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| **Task-level Phenomena:** Students investigate the degree of resistance of bacteria and various antibiotics, from one country to the next.**Synopsis of high-quality task:**The goal of this task is to analyze and interpret data about bacteria and their resistance to certain antibiotics across various countries. Students present their data in a public service announcement to the class. **Anticipated student time spent on task:** Three 55mins class sessions**Type of Task (check one):** \_\_\_\_ 1. Investigation/experimentation/design challenge\_\_X\_ 2. **Data representation, analysis, and interpretation**\_\_\_\_ 3. Explanation **Student task structure(s):** Small group work  |
| **STE Standards and Science and Engineering Practices:****STE Standards:****HS-LS4-4**. Research and communicate information about key features of viruses and bacteria to explain their ability to adapt and reproduce in a wide variety of environmentsClarification Statement: * Key features include a high rate of mutations and the speed of reproduction which produces many generations with high variability in a short time, allowing for rapid adaptation.

**HS-LS4-5.** Evaluate the merits and limitations of a model that demonstrates how changes in environmental conditions may result in the emergence of new species over generations and/or the extinction of other species, and that these processes may occur at different rates depending on the conditions.Clarification Statement:* Examples of the processes occurring at different rates include gradualism versus punctuated equilibrium and background extinction versus mass extinction

**Science and Engineering Practice:**  * Analyzing and interpreting data
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| **Prior Knowledge from the** [**Strand Map**](http://www.doe.mass.edu/stem/standards/StrandMaps.html)**:**Standards:**8.MS-LS4-4.** Use a model to describe the process of natural selection, in which genetic variations of some traits in a population increase some individuals’ likelihood of surviving and reproducing in a changing environment. Provide evidence that natural selection occurs over many generations. Clarification Statements:* The model should include simple probability statements and proportional reasoning. Examples of evidence can include Darwin’s finches, necks of giraffes, and peppered moths.

**HS-LS4-2.** Construct an explanation based on evidence that Darwin’s theory of evolution by natural selection occurs in a population when the following conditions are met (a) more offspring are produced than can be supported by the environment, (b) there is a heritable variation among individuals, and (c) some of these variations lead to differential fitness among individuals as some individuals are better able to compete for limited resources than others.Clarification Statement:* Emphasis is on the overall result is an increase in the proportion of those individuals with advantageous heritable traits that are better able to survive and reproduce in the environment.
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| **Connections to the real-world:*** Antibiotic resistance is a current health problem in the United States.
* At least 2 million people get antibiotic-resistant infections and 23,000 people die from it.
* Antibiotic resistance threats can be:
	+ Urgent - like C. difficile
	+ Serious - like Salmonella and MRSA, or
	+ Concerning - like Streptococcus (<https://www.cdc.gov/drugresistance/biggest_threats.html>)
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| **Mastery Goals:**Learning Objective:* Research and communicate information on antibiotic resistance of a pathogen.
* Analyze and interpret data about bacteria and their resistance to certain antibiotics across various countries.

Performance Objective:* Create a PSA highlighting antibiotic resistance pathogens and how to reduce the spread.

Language Objective:* Analyze and discuss data in small groups.
* Orally share conclusions and questions in whole class group.
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| **Teacher instructions****Instructional Tips/Strategies/Suggestions:**Teacher tips:* Clarify specific tasks prior to each part, so that students are able to access the materials and participate to their maximum capacity.
* Student collaboration and working as part of a small group is important to Part I of this task.  Teacher assistance and modeling may be necessary for some groups.
* Organizers for information gathered, both in small groups and independently, will be important for some students to remain on task and focused. Small groups could be based on lab partners or groups of three students.
* Timing may vary depending on the amount of time allotted for each class period.  It would be optimal to use at least one long block period to facilitate the majority of the class work.
* Review necessary vocabulary words as needed to understand the concept of antibiotic resistance bacteria.

**Teacher Facilitation:****Day 1****Introduction: (Whole group)**1. Show students the video: Rise of the Superbug <https://www.youtube.com/watch?v=fyRyZ1zKtyA>  or something similar. Have students share their initial ideas/reactions/questions. Ask how this relates to their lives.
2. Discuss key concepts of antibiotic resistance as it relates to the real world.
3. Review the student handout, including the vocabulary words. *Tip: Provide students with a separate handout with definitions and/or point students to use prior notes.*

**Part 1: (Small group)**1. Group students into four groups and give the same pathogen
2. Groups review and explore the maps, charts, and trends on https://resistancemap.cddep.org/
3. Students analyze the data to determine to what degree the pathogen is resistant to antibiotics.
4. As a small group, students complete two tasks:
	1. A notice and wondering chart: “I noticed that… “I wonder….”
	2. A conclusion statement citing evidence from the data: “Based on the data, our conclusion is…”

**Part 2: (Small Group/Independent work)**1. Assign small groups the other pathogens and one country to independently analyze and interpret the data in comparison to United States data.
2. Students use the graphic organizer to record similarities and differences between the country they chose and the United States.

**Part 3: (Whole group share out)**1. Each group selects a person to share out the information to the whole class.
2. As each group is sharing out, group members are listening for similar/different conclusions and taking notes.
3. Allow opportunity for groups to ask each other clarifying or probing questions.
4. Record similarities/differences on the board.
5. Create an anchor chart of questions to further explore.

**Day 2****Part 4: (End product)**1. Show students the video: Rise of the Superbug <https://www.youtube.com/watch?v=fyRyZ1zKtyA>  or something similar again. Ask them what about the video stood out to them? What parts resonated with them and why?
2. Using a rubric, explain the project; Construct a Public Service Announcement (PSA), discussing the causes of antibiotic-resistant bacteria, the global challenges of antibiotic-resistant pathogens, and ways to help decrease the spread of current resistant pathogens and the evolution of new resistance.
3. Students should use the various information they and their classmates gathered the day before.
4. PSA media could include: Powerpoint/Slides, Infographics, iMovies, Flipgrid, Spark Flyers by Adobe, and/or PowToons, etc.

**Day 3****Part 5: Student Presentations**1. Students post their PSAs for everyone to review through a gallery walk.
2. Students provide feedback on each other’s PSAs. Resource for gallery walks, https://betterlesson.com/strategy/13/gallery-walk
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| **Instructional Materials/Resources/Tools:****Materials*** Student handout with background information, explanation of the task, explanation of end result
* Rubric for grading is provided in this plan
* Computer access
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| **Task Source:**https://resistancemap.cddep.org/AntibioticResistance.php |
| **Accessibility and Supports:*** Preview of Vocabulary: bacteria, evolution, pathogen, vaccine, antibiotics, resistance, gram-negative
* Graphic organizer
* Student Handout/checklist
* Examples of PSAs should be available for students to use
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| **Student Handout****Global Antibiotic Resistance****Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_\_\_\_\_****Background Information:** ResistanceMap is a web-based collection of data visualization tools that allows interactive exploration of antimicrobial resistance (AMR) and antibiotic use trends in countries across the globe. Bacteria continue to adapt to the use of antibiotics, causing areas of resistance across the globe. As we investigate more about the various types of bacteria, you will begin to see examples of resistance localized in different countries. Your task is to develop a Public Service Announcement (PSA) discussing the causes of antibiotic-resistant bacteria, the global challenges of antibiotic-resistant pathogens, and ways to help decrease the spread of current resistant pathogens and the evolution of new resistance. But first, let’s learn how to use the ResistanceMap together analyzing one bacterium.**Class Pathogen Research:** Explore the various global areas which are resistant to *Escherichia coli* and which antibiotics. Fill in the chart below, as well as finishing the sentence stems https://resistancemap.cddep.org/AntibioticResistance.php

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| **Antibiotic** | **Resistance Info** | **Antibiotic** | **Resistance Info** |
| Aminoglycosides |  | Fluoroquinolones |  |
| Aminopenicillins |  | Glycylcyclines |  |
| Amoxicillin-clavulanate |  | Macrolides |  |
| Ampicillin-sulbactam |  | Piperacillin-tazobactam |  |
| Carbapenems |  | Polymyxins |  |
| Cephalosporins (3rd gen) |  |  |  |

“ I Notice” “I wonder….” \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_“Based on the data, our conclusion is…” \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Small Group Assigned Pathogen:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Graphic Organizer:Venn Diagram graphic organizer**PSA Planning (What info do you want to include? What message do you want to get across to your audience?):****Rubric for Grading Public Service Announcement (PSA):**

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| **Category** | **4** | **3** | **2** | **1** |
| **Creativity**   The message is told in unexpected or novel ways.Elements in the message are woven together with insight andimagination grabbing the attention of the intended audience. |  |  |  |  |
| **Tag Line**   The message is clear and concise.  A single thoughtor phrase within the PSA summarizes the entire message. |  |  |  |  |
| **Social Benefit**   The ideas shown have an application to thelives of the targeted audience. The PSA is one that willmotivate change to improve the targeted audience’sbehavior in a meaningful way. |  |  |  |  |
| **Facts**   The message is based on accurate and verifiable information.  Opinion or bias expressed is based in and supported by fact.  |  |  |  |  |
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| **Vocabulary & Definitions****Bacteria** - a member of a large group of unicellular microorganisms which have cell walls but lack organelles and an organized nucleus, including some which can cause disease.**Evolution** - the process by which different kinds of living organisms are thought to have developed and diversified from earlier forms during the history of the earth.**Pathogen** - a bacterium, virus, or other microorganism that can cause disease.**Vaccine** - a substance used to stimulate the production of antibodies and provide immunity against one or several diseases, prepared from the causative agent of a disease, its products, or a synthetic substitute, treated to act as an antigen without inducing the disease.**Antibiotics** - a medicine (such as penicillin or its derivatives) that inhibits the growth of or destroys microorganisms.**Resistance** - the ability not to be affected by something, especially adversely.**Gram-negative** - a staining technique for the preliminary identification of bacteria, in which a violet dye is applied, followed by a decolorizing agent and then a red dye. Reference: Google Definitions |

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| **Student Work Sample:****This is a student generated infographic about antibiotic resistance, warning the reader to only take anitbiotics when needed** |