How to Survive the Zombie Apocalypse: A Study in Microbial Warfare

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6-8th grade

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Part One- Introduction:

This unit is designed to help instructors teach a highly engaging introductory unit for microbiology. In other words, it will guide you (the teacher) on how to develop a well-educated army of minions to help you and your family survive when the inevitable happens.

There are a wide number of practical and conceptual skills students will gain as well. They will assume the role of epidemiologists fighting the clock to make sure humanity is well prepared. They will learn about various disease-causing agents (viruses, bacteria and parasites) and how one of them will be the true culprit for an outbreak. Students will also discover how "zombies" already exist and practical steps one can take to avoid them.

Prevention is key in the fight for survival, but students will learn about treatment techniques as well. Just as immunologists engage in research and development for cures, students will also project biological-based antidotes for treatment. Ultimately, students will walk away from this unit with a sophisticated understanding of germ warfare they will apply when constructing their very own guide for survival.

Differentiation for gifted learners: the depth and complexity features of this unit are intended for gifted learners but will certainly be intellectually stimulating for all students. Its emphasis on inquiry-based approaches to learning and roots in conceptual understanding complement research on what works best in gifted education. Students will see their learning as timely, important and essential—*it matters*. Accelerated content features will expose students to research and design methods they wouldn't normally encounter until a college-level biology course.

This unit has been taught on numerous occasions to different "types" of gifted learners. Most students who take this course have been identified as gifted by their respective school district on a variety of levels from "above grade level" to "highly gifted". It is appropriate in content and delivery to meet the needs of students from a diverse range of socioeconomic, cultural and other backgrounds. Special consideration should be noted when discussing diseases rooted in developing countries or exposure to different cultural practices and beliefs.

It should also be noted that not all students will enter this course with similar background knowledge. Most students I have taught have little to no previous content knowledge about microbes, pathogens or how scientists prevent and contain outbreaks. No prior knowledge is needed for students to thrive and excel in this course.

Please contact the curriculum developer, Desirae Codfelter, with any inquiries relating to course content or process. You can reach her at declodfelter@wsfcs.k12.nc.us

Part Two: Goals and Outcomes

This unit has traditionally been taught at summer enrichment camps, but the goals and strategies can be adapted to fit virtually any circumstance. It is meant to be an informational and exciting unit where

students get an insider's peak into the world of epidemiology through the lens of a looming "zombie apocalypse".

There are three main goals that direct the unit's purpose:

1. **Content**- in this course, students will survey a significant amount of content in microbiology from both a prevention and treatment perspective. As such, the goal of content is to expose students and enable them to understand complex vocabulary. The instruction is rigorous, relevant and thought provoking for deeper levels of understanding. The course builds on an eighth grade standard (below), but covers many things that students wouldn't normally be exposed to until the advanced high school or college introductory class.
2. **Process-** a key goal throughout the unit is that students see what it would be like to be a public health professional. They assume the role of scientists who would be charged with finding solutions to outbreaks in their careers. They gather facts, make hypothesis, test for variables (through bacterial growth) and adjust and revise plans as needed. The methodology of this course mirrors what students have practiced in the scientific method but encourages key features of the engineering design process as well (specifically with the research and revise components).
3. **Concept-** the concept of "survival" is reiterated throughout the week as students draw the connection between adaptations and survival. They will understand things cannot live without changing to meet the needs of different environments. At the conclusion of the unit, students will have a complex conceptual understanding on how survival necessitates adaptation.

NC Essential Standard: **8.L.1.1-** Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

Part Three: Assessment Plan

The assessment for this course is centered around a building performance task that students will add to each day before a presentation on Friday.

At the beginning of the course, students are introduced to the essential question "how does survival necessitate adaptation?" First, the teacher needs to guide students through breaking down the meaning of each word of the essential question to ensure understanding. The essential question and concept are consistently weaved throughout each day's instruction. Students are directed to answer "how does survival necessitate adaptation?" on a post-it note as the exit ticket before they leave. Answers are spiraled into the beginning of the next day's lesson.

The following performance task will guide the assessment for the week:

You have been hired by the Centers for Disease Control to create a "Zombie Apocalypse Survival Guide". Your report's table of contents should identify different microbes in question, address adaptations that poise these pathogens for survival, and conclude ways in which people can also adapt to ultimately survive. Your product will be presented and evaluated by a CDC appointed public health expert at the conclusion of this week.

The task is broken into four different days with a presentation portion on the fourth day of class. Here is a suggested sequence for inclusion:

Day One: "Identify different microbes in question"- students will differentiate among what virus, bacteria and parasites are and how they adapt in order to survive

Day Two: "Address adaptations that poise these pathogens for survival"- students will talk about specific adaptations that bacteria, parasites and viruses have that give them a competitive edge for survival

Day Three: "Conclude in which people can also adapt to ultimately survive"- students will describe and analyze different options that would aid in human survival. This will focus on health measures taken to prevent an outbreak from spreading as well as treatment options once someone is infected.

Method of Presentation

For this course, students were instructed to use google slides to document their work and share it with the instructor. Since this was taught as a summer enrichment piece, no special criteria were mandated in regards to syntax beyond basic grammar. Students were evaluated based the substance of their ideas and work that showed depth of understanding and application.

Exemplar: The following excerpts are the text taken from a sixth grade student's Survival Guide at the conclusion of a summer camp experience. Additional visual details were also included, like illustrations of her key culprit parasites and moving image files.

Pathogens in Question:

"There are several pathogens that are zombie-creators. Those pathogens can be bacteria, viruses, or parasites. They can control brain and body motions, make you sick, and possibly kill you. That is why you need to watch out for pathogens in question. why you need to watch out for pathogens in question."

Bacteria in Question:

"A bacteria called Phytoplasma turns plants and insects into zombies. The bacteria infects plants and makes their flowers turn into leafy shoots, their petals turn green, and they develop a mass of shoots called "witches brooms." This process sterilizes the plant while attracting the sap-sucking insects that carry the bacteria to itss new host. The plant appears alive, but it only stays there because the bacteria controls it and makes it stay alive. It doesn't do anything for itself like produce flowers and seeds. Scientists have yet to find a way to prevent this zombie bacteria. Luckily, it doesn't affect humans.

Sources: https://www.scientificamerican.com/article/bacteria-turn-plants-and-insects-into-zombies/ https://motherboard.vice.com/en_us/article/nz7jex/inside-the-grim-work-of-the-zombie-plant-bacteria"

Viruses in Question:

"Everyone has had the Flu, right? Well, if the Flu got combined with Rabies, then a zombie outbreak could be caused. As you know, Rabies causes people and animals to have zombie-like actions. Well, if it was combined with the Flu, it would spread quickly through the air, because as you know, the Flu is contagious. So, if someone had Rabies and the Flu at the same time, then the Rabies and the Flu would combine, spread through the air, cause a zombie outbreak, make everyone die because Rabies kills you, and eventually end the human race. The only way to prevent that happening is getting your Flu and Rabies vaccines. Some people don't believe in vaccines, but they are actually very important because they prevent bad and sometimes deadly diseases. So, get your vaccines.

Source:http://news.nationalgeographic.com/news/2010/10/1001027-rabies-influenza-zombie-virus-science/ "

Parasites in Question:

"*Toxoplasma gondii,* a parasite that affects cats, rats, and even humans, starts its life in cat droppings. The rat eats the cat droppings, and becomes captivated by the smell of cats, and leap fearlessly into their claws, facing certain death. But, if the rat bites a human before it leaps fearlessly to certain death, the parasite can be transferred to the human. Some researchers estimate that around thirty percent of the humans on Earth carry the parasite in their brain. Humans can have symptoms like altered activity levels, changes in risk behaviors, and decreased reaction times. If you think this is some foreign parasite, then you're wrong, because researchers estimate that more than 60 million people in the US alone have the parasite in their brains. And most of them don´t know, because there are no symptoms. Until the parasite strikes.

Source:http://blogs.discovermagazine.com/crux/2015/10/29/parasite-human-brain-control/#.WXDwNYLrc"

Conclusion: “As you have learned through this presentation, there are several parasites, bacteria, and viruses that cause zombie actions. To prevent this happening to you, get your vaccines, wear appropriate clothing when you are in places like the jungle and hot, humid places. Just by you getting your vaccines and wearing appropriate clothing, you could prevent the zombie outbreak that could possibly end the human race. Follow these suggestions, and even if other people turn into zombies, you might still survive.”

Part Four: Lesson Plans

The following lessons are planned for 8 hours of instruction (4 days, approximately 2 hours per day). The pace can be adjusted to meet individual course needs.

TEACHER NAME			Lesson #
D. Clodfelter			1
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Simulation	**Science**	**8**	
CONCEPTUAL LENS		**LESSON TOPIC**	
Survival		**How to Identify a Zombie Apocalypse**	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

8.L.1.1- Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	**THE ESSENTIAL QUESTION** *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Survival necessitates adaptation	How does survival necessitate adaptation?
CONTENT KNOWLEDGE **(What factual information will students learn in this lesson?)**	**PROCESS SKILLS** **(What will students be able to do as a result of this lesson?)**
- a **pathogen** is a living or non-living microbe that is considered a disease-causing agent -a **vector** is an item or living thing that allows a pathogen to spread from one thing to another -**bacteria** are microscopic living organisms that spread and reproduce without needing a host. They can live on different surface for various amounts of time. -a **parasite** is an organism that robs nutrients from a host animal to sustain its own life	-evaluate how characteristics of microbes enable them to survive -analyze adaptations that enable the survival of microbes -apply rules of scientific inquiry to determine the best methods to survive a microbe-induced "zombie outbreak"

GUIDING QUESTIONS

What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	**During Lesson Questions:**	**Post Lesson Questions:**

-What is a necessity? -What is survival? -What is an adaptation? -What is bacteria? -What is a pathogen?	-Which characteristics of microbes make them best fit for survival? -How do bacteria and viruses adapt in a parasitic way to survive? -How can microbes illicit "zombie" characteristics in host organisms? -What is the role of vectors in the spread of disease? -How do different microbes adapt in order to survive?	-In what ways do microbes threaten humanity's existence at the top of the food chain? -Why is it essential for you to know how pathogens spread? -How is knowledge of various microbes essential for survival? -How can scientists use this knowledge to make public health better? -How does survival necessitate adaptation?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
The lab-based inquiry components (inoculating cultures for isolation, growing cultures, testing for resistance) provide exposure that most students won't experience before the collegiate level.	Advanced critical thinking applications mimic processes scientists use in university and private labs.		Students will work in collaborative groups to draft part one of their Survival Guide (identify different microbes that could illicit zombie-like behaviors

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Ice Breaker: Epidemics and plagues have scourged humanity since its inception. Some cause bizarre behavior, unique symptoms or ominous prognosis. Consider ailments that you know and pick a "favorite". Take five minutes to prepare a presentation on how your chosen ailment relates to your and your personality. Use creativity in your presentation.

Students will work individually to prepare their response. At the conclusion of five minutes, each student will individually present to the rest of the class. The teacher will also use this as a away to assess student prior knowledge of diseases and their characteristics. Adjustments to the presentation of content will be adjusted, if necessary.

We will then transition into the introduction to the essential question and answer pre-lesson questions.

-What is a necessity?
-What is survival?
-What is an adaptation?
-What is bacteria?
-What is a pathogen?

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Pathogens and hosts both have to adapt to survive. In many ways, a zombie like apocalypse or outbreak is plausible and already exists. Students will explore the most likely culprits of a modern-day epidemic.

Students will then watch the following clip from "It's Okay to be Smart" (PBS Studios): https://www.youtube.com/watch?v=AgCQStTSMuk

The teacher will use a "think, pair, share" model to answer the following questions.

-Which characteristics of microbes make them best fit for survival?
-How do bacteria and viruses adapt in a parasitic way to survive?
-How can microbes illicit "zombie" characteristics in host organisms?
-What is the role of vectors in the spread of disease?
-How do different microbes adapt in order to survive?

To transition, the teacher will utilize a "think-aloud process" that guides students to draw the connection among viruses, bacteria and parasites. I want them to "see" how a zombie outbreak is actually possible based on the information provided.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

In this phase, students will learn how to grow bacteria cultures using swabs and agar plates.

Groups will pick three locations on campus that they believe will be best suited for microbe survival. Proper safety precautions will be made to ensure student safety (gloves, instructions on lab safety and sanitary disposal of materials).

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.*

Students will be presented with the following task and instructed to make a draft of part one.

You have been hired by the Centers for Disease Control to create a "Zombie Apocalypse Survival Guide". Your report's table of contents should identify different microbes in question (bacteria, virus, parasite), address adaptations that poise these pathogens for survival, and conclude ways in which people can also adapt to ultimately survive. Your product will be presented and evaluated by a CDC appointed public health expert at the conclusion of this week.

Students will work in collaborative pairs to identify the structure for their survival guide and address part one (identify different microbes in question—bacteria, viruses and parasites).

During the work time, the teacher will circulate the room, coaching and correcting as necessary. Students will be asked to identify specifically how various microbes have adapted over time for survival. Students will have access to technology and directed to look at resources like CDC.gov and similar entities.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Each student will be given an individual post-it note. They will answer the question "How does survival necessitate adaptation?". The teacher will collectively review responses to close out the class. The post it serves as their exit ticket.

TEACHER NAME		Lesson #
D. Clodfelter		2

MODEL	CONTENT AREA	GRADE LEVEL
Simulation	**Science**	**8**

CONCEPTUAL LENS	LESSON TOPIC
Survival	**How to Find a Pathogen**

LEARNING OBJECTIVES *(from State/Local Curriculum)*

8.L.1.1- Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Survival necessitates adaptation	How does survival necessitate adaptation?

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
- Colony **morphology** is how microbiologists evaluate growth in an agar sample using features like shape, size, transparency and texture (visually identified) -different type of samples found on agar plate growth include bacteria, yeasts, mold, and other types of fungi -some microbes (i.e. fungi like mold) have naturally antibiotic properties	-interpret the results of microbe growth on agar plate samples -explain how survival methods depend on the type of microbe -apply knowledge -evaluate the strength of proposed solutions to prevent a hypothetical outbreak -analyze microbe growth morphology to interpret and compare agar growth samples

GUIDING QUESTIONS

What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:

-How does scientific research have to adapt for survival? -Why do microbes adapt in order to survive? -How do bacteria adapt in order to survive? -How do fungi adapt in order to survive? -Which conclusions about colony growth samples would change how scientists respond?	-Which precautions should scientists take to make sure they aren't infected with the colonies they are studying? -Which methods of prevention should be taken to avoid the expense of treatment? -Which features of colonies make them identifiable? -Which visible results would prove swabbed bacteria is antibiotic resistant? -How do scientist alter treatment options based on observed culture growth results?	-How does knowledge of samples help scientists determine appropriate treatment options? -How can scientists use knowledge of certain microbes to help defeat more dangerous ones? -How must treatment and prevention options continuously adapt for humanity to survive? -Why is it important to properly identify the type of pathogen? -How can scientists use certain microbial properties to destroy others?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
The lab-based inquiry components (inoculating cultures for isolation, growing cultures, testing for resistance) provide exposure that most students won't experience before the collegiate level.	Advanced critical thinking applications mimic processes scientists use in university and private labs.	Students will work in pairs to analyze bacteria colonies through inoculating samples and creating slides for microscopic observation.	

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Students will begin today's lesson through reviewing the things they have learned so far. We will complete a kahoot exercise where students will answer questions relating to pathogens.

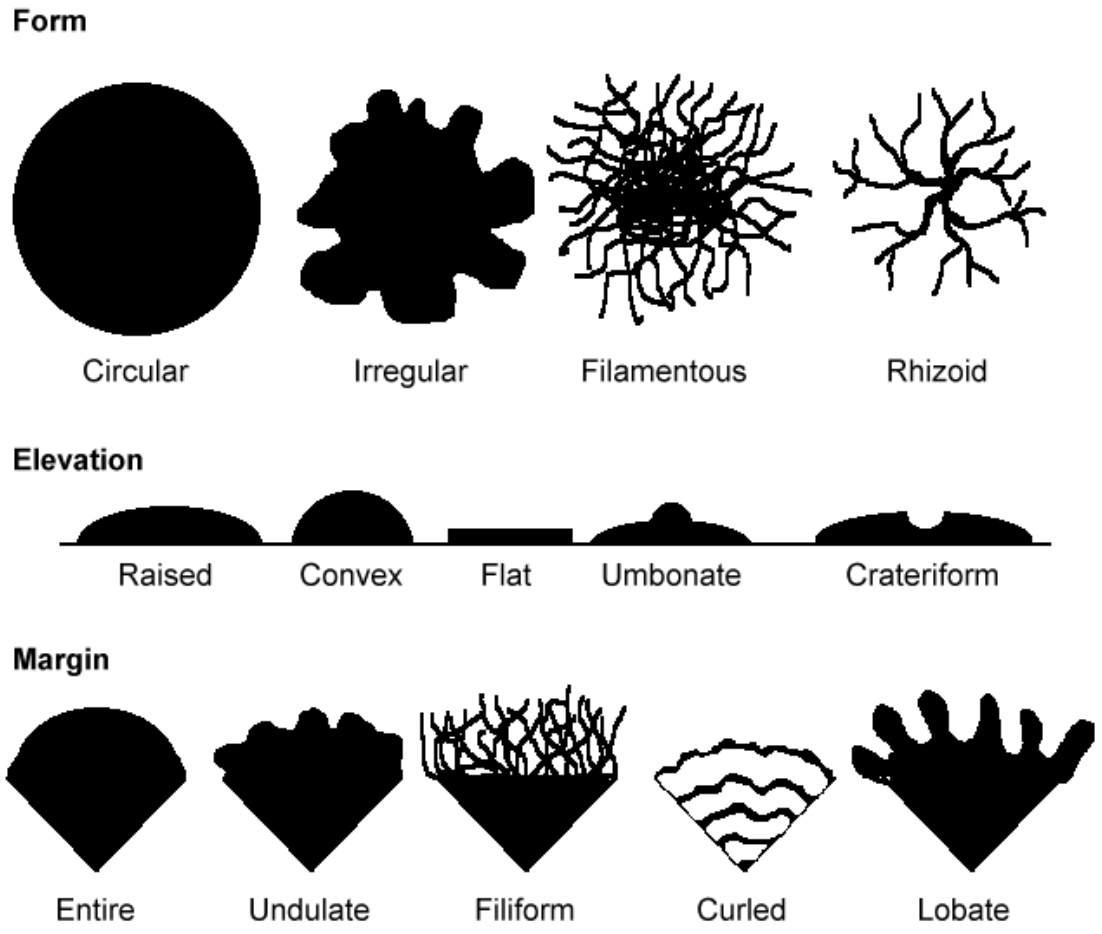
We will then move on to discuss open-ended pre-lesson questions to prepare students for today's content.

-How does scientific research have to adapt for survival?
-Why do microbes adapt in order to survive?
-How do bacteria adapt in order to survive?
-How do fungi adapt in order to survive?
-Which conclusions about colony growth samples would change how scientists respond?

At this point, answers aren't evaluated by right/wrong but rather process and reasoning. The teacher will coach,correct, extend* as necessary.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

In this phase, students will work in their research groups to identify the type of microbe growing in their agar culture. They will analyze the type of organism growing by looking at shape, texture, and other features.



The teacher will circulate the room to coach, correct, and extend the conclusions and questions from groups.

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

In this phase, students will extract samples from their colonies. The teacher will thoroughly model the process before students receive any materials.

They will wear protective gear (goggles, gloves, face masks). Then, they will use a sterilized inoculation loop to extract part of a sample and sterilize (kill) it under an open flame (tea light). Then groups will use compound light microscopes to further study the specimens to help determine the type of microbe samples.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.*

In this phase students will present their findings, discuss unresolved questions about their findings and connect what they have discovered in the context of the "zombie apocalypse" simulation.

The teacher will then present as a facilitator to lead an evaluate discussion on the following questions:

-Which features of colonies make them identifiable?
-Which visible results would prove swabbed bacteria is antibiotic resistant?
-How do scientist alter treatment options based on observed culture growth results?

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will work in their research groups to add documentation to their "Zombie Apocalypse Survival Guide". Today's portion will focus on how pathogens adapt in order to survive. Students will build on the pathogens they identified in part one to explain in part two how each can adapt to survive a zombie apocalypse. An emphasis will be made that microbial "survival" means things pathogens could do to overtake humanity in the struggle for survival.

ACHER NAME	Lesson #
D. Clodfelter	3

MODEL	CONTENT AREA	GRADE LEVEL
Simulation	**Science**	**8**

CONCEPTUAL LENS	LESSON TOPIC
Survival	**How to Survive a Zombie Apocalypse**

LEARNING OBJECTIVES *(from State/Local Curriculum)*

8.L.1.1- Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Survival necessitates adaptation	How does survival necessitate adaptation?

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
- **Antibiotics** are the most common medicine used to eradicate harmful bacteria -**Antibiotic resistance** is when bacteria have adapted to treatment in one or more forms -**Immunology** is a field of science that deals with eradicating harmful diseases -A **vaccine** is a weakened disease injected into a host so its immune system can kill it	-analyze lab grown bacterial cultures for antibiotic resistance -utilize findings in scientific investigation to formulate immunological solutions -hypothesize alternate outcomes that could compromise findings

GUIDING QUESTIONS

What questions will be asked to support instruction?

Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
-What does survival mean on the molecular level? -How do microbes adapt to insure survival? -how do people need to evolve (scientifically speaking) to stay "ahead" of the disease? -In what ways should treatment change in order for people to survive? How should immunologists anticipate failure to develop alternate, successful treatments?	-which components of your culture samples survive antibiotic treatment? -what makes an antidote viable? -how could you manipulate variables in this experiment for alternate outcomes? -which confounding variables could compromise your results? -How alternate outcomes compromise findings?	-How does science continuously evolve to aid in humanity's survival? -How can treatment kill harmful microbes without obliterating potentially beneficial ones? -What happens when microbes resist treatment? -How does science/immunology need to evolve when microbes become resistant? -Which changes should be made when antidotes and vaccines fail?

DIFFERENTIATION *(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.*			
Content	**Process**	**Product**	**Learning Environment**
The lab-based inquiry components (inoculating cultures for isolation, growing cultures, testing for resistance) provide exposure that most students won't experience before the collegiate level.	Advanced critical thinking applications mimic processes scientists use in university and private labs.	Students will create authentic scientifically-reasoned solutions with real-world and practice based solutions	

PLANNED LEARNING EXPERIENCES *(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)*

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the student*

Students will enter through a class door outlined in "caution:keep out" tape. There will be a sectioned off area in a corner of the room with a collection of sealed envelopes on the floor labeled "Top Secret"/"Time Sensitive". Inside will be pathology reports for known victims of deadly diseases (cross section of cholera, ebola, bubonic plague, schistosomiasis). Individually, each student will initially reflect on what it would mean to be "in charge" of putting together a solution for their chosen ailment (though the name of disease is not explicitly stated at this point).

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Students will combine with groups that had the same background disease (they are randomly color coded). They will in pairs and small groups answer the following questions. The teacher will circulate the room, coaching and correcting as necessary, and address relevant topics and questions in a whole group manner when needed.

-What does survival mean on the molecular level?
-How do microbes adapt to insure survival?
-how do people need to evolve (scientifically speaking) to stay "ahead" of the disease?
-In what ways should treatment change in order for people to survive?
How should immunologists anticipate failure to develop alternate, successful treatments?

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

For this phase, students will be given an article on the process in which vaccines are developed and used. http://www.chop.edu/centers-programs/vaccine-education-center/making-vaccines/how-are-vaccines-made

In groups (or pairs, depending), they will develop a "survival checklist" that immunologists will need to use in research and development.

They will share/critique/justify their reasoning as a whole group.

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.*

Students will break in to investigative groups and retrieve samples that test for antibiotic resistance. It is imperative at this stage that all students correctly utilize use of personal protective equipment. The instructor will explicitly model why it is important to "suit up" and how to use materials for safety (masks, gloves, aprons, etc).

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will be presented with the essential question, once again, in lieu of new information observed today. "How does survival necessitate adaptation?" They will add to it the lense of new information today on antidotes, vaccines, quarantines and other public health measures.

Students will spend the remainder of the time in their consultative groups to formulate part three of their "Zombie Apocalypse Survival Guide" focused on treatment.

They will once again conclude class through individually answering and reflecting on our essential question "How does survival necessitate adaptation"? A particular focus will be placed on the treatment of disease.

Sample Pathology/Case Reports for Lesson Three:

65 year old male was admitted for trouble breathing, chest pain and nausea. He was admitted at 5 pm, stabilized within 2 hours and appeared recovered. Patient later suffered an acute hematoma and died at home. Time of death was 11:15 pm.

23 year old female admitted for hemorrhaging from multiple places, vomiting and dysentery-like symptoms. Given IV fluids and antibiotic drip. Transferred to Intensive Care Unit at 2 am. Prognosis critical and severe.

35 year old male admitted for extreme headache, blurred vision and vomiting. Brain scan results pending and patient recently returned from travel to a rural village in Congo to study gorilla migration patterns.

15 year old girl admitted to hospital with flu-like symptoms. Given IV drip and fluids to prevent dehydration from vomiting. Patient is recovering but not stable. Needs continuous fluids to prevent water loss and altered bodily function.

Day Three Guided Questions for Diseases:

Partner Names:_____

You need to draft the CDC initial response to your unknown disease. Answer the questions below to guide the process:

1. What does survival mean on the molecular level?

2. How do microbes adapt to insure survival?

3. how do people need to evolve (scientifically speaking) to stay "ahead" of the disease?

4. In what ways should treatment change in order for people to survive?

5. How should immunologists anticipate failure to develop alternate, successful treatments?

Guided Questions, Page Two

Survival Checklist: Define the steps immunologists need to use to help humanity survive. Each step should come with a reason on its importance. (Include at least five)

Article for Day Three:

Making Vaccines: How Are Vaccines Made?

Several basic strategies are used to make vaccines. The strengths and limitations of each approach are described here.

Weaken the virus

Using this strategy, viruses are weakened so they reproduce very poorly once inside the body. The measles, mumps, German measles (rubella), rotavirus, oral polio (not used in the U.S.), chickenpox (varicella), and shingles vaccines are made this way. Viruses usually cause disease by reproducing themselves many times in the body. Whereas natural viruses reproduce thousands of times during an infection, vaccine viruses usually reproduce fewer than 20 times. Because vaccine viruses don't reproduce very much, they don't cause disease, but vaccine viruses replicate well enough to induce "memory B cells" that protect against infection in the future.

The advantage of live, "weakened" vaccines is that one or two doses provide immunity that is usually life-long. The limitation of this approach is that these vaccines usually cannot be given to people with weakened immune systems (like people with cancer or AIDS).

Inactivate the virus

Using this strategy, viruses are completely inactivated (or killed) with a chemical. By killing the virus, it cannot possibly reproduce itself or cause disease. The inactivated polio, hepatitis A, influenza (shot), and rabies vaccines are made this way. Because the virus is still "seen" by the body, cells of the immune system that protect against disease are generated.

There are two benefits to this approach:

- The vaccine cannot cause even a mild form of the disease that it prevents
- The vaccine can be given to people with weakened immune systems

However, the limitation of this approach is that it typically requires several doses to achieve immunity.

Use part of the virus

Using this strategy, just one part of the virus is removed and used as a vaccine. The hepatitis Band the human papillomavirus (HPV) vaccines are made this way. The vaccine is composed of a protein that resides on the surface of the virus. This strategy can be used when an immune response to one part of the virus (or bacteria) is responsible for protection against disease.

These vaccines can be given to people with weakened immunity and appear to induce long-lived immunity after three doses.

Use part of the bacteria

Some bacteria cause disease by making a harmful protein called a toxin. Several vaccines are made by taking toxins and inactivating them with a chemical (the toxin, once inactivated, is called a toxoid). By inactivating the toxin, it no longer causes disease. The diphtheria, tetanus and pertussis vaccines are made this way.

Another strategy to make a bacterial vaccine is to use part of the sugar coating (or polysaccharide) of the bacteria. Protection against infection by certain bacteria is based on immunity to this sugar coating (and not the whole bacteria). However, because young children don't make a very good immune response to the sugar coating alone, the coating is linked to a harmless protein (this is called a "conjugated polysaccharide" vaccine). The *Haemophilus influenzae* type B (or Hib), pneumococcal, and recently licensed meningococcal vaccines are made this way.

Two new meningococcal vaccines, which prevent against one particular type of the bacterium (type B) not contained in the other meningococcal vaccines, are made using two or more proteins from the bacteria, not the bacterial polysaccharide.

Just like for inactivated viral vaccines, bacterial vaccines can be given to people with weakened immune systems, but often require several doses to induce adequate immunity.

Listen to Dr. Offit explain how vaccines are made by watching this short video, part of the *Talking About Vaccines with Dr. Paul Offit* video series.

View this video with a transcript

TEACHER NAME		Lesson #
D. Clodfelter		4

MODEL	CONTENT AREA	GRADE LEVEL
Simulation	**Science**	**8**

CONCEPTUAL LENS	LESSON TOPIC
Survival	**How to Survive a Zombie Apocalypse**

LEARNING OBJECTIVES *(from State/Local Curriculum)*

8.L.1.1- Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Survival necessitates adaptation	How does survival necessitate adaptation?

CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
- a **vaccine** is a weakened and/or nearly dead virus that is introduced to a host immune system so that it can "beat it" and hold instructions to destroy potential future invasions - an **antibiotic** is a lab-created solution that kills bacterial infections -**prevention** is considered an extremely effective solution to global health; it is said that "an ounce of prevention is worth a pound of cure" meaning that it is more cost effective and logical to avert public health crisis in the first place	-collaboratively evaluate the potential effectiveness of treatments for disease -understand that survival is dependent on an organism's ability to adapt -apply rules of scientific inquiry to analyze the best solutions to survive a microbe-induced "zombie outbreak" -evaluate the strength of proposed solutions to prevent a hypothetical outbreak

GUIDING QUESTIONS
What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:

-How do "zombie" pathogens adapt in order to overtake a host? -In what ways do people need to adapt in order to survive a zombie outbreak? -How might vaccines and antibiotics help people survive outbreaks? -How should solutions to outbreaks focus on both prevention and cures? –How should one consideration be weighted in comparison to the other (prevention vs. cure)? -which considerations weighed the heaviest in your group's quest to find a solution?	-How can your recommendations necessitate survival? -What features of vaccines and antidotes make them strong solutions to prevent outbreaks? -What type of considerations must public health experts and immunologists take in to consideration to evaluate cures? -how might proposed solutions need to adapt in light of potential new information on these pathogens (i.e. whether they are bacteria, viruses, parasites, etc)? -which features of certain prevention and treatment options make them stronger than others?	-how does a host continuously adapt to necessitate its survival? -which features make proposed outbreak solutions stronger than others? -what type of ethical concerns should be taken into consideration when evaluating the safety of proposed solutions to outbreaks? -How can public health experts create solutions to disease that are able to adapt when circumstances change? -how did your group's process of finding a solution mimic the work of immunologist's research in real-world outbreaks (i.e. Ebola, HIV/AIDS, Tuberculosis)

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
The lab-based inquiry components (inoculating cultures for isolation, growing cultures, testing for resistance) provide exposure that most students won't experience before the collegiate level.	Advanced critical thinking applications mimic processes scientists use in university and private labs.	Students will present authentic scientifically-reasoned solutions to a panel of public health experts (volunteers with CDC and other health-related experiences)	

PLANNED LEARNING EXPERIENCES

(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instruction)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Upon entering the room, "Thriller" will be playing as students speculate individually the appearance and meaning of zombie-like depictions in pop culture.

We will discuss, as a class, the plausibility and details on the pathogens we learned about this week could lead to a zombie outbreak.

-How do "zombie" pathogens adapt in order to overtake a host?
-In what ways do people need to adapt in order to survive a zombie outbreak?
-How might vaccines and antibiotics help people survive outbreaks?
-How should solutions to outbreaks focus on both prevention and cures? –How should one consideration be weighted in comparison to the other (prevention vs. cure)?
-which considerations weighed the heaviest in your group's quest to find a solution?

Students will begin the class with a close read of "A History of 'Real' Zombies". We will connect the information in the article to different things we have learned throughout the week about epidemics/pandemics, the spread of pathogens, and how to prevent outbreaks of a disease.

Article: https://www.seeker.com/a-history-of-real-zombies-1765817344.html

After reading, the teacher will pose the following questions to students. Responses will follow a "think/pair/share" model to make sure students are adequately thinking about their responses before speaking:

1. How might "zombies" have been prevented in some of the cultures described in the article?
2. How would "zombie prevention" be different in a culture that recognizes the role of pathogens in the spread of disease?
3. Should a "zombie response plan" focus more on prevention or treatment? Describe the benefits of your chosen course of action.

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Today, students will finalize their "Zombie Apocalypse Survival Guides" in their collaborative groups. Students were given access to laptops/personal devices for research purposes.

The instructor will provide students with ten minutes to practice their presentation and evaluate the plausibility of their solutions. The instructor will navigate throughout the room, checking on each group, and ask them probing questions designed to help strengthen their presentation.

1. How do the recommendations you are proposing necessitate humanity's survival?
2. What features of vaccines and antidotes make them strong solutions to prevent outbreaks?
3. What type of considerations must public health experts and immunologists take in to consideration to evaluate cures?
4. how might proposed solutions need to adapt in light of potential new information on these pathogens (i.e. whether they are bacteria, viruses, parasites, etc)?

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

For this phase in the lesson, the instructor will lead a class presentation/reflection model on the proposed survival guides. We will critically analyze each group's recommendations to project survival. One group will be deemed "Most likely to Survive a Zombie Apocalypse"

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways.*

For this phase, students will reflect on new information they have gained from observing other groups' presentations. They will form back in their collaborative groups to make any last-minute edits or additions to their survival guides.

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will be assigned a short culminating task that will tie in content learned throughout the week.

"It pays to be prepared against a potential zombie apocalypse. You have been assigned the task of making a sign to be hung at the school's gate in the event of an outbreak. Write a sentence to the public describing how survival necessitates adaptation. Your sign should be eye catching, easy to read and contain to more than 50 characters."

Day Four Article: A History of 'Real' Zombies

They seem to be everywhere these days. But where do zombies come from?

BY BEN RADFORD

OCTOBER 31, 2016

8:01 AM EDT

Zombies are all the rage these days - on television, in movies, books and now in the news. Of course zombies aren't new - they were co-opted decades ago by pop culture, especially in George Romero's 1968 classic zombie film Night of the Living Dead.

Or were they? Actually, notes Blake Smith, zombie aficionado and co-host of the monster-themed MonsterTalk podcast, "Though many people think of Night of the Living Dead as being all about zombies, Romero never called them zombies; he wanted them to be ghouls. The public called them zombies, so the name stuck."

Though many people treat the current "zombie apocalypse" as a fun pop culture meme, it's important to realize that some people believe zombies are very real. Haitian culture - like many African cultures - is heavily steeped in belief in magic and witchcraft. Belief in zombies is related to the Voodoo religion, and has been widespread throughout Haiti for decades. The existence of zombies is not questioned, though believers would not recognize the sensational, Hollywood brain-eating version that most Americans are familiar with.

Unlike today's malevolent movie zombies, the original Haitian zombies were not villains but victims. They are corpses who have been re-animated and controlled by magical means for some specific purpose (usually labor). Historically, fear of zombies was used as a method of political and social control in Haiti. Those people believed to have the magical power to zombify a person - mainly witch doctors called bokors - were widely feared and respected. Bokors were also believed to be in service of the Tonton Macoute, the brutal and much-feared secret police used by the oppressive Duvalier political regimes (1957-1984). Those who defied authorities were threatened with becoming the living dead-a concern not taken lightly.

In popular fiction there are several ways to destroy zombies (decapitations or gunshots to the head are popular), though according to Haitian folklore the goal is to release the person from his or her zombie state, not to outright kill the person. There are several ways to free a zombie; one is to feed the zombie salt; others say that if a zombie sees the ocean its mind will return and it will become self-aware and angry, trying to return to its grave.

So are zombies real? Many believe so, but evidence is scarce. There are a few supposed cases of real zombies, including a mentally ill man named Clairvius Narcisse, who in 1980 claimed that he had "died" in 1962, then become a zombie and forced to work as a slave on one of Haiti's sugarcane plantations. He offered no evidence of his claims, and could not show investigators where he had supposedly worked for almost twenty years.

Outside of Haiti (and a few other places where belief in Voodoo exists), zombies were widely assumed to be nothing more than a legendary boogeyman, not unlike werewolves and vampires. However this changed in the 1980s when Wade Davis, a Harvard ethnobotanist, claimed to have discovered a secret "zombie powder" while doing field work in Haiti. The main active ingredient was said to be a neurotoxin which could be used to poison victims into a zombie-like state.

Voodoo magic was an unlikely source of zombies-but could science and medicine explain them? Davis wrote several books on the topic, including The Serpent and the Rainbow, later made into a horror film by director Wes Craven. Though the book was a public success, many scientists were skeptical of Davis's claims, suggesting that they were exaggerated and that the amounts of neurotoxin in the powder samples he found were inconsistent and not high enough to induce the zombifying effects. While in theory the zombie power might work under certain ideal conditions, in the real world it would be very difficult to create a zombie with it; too little of the toxin would have only temporary effects, and too much could easily kill its victim.

Pharmacological doubts aside, there are other reasons to doubt the claim that people had for decades been turned into zombie slave labor. For one thing, the very process that would turn people into zombies (assuming it didn't kill them) would leave them brain-damaged, uncoordinated, and slow - in other words, hardly ideal farm workers.

Furthermore, the economics of zombie-making don't make sense: Haiti is the poorest country in the Western Hemisphere, with no shortage of very cheap labor to work farms and plantations. In a country where the average annual income is less than $2,000 there are plenty of able-bodied, non-zombified people willing to work for almost nothing. Unpaid zombie workers would still need to be clothed, housed, and fed, negating most of the potential profit from using them. And, of course, the sugar plantations allegedly filled with fields of zombies have never been found.

With the main reason for creating zombies pretty well debunked, the question remains - even if Davis's zombie powder is all he claims it is - why anyone would bother to make a zombie in the first place. It would be a lot of time and effort to abduct someone, fake their death, get the toxins just right, revive them, and put them to work.

There are easier ways to give someone brain damage, and even if it worked there's no guarantee that the person would be docile or compliant; it's just as likely that they would be left in a vegetative state. While zombies are infesting television and film (and, some cases, news headlines), true zombies remain an unproven myth.

Part Four: Suggested Resources

Check out these materials and ideas to make sure you and your students stay a step ahead of invasive zombie microbes!

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