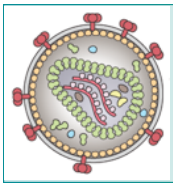

Hands-on Activity
Viral DNA Integration

hhmi | BioInteractive

Student Worksheet

INTRODUCTION

The human immunodeficiency virus (HIV) infects and destroys cells of the immune system called helper T cells. Over time, HIV infection weakens a person's ability to fight other infections and some diseases. The advanced stage of HIV infection is termed acquired immunodeficiency syndrome (AIDS). An individual with AIDS has a severely impaired immune system. Although there is no cure for AIDS, HIV infection can be controlled with proper treatment and early medical care.

HIV is a retrovirus. Like all viruses, retroviruses can only replicate within host cells. They use the host cell's machinery to make copies of the viral genome and produce its proteins. Retroviruses are distinguished from other types of viruses by two key steps in the replication cycle: reverse transcription and integration. After HIV infects a host cell, reverse transcription results in the production of a double-stranded DNA copy of the single-stranded HIV RNA genome. Integration then results in the insertion of the double-stranded DNA copy into the host's genome. The host cell then treats the integrated HIV DNA as part of its own genome.

In this activity, you will model the integration process.

MATERIALS

For this activity, you will need pop beads of three different colors to represent:

- the double-stranded DNA genome of the host cell (about 40 to 50 beads)
- the single-stranded RNA genome of the virus (about 5 to 10 beads)
- the double-stranded DNA copy of the virus's genome (double the number of beads used for the RNA)

PROCEDURE

1. Watch an animation of the HIV life cycle (http://www.hhmi.org/biointeractive/hiv-life-cycle). Pay particular attention to the section on reverse transcription and integration. Take notes on the enzymes involved in these two steps. You may have noticed in the animation that each HIV particle contains two copies of the HIV genome. Each copy is a single-stranded RNA molecule.

2. Go through the HHMI "Click & Learn" activity entitled **"Virus Explorer"** (https://www.hhmi.org/biointeractive/virus-explorer). In particular, read the definitions for genome, structure, and envelope by clicking on the "i" icon next to each word. Click on HIV and look at both the 3-D model and cross-section images. Then answer questions #1-5 below.

QUESTIONS

1. Draw a diagram and explain the basic characteristics of HIV. (If you are filling out the form on your computer, take a photo of your drawing and upload it in the space provided.)

Labeled Diagram	Explanation of Labeled Structures

2. Define the term "genome" and describe the HIV genome.

3. What is the host cell for HIV? How are the composition and size of the host cell genome different from those of HIV?

4. What is the enzyme responsible for reverse transcription? Is it a viral or host enzyme?

5. What is the enzyme responsible for the insertion of the viral DNA into the host genome? Is it a viral or host enzyme?

PROCEDURE

6. You will now make a model of the host cell genome and virus genome using pop beads. Use the longer strand to represent the DNA of the host cell. Draw a diagram of what you constructed in Table 1 below.

7. Once inside the host cell, an HIV enzyme produces a double-stranded DNA copy of the viral genome. Use the third color of pop beads to model the double-stranded DNA copy of the viral RNA. Draw a diagram of your pop-bead model in the table below. (You can also take photos of your models and upload the photos in the spaces provided.)

Table 1. Models of Host Cell Genome, HIV Genome, and Reverse-Transcribed Viral DNA.

Model	Host Cell Genome	HIV genome	DNA copy of HIV genome
Draw a diagram of the model you constructed			
Characteristics (RNA or DNA; single- or double-stranded; relative size)			

8. Compare the three molecules you constructed. What are the key similarities and differences?

9. After the viral DNA is produced, the next step in the HIV life cycle is the insertion of viral DNA into the host cell genome. Use the double-stranded viral DNA and the host DNA pop-bead models to construct a model showing how the virus's genome is integrated into the host genome. Draw a diagram of your pop-bead construction below and make sure you label your diagram. (You can also take a photo of your model and upload it in the space provided.)

10. Describe the steps involved in the integration process. (Think about what you had to do with the beads.)

11. Describe what happens to the viral DNA now that it is integrated into the host cell genome.