

INTRODUCTION

This handout complements the Click and Learn “Virus Explorer” developed in conjunction with the 2016 documentary, *Spillover: Zika, Ebola & Beyond* (<http://www.hhmi.org/biointeractive/virus-explorer>).

PROCEDURE

Follow the instructions as you proceed through the Click and Learn, and answer the questions in the spaces provided.

1. Let’s review. Click on the “About” tab at the bottom. Read the information and list four (4) ways in which viruses can differ from each other.

viruses have different families.

viruses have different genomic makeup

Viruses have different host range.

Viruses have different transmission mechanism.

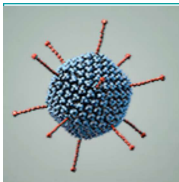
2. This interactive uses several abbreviations. Fill in what each abbreviation stands for in the table below.

Abbreviation	Description
nm	Nanometer
bp	Base pairs
ss	Single-Stranded
ds	Double-stranded

3. Close the “About” window, and locate the  next to each viral characteristic tab across the top. Click on these icons and answer the questions below associated with each viral characteristic.

a. **Envelope:** Not all viruses have an envelope. If a virus has this outer layer, explain how it forms.
The envelop forms by budding processing which occurs when they exit the host.

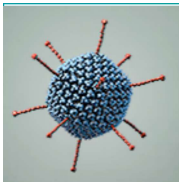
b. **Structure:** What determines the shape of the capsid, or core?
The shape the capsid is determined by individual proteins.



- c. **Host(s):** From the virus' perspective, why is the host important?
The host allows the virus to replicate and survive
- d. **Genome Type:** Viral genomes may vary by four characteristics of their genetic information.
What are they?
they are :nucleic acid
number of strands of nucleic acid
polarity
structure
- e. **Transmission:** Define the terms "vector" and "zoonotic."
Vector is an organism that transfer pathogens from one host to another.
Zoonotic- a virus that can be transferred from animals to humans.
- f. **Vaccine:** What is one advantage of being vaccinated against a particular virus?
vaccination against a disease will help one to develop immunity towards the virus such that the chance of occurrence of that viral disease is very minimal.

4. Virus Scavenger Hunt: Use the home page of the Virus Explorer and the various viral characteristic tabs across the top to answer the questions below.

- a. What is one difference between the rabies virus and the influenza virus?
Rabies has no cure and causes aggression while influenza has cure and does not cause aggression.
- b. Of the nine viruses shown, which is the only one that infects plants?
TMV
- c. What are three characteristics that adenoviruses, T7 virus, and papillomaviruses have in common?
The three viruses have icosahedral structures.
Both viruses possess DNA.
The viruses' DNA is double stranded
- d. Recently, Zika virus has been in the news. Treatment of it is of particular concern. Why?
Zika virus has no specific medication or vaccine and has high risk of neurological complications
- e. Which two viruses infect all the vertebrates included in the interactive?
Rabies and Ebola
- f. Of the nine viruses shown, which is the only one that infects bacteria?
T7 virus



Click and Learn *Virus Explorer*

- g. List four characteristics that human immunodeficiency virus (HIV) and Ebola virus have in common. (Be specific.)

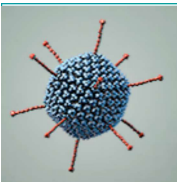
Both are transmitted through body fluids like blood and sexual fluids
Both HIV and Ebola cause stigma among the infected individuals

- h. List four characteristics that HIV and Ebola virus do not share. (Be specific.)

HIV has long incubation period while Ebola has short latency period
HIV has low visibility symptoms while Ebola has high visibility symptoms
HIV kills the patient by lowering immunity while Ebola kills the patient by causing hemorrhage
HIV is transmitted through human fluids while Ebola can be transmitted from human-human contact
and life to human contact

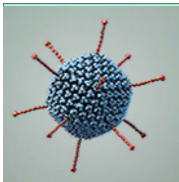
5. Locate the + next to each virus name. Click on these icons and answer the questions below associated with selected viruses.

- a. Rabies virus: People often associate rabies virus with dogs. Why is this incomplete?
Dogs can have rabies as well as other species. Rabies is transmitted through contact from one species so the dog could get it from another species
- b. Influenza virus: Influenza virus has a segmented genome. Why is this an advantage for the virus?
The genome segment in influenza provides an extra mechanism for evolution of new types of viruses as well as producing new combinations of segments for a new virus
- c. HIV: HIV infects immune cells. Why is this a disadvantage to the infected person?
The HIV infection lowers the patient's immunity such that it becomes difficult to fight off the disease.
- d. HIV: Where in the world is HIV most prevalent?
South Africa
- e. Adenovirus: Adenoviruses can cause many mild clinical conditions in humans. What are three?
flu-like symptoms
sore throat
fever
- f. Papillomavirus: What is the common name for papillomas?
Warts



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Virus Explorer

- g. Papillomavirus: What kind of symptoms do some human papillomaviruses cause?
- Genital warts
 - Common warts
 - Flat warts
 - Plantar warts
- h. Zika virus: Why is Zika virus of great concern to pregnant women?
- Zika virus may cause microcephaly in infants as well as other neurological disorders.
- i. Tobacco mosaic virus (TMV): Name one unique characteristic of the tobacco mosaic virus.
- It was the first pathogen to be identified as virus
- j. Ebola virus: What animal is associated with Ebola virus outbreaks?
- Fruit bat



EXTENSION ACTIVITY: SIZE, SCALE, AND PROPORTION: HOW BIG IS A VIRUS ANYWAY?

Instructions: Click on the “Show Relative Sizes of the Viruses” tab at the bottom of the interactive home page. Answer the questions below in the spaces provided. (You will need a calculator for some items.)

1. Using the white scale bar provided, approximately how long (tall) is TMV? 200 nm twice that of sca
2. What is the approximate diameter of HIV? 100nm same as scale b
3. What is the approximate diameter of Zika virus? 1/3 of scale bar=33nm
4. So, how big is a nanometer? Study the sample problem provided and then answer Questions 5–10, showing your work in the space provided for each.

Sample Problem

An average small paperclip measures 3.0 cm in length.

Calculate the length of the paperclip in millimeters, micrometers, and nanometers.

- a. Millimeters (mm)? 30 mm

Since there are 10 mm in a centimeter, the calculation is completed in the following way:

$$3.0 \text{ cm} \times 10 \text{ mm}/1 \text{ cm} = 30/1 = 30 \text{ mm}$$

- b. Micrometers (μm)? 30,000 μm

Since there are 1000 μm in a millimeter, the calculation is completed in the following way:

$$30 \text{ mm} \times 1000 \mu\text{m}/1 \text{ mm} = 30,000 \mu\text{m}$$

- c. Nanometers (nm)? 30,000,000 nm

Since there are 1000 nm in a micrometer (μm), the calculation is completed in the following way: $30,000 \mu\text{m} \times 1000 \text{ nm}/1 \mu\text{m} = 30,000,000 \text{ nm}$

So, a small paperclip measures 3.0 cm in length, or you can say it measures 30,000,000 nm in length!

5. A single grain of salt measures 0.5 mm in width.

- a. What is the width in micrometers (μm)? 500um

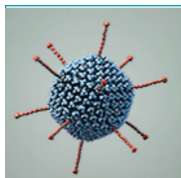
(Show your work.)

The width in um would be: $0.5 \times 1000 = 500 \text{ um}$.

- b. In nanometers (nm)? 500000nm

(Show your work.)

The width in nm would be : $500 \text{ um} \times 1000 = 500000 \text{ nm}$.



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6. The average human skin cell measures $30\text{ }\mu\text{m}$ in diameter.

a. What is the diameter in millimeters (mm)? 0.03mm

(Show your work.)

The diameter of cell is 30 micrometer.

1 micrometer = 10^{-3} mm .

So, $30\text{ micrometer} = 0.03\text{ mm}$.

b. In nanometers (nm)? 3090

(Show your work.)

1 micrometer = 10^3 nm

So, $30\text{ micrometer} = 30 \times 10^3\text{nm} = 3090$

7. If you lined up human skin cells side-by-side, how many would fit along the length of the paperclip in the sample problem above? Justify your answer with math. 1000 cells

The size of a human cell = $30\mu\text{m}$

The length of the paper clip measuring 3cm .

$3\text{ cm} = 30000\text{ microns}$
 $= 30000/30$

8. Using your response to item 1 above, if you lined up TMV particles end to end, how many would fit along the length of the same paperclip? Justify your answer with math. 1560

The average length of the TMV particle is : 200nm or $200 \times 10^{-9}\text{m}$

Thus, the number of TMV particles required to align along the paper clip would be: $0.03/200 \times 10^{-9}$

$= 1560\text{ particles}$

9. Using your responses to item 6, if you lined up TMV particles end to end, how many would fit across the diameter of the average human skin cell? Justify your answer with math. 150 particles

Average particle size of a TMV: $200 \times 10^{-9}\text{m}$

Thus, the number of TMV particles that would align across the human skin cell's diameter : $30 \times 10^{-6}/200 \times 10^{-9}$

10. Claim: An individual virus docks on the surface of a cell, infects it, hijacks the cellular machinery inside, and replicates itself, sometimes thousands of times.

Justification: Based on what you learned about size, scale, and the component parts of a virus, justify with scientific reasoning how a virus is able to accomplish this.

First step is attachment which occur by the virus attaching to the specific receptor of host cell membrane with the help of attachment protein present in the capsid or through glycoprotein present on envelop of virus. the virus then gains entry into the host. Once the virus get inside the host cell, capsid is degraded and nucleic acid is released. After entering to the host cell viral genome integrate with host cell genome and undergoes replication. If a host cell does not provide the enzymes necessary for viral replication, viral genes supply the information to direct synthesis of the missing proteins. Retroviruses has RNA which is reverse transcribed into DNA with the help of an enzyme reverse transcriptase encoded by viral genome. Finally egress which is the last stage of viral replication occurs. it involves the release of the new virions produced in the host organism. They are then able to infect adjacent cells and repeat the replication cycle.