By definition, a **drug** is any substance, other than food, that changes the structure or function of the body. Some drugs, such as cocaine and heroin, are so powerful and dangerous that their possession is illegal. Other drugs, including penicillin and codeine, are prescription drugs and can be used only under the supervision of a doctor. Still other drugs, including cough and cold medicines, are sold over the counter. All drugs, both legal and illegal, have the potential to do harm if they are used improperly or abused.

Drugs differ in the ways in which they affect the body. Some drugs kill bacteria and are useful in treating disease. Other drugs affect a particular system of the body, such as the digestive or circulatory systems. Among the most powerful drugs, however, are the ones that cause changes in the nervous system, especially to the brain and the synapses between neurons.

**Drugs That Affect the Synapse**

The nervous system performs its regulatory functions through the transmission of information along pathways from one part of the body to another. Synapses are key relay stations along the way. The nervous system depends on neurotransmitters to bridge the gap between neurons or between a neuron and an effector. A drug that interferes with the action of neurotransmitters can disrupt the functioning of the nervous system.

**Stimulants**

A number of drugs, called **stimulants**, increase the actions regulated by the nervous system. **Stimulants increase heart rate, blood pressure, and breathing rate.**

Common stimulant drugs include amphetamines, cocaine, nicotine (found in cigarettes), and caffeine (found in coffee, tea, chocolate, and cola products). In addition, stimulants increase the release of neurotransmitters at some synapses in the brain. This release leads to a feeling of energy and well-being. When the effects of stimulants wear off, however, the brain’s supply of neurotransmitters has been depleted. The user quickly falls into fatigue and depression. Long-term use can cause circulatory problems, hallucinations, and psychological depression.
Depressants Some drugs, called depressants, decrease the rate of functions regulated by the brain. 

Depressants slow down heart rate and breathing rate, lower blood pressure, relax muscles, and relieve tension. Some depressants enhance the effects of neurotransmitters that prevent some nerve cells from starting action potentials. This calms parts of the brain that sense fear and relaxes the individual. As a result, the user comes to depend on the drug to relieve the anxieties of everyday life, which may seem unbearable without the drug. When depressants are used with alcohol, the results are often fatal because that combination can depress the activity of the central nervous system until breathing stops.

Cocaine Even stronger effects are produced by drugs that act on neurons in what are known as the pleasure centers of the brain. The effects of cocaine are so strong that they produce an uncontrollable craving for more of the drug. Cocaine is obtained from the leaves of coca plants. 

Cocaine causes the sudden release in the brain of a neurotransmitter called dopamine. Normally, this compound is released when a basic need, such as hunger or thirst, is fulfilled. By fooling the brain into releasing dopamine, cocaine produces intense feelings of pleasure and satisfaction. So much dopamine is released when the drug is used that the supply of dopamine is depleted when the drug wears off. Users quickly discover that they feel sad and depressed without the drug. The psychological dependence that cocaine produces is difficult to break.

Cocaine also acts as a powerful stimulant, increasing heart rate and blood pressure. The stimulation can be so powerful that the heart is damaged. Sometimes, even a first-time user may experience a heart attack after using cocaine. A particularly potent and dangerous form of cocaine is crack. Crack becomes addictive after only a few uses. The intense “high” produced by crack wears off quickly and leaves the brain with too little dopamine. As a result, the user suddenly feels sad and depressed, and quickly seeks another dose of the drug. In time, the urge to seek this drug can be so strong that it leads users to commit serious crimes and to abandon their families and children.

Opiates The opium poppy, like the one shown in Figure 35–17, produces a powerful class of pain-killing drugs called opiates. 

Opiates mimic natural chemicals in the brain known as endorphins, which normally help to overcome sensations of pain. The first doses of these drugs produce strong feelings of pleasure and security, but the body quickly adjusts to the higher levels of endorphins. Once this happens, the body cannot do without the drug. A user who tries to stop taking these drugs will suffer from uncontrollable pain and sickness because the body cannot produce enough of the natural endorphins.
35–5 (continued)

Use Visuals

Figure 35–18 Ask students to read about the effects on the body of the different types of commonly abused drugs. Then, guide them in applying the information by asking: How might someone behave who is taking stimulant drugs? (The person might be slow moving and sleepy and speak indistinctly.) What particular abilities might be impaired by the two different types of drugs? (Stimulants might impair the ability to relax and sleep, and depressants might impair the ability to concentrate and drive.)

Build Science Skills

Making Judgments Have students find and read five newspaper articles that relate to alcohol in some way. For example, they might find articles that report on a new alcohol treatment program, a teen killed by a drunk driver, or an increase in under-age drinking. Challenge students to use the information provided in the articles to write a brief report summarizing some of the effects of alcohol abuse on society.

Address Misconceptions

Many people think that black coffee or a cold shower can sober up someone who is intoxicated by alcohol. Explain that the body breaks down alcohol at a rate that depends on the person’s weight and metabolism. Black coffee and a cold shower cannot increase this rate or sober up an intoxicated person more quickly.

Marijuana Statistically, the most widely abused illegal drug is marijuana. Marijuana comes from Cannabis sativa, a species of hemp plant. Hashish, or hash, is a potent form of marijuana made from the flowering parts of the plant. The active ingredient in all forms of marijuana is tetrahydrocannabinol (THC). Smoking or ingesting THC can produce a temporary feeling of euphoria and disorientation. Smoking marijuana is bad for the lungs. In fact, smoking marijuana is even more destructive to the lungs than smoking tobacco. Long-term use of marijuana can also result in loss of memory; inability to concentrate; and, in males, reduced levels of the hormone testosterone.

Alcohol One of the most dangerous and abused legal drugs is alcohol. The most immediate effects of alcohol are on the central nervous system. Alcohol is a depressant that slows down the rate at which the central nervous system functions. Alcohol slows down reflexes, disrupts coordination, and impairs judgment. Heavy drinking fills the blood with so much alcohol that the central nervous system cannot function properly. People who have two or three drinks in the span of an hour may feel relaxed and confident, but their blood contains as much as 0.10 percent alcohol, making them legally drunk in most states. They usually cannot walk or talk properly, and they are certainly not able to safely control an automobile, as shown in Figure 35–19.

The abuse of alcohol has a frightening social price. About 40 percent of the 50,000 people who die on American highways in a typical year are victims of accidents in which at least one driver had been drinking. One third of all homicides can be attributed to the effects of alcohol. When health care, property damage, and lost productivity are considered, alcohol abuse costs the U.S. economy at least $150 billion per year.

<table>
<thead>
<tr>
<th>Commonly Abused Drugs</th>
</tr>
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<tbody>
<tr>
<td><strong>Drug Type</strong></td>
</tr>
<tr>
<td>Stimulants</td>
</tr>
<tr>
<td>Depressants</td>
</tr>
<tr>
<td>Opiates</td>
</tr>
</tbody>
</table>

*Figure 35–18 Legal drugs that are used for medical purposes can also be abused. Applying Concepts: Do you think a person can become addicted to a legal drug?* 

*Figure 35–19 Alcohol slows down the rate at which the central nervous system functions. It slows down reflexes, disrupts coordination, and impairs judgment. For this reason, you should never get into a car with a driver who has been drinking.*

**Background**

**Effects of some drugs**

Some drugs, such as anesthetics and certain environmental toxins, including chlorinated hydrocarbons that are found in pesticides, can make neurons more or less likely to respond to electrical impulses. Often this is because the substance affects the permeability of membranes to calcium ions. When permeability is decreased so that there is a lower-than-normal concentration of calcium ions, sodium channels may not close completely between action potentials, allowing sodium ions to cross the membrane. This makes the neurons fire more readily, and muscle spasms may result. When membrane permeability is increased and the calcium ion concentration is higher than normal, the opposite result occurs; neurons become less excitable and more difficult to fire.
But the toll of alcohol abuse does not stop there. Women who are pregnant and drink on a regular basis run the risk of having a child with fetal alcohol syndrome. **Fetal alcohol syndrome** (FAS) is a group of birth defects caused by the effects of alcohol on the fetus. Babies born with FAS can suffer from heart defects, malformed faces, delayed growth, and poor motor development. In the United States alone, more than 50,000 babies are born every year with alcohol-related birth defects, many of which are irreversible.

**Alcohol and Disease** People who have become addicted to alcohol suffer from a disease called alcoholism. Some alcoholics feel the need to have a drink before work or school—every day. They may drink so heavily that they black out and cannot remember what they have done while drinking. Some alcoholics, however, do not drink to the point where it is obvious that they have an alcohol-abuse problem. If a person cannot function properly without satisfying the need or craving for alcohol, that person is considered to have an alcohol-abuse problem.

Long-term alcohol use destroys cells in the liver, where alcohol is broken down. As liver cells die, the liver becomes less able to handle large amounts of alcohol. The formation of scar tissue, known as cirrhosis of the liver, occurs next. The scar tissue blocks the flow of blood through the liver and interferes with its other important functions. Eventually, a heavy drinker may die from liver failure.

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**Analyzing Data**

**Blood Alcohol Concentration**

Blood alcohol concentration (BAC) is a measure of the amount of alcohol in the bloodstream per 100 mL of blood. A BAC of 0.1 percent means that one tenth of 1.0 percent of the fluid in the blood is alcohol. In some states, if a driver has a BAC of 0.08 percent, he or she is considered legally drunk. In other states, drivers with a BAC of 0.10 percent are considered drunk. The graph shows the relative risk of being involved in a fatal accident as a result of the blood alcohol concentration of the driver.

1. **Using Tables and Graphs** What trends do you see in the number of fatal crashes from age 17 to age 66+ based on the two ranges of BAC?
2. **Using Tables and Graphs** How does the consumption of alcohol affect driving risk for the average driver?
3. **Drawing Conclusions** Is the effect of alcohol consumption on driving independent of the age of the driver? Are young drivers more affected by alcohol or less affected by it than older drivers?

**Answers to . . .**

1. At the higher BAC range, the percent of fatal car crashes increases from ages 17 to 35, levels off until age 50, and then starts to decline. At the lower BAC range, the percent of fatal car crashes decreases from ages 17 to 35, levels off until age 50, and then starts to rise.
2. For the average driver, there is a greater risk of fatal crashes at the higher BAC range.
3. No, the effect is not independent of the age of the driver. Young drivers are more affected by lower levels of alcohol and less affected by higher levels than older drivers are.
4. Students probably will say that the legal limit of blood alcohol should be less than 0.09 percent.

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**Analyzing Data**

Have students find out the BAC for the legal limit of blood alcohol for drivers in their state. Check students' understanding of what BAC means by asking: If a person has a BAC of 0.1, how much alcohol is present in all 5 liters of his or her blood? (5 mL of alcohol)

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**Answers**

1. At the higher BAC range, the percent of fatal car crashes increases from ages 17 to 35, levels off until age 50, and then starts to decline. At the lower BAC range, the percent of fatal car crashes decreases from ages 17 to 35, levels off until age 50, and then starts to rise.
2. For the average driver, there is a greater risk of fatal crashes at the higher BAC range.
3. No, the effect is not independent of the age of the driver. Young drivers are more affected by lower levels of alcohol and less affected by higher levels than older drivers are.
4. Students probably will say that the legal limit of blood alcohol should be less than 0.09 percent.

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**Lung damage, loss of memory, inability to concentrate, and reduced levels of testosterone in males**

**Figure 35–18** Yes, a person can become addicted to legal drugs, including amphetamines, barbiturates, tranquilizers, morphine, and codeine.

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**Nervous System** 913
Chapter 35

Stimulants increase the release of neurotransmitters, cocaine causes the sudden release of dopamine, depressants enhance the effects of certain neurotransmitters, and opiates mimic endorphins.

As with other drugs, dealing with alcohol abuse is not simply a matter of willpower. Alcoholics often need special help and support to quit their drinking habit. Organizations such as Alcoholics Anonymous are available in most communities to help individuals and families deal with the problems created by alcohol abuse.

Drug Abuse

Each of the drugs discussed so far presents a danger to users. The misuse of either a legal or an illegal drug is a serious problem in modern society. Drug abuse can be defined as the intentional misuse of any drug for nonmedical purposes. With some drugs, such as cocaine, drug abuse causes serious physical damage to the body. With other drugs, such as marijuana, drug abuse produces psychological dependence that can be strong enough to disrupt family life and schoolwork.

An uncontrollable dependence on a drug is known as a drug addiction. Some drugs cause a strong psychological dependence. People who are psychologically dependent on a drug have a mental craving, or need, for the drug. Other drugs cause a strong physical dependence. Physical dependence occurs when the body cannot function without a constant supply of the drug. Any attempt at withdrawal, or stopping the use of the drug, will cause pain, nausea, chills, and fever.

Because many users inject drugs for maximum effect, there is another important consequence of drug use—the increased transmission of human immunodeficiency virus (HIV), the virus that causes AIDS. The virus can be spread rapidly from person to person when drug users share contaminated needles. Many of the new AIDS cases reported in the United States can be traced back to the use of injected drugs.

The best way to avoid the effects of drugs is to avoid drugs. The decision not to use drugs can be difficult when you are faced with pressure to take them. By deciding not to take drugs, you are acting to take control of your life.

35–5 Section Assessment

1. Key Concept Describe the effects of stimulants, cocaine, depressants, and opiates on the central nervous system.
2. Key Concept Explain the effects of alcohol on the body.
3. What is a drug?
4. Why is drinking and driving an extremely dangerous behavior?
5. Critical Thinking Inferring
   Which do you think is a more difficult addiction to break: one in which a person is physically dependent on a drug, or one in which a person is psychologically dependent on a drug? Explain your answer.

Persuasive Writing

Research one of the drugs mentioned in this section to find out more about the short- and long-term effects of the drug on the body. Then, develop an informational brochure trying to persuade someone not to take the drug. Hint: Be sure to include specific facts.