of volunteers to test for the presence of cholera in various wells in several neighborhoods and camps. Make sure to wear gloves and goggles, and wash your hands afterward. In the space below, write down your assigned neighborhood and whether the water tested positive or negative for cholera:

Camp number and name	Cholera present	Cholera absent

Total number of camps with cholera present: \_\_\_\_\_

On the map of Port-au-Prince in the front of the office, put a **red** pin or tag in the camps WITH cholera in the water, and a **green** pin or tag in the camps WITHOUT cholera in the water, according to your results.

8. What patterns do you notice in the location of cholera-contaminated water?

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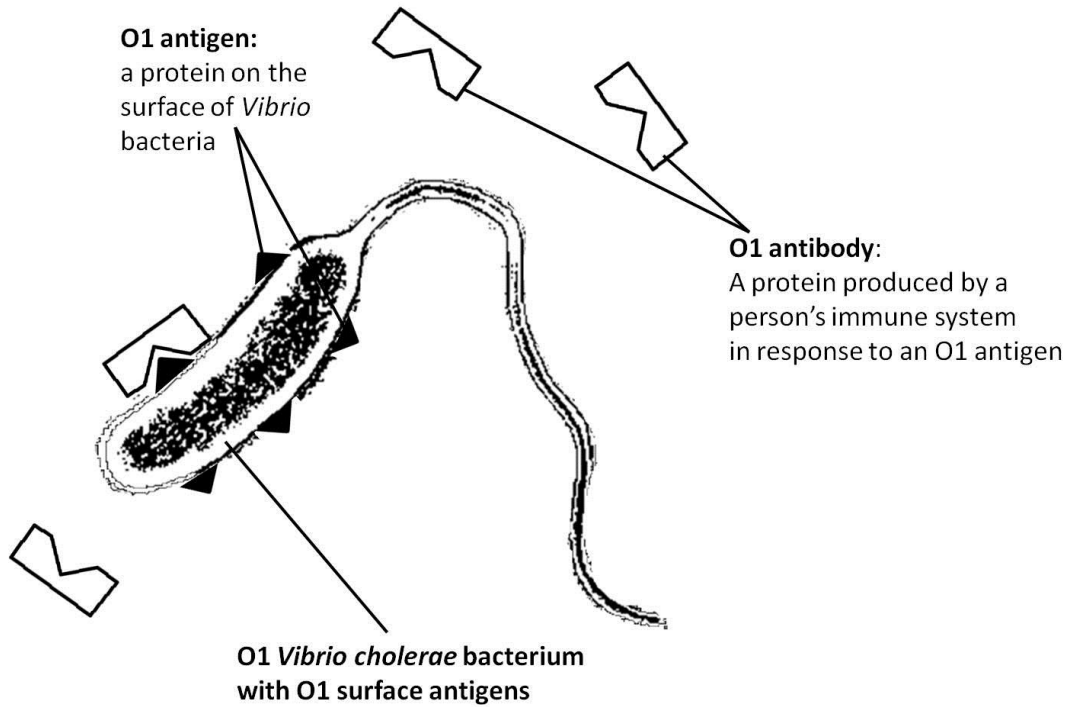


9. Add up each group's results for the number of camps with cholera present. What proportion of camps tested positive for cholera?
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**Part 2:** There are many different strains of cholera, including strains that are non-pathogenic, and just occur in the environment. There are also several different strains and biotypes that produce the cholera toxin, leading to illness. There are also multiple other diarrheal illnesses that look similar to cholera, so it is essential to test patients to see if they have cholera, or a different disease, in order to track the outbreak of the pathogen. Our next task is to go into health clinics and hospitals in all of the camps, and test diarrheal patients to see if they have a specific strain of cholera or not. The O1 type of cholera has a specific antigen present on the exterior of the bacteria, and is also a pathogenic strain, containing the cholera toxin. We're going to test for type O1 cholera antibodies in patients who have symptoms of cholera in order to see if they have type O1. But first, I want to be sure that you understand what antigens and antibodies are, so that you know why it's so important to wear protective gear like gloves and goggles.

**Antigen:** a protein on the surface of bacteria or other pathogen; different bacteria have different antigen

**Antibody:** a protein produced by the immune system to recognize a specific antigen and to then initiate an immune response



10. Describe the differences between antigens and antibodies.

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11. What do you expect will happen if you mixed O1 antibodies with cholera bacteria that have O1 antigens?

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To do this test, we'll be using a control sample in order to see what should happen if there are O1 antigens present in our patients. The positive control will clump together in a white solid that precipitates out of the solution.

12. What is the substance that precipitates out of the positive control?

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13. What would you expect to happen in negative samples?

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Each group will visit one patient in a health clinic or hospital in each camp to determine if they have O1 type cholera. Put 2 drops of the O1 antibody on each antibody test circle. Perform your positive control

by putting 2 drops of the known O1 antigen on the left circle, and then put 2 drops of the *Vibrio cholerae* sample from your patient on the right circle. Wash the test sheet after each patient.

Camp number and name	O1 Cholera present	O1 Cholera absent

On the map of Port-au-Prince, indicate with a **blue** flag where you found O1 type cholera.

14. Add up each group's results for the number of camps with O1 cholera present in patients. What proportion of camps tested positive for O1 cholera?

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15. What patterns do you notice in the location of both the pathogenic and the type O1 cholera?

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**Part 3:** Open the Google Earth file (kml) for Haiti, Internally Displaced Person Camps. Find one of your group's camps on the map, and zoom in.

16. Describe the camp below:

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17. Find the rest of your group's camps, zoom in on them, and describe the similarities and differences between all of them, particularly noting if one of them contained cholera contamination:

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18. Use the maps of environmental cholera presence to isolate the cholera-contaminated camps, and zoom in to explore those areas. What features do you notice about those contaminated areas that might have helped to contribute to the spread of cholera in that region? Explain.

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## Differentiation for Advanced students: *Dot Blot Simulation*

### “Dot Blot” Laboratory Protocol

The dot blot is a technique for detecting, analyzing, and identifying proteins, similar to the western blot technique. The dot blot differs from the western in that the protein samples are not separated electrophoretically but are spotted through circular templates directly onto the membrane or paper substrate. Concentration of proteins in crude preparations (such as culture supernatant) can be estimated semi-quantitatively by using the dot blot method if you have both purified protein and specific antibody against it.

#### Materials:

Nitrocellulose membrane  
Incubating Tray  
Serum  
Blocking Solution (Block)  
Primary Antibody (1° Ab)  
UV-conjugated Secondary Antibody (2°Ab)  
TBS-T Solution (Wash)  
UV Light

1. Obtain a nitrocellulose membrane with grid. The grid is drawn on the membrane to indicate the regions that you are going to blot.
2. For each sample, spot 2  $\mu$ l of serum onto the nitrocellulose membrane at the center of the appropriate grid space. Apply the sample slowly to minimize the area of the dotted sample.
3. Place the membrane in the incubation tray and allow the membrane to dry for 10 minutes.
4. Block the membrane by immersing in enough blocking solution to cover the membrane as it lays in the tray. Block for 5 minutes at room temperature to prevent non-specific binding of the antibody.
5. Dump the blocking solution into a waste container. Incubate the membrane with primary antibody solution for 10 minutes at room temp. Make sure to frequently shake the tray so as to disperse the solution evenly across the membrane.
6. Wash the membrane three times with TBS-T (3 x 2 min).
7. Incubate the membrane with secondary antibody for 10 min at room temp. Make sure to shake frequently so as to disperse the solution evenly across the membrane.
8. Wash the membrane three times with TBS-T (3 x 2 min).
9. Allow the membrane to completely dry before checking the samples. If the antigen is present in the patient sample, the sample should glow under the UV light. Fill in the first two columns of the following table with your results!

<b>Sample</b>	<b>Positive? (Y/N)</b>
Neg Control	
Pos Control	
Patient 1	
Patient 2	
Patient 3	
Patient 4	
Patient 5	
Patient 6	

### Dot Blot Lab – Instructions and Prep

1. Nitrocellulose membranes to blot samples (Bio-Rad, Sample cat # 162-0146). For the exercise we did in ICORE, I took each membrane and cut it in half. Each half-membrane was gridded for 8 samples and given to a pair of students.
2. Serum Samples – we used 8 for this experiment: 1 pos control, 1 neg control, and 6 patient samples. The controls are necessary, but the number of patient samples is arbitrary and can be changed to fit your story line. You can also incorporate testing the same sample multiple times, as often lab experiments are done in triplicate (at least) to account for false positives or contamination. The samples are just water with a little bit of red food coloring to make them look like serum (go easy on the red food coloring, you don't need a lot as it's quite potent).
3. Reagents – Block, Wash, Primary Ab, Secondary Ab. Again, all of these were just water. The secondary antibody had a little bit of blue food coloring added, to simulate the UV conjugate. If you're feeling extra energetic, you can even put a few drops of milk/milk powder in the block to make it look like a true milk-based blocking solution.
4. Falcon Tubes/Micro Tubes – we used these to store the serum samples as well as the reagents (wash, block, etc). These are available from a multitude of vendors, such as Fisher; however, beakers would work just as well to hold the reagents.
5. Sharpies/UV Pen – The sharpies are necessary for drawing either a grid or circles onto the membrane to show the students where to blot their samples, and of course the UV pen to fill in the positive ones. The UV pens can be bought from Blacklight.com, there are multiple pens that will work, but the one I used was the Opticz invisible ink pen, which glows blue under UV light (item #SPPENH), and is waterproof.
6. Pipettors: If you don't have pipettors or aren't going to request that particular locker, you can use a regular dropper to blot the samples onto the membrane. As its written this assay is not quantitative, so the amount of "serum" that's added is not critical.

**Day 4 Elaborate:**

\* **STEM careers** relating to life science/pathology/disease – *Cholera video clips* will be used as a springboard for discussion on careers related to this field of science. An anecdotal story of my trip to U of F this summer and the experiences I had will be shared at this time. I will also give students information about which magnet high schools and career academies focus on biotechnology/pathogen careers. **ViralQuest Lesson 10** will allow students to explore careers in biotechnology.

# LESSON 10: BIOTECHNOLOGY CAREERS

**LESSON SUMMARY**

In this lesson students will explore various aspects of careers in biotechnology and create position statements about their interest in specific careers. This lesson was adapted from <http://www.teachersdomain.org/resource/biot09.biotech.car.careers/>

**GUIDING QUESTIONS**

- What are some common biotechnology careers?
- What are the qualifications and salaries for careers in biotechnology?

**TIME ESTIMATE**

1 class period (50 minutes). An extension activity (1-2 additional class periods) is available on the teacher CD.

**STUDENT LEARNING OBJECTIVES**

The student will be able to describe different divisions found in a biotechnology company. The student will be able to detail requirements for sample positions in a single division.

**BACKGROUND INFORMATION**

What Is Biotechnology? From: <http://bio.org/speeches/pubs/er/BiotechGuide2008.pdf>

At its simplest, biotechnology is technology based on biology. From that perspective, the use of biological processes is hardly noteworthy. We began growing crops and raising animals 10,000 years ago to provide a stable supply of food and clothing. We have used the biological processes of microorganisms for 6,000 years to make useful food products, such as bread and cheese, and to preserve dairy products.

Crops? Cheese? That doesn't sound very exciting. So why does biotechnology receive so much attention?

The answer is that in the last 40 years we've gone from practicing biotechnology at a macro level—breeding animals and crops, for example—to working with it at a micro level. It was during the 1960s and '70s that our understanding of biology reached a point where we could begin to use the smallest parts of organisms—the biological molecules of which they are composed—in addition to using whole organisms.



An appropriate modern definition of biotechnology would be “the use of cellular and biomolecular processes to solve problems or make useful products.” We can get a better handle on the meaning of the word biotechnology by thinking of it in its plural form, biotechnologies. That’s because biotechnology is a collection of technologies that capitalize on the attributes of cells, such as their manufacturing capabilities, and put biological molecules, such as DNA and proteins, to work for us.

## MATERIALS

- Computer with internet access and projector
- VQ\_Updates&BellRingers PowerPoint (available on teacher CD)
- Student copies of Biotechnology Career Profiles sheets (one copy for each pair of students within a division) (available on teacher CD)

## ADVANCE PREPARATION

Make one copy of the Biotechnology Career Profiles worksheets for each student. Prepare overhead transparency of Biotechnology Industry Facts sheet. Make career posters available for students to access.

## PROCEDURE

1. Open the VQ\_Updates&BellRingers PPT.
2. Have students complete the Bell Ringer in their VQN to recall any prior knowledge.
3. Choose two career profile videos to show to the class from the following website:  
<http://www.teachersdomain.org/resource/biot09.biotech.car.careers/>
4. Whole class discussion:
  - What are your impressions of the video?
  - Do the individuals seem to enjoy their work?
  - What is biotechnology?
  - Has anyone ever considered a career in biotechnology?
  - Who might consider a science-related career?
  - Where did all of these individuals work?
5. Divide students into pairs and evenly assign each pair to one of four divisions (career path) within a biotech company (Biotech R Us):
  - Research and Development (Scientific Research Manager; Biomedicine; Epidemiologist)
  - Manufacturing and Production (Manufacturing Technician; Biorobotics; Process Development Scientist)
  - Quality Control and Assurance (Quality Control Associate; Quality Assurance Associate Batch Review and Release)
  - Clinical Research (Laboratory Technician; Forensic Biological Scientist)
6. Within each division, the students will pair up to complete the student worksheet (one worksheet per pair) covering TWO positions within their division using the Biotechnology Career Profiles sheets aligned with each division.
7. Once all students in the division have completed their worksheet, one pair from each division meets with pairs from each of the other divisions (in a jigsaw format) to discuss the careers in their division. While a pair is sharing the careers from their division, the other students ask questions and take notes on those careers.

8. Remind students to consider which career sounds most interesting to them and take additional notes on that career. Explain that they will be required to write a personal statement about their favorite career.
9. Assign students to complete the Journal entry for today's lesson requiring them to write a position statement addressing the following questions:
  - Which career would you most want to pursue?
  - Why is that career appealing to you?
  - What qualifications do you have that would make you a perfect candidate for that job?
  - What would you hope to accomplish as an employee in that position?

### DISCUSSION QUESTIONS

- What are your impressions of the video?
- Do the individuals seem to enjoy their work?
- What is biotechnology?
- Has anyone considered a career in biotechnology?
- Who might consider a science related career?
- Where did all of these individuals work?

### ASSESSMENT SUGGESTIONS

- Student worksheets with each of the careers from assigned division.
- Student position statements.

### TEACHER RESOURCES

- Biotechnology Industry Facts: <http://bio.org/speeches/pubs/er/statistics.asp>
- Extensive Guide to Biotechnology from industry perspective: <http://bio.org/speeches/pubs/er/BiotechGuide2008.pdf>
- [http://www.accessexcellence.org/RC/CC/bio\\_career\\_1.php](http://www.accessexcellence.org/RC/CC/bio_career_1.php)
- [http://www.accessexcellence.org/RC/CC/bio\\_career\\_2.php](http://www.accessexcellence.org/RC/CC/bio_career_2.php)
- <http://www.accessexcellence.org/RC/CC/CP/>
- <http://www.biotechinstitute.org/careers/>
- <http://www.careervoyages.gov/biotechnology-main.cfm>
- [www.fiercebiotech.com/jobs](http://www.fiercebiotech.com/jobs)
- <http://www.amgen.com/>
- <http://www.amgen.com/careers/careers.html>
- <http://www.pfizer.com/home/>
- <http://www.pfizer.com/careers/>

## SCIENTIFIC RESEARCH MANAGER

### Type of Work

This is work managing a scientific research program.

### Examples of Work (not all inclusive):

- Recommends and implements operating policies and procedures.
- Plans and participates in research projects.
- Directs and modifies research plans.
- Prepares and monitors operating budget.
- Develops methods and techniques for, and evaluates results of, experiments or studies.
- Prepares and reviews manuscripts for publication and presentations at scientific meetings.

### Minimum Qualifications

A bachelor's degree in an appropriate area of specialization and four years of appropriate experience. Appropriate college coursework may substitute at an equivalent rate for the required experience.

**Salary Range:** Depends on education and experience but starting salaries average \$40,000 and senior level managers make \$60,000+ per year.



Good Management is nothing more than motivating people in a positive way. This is best done through example.



**Mahatma Moriko**

**"My work and purpose here at The National Laboratory for Biotechnology and Bioinformatics is to run a smooth, clean and productive laboratory. I must ensure that my staff have their needs met, from quality resources and equipment to a safe working environment. Being the boss brings great joy and with that joy comes a great deal of responsibility."**

# Career Spotlight

## Biomedicine

### Education and Training

Full qualification is mandatory in one or more of the biomedical science specialties in this utilization field. Also, a minimum of 24 months of experience is mandatory in planning and administering biomedical sciences programs for the award of the qualified Biomedical Scientist.

Knowledge is mandatory of biomedical sciences programs, including an understanding of all specialties and disciplines within the Biomedical Sciences Corps.



### Salary Range

Salary depends on experience and education but starting salary averages \$50,000-\$70,000.

### Job Description

A biomedical scientist carries out laboratory tests on human samples to help clinicians diagnose illness and evaluate the effectiveness of treatment. This work is vital to the wellbeing of patients because doctors treat their patients on the basis of the results of these tests.

Following basic training, most biomedical scientists specialize in one aspect of medical laboratory science. The main areas are: medical microbiology (identification of microorganisms causing disease, and their antibiotic treatment); clinical chemistry (the chemical analysis of body fluids); transfusion science (determination of donor unit compatibility and investigations into group antigens and antibodies); hematology; histopathology; cytology; immunology; and virology.

# DIAGNOSTIC EXCELLENCE

National Laboratory for Biotechnology and Bioinformatics

## **Position Title: Epidemiologist**

Epidemiologists study both frequency and distribution of diseases within human populations and human environments. They work to measure the incidence of disease occurrence and relate it to different characteristics of populations and environments. Epidemiologists not only perform research but also work in education and public health practices in universities, government agencies, international organizations, and private corporations.

## **Examples of work:**

- Develop methods of measuring and evaluating disease occurrences in human populations.
- Make recommendations for public health policy both at state and national levels.
- Develop educational resources for public use in order to keep people informed about diseases, how they spread, and how best to prevent them.
- Conduct various kinds of research in virology, population genetics and ecology, microbiology, and public health.

## **Qualifications:**

- Lead and senior researchers have PhD's in biology or public health.
- Laboratory technicians usually have bachelors or masters in biology or public health and 2-3 years experience in laboratory environments.

**Salary Range:** \$30,000-100,000 per year, depending on education and experience.



**Trevor Simms**

**“Working at the National Laboratory for Biotechnology and Bioinformatics allows me to mix my passions for studying viruses and infectious diseases with the goals of providing research that will lead to effective policy and public health changes in the future in order to minimize the threat of new and emerging pathogens. I get to work not just with scientists, but with educators and politicians to make the world both a healthier and safer place.”**



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# Career Spotlight

## Manufacturing Technician

### **Education and Training**

A Manufacturing Technician helps in the synthesizing and production of vaccines. The candidate must be careful and thorough, with a high degree of attention paid to Standard Operating Procedures (SOPs). This position provides critical support to the manufacture of vaccines in accordance with cGMPs (current Good Manufacturing Practices). Manufacturing Technicians weigh, measure, and check raw materials to ensure that manufactured batches contain the correct ingredients and quantities. They maintain records to ensure that the production areas comply with regulatory requirements. Duties may also include tissue culture, cleaning and sterilizing glassware and tools, as well as critical cleaning of the manufacturing facility and equipment. This is an excellent opportunity to get started in the industry and work your way up.



**Salary Range:** Depends on education and experience but averages from \$28,000-\$40,000 per year though it increases with education and experience.

### **Job Description**

- Prepare solutions and equipment for use in the preparation of a commercial pharmaceutical product.
- Document data in batch records to ensure product is made in accordance with specifications.
- Prepare solutions and culture media pertinent to cell manufacturing
- Work in clean room environment and class 100 BioSafety Cabinet
- Monitor and maintain equipment, and prepare equipment for use in production.
- Inspect the product by performing visual checks.
- Assist in filling out equipment logs.
- Assist in facility and equipment cleaning.
- Assist in reviewing batch records and SOPs as necessary.
- Assist in the generation of SOPs, production batch records

# CAREER SPOTLIGHT

## Biorobotics

### Education and Training

- BS or higher in an engineering (EE, ME, CS, CE) or biotechnology related discipline (chemistry, biology, etc.) or math and 3-5 years of experience.
- Electro-mechanical aptitude with ability to assemble test set-ups, including electrical and fluid connections.
- Exposure to software test procedures and protocols strongly desired, along with some course work in a programming language such as Visual Basic, C or C++.
- Coursework or experience in robotics and precision liquid handling a plus.



### Salary Range

Depends on Education and experience, but averages from \$35,000 to \$50,000 starting pay.

### Job Description

#### **LEAD TEST ENGINEER**

Performs product testing assignments of new or enhanced products. Competent to draft test procedures, modification of programs for testing (hardware and software), analysis of test data. May supervise and direct other test engineer(s). Updates project/product bug lists in a timely manner. Documents common failure modes for incorporation into improved test protocols. Applies industry and company standard engineering and design principles to assigned tasks.

### **Process Development Scientist**

I help people! I figure out how to take discoveries made at the bench and turn them into a pure, potent, and safe product that can be mass produced! I conduct experiments, analyze data, write technical reports and assessments, assist with regulatory documents, and communicate project updates to management and to team members. I am organized, pro-active, able to work independently as well as with others, and show strong scientific/engineering problem solving abilities. I must also have knowledge of current "Good Manufacturing Practices."

#### **JOB REQUIREMENTS**

- Improve product yield and reduce costs.
- Develop cell cultures to produce vaccines.
- Compare cell growth & productivity in media
- Operate and troubleshoot cell culture equipment such as bioreactors/fermenters, and analyzers. Grow cells in T-flasks.
- Analyze cell growth and production data
- Running gels, PCR, and/or ELISA type assays, performing dilutions, operating a pipette, determining pH and conductivity.

**QUALIFICATIONS:** Entry level (Assistant) requires Bachelor's degree in a science field. Mid to Senior level (Associate/Scientist) requires a Masters or Ph.D. and a minimum two years related experience and/or training.

**Salary Range:** \$40,000-\$100,000 based on education and experience.



**Linden Wenona**

"I've been at the National Laboratory for Biotechnology and Bioinformatics for well over fifteen years. I know I am making a difference in the quality of people's lives by helping to synthesize medicines and treatments for various diseases. Just last year I helped produce a drug treatment with limited side effects for diabetes .

This year we are working on synthesizing a glycosidase inhibitor that slows sugar absorption and will help increase quality of life. My work is socially conscious, valuable to the community I work with and rewarding both personally and professionally."



## **Position Title: Quality Control Associate**

A Quality Control Associate performs testing of raw materials, in-process samples, finished products, and manufacturing processes necessary to demonstrate that products meet all required specifications prior to being released for sale. Because the vaccines we manufacture directly impact people's lives, strict Food and Drug Administration (FDA) regulations must be followed and documented at every step. Candidates professionally assist with the development of new tests and standards, and qualify them in advance of product release testing.

### **JOB REQUIREMENTS:**

- Perform **gel electrophoresis** and data analysis on Manufacturing and stability samples including drug product, drug substance, and intermediates
- Perform **PCR** to test for residual DNA on drug substance
- Provide analytical support to Development
- Perform **ELISA** tests on products and samples
- Analyze data for documentation and reporting of test results
- Maintain documentation for regulatory compliance

### **Qualifications:**

- A.S. degree in Biotechnology, or B.S. in Biology in Chemistry
- 2-5 years of experience in Biotech Environment
- Ability to work independently as well as an part of a cohesive team

**Salary Range:** \$30,000-60,000 per year, depending on education and experience.



**Jefferson Earle**

**"The production of a biotechnology substance involves meeting specifications for precision, reproducibility and safety. Our products are consumed by people and animals, or are distributed into their environment. My job here at the National Laboratory for Biotechnology and Bioinformatics is to assure that our product is safe for environmental exposure and consumption by living organisms. I am the safety inspector and have the company as well as public interest in mind when formulating safety procedures and F.D.A. approved Best Practices."**

# EXCELLENCE IN PERFORMANCE

National Laboratory for Biotechnology and Bioinformatics

## **Position Title: Quality Assurance Associate Batch Review and Release**

In this position, an individual is responsible for the review of batch record files and final product release. It is critical that our vaccines not be released for sale if they have not been manufactured in a controlled environment. This position involves participation in investigations and trending of quality issues as well as supporting Quality Assurance inspections for all manufactured batches and review/release raw materials, labeling materials, and packaging materials as needed. Although this person will not "do" science, it is imperative that they understand the science behind the manufacturing and testing of vaccines.

### **JOB REQUIREMENTS:**

- Assist in the development, implementation and maintenance of quality assurance systems to ensure compliance with FDA regulations and methods impacting the identity, strength, quality and purity of drug products.
- Assist in the review of production processes and records to assure quality; analyze trends.
- Ensure Good manufacturing Practices.
- Assist in the review of all lot testing results and endurance of corrective actions where indicated.
- Assist in the support of QA in-line inspections for all manufactured batches as needed.

### **Qualifications:**

Requires a bachelor's degree in a scientific discipline with 2-4 years experience in a regulated industry.  
Working knowledge of Good Laboratory Practices.  
Working knowledge of FDA regulations and guidelines preferred.

**Salary Range:** \$40,000 to \$50,000 annually, based on education and experience



**Maleah Annika**

**"The production of a biotechnology substance involves meeting specifications for precision, reproducibility and safety. Our products are consumed by people and animals, or are distributed into their environment. My job here at the National Laboratory for Biotechnology and Bioinformatics is to assure that our product is safe for environmental exposure and consumption by living organisms. In many ways I am the safety inspector and have the company as well as public interest in mind when formulating safety procedures and F.D.A. approved Best Practices."**



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**Isabella Pompeo**

"I started working here after I got my Associates of Science degree from the local community college. This job helped provide me with the income to get my Bachelor's of Science degree. Not only are my job opportunities growing, but I have learned a significant amount of information in a field which is booming with career paths that enhance peoples quality of life. The work I do ensures urgently needed new medicines and treatments for patients can be produced in a consistent, methodological and productive way. In many ways, I am the foundational block of this institution"

**LABORATORY TECHNICIAN**

**Type of Work**

This is work performing established laboratory procedures, otherwise known as "Best Practices".

**Examples of Work (not all inclusive)**

- Performs a variety of standard laboratory tests and analyses.
- Operates and maintains a variety of laboratory equipment.
- Dissects tissues and prepares specimens and samples for study.
- Performs field work by gathering data and collecting samples.
- Assists in embalming human bodies.
- Collects and organizes data and documents results.

**Minimum Qualifications**

A high school diploma and two years of appropriate experience. Appropriate college course work or vocational/technical training may substitute at an equivalent rate for the required experience.

**Salary Range:** Depends on education and experience but starting salaries average between \$25,000-35,000/year.



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**Alper Hameed**

"My work here has truly been fulfilling. We research different strains of virus's that affect agricultural resources from the food we eat, to the plants we grow for alternative biofuels like ethanol. It is my job to maintain our equipment, run experimental compounds and collect data on the growing cultures. I keep the laboratory running smoothly, the tools calibrated precisely and our supplies fully stocked. At the end of the week I go home satisfied knowing that my work benefited my community."

# Career Spotlight

## Forensic Biological Scientist

### Education and Training

A wide range of expertise is required in forensic investigations. A forensic scientist may specialize in chemistry, physics, biochemistry, molecular biology, botany, geology, metallurgy, pharmacology, toxicology, crime scene examination, firearms examination, fingerprint and document examination.

The minimum requirement is a bachelor's degree in chemistry, biology, physics, molecular biology, or a related science. In the future, a master's degree may be required. In deciding whether to get a degree in chemistry or biology, or one in forensic science, study the courses offered. At least 24 semester hours of either chemistry or biology are required and math is a must. The title of the degree is not as important as the courses taken.



### Salary Range

Depends on level of education and experience, but averages from \$35,000 to \$55,000 per year.

### Job Description

- Analyzing samples, such as hair, body fluids, glass, paint and drugs, in the laboratory;
- Applying techniques such as gas and high performance liquid chromatography, scanning electron microscopy, mass spectrometry, infrared spectroscopy and genetic fingerprinting;
- Sifting and sorting evidence, often held in miniscule quantities; attending and examining scenes of crimes; recording findings and collecting trace evidence from scenes of crimes or accidents.
- Inputting relevant data into computer programs; reviewing and supervising the work of assistants; presenting results of work in written form or by giving oral evidence and justifying findings under cross-examination in courts of law.
- Researching and developing new techniques; coordinating with outside agencies and offering expert advice; analyzing and interpreting results and computer data.
- Liaising with police to establish forensic strategies; writing detailed reports for court; instructing on procedures for cases.