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Can the strong get stronger? A laboratory investigation of natural selection for antimicrobial resistance

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High Impact Fellows Project Overview

Project Title, Course Name, Grade Level

Can the strong get stronger? A laboratory investigation of natural selection for antimicrobial resistance.

The project is written for a high school biology class covering the scientific method, experimental design, evolution and natural selection.

Team Members

Student(s): *Sarah Grace Keaveany, Elizabeth Ramsey*

High School Teacher: *Deborah Stripling* School: Chesnee High School
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Brief Description of Project (<150 words)

The students, Sarah Grace Keaveany and Elizabeth Ramsey, completed original research with to investigate 1) standing variation among common bacterial species (*Escherichia coli* and *Stapholococcus epidermidis*) in the amount of resistance to triclosan, a common anti-microbial used in hand washes; and 2) the capacity for these bacteria to develop increased resistance to triclosan through selection. The students have developed lab modules based on this research. One module includes a wet lab, where students will culture their own bacteria. The other module allows students to obtain data from photographs of bacterial plates in lieu of a wet lab component.

List of Materials Required and Costs, if Applicable (these are costs to teachers…)

There are two modules available, one with a wet lab component and one without.
Materials and prices vary depending on what equipment is available to teachers.

The wet lab will require:
*Nutrient agar for growing bacteria – 100g for $36.95 from Carolina Biological
*Sterile swabs for collecting and plating bacteria – 50 swabs for $34.95 from Carolina Biological
*Sterile Petri plates, 60 x 15 mm – Packs of 20 for $6.25 at Carolina Biological
*A balance, autoclave, and microwave for preparing nutrient agar
Bacterial cultures (if these will not be collected) - $10.00 – 15.00
Sterile water
Triclosan or other antimicrobial agent ($40.50 from Fisher Scientific)

*Kits can be purchased from Carolina Biological with agar, petri dishes, and swabs: this eliminates the need for an autoclave and balance, but agar needs to be heated. (http://www.carolina.com/biological-media-kits/tryptic-soy-agar-media-kit/821040.pr?catId=&mCat=&sCat=&ssCat=&question=petri+plates)

There are also a number of kits available via Amazon.com

*Prepared media plates can also be purchased – (20 plates for $20.50 from Carolina Biological) eliminating the need for a balance, autoclave, and microwave.

The dry lab requires a color printer to print the pictures of the bacterial plates for analysis along with rulers or calipers for taking measurements.

AVD High Impact Fellows Lesson in Selection for Resistance to a Common Antimicrobial	
Title	**Can the strong get stronger? A laboratory investigation of natural selection for antimicrobial resistance.**
Resource Type	Lesson Plan & Lab Activity- There are two different Modules. Module 1 includes a wet lab where students grow the bacteria. Module 2 includes a distance learning (dry) lab where students analyze pictures of the results.
Description	Student researchers conducted original research to investigate 1) standing variation among common bacterial species (*Escherichia coli* and *Stapholococcus epidermidis*) in the amount of resistance to triclosan, a common anti-microbial used in hand washes; and 2) the capacity for these bacteria to develop increased resistance to triclosan through selection. The student researchers have developed lab modules based on this research. One module includes a wet lab, where students will culture their own bacteria. The other module allows students to obtain data from photographs of bacterial plates in lieu of a wet lab component.
Author(s)	Sarah Grace Keaveny and Elizabeth Ramsey
Author Institution(s)	Wofford College, Spartanburg, SC

Objective	Upon completion of this activity students should have either a better understanding of real world applications of natural selection. They will gain such insight through the completion of labs (wet and/or dry), videos, and analysis.		
Key Concepts	This review will familiarize students with key concepts of natural selection such as heritable variation, and differential reproductive success. Students will also become familiar with sterile technique, data tables/graphs, and formulating a prediction and hypothesis.		
Student Prep	Review concepts of evolution and natural selection learned previously in class.		
Materials	The wet lab will require: -Nutrient agar for growing bacteria – 100g for $36.95 from Carolina Biological -Sterile swabs for collecting and plating bacteria – 50 swabs for $34.95 from Carolina Biological -Sterile Petri plates, 60 x 15 mm – Packs of 20 for $6.25 at Carolina Biological -A balance, autoclave, and microwave for preparing nutrient agar -Bacterial cultures (if these will not be collected) - $10.00 – 15.00 -Sterile water -Triclosan or other antimicrobial agent ($40.50 from Fisher Scientific) -Rulers or calipers The dry lab will require: -Laminated print outs of pictures of results (from document provided) -Ruler or calipers *Kits can be purchased from Carolina Biological with agar, Petri dishes, and swabs: this eliminates the need for an autoclave and balance, but agar needs to be heated.		
Grade Level(s)	Appropriate [as written] for Applied General Biology students and above. Maybe be modified with additional questions or eliminate included questions to make it appropriate for lower level Biology classes or enhanced with more difficult questions for AP level students.		
Teacher Prep Time	~30 minutes to become familiar with format and lab procedure	**Class Time**	3 (90 minute) class periods
National Standards	B-1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.9 B-5.1, 5.2, 5.3, 5.4		
State Standards	B-1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.9 B-5.1, 5.2, 5.3, 5.4		
Sources	Research is the product of the collaboration between students and their research advisors, Dr. Ivy and Dr. Spivey, at Wofford College. Lesson plans were produced by the student researchers and reviewed by research advisors.		
References	All images were taken by student researchers, with the exception of free online cartoons. Bacteria pictures from Dennis Kunkel Microscopy, Inc. online resources.		
Assessment	Groups will turn in data tables and graphs at the end of wet lab and dry lab. Students should also turn in a paragraph analysis/summary of their findings. OR Lab experiments will eventually culminate in lab report.		