MAMMOTH SCIENCE PUBLISHING

Viruses

Exploring Viruses: A Study of Their Biology and Impact on the World

Biology Narratives: Charlie

Charlie, a curious chimpanzee in the rainforest, found a plant that he thought had ripe fruit due to the ethylene gas it produced. However, upon contact, the plant exhibited thigmotropism, shriveled, and Charlie took a bite and became sick. Despite this, his body systems worked together to maintain homeostasis, such as the digestive system breaking down the fruit, the immune system producing antibodies to attack the foreign substance, and the respiratory and circulatory systems struggling to deliver oxygen to tissues. Charlie's story emphasizes the importance of homeostasis in maintaining a healthy body and the interaction between different body systems in responding to changes in the external and internal environment.

Table of Contents

Background

Charlie - Viruses

Charlie was a young chimpanzee who lived amidst the lush greenery of an African forest. His days were filled with joy, as he would swing from branch to branch, gather fruits and nuts, and play with his family and friends. But one day, his world turned upside down.

As he was exploring his surroundings, Charlie stumbled upon a group of humans who had come to study his kind. The humans' presence was new and fascinating to him, and he watched them with great curiosity. Little did he know that one of the humans was carrying a virus that would soon cause chaos in the chimpanzee community.

As the days went by, Charlie and his family started to interact with the humans. The humans' gadgets and tools were strange to them, but Charlie found them intriguing. He would often come close to the humans, sniffing and inspecting them with keen interest.

But soon, something terrible happened. The virus that the human was carrying started to spread among the chimpanzees. Many of Charlie's family members and friends started showing symptoms of the virus, such as coughing, fever, and fatigue. Charlie himself started to feel weak and tired, and his once-playful nature turned into lethargy. He was scared and didn't know what was happening to him.

Desperate to find a cure, Charlie remembered a valuable lesson he had learned from his mother: orchids could help boost his immune system.

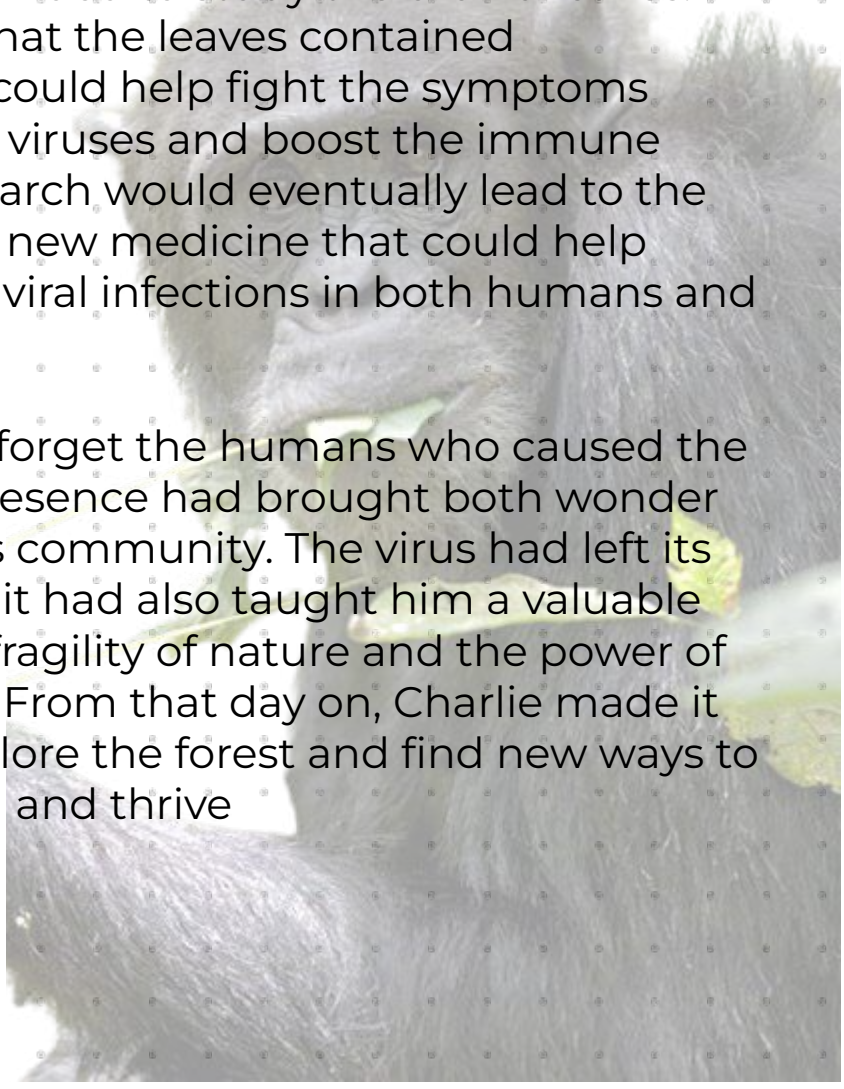
Charlie - Viruses

Without hesitation, he climbed up a nearby tree and started eating the leaves of an orchid. To his surprise, the orchid not only boosted his immune response but also increased the amount of sugar in his body, giving him a burst of energy he had never felt before.

With newfound strength, Charlie fought the virus with all his might, and eventually, he emerged victorious. His family and friends were amazed at his recovery, and he shared with them the secret of the orchids.

The human researchers were intrigued by Charlie's recovery and continued to study the orchid leaves. They discovered that the leaves contained compounds that could help fight the symptoms caused by certain viruses and boost the immune system. Their research would eventually lead to the development of a new medicine that could help prevent and treat viral infections in both humans and chimpanzees.

Charlie will never forget the humans who caused the outbreak. Their presence had brought both wonder and tragedy to his community. The virus had left its mark on him, but it had also taught him a valuable lesson about the fragility of nature and the power of natural remedies. From that day on, Charlie made it his mission to explore the forest and find new ways to use nature to heal and thrive



Student Expectations

Student Expectations

- **Identify** the basic structure of a virus, including its nucleic acid core and outer protein capsid.
- **Compare** and **contrast** the size of viruses to bacteria and plant/animal cells.
- **Describe** the composition of the membranous envelope that may surround some viruses.
- **Analyze** the characteristics of viruses that differentiate them from living organisms.
- **Summarize** the steps of viral replication, including how viruses enter host cells and the differences between the lytic and lysogenic cycles.
- **Evaluate** how the lysogenic cycle of HIV leads to the development of AIDS, including how the virus attaches to cells and destroys T cells.
- **Discuss** the various modes of transmission of HIV, including through body fluids and from mother to child.
- **Explain** how the influenza virus causes the flu through the lytic cycle, including how it enters and replicates within host cells.

Guiding Questions

Guiding Questions

- How do the basic structures of viruses compare and contrast with those of bacteria and eukaryotic cells, and what implications does this have for viral replication?
- What are the key steps involved in viral replication, and how do these differ between the lytic and lysogenic cycles?
- In what ways do viruses differ from living organisms, and how does this impact their ability to replicate and infect host cells?
- How do viruses use host cells to replicate, and what are the implications of this for both the virus and the host cell?
- What are some of the strategies that host cells use to defend against viral infections, and how do viruses evade or overcome these defenses?

Vocabulary

Vocabulary - Page 1

antibiotic	Antimicrobial agent made from microorganisms, and can kill and inhibit the growth of microorganisms, especially those that are infectious or disease-causing
bacteriophage	A virus capable of infecting a bacterial cell, and may cause lysis to its host cell.
capsid	is a three-dimensional proteinaceous capsular shell around a virus that encloses the viral genetic material.
chicken pox	A highly contagious airborne disease caused by varicella zoster virus commonly affecting children and manifests as a pruritic blister-like rash on the skin and mucous membranes
DNA virus	A virus containing DNA as its genetic material and using a DNA-dependent DNA polymerase during replication.
genetic material	Genetic material is the hereditary substance in the cell. It carries all information specific to an organism. It is known as DNA (deoxyribonucleic acid) or RNA (ribonucleic acid).
genome	a genome is a complete set of deoxyribonucleic acid (DNA) within a living cell.
herpes	Herpes simplex viruses -- more commonly known as herpes -- are categorized into two types: herpes type 1 (HSV-1, or oral herpes) and herpes type 2 (HSV-2, or genital herpes). Most commonly, herpes type 1 causes sores around the mouth and lips (sometimes called fever blisters or cold sores). HSV-1 can cause genital herpes,
host	A host cell is a living cell that serves as a shelter and a food source to the foreign organism.
human immunodeficiency virus (HIV)	a type of retrovirus that is responsible for the fatal illness. Can lead to AIDS - An epidemic disease caused by an infection by a retrovirus that causes immune system failure and debilitation and is often accompanied by infections such as tuberculosis. Aids is spread through direct contact with bodily fluids
immune cells	Immune cells develop from stem cells in the bone marrow and become different types of white blood cells. These include neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes

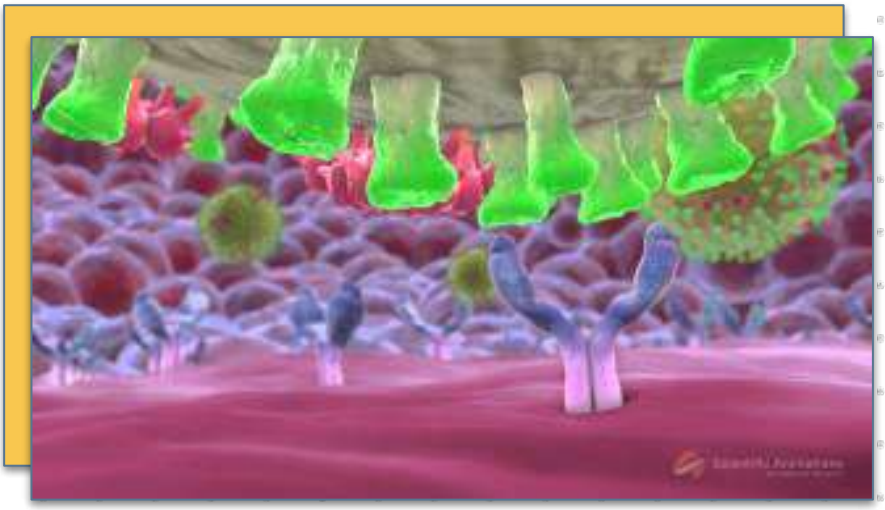
Vocabulary - Page 2

immune system	The organ system that is involved in protecting the organism from infection, infestation, and other potential harm from the presence of foreign (non-self) bodies
infect	To affect with infectious disease; to communicate infection to; as, infected with the plague. Them that were left alive being infected with this disease
influenza	An acute viral infection involving the respiratory tract, occurring in isolated cases, in epidemics or in pandemics striking many continents simultaneously or in sequence. It is marked by inflammation of the nasal mucosa, the pharynx and conjunctiva and by headache and severe, often generalized myalgia. Fever, chills and prostration are common.
lysogenic cycle	viral replication cycle in which the virus's nucleic acid is integrated into the host cells chromosome; a provirus is formed and replicated each time the host cell reproduces; the host cell is not killed until the lytic cycle is activated
lytic cycle	One of the two cycles of viral reproduction (the other being the lysogenic cycle), which is usually considered as the main method of viral reproduction because it ends in the lysis of the infected cell releasing the progeny viruses that will in turn spread and infect other cells.
pathogen	An agent causing disease or illness to its host, such as an organism or infectious particle capable of producing a disease in another organism.
prion	an infectious protein particle similar to a virus but lacking nucleic acid; thought to be the agent responsible for scrapie and other degenerative diseases of the nervous system.
retrovirus	Any of the group of viruses in the family Retroviridae. The virus is characterized by having a single-stranded RNA as its genetic material, which it uses to incorporate into the genome of the host cell as a means to propagate.
RNA virus	A virus containing RNA as its genetic material. The RNA may be single stranded or double stranded. Examples of RNA viruses include Reoviruses, Picornaviruses, Togaviruses, Orthomyxoviruses, Rhabdoviruses, etc.
t-cell	T lymphocytes, also called T cells, are a type of lymphocytes responsible for the cell-mediated immunity.
vaccine	A suspension containing live, attenuated, modified, or killed microorganisms (or their toxins), or tumor antigens, which when administered into the body stimulates the body's immune system to produce antigen-specific antibodies
virus	A submicroscopic infectious agent that is unable to grow or reproduce outside a host cell. It is non-cellular but consists of a core of DNA or RNA surrounded by a protein coat.

Phenomena

List of Phenomena - P1

Main Phenomena

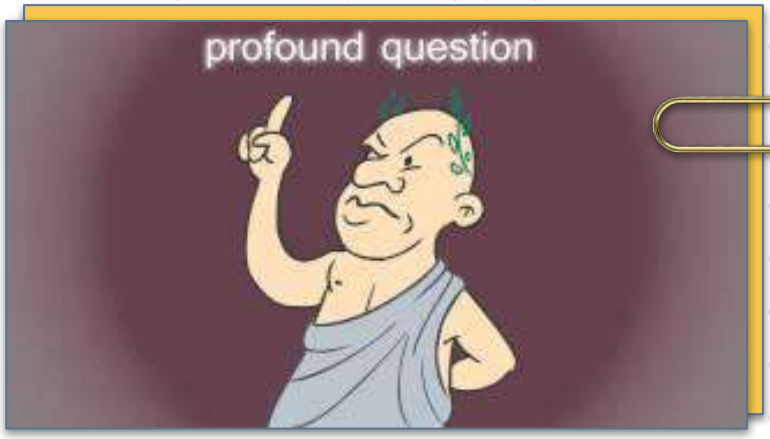


How does the infection of healthy cells by the Swine Flu H1N1 influenza virus cause damage to the respiratory system?

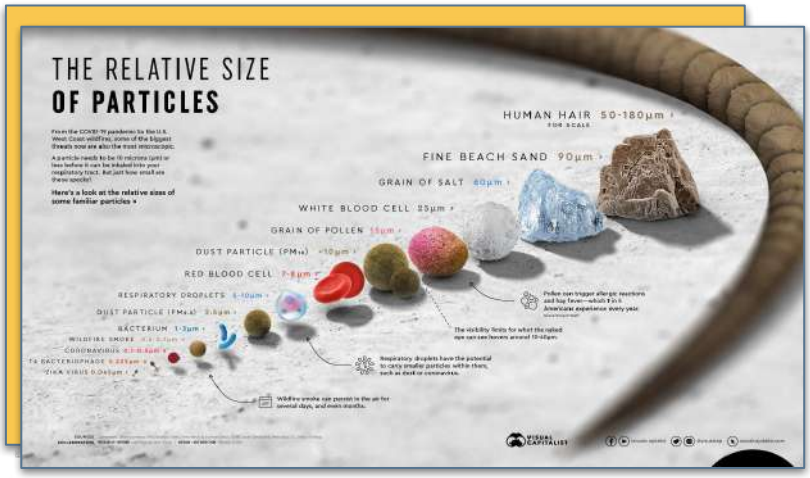
Scientific Animations (n.d.). *SwineFlu Influenza H1N1 Mechanism of Action MOA Animation.* Youtube. https://youtu.be/NPr-i-IbA7s

Super Scienced (n.d.). *What is a Living Thing? Viruses - Dead or Alive?* Youtube. Retrieved May 1, 2023, from https://youtu.be/iQqgNny8OGg

Do viruses exhibit any of the characteristics of living things, such as growth, reproduction, and metabolism? If not, what distinguishes them from living organisms?

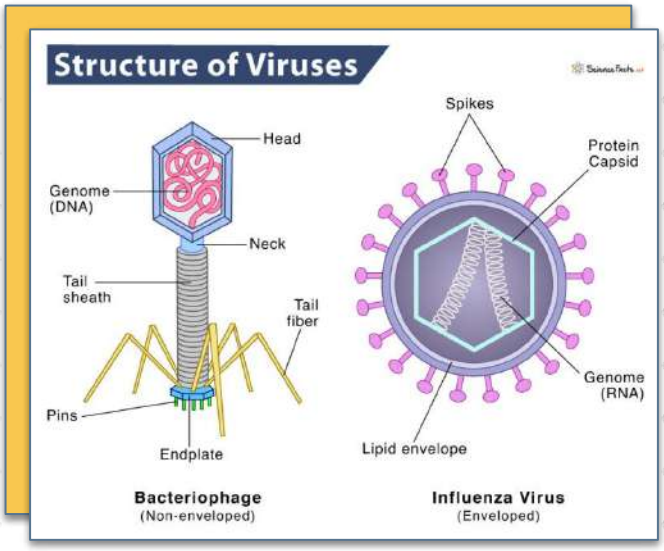


(2020). *World's smallest particles* [Photograph]. https://assets.weforum.org/editor/VA3n8eC_pHvbZGL13lARzzkBw7h-xyOBM4E48Mf_yjw.jpg



How do viral particles compare in size to other biological particles, such as bacteria, cells, and organelles?

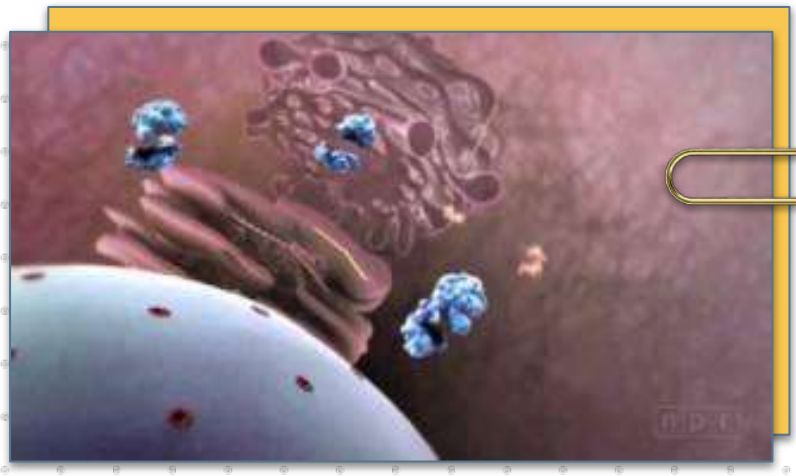
List of Phenomena - P2



Unknown, U. (2023). *Virus: Parts and Structure with Characteristics and Diagram* [Photograph]. https://www.sciencefacts.net/wp-content/uploads/2020/05/Virus-Structure-Diagram-768x624.jpg

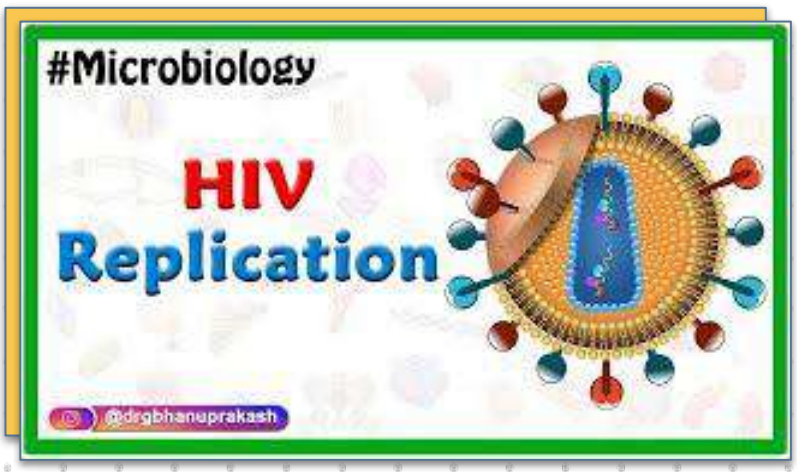
How is the structure of a virus related to its ability to infect host cells, and what are some of the key features of viral particles that enable them to enter and replicate within these cells?

[NPR]. (2010, June 9). *Flu Attack! How A Virus Invades Your Body | Krulwich Wonders | NPR* [Video]. Youtube. https://youtu.be/Rpj0emEGShQ



What are the main steps of the lytic cycle, and how do viral particles utilize the host cell machinery to replicate and assemble new virus particles?

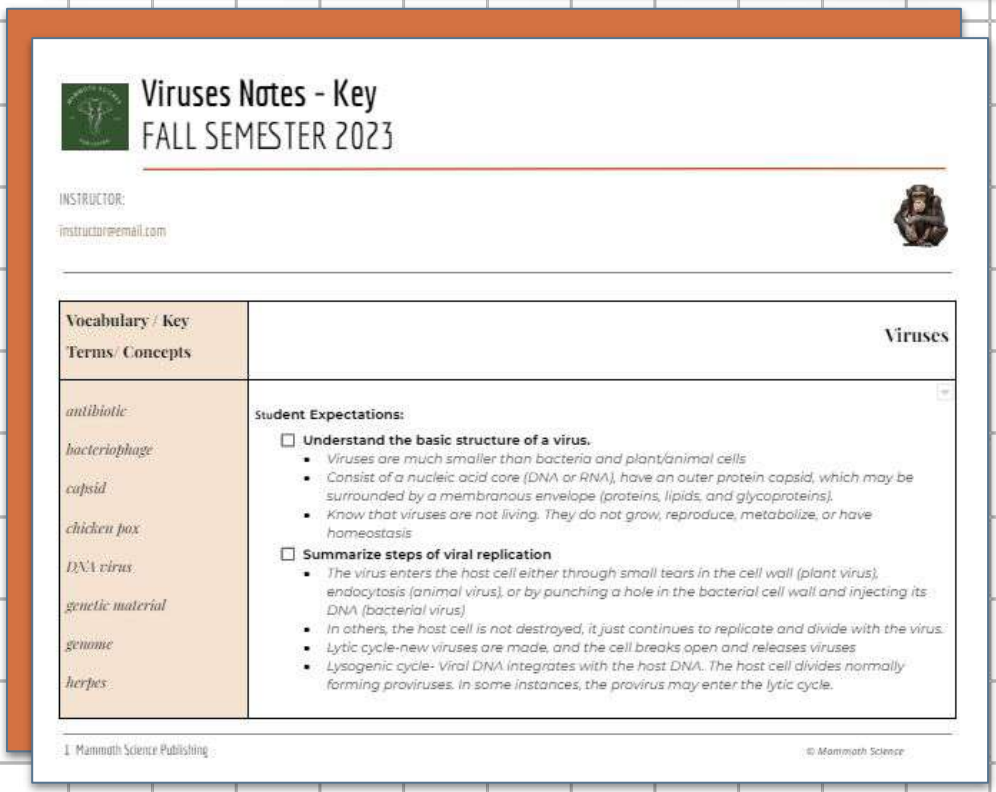
[Dr.G Bhanu Prakash Animated Medical Videos]. (2019, June 12). *HIV Replication - Microbiology Medical Animations* [Video]. Youtube. https://youtu.be/XWFpTxO_oCA



What is the role of the lysogenic cycle in HIV infection, and how does the integration of viral DNA into the host genome impact viral replication and pathogenesis?

Lecture

Slides and Notes



Viruses Notes - Key
FALL SEMESTER 2023

INSTRUCTOR:
instructor@email.com

Vocabulary / Key Terms/ Concepts	Viruses
antibiotic *bacteriophage* *capsid* *chicken pox* *DNA virus* *genetic material* *genome* *herpes*	**Student Expectations:** ☐ **Understand the basic structure of a virus.** • *Viruses are much smaller than bacteria and plant/animal cells* • *Consist of a nucleic acid core (DNA or RNA), have an outer protein capsid, which may be surrounded by a membranous envelope (proteins, lipids, and glycoproteins).* • *Know that viruses are not living. They do not grow, reproduce, metabolize, or have homeostasis* ☐ **Summarize steps of viral replication** • *The virus enters the host cell either through small tears in the cell wall (plant virus), endocytosis (animal virus), or by punching a hole in the bacterial cell wall and injecting its DNA (bacterial virus)* • *In others, the host cell is not destroyed, it just continues to replicate and divide with the virus.* • *Lytic cycle-new viruses are made, and the cell breaks open and releases viruses* • *Lysogenic cycle- Viral DNA integrates with the host DNA. The host cell divides normally forming proviruses. In some instances, the provirus may enter the lytic cycle.*

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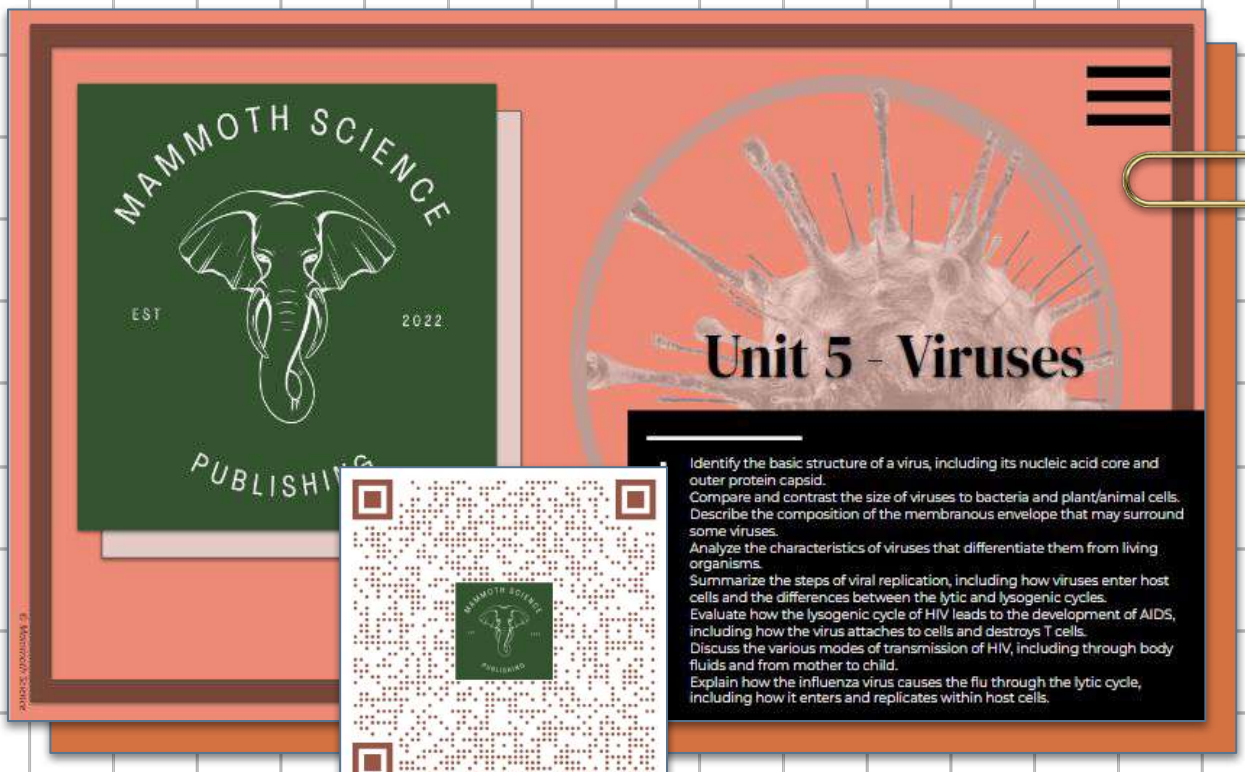
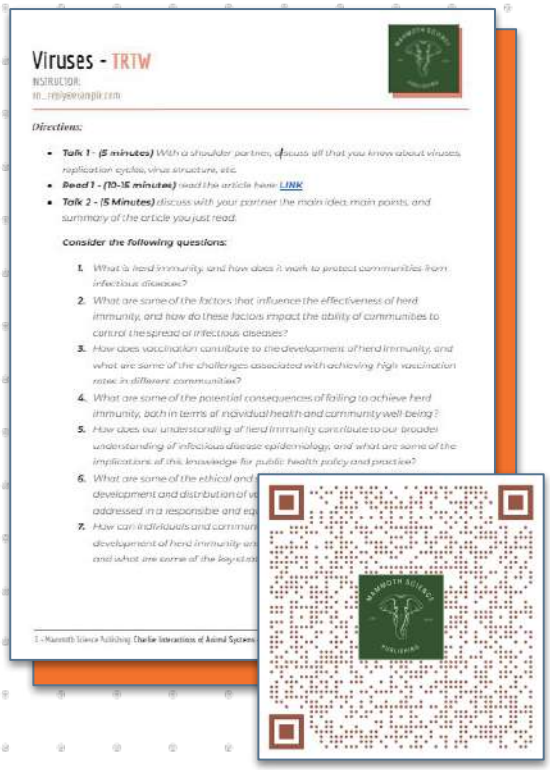
Teacher

Student



Instructional Materials

Instructional Materials - P1



Viruses - TRTW

INSTRUCTOR:

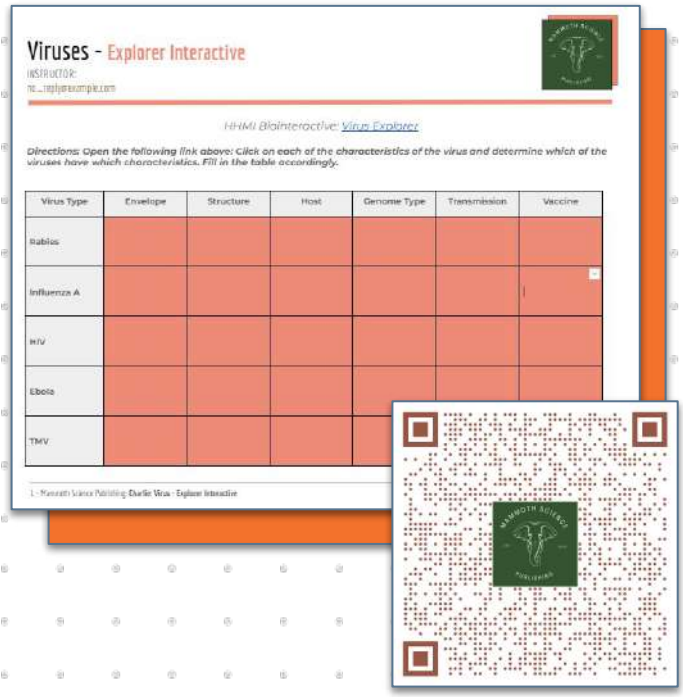
Directions:

- **Talk 1 - (5 minutes)** With a shoulder partner, discuss all that you know about viruses, replication cycles, virus structure, etc.
- **Read 1 - (10-15 minutes)** read the article here: LINK
- **Talk 2 - (5 Minutes)** discuss with your partner the main idea, main points, and summary of the article you just read.

Consider the following questions:

1. What is herd immunity, and how does it work to protect communities from infectious diseases?
2. What are some of the factors that influence the effectiveness of herd immunity, and how do these factors impact the ability of communities to control the spread of infectious diseases?
3. How does vaccination contribute to the development of herd immunity, and what are some of the challenges associated with achieving high vaccination rates in different communities?
4. What are some of the potential consequences of failing to achieve herd immunity, both in terms of individual health and community well-being?
5. How does our understanding of herd immunity contribute to our broader understanding of infectious disease epidemiology, and what are some of the implications of this knowledge for public health policy and practice?
6. What are some of the ethical and
development and distribution of v
addressed in a responsible and eq
7. How can individuals and commun
development of herd immunity wi
and what are some of the key ob

1 - Mammoth Science Publishing: Charlie Interactions of Animal Systems



Viruses - Explorer Interactive

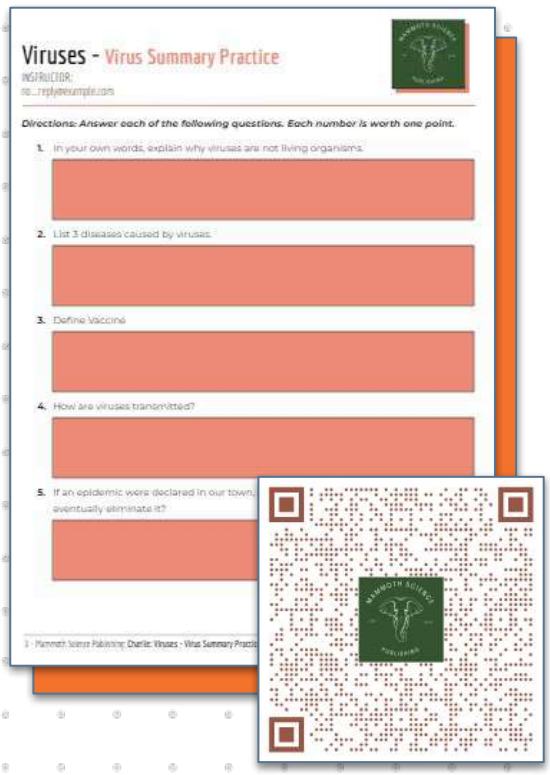
INSTRUCTOR:

HHMI BioInteractive: Virus Explorer

Directions: Open the following link above: Click on each of the characteristics of the virus and determine which of the viruses have which characteristics. Fill in the table accordingly.

Virus Type	Envelope	Structure	Host	Genome Type	Transmission	Vaccine
Rabies						
Influenza A						
HIV						
Ebola						
TMV						

1 - Mammoth Science Publishing: Charlie Virus - Explorer Interactive



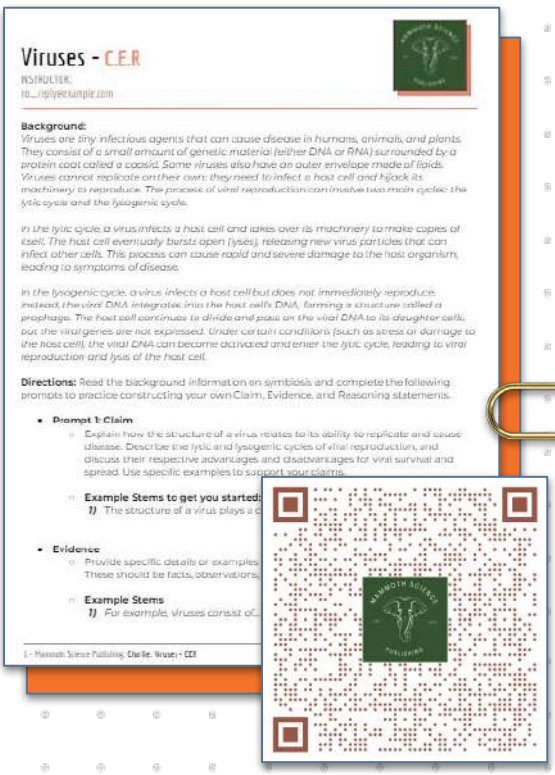
Viruses - Virus Summary Practice

INSTRUCTOR:

Directions: Answer each of the following questions. Each number is worth one point.

1. In your own words, explain why viruses are not living organisms.
2. List 3 diseases caused by viruses.
3. Define Vaccine
4. How are viruses transmitted?
5. If an epidemic were declared in our town,
eventually eliminate it?

1 - Mammoth Science Publishing: Charlie: Viruses - Virus Summary Practice



Viruses - C.E.R

INSTRUCTOR:

Background:

Viruses are tiny infectious agents that can cause disease in humans, animals, and plants. They consist of a small amount of genetic material (either DNA or RNA) surrounded by a protein coat called a capsid. Some viruses also have an outer envelope made of lipids. Viruses cannot replicate on their own; they need to infect a host cell and hijack its machinery to reproduce. The process of viral reproduction can involve two main cycles: the lytic cycle and the lysogenic cycle.

In the lytic cycle, a virus infects a host cell and takes over its machinery to make copies of itself. The host cell eventually bursts open (lyses), releasing new virus particles that can infect other cells. This process can cause rapid and severe damage to the host organism, leading to symptoms of disease.

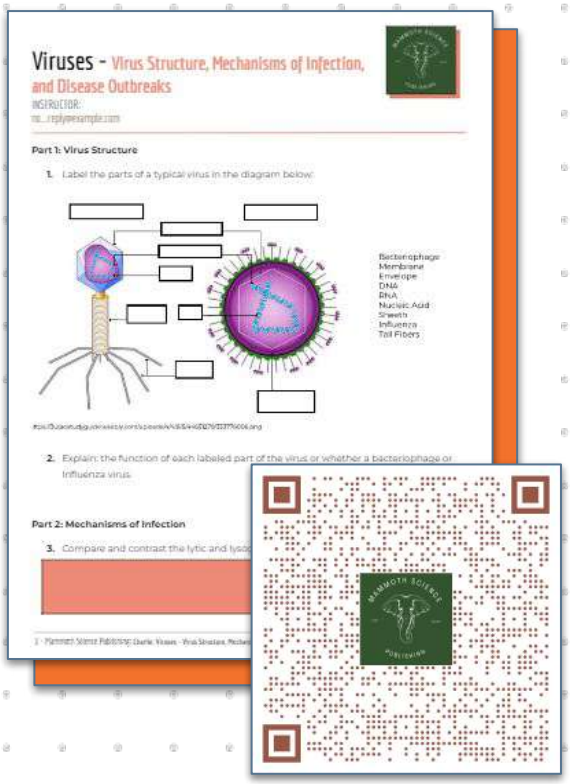
In the lysogenic cycle, a virus infects a host cell but does not immediately reproduce. Instead, the viral DNA integrates into the host cell's DNA, forming a structure called a prophage. The host cell continues to divide and pass on the viral DNA to its daughter cells, but the viral genes are not expressed. Under certain conditions (such as stress or damage to the host cell), the viral DNA can become activated and enter the lytic cycle, leading to viral reproduction and lysis of the host cell.

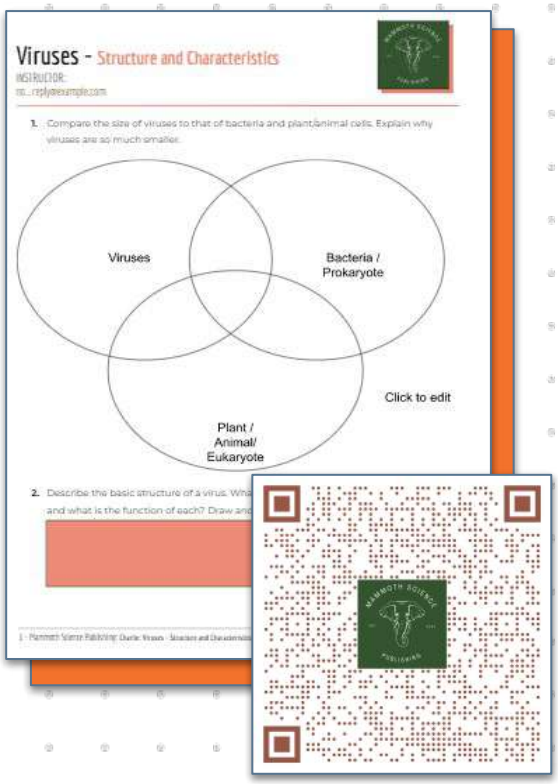
Directions: Read the background information on symbiosis and complete the following prompts to practice constructing your own Claim, Evidence, and Reasoning statements.

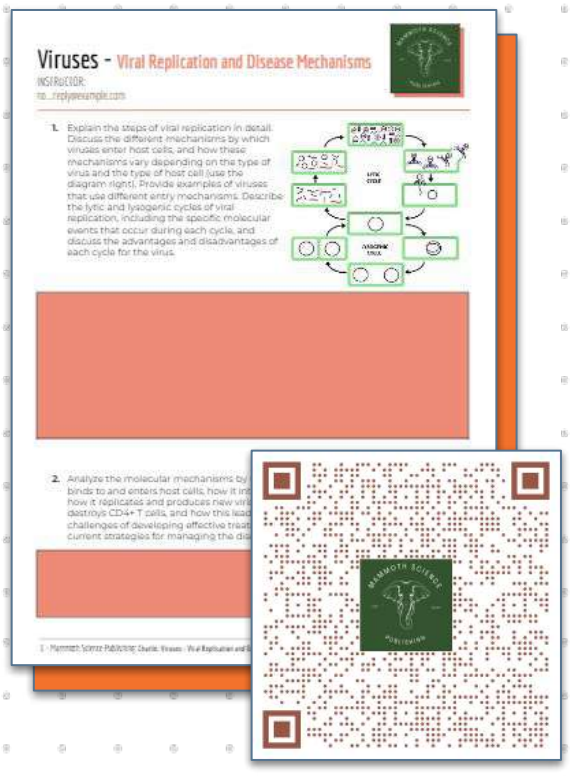
- **Prompt 1: Claim**
  - Explain how the structure of a virus relates to its ability to replicate and cause disease. Describe the lytic and lysogenic cycles of viral reproduction, and discuss their respective advantages and disadvantages for viral survival and spread. Use specific examples to support your claims.
  - **Example Stems to get you started:**
    1) The structure of a virus plays a c
- **Evidence**
  - Provide specific details or examples
    These should be facts, observations,
  - **Example Stems**
    1) *For example, viruses consist of C*

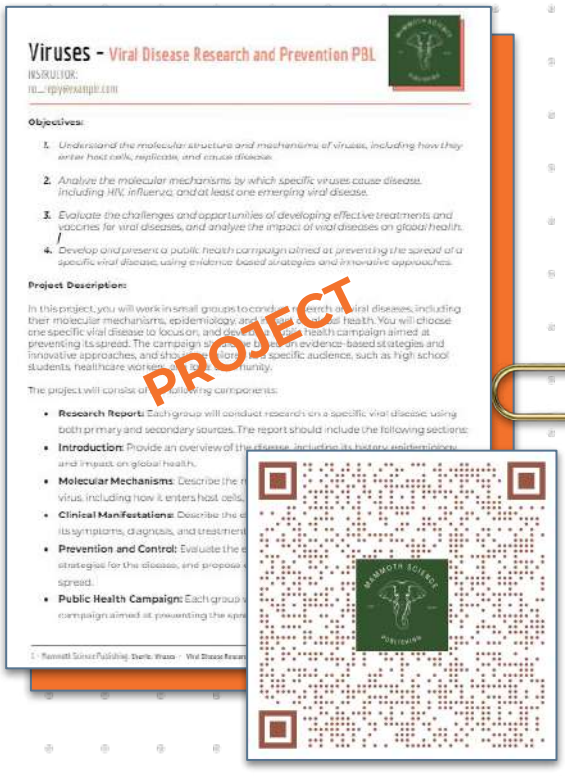
1 - Mammoth Science Publishing: Charlie: Viruses - CER

Instructional Materials - P2

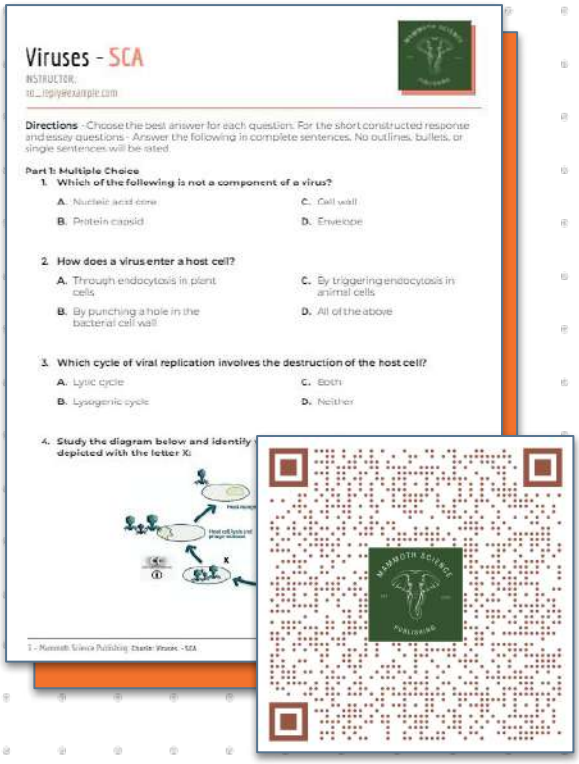








Assessment Materials



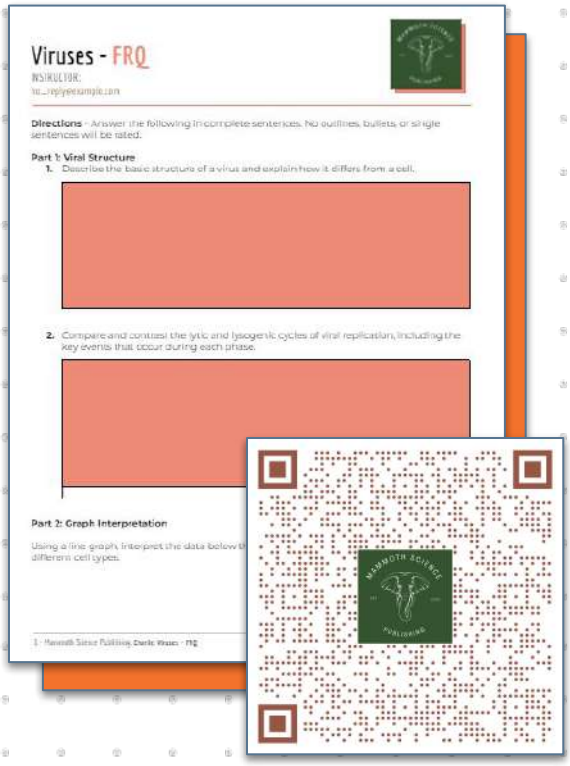
Viruses - SCA

INSTRUCTOR:

Directions - Choose the best answer for each question. For the short constructed response and essay questions - Answer the following in complete sentences. No outlines, bullets, or single sentences will be rated.

Part 1: Multiple Choice

1. Which of the following is not a component of a virus?
   - A. Nucleic acid core
   - B. Protein capsid
   - C. Cell wall
   - D. Envelope
2. How does a virus enter a host cell?
   - A. Through endocytosis in plant cells
   - B. By punching a hole in the bacterial cell wall
   - C. By triggering endocytosis in animal cells
   - D. All of the above
3. Which cycle of viral replication involves the destruction of the host cell?
   - A. Lytic cycle
   - B. Lysogenic cycle
   - C. Both
   - D. Neither
4. Study the diagram below and identify depicted with the letter X:



Viruses - FRQ

INSTRUCTOR:

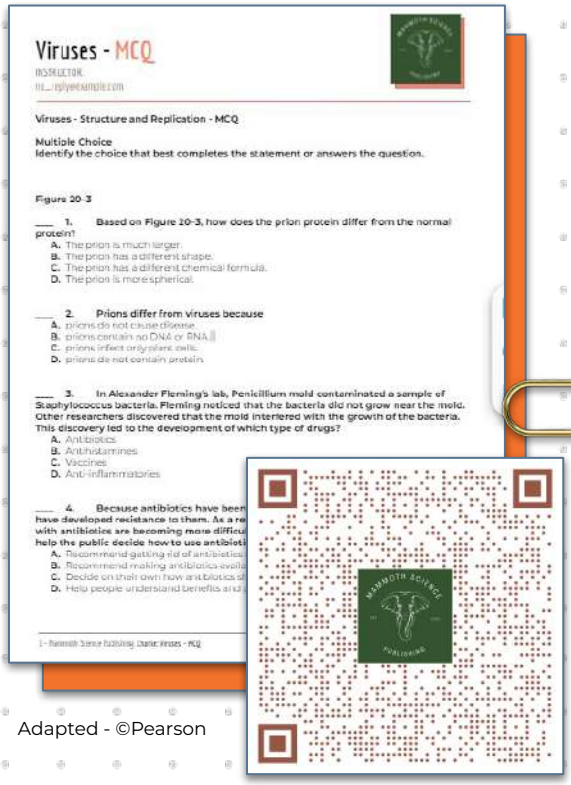
Directions - Answer the following in complete sentences. No outlines, bullets, or single sentences will be rated.

Part 1: Viral Structure

1. Describe the basic structure of a virus and explain how it differs from a cell.
2. Compare and contrast the lytic and lysogenic cycles of viral replication, including the key events that occur during each phase.

Part 2: Graph Interpretation

Using a line graph, interpret the data below t different cell types.



Viruses - MCQ

INSTRUCTOR:

Viruses - Structure and Replication - MCQ

Multiple Choice
Identify the choice that best completes the statement or answers the question.

Figure 20-3

___ 1. Based on Figure 20-3, how does the prion protein differ from the normal protein?
   - A. The prion is much larger.
   - B. The prion has a different shape.
   - C. The prion has a different chemical formula.
   - D. The prion is more spherical.

___ 2. Prions differ from viruses because
   - A. prions do not cause disease.
   - B. prions contain no DNA or RNA.
   - C. prions infect only plant cells.
   - D. prions do not contain protein.

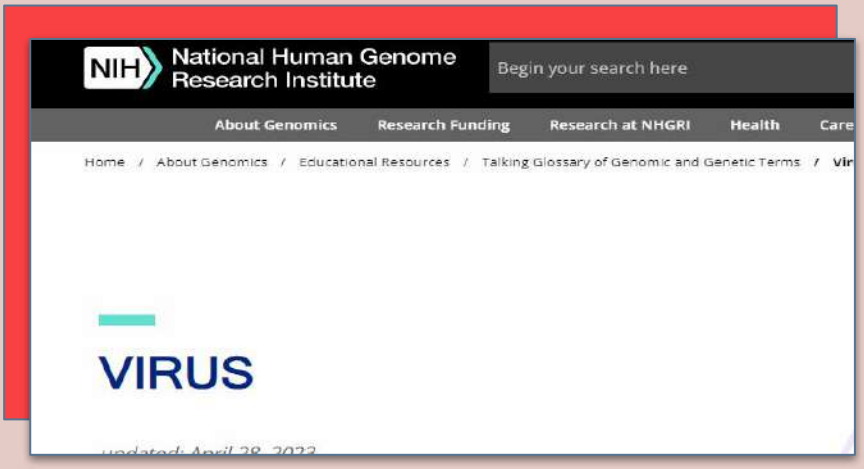
___ 3. In Alexander Fleming's lab, Penicillium mold contaminated a sample of Staphylococcus bacteria. Fleming noticed that the bacteria did not grow near the mold. Other researchers discovered that the mold interfered with the growth of the bacteria. This discovery led to the development of which type of drugs?
   - A. Antibiotics
   - B. Antihistamines
   - C. Vaccines
   - D. Anti-inflammatories

___ 4. Because antibiotics have been have developed resistance to them. As a re with antibiotics are becoming more difficu help the public decide how to use antibioti
   - A. Recommend getting rid of antibiotics
   - B. Recommend making antibiotics availa
   - C. Decide on their own how antibiotics sh
   - D. Help people understand benefits and

Adapted - ©Pearson

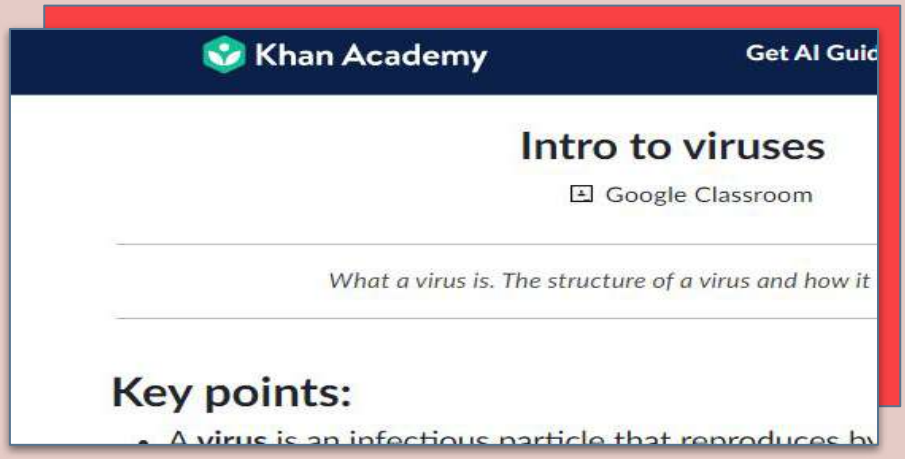
Resources

Websites



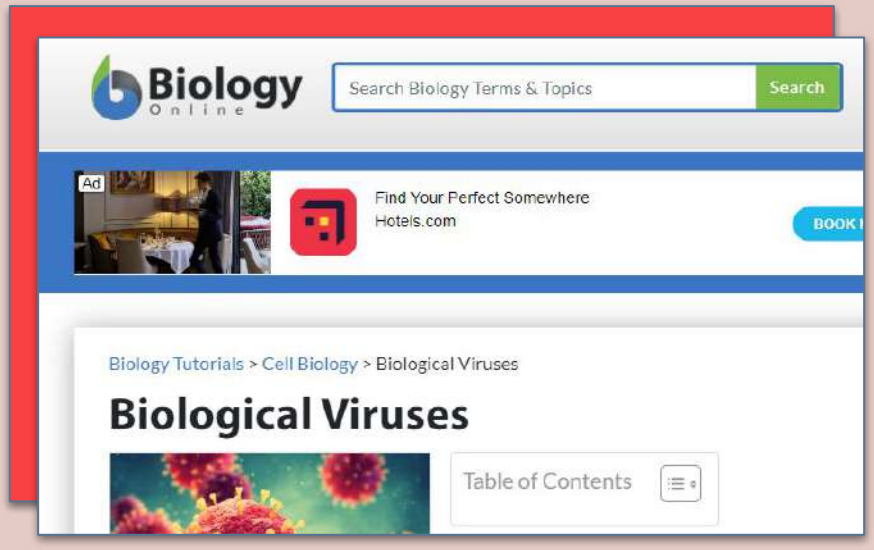
U. (n.d.). *Viruses*. National Human Genome Research Institute. Retrieved May 2, 2023, from https://www.genome.gov/genetics-glossary/Virus

U. (n.d.). *Viruses*. Retrieved May 2, 2023, from https://www.khanacademy.org/science/biology/biology-of-viruses/virus-biology/a/intro-to-viruses



U. (n.d.). *Viruses*. Retrieved May 2, 2023, from https://byjus.com/biology/virus/

Websites



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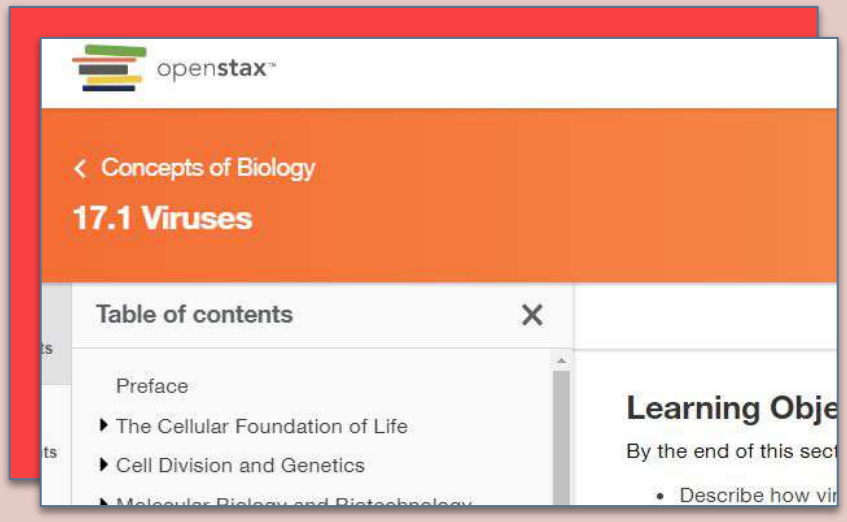

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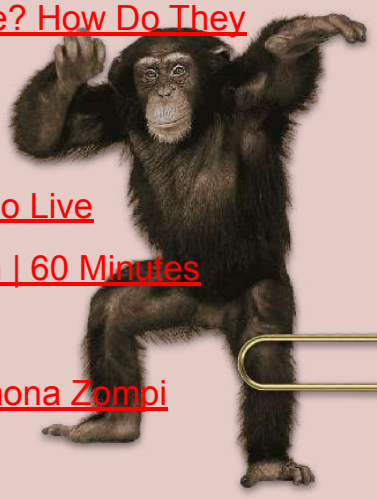
Video

- A changing climate, changes disease
- Dr. Pritish Tosh discusses emerging infectious diseases
- What is an Emerging Infectious Disease?
- What is a Virus? | Breakthrough
- What are viruses | Cells | Biology | FuseSchool
- Virus Life Cycle | Health | Biology | FuseSchool
- Virus | Structure and Classification | Biology | Extraclass #bacteriophage
- Lytic vs Lysogenic Cycle
- Prion Disease - Susan Lindquist (MIT/HHMI)
- AIDS - Replication of HIV (Life Cycle)
- Viruses
- Viral Replication
- Viral Replication Simulation
- Viruses (Updated)
- Antibiotics, Antivirals, and Vaccines
- What Are Vaccinations? | Health | Biology | FuseSchool
- How do vaccines work? - Kelwalin Dhanasarnsombut
- GCSE Biology - What Are Vaccines? Are They Safe? How Do They Work? Vaccines Explained #39
- Immunity and Vaccines Explained
- Risk Takers: Working With Deadly Viruses | Nat Geo Live
- Inside Ebola's hotzone - most deadly virus on earth | 60 Minutes Australia
- How we conquered the deadly smallpox virus - Simona Zompi
- Comparison: Most Deadly Diseases



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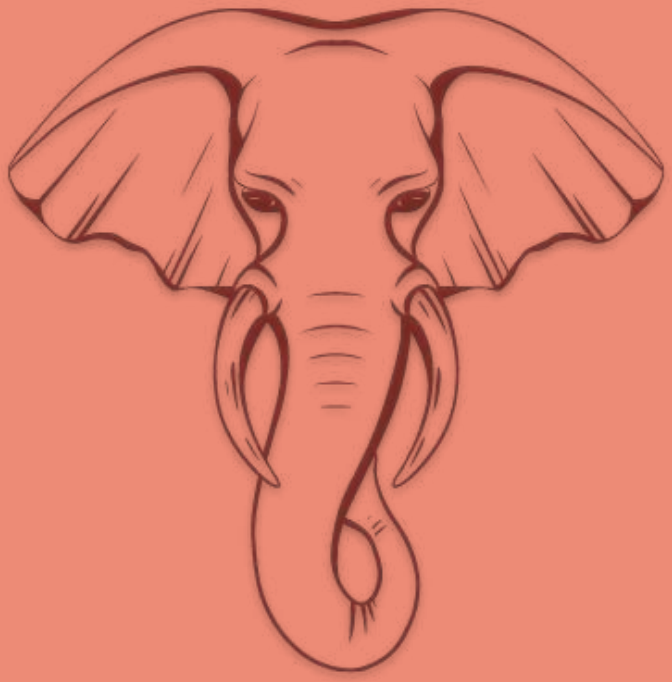

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