Lesson Title: *Disease and Pathogens*

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Topic: *Cells specialization and disease spread*

Targeted Grade Level: *9-12.*

Time Needed: *8-10 days*

Subject Integration: *Science, Literacy, Technology*

Justification: Science is life. This lesson is based on a Biology class and therefore integrates the science of Biology well. We will also integrate some technology into this lesson as students learn and watch the teacher demo of preparing a Gram stain and then how scientists classify bacteria based on its stain. (This process is a complicated technological one that is used in labs every day.) Students will look at fluid data from the Washington Post and understand the math behind "flattening the curve."

Standards: NGSS LS1.A

NGSS Performance Expectations		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts:
Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of	LS1.A: Structure and Function x Systems of specialized cells within organisms help them perform the essential functions of life. x All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (Note: This	Structure and Function x Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

evidence consistent with scientific ideas, principles, and theories. x Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.	Disciplinary Core Idea is also addressed by HS-LS3-1.)	

Measurable Student Learning Objectives

1. Students will be able to classify a pathogen as a virus, bacteria, protist, or helminth.
2. SWBAT explain methods of treating pathogens. (antibiotics, anti-virals, anti-parasitics, etc.)
3. SWBAT explain how the spread of disease can be slowed or stopped.

Nature of STEM: *This lesson would be taught in a Biology classroom of 10th graders. Science is the backbone of the lesson. Technology and engineering would be integrated in the portion of the stations where students will learn about*

Gram negative and positive tests. These tests involve some pretty scientific flow charts and tests to determine how to treat a bacterial disease depending on whether it is positive or negative.

Engaging Context/Phenomena:

The "hook" for this lesson is a demonstration of how disease spreads. Students will come into class and receive a test tube. All but one will contain water, and one will contain sodium hydroxide. The teacher will take note of who gets the sodium hydroxide tube. Students will exchange fluids with 5 other classmates which mimics the spreading of droplets and pathogens. When the exchange is done the teacher will place a drop of chemical indicator into each tube. If it turns pink the student is infected!

Data Integration: *Data from the CDC will be used to show how pathogens and diseases are tracked and traced. The most recent NASA satellite image that shows how air pollution has diminished since the COvID-19 pandemic and quarantine could also be used to pique curiosity (this relates to how we have slowed the spread of COVID 19 by sheltering in place. Washington Post's exponential growth simulator will also be used as it has digitally designed graphs that show actual movement rather than a static graph. The Post's graphs help students understand how social distancing affects disease spread.*

Differentiation of Instruction: *students who need accommodations in my classes usually need a lower reading level material. I can make sure the information they receive is on an appropriate grade level and also ensure that they student gets as much guidance as possible with guided notes, a partner, etc.*

Real-life Connection: *This lesson connects so perfectly right now with the COVID-19 pandemic. We are encouraged to socially distance, wear masks, and not congregate in large groups. It shows how a pathogen can easily be spread to surrounding people. We could also take the route of discussing the Corona virus and why it is so good at infecting lungs (all due to its structure!)*

Possible Misconceptions: *Students may have the belief that antibiotics treat all sicknesses. I often find that they believe an antibiotic will treat a virus, etc. This short unit will show them that prescriptive measures must be used according to the type of pathogen, and in the case of bacteria, it depends on whether it is Gram negative or positive.*

5E Model	5E Objectives
Engage *How does disease spread? Students participate in a fun activity to determine "patient zero" in our classroom.*	**Procedure:** *Students will share "bodily fluids" with 5 other students, writing down who they exchanged fluids with. When the exchange is over we will attempt to determine "patient zero." Before class test tubes were prepared with water and one had sodium hydroxide. During the activity students will exchange with 5 students by placing a dropper full of their fluid into their classmates, and vice versa. Students should record who they exchanged with. After the demo the teacher will place a drop of indicator solution into each tube. If a student is infected their test tube will turn pink. Prepare as many tubes of water as you need and then prepare one with sodium hydroxide. The indicator solution is phenolphthalein.* **Modifications None needed here** **Standards Addressed** *This is the hook and there aren't any specific standards being taught, but just trying to spark curiosity* **Formative/Summative Assessments** *I will move around during the demo and make sure that students are recording their contacts.* **Resources** *test tubes, water, indicator solution, sodium hydroxide, disposable droppers*
Explore *Students are collaborating and using clues to determine the patient zero.*	**Procedure:** *Students will now determine who patient zero is. The teacher is not helping as the students use white boards and work together as a group to determine who was the original infector.* **Modifications** *Students with disabilities will be paired with a partner to help them navigate this part.* **Standards Addressed** Students are specifically learning a certain standard but are collaborating and working together to determine patient zero as a class. **Formative/Summative Assessments:** As the teacher I will move around and guide students and

	ask questions but they must figure this out themselves. A homework assignment will be given: Determining Patient Zero at Disney World. **Resources** *whiteboards, student lists*
Explain *Students will move through the classroom to visit stations that show the structures of viruses and bacteria, how they spread, and how they are controlled..*	**Procedure:** Students will now learn and explore bacteria and viruses, their treatments, and how they are spread. There will be stations around the classroom. Each station will delve into more detailed facts about the pathogens. Station 1: Bozeman Biology Bacteria lecture with guided notes Station 2: Bozeman Biology Virus lecture with guided notes Station 3: Washington Post "Flattening the Curve" data analysis with graphs Station 4: Teacher demonstration of staining bacterial cells with Gram positive and Gram negative lesson. Station 5: The 1918 Spanish Flu Epidemic article and discussion **Modifications** *Students with special needs will be given guided notes and paired with another student. Articles will be reworked with appropriate Lexile levels.* **Standards Addressed** *LS-1-A* **Formative/Summative Assessments :** Students will be given a google form to complete at each station to show they have accessed the material. **Resources** Bozeman biology video bacteria/viruses, gram staining demo, Washington Post website, Spanish Flu epidemic article/materials
Elaborate *This activity allows*	**Procedure:** Students will choose a bacteria or virus from teacher generated list and research.

students a choice of their pathogen and in a fun way allows them to explain the spread, control, symptoms, and likely places they can be found..	They will be speed dating with their classmates. Students will research the pathogen's hangouts, hobbies (symptoms), sign (type of pathogen), turn-ons (what allows the pathogen to grow), turnoffs (what kills the pathogen) and one fun fact. Once complete students will create a "calling card" for their pathogen and each student will spend 5 minutes with every other student telling them about themselves. **Modifications** *Students with special needs can be paired with a partner and work with the same pathogen.* **Standards Addressed LS-1-A** **Formative/Summative Assessments** *I will assess this with a rubric (included at end). Students will also take a test over the various pathogens to indicate their knowledge of how they are spread and treated.* **Resources** *colored paper, markers, cardstock*
Evaluate	**Procedure:** Students should now categorize all the pathogens according to their classification. These pathogens will be placed into groups such as bacteria, virus, protist, etc. Students will then decide the best treatments for each classification of pathogen. They will also determine how best to control these pathogens from spreading. A classroom document will be shared with every student via google classroom and they will collaborate to create this document. **Modifications** *Students who need accommodations will be given a specific pathogen to add to the document and work with an able partner.* **Standards Addressed LS-1-A** **Formative/Summative Assessments** Formatively I will work with the students to identify any mistakes or misconceptions as they create this "chart." Students will work collaboratively and I could also assess their contributions to the project. We will eventually have a summative test.

	Resources google classroom

Teacher Background: *Students should have already mastered cells and cell organelles. This takes them deeper into the understanding of how a cell specializes itself for its "job." The DNA of a cell determines its specialization. For example, virus particles have sticky appendages that allow them to stick to tissues. Some bacteria are able to survive for years in the soil in an endospore state. This allows the student to see that specialized cells have specialized functions. We could even delve into the corona virus and look at how it got its name. It is because of the sticky crown-like appendages that appear on its surface. This allows the virus to stick to nasal passages and lungs very well. I have done bits and pieces of this unit individually in class but have never put this all together. Students really enjoy learning about diseases for some reason. So much of this short unit could spin off into so many other areas of interest. We will integrate math as we look at exponential growth and the term "flatten the curve." What does that exactly mean? How successful have we been at flattening the curve?*

Attachments:

Rubric and speed dating requirements

https://docs.google.com/document/d/1eTCs-d2ktJVeFZOAZ4LKC5TrqRkGucBE3g6XvfzPEFM/edit?usp=sharing

Washington Post Corona Virus "Flatten the Curve"

https://www.washingtonpost.com/graphics/2020/world/corona-simulator/

Bozeman Biology Bacteria lecture

https://youtu.be/h-z9-9OOWC4

Bozeman Biology Virus lecture

https://youtu.be/L8oHs7G_syI