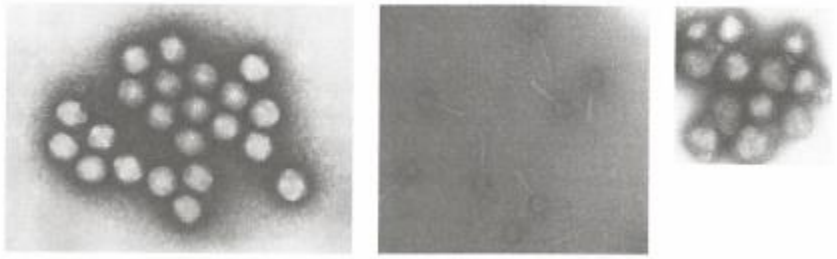
Characteristics of Viruses (and Life)

Introduction: A virus is a tiny bundle of genetic material – either DNA or RNA – carried in a protein shell called a capsid. Some viruses have an additional layer around this coat called an envelope. The envelope is made of a lipid. Three examples of viruses can be seen in Figure 10.1.

Figure 10.1. An Adenovirus, a Bacteriophage, and the Influenza Virus (These viruses are between 45 and 200 nanometers.)



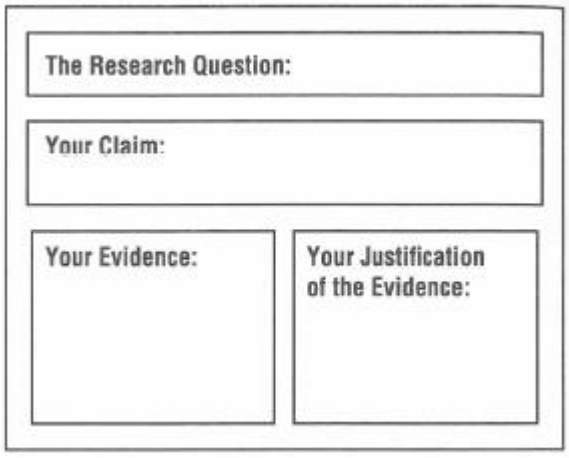
[A nanometer is 1/1,000,000,000 of a meter].

When a virus enters a cell, the information carried in a virus's genetic material enable the virus to force the infected cell to make more copies of the virus. The poliovirus, for example, can make over one million copies of itself inside a single human intestinal cell. A virus is usually very, very small compared to the size of the cell it infects.

Viruses can infect the cells of plants, animals, or even bacteria. Moreover, within an individual species, there may be one hundred or more different types of viruses, which can infect that specific species alone. There are viruses that infect only humans (for example, smallpox), viruses that infect humans and one or two additional kinds of animals (for example, influenza), viruses that infect only a certain kind of plant (for example, the tobacco mosaic virus), and some viruses infect only a particular species of bacteria (for example, the bacteriophage which infects *E. coli*). These unique traits of viruses have made many scientists wonder: **Should a virus be classified as a living thing?**

With your group and the data table provided, develop a claim that best answers this research question. Once your group has developed your claim, prepare a whiteboard that you can use to share and justify your ideas. Your whiteboard should include all the information shown in Figure 10.2.

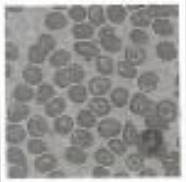
Figure 10.2. Components of the Whiteboard



When you share your work with others (or listen to their ideas), remember to ask questions instead of challenging their ideas. Here are some ideas for questions you could/should ask them:

- How did you analyze or interpret your data? Why did you decide to do it that way?
- How do you know that your analysis of the data is free from errors?
- Why does your evidence support your claim?
- Why did you decide to use that evidence? Why is your evidence important?
- How does your justification of the evidence fit with accepted scientific ideas?
- What are some of the other claims your group discussed before agreeing on your claim, and why did you reject them?

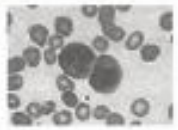
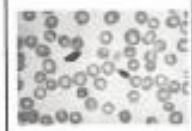
Table 10.1. Information About Viruses and Other Objects Found on Earth

Object and Size[1]	Appearance	Functional "Life" Span	Energy Source	Carbon Source	Waste Production	Responds to External Stimuli	Biomolecules[2] Present in the Object	Form of Reproduction	Genetic Material[3]	Growth?
Influenza Virus 130 nanometers in diameter		10 Years	None	None	None	No	Nucleic Acid Protein	Replication; Requires a host	RNA	No
Adenovirus 220 nanometers in diameter		10 Years	None	None	None	No	Nucleic Acid Protein Lipids	Replication; Requires a host	DNA	No
Coriander Seeds 3 millimeters in diameter		1–10 Years	Organic Compounds[4]	Carbon Dioxide	None	Yes	Nucleic Acid Protein Lipids Carbohydrates	Sexual[5]	DNA and RNA	Yes
Amoeba 500 micrometers in diameter		1–3 Months	Organic Compounds	Carbohydrates	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	Asexual[6]	DNA and RNA	Yes
Human Red Blood Cell 8 micrometers in diameter		3–4 Months	Organic Compounds	Carbohydrates	No	No	Nucleic Acid Protein Lipids Carbohydrates	None	None	No

1. 1 meter = 100 centimeters = 1000 millimeters = 1,000,000 micrometers = 1,000,000,000 nanometers
2. A biomolecule is any molecule that performs an important function in living organisms. Biomolecules are usually composed of hydrogen, carbon, oxygen, nitrogen, prosperous, or sulfur atoms and they are organized into one of four main groups (carbohydrates, proteins, lipids, and nucleic acids).
3. The genetic material of an object is the molecule(s) that play the fundamental role in determining the nature and structure of an organism or cell.
4. Organic compounds are molecules that are composed of carbon such as sugar (which is a type of carbohydrate)
5. *Sexual* refers to a form of reproduction in which two parents give rise to an offspring.
6. *Asexual* refers to a form of reproduction that involves only one parent that produces genetically identical offspring by budding or by the division of a single cell or the entire organism into two parts.

(continued)

Table 10.1. Information About Viruses and Other Objects Found on Earth *(continued)*

Object and Size	Appearance	Functional "Life" Span	Energy Source	Carbon Source	Waste Production	Responds to External Stimuli	Biomolecules Present in the Object	Form of Reproduction	Genetic Material	Growth?
Human White Blood Cell 10 micrometers in diameter		1 Month	Organic Compounds	Carbohydrates	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	None	DNA and RNA	No
Sponge 100 centimeters in diameter		100–200 Years	Organic Compounds	Carbohydrates	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	Sexual and asexual	DNA and RNA	Yes
Elodea 40 centimeters in length		2–4 Weeks	Sunlight	Carbon Dioxide	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	Sexual and asexual	DNA and RNA	Yes
Plasmodium Falciparum 15 micrometers in length		1–2 Months	Organic Compounds	Carbohydrates	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	Sexual and asexual but only occurs inside a host	DNA and RNA	Yes
E. Coli 3 micrometers in length		1–3 Months	Organic Compounds	Carbohydrates	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	Asexual	DNA and RNA	Yes
Tube Worms 1.5 meters in length		100–200 Years	Inorganic Compounds	Carbohydrates	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	Sexual	DNA and RNA	Yes
Dog 0.75 meters in height		15–20 Years	Organic Compounds	Carbohydrates	Yes	Yes	Nucleic Acid Protein Lipids Carbohydrates	Sexual	DNA and RNA	Yes
Computer 45 centimeters in height		10–20 years	Electricity	None	Yes	Yes	None	None	None	No