The Good, the Bad and the Ugly: An Exploration of *E. coli* and other Microbial ~~Fiends~~ Friends
or
Are YOU going to eat THAT?

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Abstract:
This action research project will immerse 9th grade students in an intensive, hands on, biotechnology based curriculum unit focused on emerging bacterial pathogens with the intention of generation learning gains and student interested in a population that is historically disinterested in science. The action research will take place in two 85-minute classes, where all learning styles will be addressed. Students will participate in a variety of activities, ranging from traditional lessons, to advanced gel electrophoresis, and student production of public service announcement films.

Rationale:
This project will target 9th grade students in an Integrated Science I course. At our school, this course targets lower level students, with little to no interest in science. Due to the varied topics covered in this course, it becomes a survey style class, intended to peak student interested. Historically however, at my school, the quick change of topics between the 4 major strands of science with only a superficial coverage of content leads to even more disinterest in science education.

"Good, Bad and Ugly" will expand the study of prokaryotic cells into an in-depth research unit that will fully engage the students by the use of various biotechnology methods, the emerging pathogenic effect of virulent strains of *E. coli* and other bacteria on public heath and food industry. By engaging in an in-depth study focused on a central topic with various tactics students will become more focused on the relevance of science education and ideally take a greater interest in science study.

Description of teaching unit or module(s), including expected outcomes:
This teaching unit, which will span approximately 7 instructional weeks, will focus on the following Life Science NGSSS:

- SC.912.L.14.3- Compare/Contrast Prokaryotic and Eukaryotic cells
- SC.912.L.14.6- Pathogenic Agents
- SC.912.L.17.6- Symbiotic Relationships

The learning outcomes are as follows:

- Students will differentiate between prokaryotic vs eukaryotic cells
- Students will understand the symbiotic nature of humans and microbes
- Students will identify pathogenic microbial agents found in human food sources
- Students will describe how pathogenic microbial agents could be introduced into human food sources

The student learning outcomes will be achieved through the completion of the following activities:

- Lesson: The Diverse World of Prokaryotes

- "Find Me" Giant Microbes
- Water Microarray Simulation
  - Students will then research one of the pathogens found in their "water samples" in pairs and present their finds to the class
- Lesson: Symbiotic Relationship with *E. coli*- Thank you, Microbes!
- Viewing of *Food, Inc*.
  - Discussion series with articles: How do microbes "go wrong" and how does our food become contaminated
- Begin growing bacterial colonies: *Sarcina aurantiaca* and *Serratia marcescens*
  - Lesson: Sterile technique and colony counting
- PSA project: Students will write, film and edit short PSA's about pathogens in human food sources
- Lesson: Introduction to Biotechnology
  - Micropipetting and Designer Plates
- Mahoney Visits Germany Lab (aka Outbreak!)
- Protein digest and SDS PAGE analysis of classroom bacterial colonies

Data collection techniques and/or student assessments:

- Unit Pre-Test
- Class Presentation of Microbe Research (from simulated microarrary results)
- "The Good" virtual poster: an explanation of human symbiosis with microbes
- "The Bad and sometimes Ugly" PSA: Dangerous microbes in our food (after watching *Food, Inc.*)
- Lab Reports (Outbreak! Lab, Protein SDS PAGE for bacterial protein comparison)
- Post Test

Use of equipment lockers and/or UF visit (either in the classroom or UF campus):

- Giant Microbes with question/answer cards Locker
- Pipetting Stations Locker
- Advanced Gel Electrophoresis Locker
- Protein Electrophoresis
- Microarray Simulation Kit (Dr. Lawrence)

ICORE summer institute elements specifically included (UF connections):

- Topics from Dr. Morris' lecture on "The Age of Pandemics"
- Outbreak! Lab
- Protein Extraction and SDS-PAGE

Literature cited:

Benskin, Jonathan. "Student Bacterial Protein Extraction Protocol" In DRAFT. 2011.

Chen, Sixue. "Promteomics Module: Protein Extraction, separation and identification" UF-CPET, ICORE. 2011.

Budget and budget justification: $200

Item	Vendor/Source	Cost
211208 Outbreak! Fingerprinting Virus DNA 6-Station Kit	Carolina	$89.00
No.:90084 B-PER (250mL)	Thermo Scientific / Fisher Scientific	$187.06
L563464 Sarcina aurantiaca	Frey Scientific	$15.25
L563473 Serratia Marcescens	Frey Scientific	$15.25
D526787 Nutrient Agar-Pre Poured Plates (set of 10)	Frey Scientific	$11.69
NP0336BOX NuPAGE® 4-12% Bis Tris Gel 1.5 mm, 15 well (1 box of 10 gels)	Invitrogen	$131.00
NP0007 NuPAGE® LDS Sample Buffer (4X) (10 ml)	Invitrogen	$11.96
NP0004 NuPAGE® Sample Reducing Agent (10X) (250 ul)	Invitrogen	$11.96
BP101-25 Brilliant Blue R-250 (25g)	Fisher Scientific	$88.81
Total Cost		**$561.98***

***Additional costs will be covered by local and district funds.

SCIENCE LESSON PLAN

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TITLE: The Bad, The Ugly and the Sometimes Deadly: Bacteria in our Food PSA's

KEY QUESTION: How have changes modern in farming affected the levels of "bad" bacteria in food sources?

SCIENCE SUBJECT: Biology: Microbiology

GRADE AND ABILITY LEVEL: 9th grade, Regular Ed

SCIENCE CONCEPTS: Identify key science topics. Try not to be too narrow.

OVERALL TIME ESTIMATE:

4-85 minute class periods (3 class periods if students have editing capabilities at home)

LEARNING STYLES: Visual, auditory, and synthesis

VOCABULARY

- CFO
- E. Coli O157:H7
- Industrial Farming
- Pastoral Farming

LESSON SUMMARY:

In this multiday lesson students will screen the documentary *Food, Inc.* focused on bacterial interactions, both symbiotic and pathogenic. The teacher will prompt discussions at various stages of the documentary screen process, for clarification, debate, as well as social and political awareness. Students will produce 2-3 minute long public service announcements regarding the safety of industrial farmed foods and bacteria exposure risks.

STUDENT LEARNING OBJECTIVES WITH STANDARDS:

1. The student will be able to identify at least 2 sources of bacteria introduction into food sources. (SC.912.L.17.6- Symbiotic Relationships)
2. The student will produce a 3-minute public service announcement addressing bacterial infections in "industrial foods." (SC.912.L.14.6- Pathogenic Agents)

MATERIALS:

ESSENTIAL:

1 flipcam (or other video camera) per group (3-4 students),
1 computer/laptop per group

SUPPLEMENTAL:

poster board, makers/paint, other costuming and props as needed

ADVANCE PREPARATION:

- Screen the film: Food, Inc.
- Determine what discussion points would be most relevant for the students (or in most need of clarification)
- Obtain supplemental sources such as articles from Monsanto, copies of "Kevin's Law" and the Food, Inc Participant Guide

PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES:

Day one (~65 minutes) : Screen first half of *Food, Inc.*

- At teacher deemed times, pause the film and ask the following discussion questions. (give 5-7 minutes for whiteboarding and discussion for each question)

Day One Discussion Questions:

- State 2 possible issues that arise from monoculture.
- Explain the relationship between corn fed cattle and *E. coli.* Contrast that relationship with grass fed cattle and *E. coli.*

Day Two (~45 minutes) : (optional) Screen second half of *Food, Inc*

NOTE: the majority of the important content is in the first 50 minutes of the film. I usually allow students to finish the film, because they have high interest at this point.

Day Two, con't (~30 minutes): Pass out grading rubric, explain expectations (take any student generated questions for clarification/discussion as necessary) and have students start scripting their PSAs.

- Collect student requests for props, etc.

Day Three (85 minutes): Student filming and editing of PSAs.

Day Four (85 minutes): PSA premiers and student critiques.

ASSESSMENT SUGGESTIONS:

For Objectives 1 **and** 2: Students will write, direct, star, edit and present 2-3 minute public service announcements to address to increasing risk and presence of pathogenic strains of bacteria in public food sources.

NOTE: As students have nearly 2 days of "structure free" worktime, structured bell ringer questions and exit slips for each day may be a good idea, to keep students focused on the point of the activity, not that they are "playing with cameras and computers."

EXTENSIONS:

ACTIVITIES:

Letter writing to senators/Monsanto/local farmers.

LITERATURE:

Food Inc.: A Participant Guide: How Industrial Food is Making Us Sicker, Fatter, and Poorer-And What You Can Do About It edited by Karl Weber

The Omnivore's Dilemma: A Natural History of Four Meals by Michael Pollan

RESOURCES/REFERENCES:

Food, Inc. Dir. Robert Kenner. 2008. DVD.

"Monsanto ~ Food, Inc. Movie." *Monsanto ~ Home*. Monsanto. Web. 06 Sept. 2011. <http://www.monsanto.com/food-inc/Pages/default.aspx>.

Pollan, Michael. *The Omnivore's Dilemma: a Natural History of Four Meals*. New York: Penguin, 2006. Print.

Weber, Karl. *Food, Inc.: How Industrial Food Is Making Us Sicker, Fatter and Poorer; and What You Can Do about It : a Participant Guide*. New York: PublicAffairs, 2009. Print.