Plant Viruses

Viruses that infect plant cells can stunt plant growth and diminish crop yields. Most known plant viruses have RNA rather than DNA as their genetic material. Many of them, like the tobacco mosaic virus (TMV) shown in Figure 10.26, are rod-shaped with a spiral arrangement of proteins surrounding the nucleic acid. TMV, which infects tobacco and related plants, causing discolored spots on the leaves, was the first virus ever discovered (in 1930).

To infect a plant, a virus must first get past the plant's epidermis, an outer protective layer of cells. For this reason, a plant damaged by wind, chilling, injury, or insects is more susceptible to infection than a healthy plant. Some insects carry and transmit plant viruses, and farmers and gardeners may unwittingly spread plant viruses through the use of pruning shears and other tools.

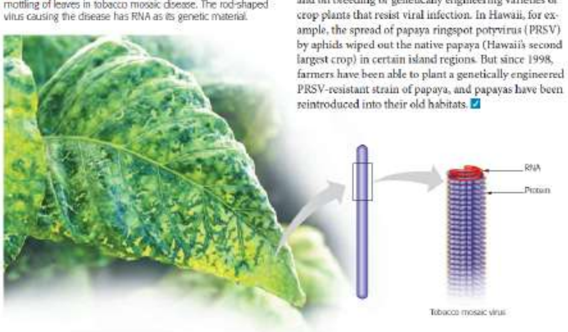
There is no cure for most viral plant diseases, and agricultural scientists focus on preventing infection and on breeding or genetically engineering varieties of crop plants that resist viral infection. In Hawaii, for example, the spread of papaya ringspot potyvirus (PRSV) by aphids wiped out the native papaya (Hawaii's second largest crop) in certain island regions. But since 1998, farmers have been able to plant a genetically engineered PRSV-resistant strain of papaya, and papayas have been reintroduced into their old habitats. ☑

☑ CHECKPOINT

What are three ways that viruses can get into a plant?

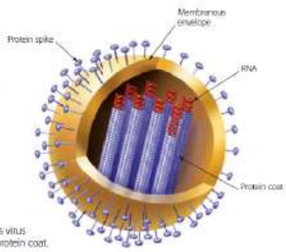
Answer: through lesions caused by injuries, transfer by insects that feed on the plant, and contaminated farming or gardening tools

▼ **Figure 10.26 Tobacco mosaic virus.** The photo shows the mottling of leaves in tobacco mosaic disease. The rod-shaped virus causing the disease has RNA as its genetic material.



Animal Viruses

Viruses that infect animal cells are common causes of disease. As discussed in the Biology and Society section, no virus is a greater human health threat than the influenza (flu) virus (Figure 10.27). Like many animal viruses, this one has an outer envelope made of phospholipid membrane, with projecting spikes of protein. The envelope enables the virus to enter and leave a host cell. Many viruses, including those that cause the flu, common cold, measles, mumps, AIDS, and polio, have RNA as their genetic material. Diseases caused by DNA viruses include hepatitis, chicken pox, and herpes infections.



► **Figure 10.27 An influenza virus.** The genetic material of this virus consists of eight separate molecules of RNA, each wrapped in a protein coat.

Figure 10.28 shows the reproductive cycle of the mumps virus, a typical RNA virus. Once a common childhood disease characterized by fever and swelling of the salivary glands, mumps has become quite rare in industrialized nations due to widespread vaccination. When the virus contacts a susceptible cell, protein spikes on its outer surface attach to receptor proteins on the cell's plasma membrane. ❶ The viral envelope fuses with the cell's membrane, allowing the protein-coated RNA to enter the cytoplasm. ❷ Enzymes then remove the protein coat. ❸ An enzyme that entered the cell as part of the virus uses the virus's RNA genome as a template for making complementary strands of RNA. The new strands have two functions: ❹ They serve as mRNA for the synthesis of new viral proteins, and ❺ they serve as templates for synthesizing new viral genome RNA. ❻ The new coat proteins assemble around the new viral RNA. ❼ Finally, the viruses leave the cell by cloaking themselves in plasma membrane. In other words, the virus obtains its envelope from the cell, budding off the cell without necessarily rupturing it.

Not all animal viruses reproduce in the cytoplasm. For example, herpesviruses—which cause chicken pox, shingles, cold sores, and genital herpes—are enveloped DNA viruses that reproduce in a host cell's nucleus, and they get their envelopes from the cell's nuclear membrane. Copies of the herpesvirus DNA usually remain behind in the nuclei of certain nerve cells. There they remain dormant until some sort of stress, such as a cold, sunburn, or emotional stress, triggers virus production, resulting in unpleasant symptoms. Once acquired, herpes infections may flare up repeatedly throughout a person's life. More than 75% of American adults carry herpes simplex 1 (which causes cold sores), and more than 20% carry herpes simplex 2 (which causes genital herpes).

The amount of damage a virus causes the body depends partly on how quickly the immune system responds to fight the infection and partly on the ability of the infected tissue to repair itself. We usually recover completely from colds because our respiratory tract tissue can efficiently replace damaged cells. In contrast, the poliovirus attacks nerve cells, which are not usually replaceable. The damage to such cells by polio is permanent. In such cases, the only medical option is to prevent the disease with vaccines.

How effective are vaccines? We'll examine this question next using the example of the flu vaccine. ☑

☑ CHECKPOINT

Why is infection by herpesvirus permanent?

Answer: because herpesvirus leaves viral DNA in the nuclei of nerve cells

▼ **Figure 10.28 The reproductive cycle of an enveloped virus.** This virus is the one that causes mumps. Like the flu virus, it has a membranous envelope with protein spikes, but its genome is a single molecule of RNA.