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The Development of Virology

A. Virology, the study of viruses, developed from the work of several scientists who performed experiments during the course of many years. In this activity you will analyze events in the development of the science of virology.

During the nineteenth century, scientists discovered that bacteria cause some diseases. Scientists, however, could not find the causes of several other diseases. In 1892, Dimitri Iwanowski, a Russian biologist, was studying a disease in tobacco plants. He discovered that the disease, called tobacco mosaic, could be passed from one tobacco plant to another by rubbing the juice from an infected plant on the leaves of a healthy plant. Iwanowski thought that tobacco mosaic was caused by bacteria. He set out to test his hypothesis. He knew that bacteria were killed by heat. He boiled the juice of an infected tobacco plant and rubbed the boiled juice on a healthy plant. The healthy plant did not develop the disease. Iwanowski then obtained a new batch of juice from an infected plant and passed it through a very fine filter. The filter had such small holes that no known bacteria could pass through them. He rubbed the filtered juice on a healthy plant and the plant still developed the disease.

1. At the beginning of his experiments, what did Dimitri Iwanowski think caused tobacco mosaic?

_____

_____

2. Explain the reason that Iwanowski boiled the tobacco juice.

_____

_____

3. Why did Iwanowski's filtering experiment cause him to doubt his hypothesis about bacteria?

_____

_____

4. What conclusions would you have reached had you performed Iwanowski's experiment?

_____

_____

_____

B. A few years after Iwanowski's experiment, the Dutch scientist Martinus Beijernick named the disease-causing particles viruses. Despite the discovery of viruses, however, biologists still did not know whether they were living organisms or chemical substances. To find out the nature of viruses, scientists studied their structures and activities. They also thought about how viruses might have originated.

Viruses are much simpler than cells. They do not produce energy. They do not make proteins or other substances by themselves. Yet they contain nucleic acids and proteins—substances found only in living organisms. Viruses contain hereditary information that allows them to reproduce. But they only reproduce inside living cells. A virus uses the machinery of the cell to reproduce itself.

Read each of the following passages that summarize hypotheses about the origin of viruses. Then answer the questions.

Hypothesis 1: Parasites Have Evolved To Become Viruses.

There are many types of parasites in the world. Internal parasites, for example, are those that live inside the bodies of other organisms. The tapeworm is an internal parasite. Its ancestors, however, were free living. They had organ systems, including a fully developed digestive system. The tapeworm no longer needs a digestive system because it absorbs digested food directly from its hosts. It is thought that during the process of evolution, the tapeworm and other internal parasites lost many of the structures that their ancestors needed for survival as free-living organisms.

Viruses fit the definition of parasites because they live off living organisms. Some biologists hypothesize that viruses were once free-living cells that became internal parasites.

1. Discuss how viruses reached their current form, according to this hypothesis.

2. Describe the problems associated with testing such a hypothesis.

Hypothesis 2: Viruses Are Descendants of the First Living Organisms

Some biologists have hypothesized that viruses are descendants of the first living organisms. Many scientists think that bodies of water that existed on Earth four billion years ago were like seas of organic "soup" and that life arose from this rich chemical environment. According to this hypothesis, during the early stages of life, all of the materials necessary for the activities of life were floating in the organic soup. Processes took place there that take place today only inside living organisms. It has been hypothesized that viruses that lived in the organic soup could replicate themselves by using materials found in the soup. As life evolved, the organic soup environment disappeared.

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3. What would be the conclusion of this hypothesis?

4. Explain why this hypothesis might be criticized.

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CHAPTER 17

Viruses and Monerans
Section 17–2

SKILL ACTIVITY
Analyzing data

Identifying Unknown Bacteria

Bacteria and other microbes are considerably difficult to identify. Bacteria are extremely small and show only a few variations in appearance. Testing for chemical characteristics is often needed to distinguish between bacteria that are similar in appearance. The table below gives characteristics for a variety of bacteria that often need to be identified in medical laboratories.

Familiarize yourself with the table. A plus sign in the table indicates that an organism does have the listed characteristic. A minus sign in the table indicates that the bacterium does not have the characteristic. A blank means that the information is not available. Use the information in the table to identify two unknown organisms.

Organism	Shape or Form	Type of Cell Wall	Capsule	Flagella	Endospores	Aerobic	Causes Lysis of Red Blood Cells	Grows Well at 20°C	Sugars Fermented		
									Glucose	Maltose	Lactose
1. *Bacillus anthracis*	Bacillus	A	+	−	+	+	−	−	+	+	+
2. *Bacillus subtilis*	Bacillus	A	−	−	+	+	−	+	+	+	+
3. *Clostridium botulinum*	Bacillus	A	−	+	+	−	+	−	+		−
4. *Clostridium tetani*	Bacillus	A	−	+	+	−	+	−	−		−
5. *Streptococcus pneumoniae*	Diplococcus	A	+	−	−	+	+	−			
6. *Escherichia coli*	Bacillus	B	−	−	−	+	−	−	+	+	+
7. *Klebsiella pneumoniae*	Bacillus	B	+	−	−	+	−	−	+	+	+
8. *Neisseria catarrhalis*	Diplococcus	B	−	−	−	+	−	+	+	+	−
9. *Neisseria gonorrheae*	Diplococcus	B	−	−	−	+	−	−	+	−	−
10. *Neisseria meningitidis*	Diplococcus	B	−	−	−	+	−	−	−	−	−
11. *Pseudomonas aeruginosa*	Bacillus	B	−	+	−	+	−	+	−	−	−
12. *Salmonella typhi*	Bacillus	B	−	+	−	+		−	+	+	−
13. *Serratia marcescens*	Bacillus	B	−	+	−	+		+	+	+	−
14. *Staphylococcus aureus*	Staphylococcus	A	−	−	−	+	+	−	+		
15. *Staphylococcus epidermidis*	Staphylococcus	A	−	−	−	+	−	−	+		
16. *Streptococcus fecalis*	Streptococcus	A	−	−	−	+	−	−	+		
17. *Streptococcus hemolyticus*	Streptococcus	A	−	−	−	+	+	−	+		

1. Unknown A is examined under a microscope and observed to be a diplococcus. A test is done that shows that the diplococcus has cell wall type B and has no capsule. Samples of unknown A are placed in incubators at 20°C and at 37°C. The sample at 37°C grows well, but the one at 20°C does not. The unknown organism is tested for the ability to ferment the sugars glucose, maltose, and lactose. It can only ferment glucose.

   The identity of unknown A is _____.

2. Unknown B is a bacillus with cell wall type A. It is anaerobic and causes lysis (bursting) of red blood cells. This organism is tested for the ability to ferment the sugars glucose and lactose. It cannot ferment either of these sugars.

   The identity of unknown B is _____.

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CHAPTER 17

Viruses and Monerans
Section 17–3

SKILL ACTIVITY
Applying concepts

Examining Bacterial Contamination

The bacterial contamination of milk products is a major concern of the dairy industry. Contaminated products usually cause illness—such as upset stomachs, diarrhea, sore throats—and may even result in the death of the consumer. Contamination also forces producers to destroy their products. In this activity you will examine how milk is treated to prevent bacterial contamination.

Enormous amounts of milk and milk products—ice cream, butter, and cheese—are consumed every day. Milk provides a good culture for many microorganisms. Disease-causing bacteria can grow rapidly in milk. The milk you buy in food stores comes from hundreds of dairies. It is processed by many people and is often transported over long distances before you buy it. Milk is exposed to contamination from the moment it is taken from the cow. At any time during its journey from the dairy to the consumer, it may be contaminated by bacteria.

Figures 1 through 6 illustrate some of the steps involved in bringing milk to the consumer. Use your knowledge of the life processes of bacteria to develop a system of safeguards that will reduce the number of bacteria in milk. Write the safeguard(s) for each step under that step.

Figure 1

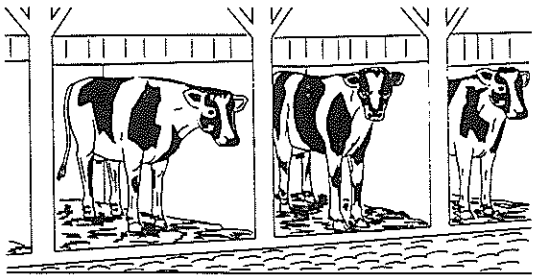
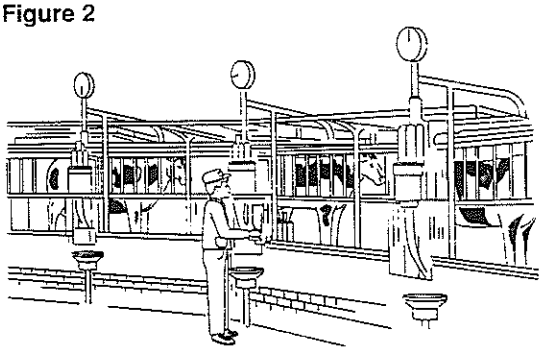


Figure 2



1. _____

_____

_____

_____

_____

_____

2. _____

_____

_____

_____

_____

_____

Figure 3

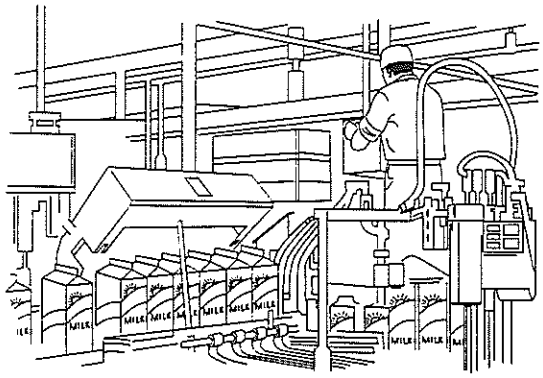
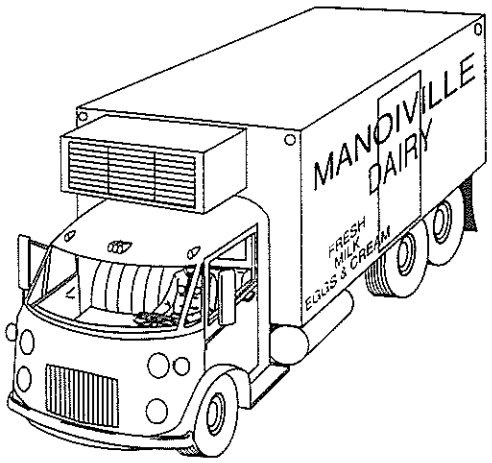


Figure 4



3. _____

_____

_____

4. _____

_____

_____

Figure 5

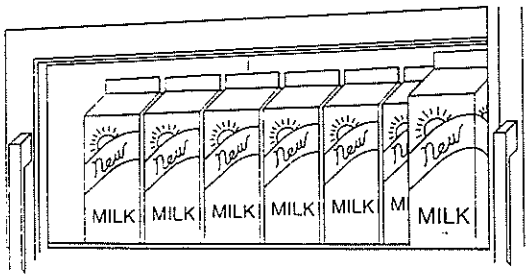
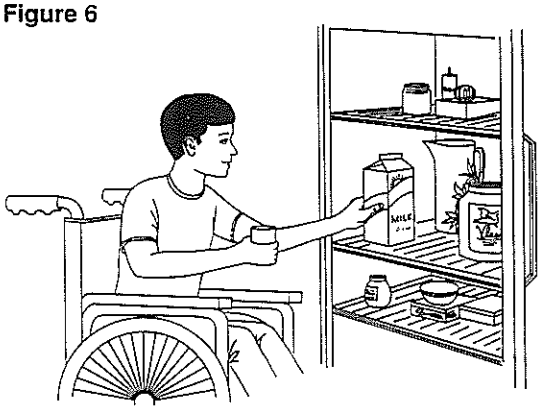


Figure 6



5. _____

_____

_____

6. _____

_____

_____

The bacteria *Clostridium botulinum* cause the sometimes deadly disease called botulism. The bacteria grow and reproduce in meat and vegetables that were not thoroughly cooked and then were packed in airtight sterilized cans. The bacteria grow in the airtight cans and release poisons. A person who eats the spoiled food shows signs of botulism within 12 to 36 hours. Symptoms of botulism include muscle paralysis and an inability to breathe.

7. Is *Clostridium botulinum* an aerobe or an anaerobe? _____

8. The poisons released by botulism are destroyed by heat. How can people preparing canned foods prevent botulism? _____

Across

1. Monerans that use solar energy in a manner similar to green plants are called _____ autotrophs
4. Spiral-shaped bacterium
6. Virus that contains RNA as its genetic information
7. Organism that depends entirely on another living organism for its existence in a way that harms the other organism
9. Rod-shaped bacteria
10. An organism that requires oxygen to live is an obligate _____
11. Viruses that invade bacteria
12. Suffix meaning plants
13. An organism that can survive with or without oxygen is a facultative _____
16. Cells that lack nuclei
18. Form of sexual reproduction that occurs in some bacteria

Down

2. Spherical bacterium
3. Noncellular particle made up of protein and genetic material that can invade living cells
5. Bacterium that produces methane gas
7. Viral DNA that has become part of the host cell's DNA
8. Organisms that feed off once-living organisms
11. One-celled prokaryotes
14. Drug that can kill bacteria
15. Poisons produced by bacteria
17. Type of virus that infects living cells, causing them to burst