Don’t Stop Till You Get Enough?
Drugs and Their Modifying Effects on the Human Body

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BioS 10
Bioscience in the 21st Century
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Outline

I. Overview of Drugs
   I. Classification
   II. Facts and Figures
   III. Systems Affected

II. Cocaine
   I. How it works
   II. Side effects

III. Amphetamines
   I. How it works
   II. Side effects

IV. Heroin
   I. How It works
   II. Side effects

V. Popular Drugs of the 21st Century
What is a Drug?

• **Drug** --- A chemical substance that, when taken into the body, alters the structure or functioning of the body in some way.
Four Categories of Drug-Taking Behaviors, Derived From The Combination of Goal and Legal Status

<table>
<thead>
<tr>
<th>Goal</th>
<th>Licit</th>
<th>Illicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrumental Use</td>
<td>Taking Valium with a prescription to relieve anxiety</td>
<td>Taking amphetamines without a prescription to stay awake the night before a test</td>
</tr>
<tr>
<td></td>
<td>Taking No Doz to stay awake on a long trip</td>
<td>Taking morphine without a prescription to relieve pain</td>
</tr>
<tr>
<td>Recreational Use</td>
<td>Having an alcoholic drink to relax before dinner</td>
<td>Smoking marijuana to get high</td>
</tr>
<tr>
<td></td>
<td>Smoking a cigarette or a cigar for enjoyment</td>
<td>Taking LSD for the hallucinogenic effects</td>
</tr>
</tbody>
</table>
Illicit Drug Use Prevalence Rates For U.S. College Students In 2008

### TABLE 1.2

Percentage of illicit drug use among college students, aged 19-22

<table>
<thead>
<tr>
<th></th>
<th>Ever In Lifetime</th>
<th>In Past Twelve Months</th>
<th>In Past Thirty Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marijuana</td>
<td>47.5</td>
<td>31.8</td>
<td>16.8</td>
</tr>
<tr>
<td>Hallucinogens</td>
<td>9.1</td>
<td>4.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Cocaine</td>
<td>8.5</td>
<td>5.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Crack cocaine</td>
<td>1.3</td>
<td>0.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Heroin</td>
<td>0.5</td>
<td>0.2</td>
<td>0.1</td>
</tr>
</tbody>
</table>

U.S. Deaths per Year From Tobacco, Alcohol, and Illicit Drug Use

More than four times as many Americans die from tobacco-related illnesses such as cardiovascular and respiratory diseases and cancer as die from alcohol-related and illicit drug-related problems combined.
Nervous System

Peripheral Nervous System
Spinal and cranial nerves

Central Nervous System
Brain and spinal cord

Somatic System
Connects central nervous system to voluntary muscles

Autonomic System
Connects central nervous system to involuntary muscles, glands

Sympathetic System
Readies body for activity, use of energy

Parasympathetic System
Readies body for restoration of energy
The Brain

- Cerebral cortex
- Thalamus
- Midbrain
- Cerebellum
- Corpus callosum
- Nucleus accumbens
- Hypothalamus
- Pituitary gland
- Pons
- Medulla
- Spinal cord
Synaptic Transmission
# Drugs and the CNS

## Table 3.1
Drug Effects and Synaptic Communication in the Nervous System

<table>
<thead>
<tr>
<th>Drug</th>
<th>Result</th>
<th>Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>amphetamines</td>
<td>CNS stimulation</td>
<td>Mimicking of norepinephrine at its receptor sites</td>
</tr>
<tr>
<td>antianxiety drugs in general</td>
<td>Reduction in anxiety and stress</td>
<td>Stimulation of GABA receptors in the brain</td>
</tr>
<tr>
<td>antidepressant drugs, MAO-inhibitor type</td>
<td>Reduction in depressive symptoms</td>
<td>Inhibition of enzymes that metabolize norepinephrine and serotonin</td>
</tr>
<tr>
<td>antidepressant drugs, tricyclic type</td>
<td>Reduction in depressive symptoms</td>
<td>Slowing down of reuptake of norepinephrine and serotonin at their receptor sites</td>
</tr>
<tr>
<td>antipsychotic drugs, typical type</td>
<td>Reduction in schizophrenic symptoms</td>
<td>Dopamine blocked from entering receptor sites in the brain</td>
</tr>
<tr>
<td>caffeine</td>
<td>CNS stimulation</td>
<td>Adenosine (an inhibitory neurotransmitter) blocked from entering its receptor sites</td>
</tr>
<tr>
<td>cocaine</td>
<td>CNS stimulation and local anesthesia</td>
<td>Blocking the reuptake of norepinephrine and dopamine at their receptor sites</td>
</tr>
<tr>
<td>LSD</td>
<td>Visual hallucinations and disordered thinking</td>
<td>Stimulation of receptor sites sensitive to serotonin</td>
</tr>
<tr>
<td>morphine, heroin, and codeine</td>
<td>Pain relief and euphoria</td>
<td>Stimulation of endorphins at their receptors in the spinal cord and brain</td>
</tr>
</tbody>
</table>

The Major Stimulants: Cocaine
The Major Stimulants: Cocaine

In the late 1800s in the United States, cocaine was an ingredient in over-the-counter medications.
The Major Stimulants: Cocaine

Side Effects

- Powerful burst of energy
- General sense of well-being
- Heart rate and respiration are increased
- Appetite is diminished
- Blood vessels constrict and blood pressure is increased
- Pupils are dilated
- Continuously stuffy or runny nose
- Hallucinations (cocaine psychosis)
The Major Stimulants: Cocaine
The Major Stimulants: Amphetamines
The Major Stimulants: Amphetamines

- Euphoria
- Insomnia
- Increased heart rate
- Increased blood pressure
- Dilated pupils
- Parkinson's-like symptoms
- Tremors
- Convulsion
- Paranoia
- Hallucinations
- Strokes
- Cardiovascular collapse, death

The Face of a Meth User – 10 years

Dead at age 38
The Major Stimulants: Amphetamines
The Narcotics: Heroin

Diagram showing the effects of narcotics on neurotransmitters. The diagram illustrates the role of GABA, dopamine, and mu (µ) opiate receptors in the nucleus accumbens. Heroin and morphine are shown interacting with these receptors and affecting the synaptic cleft and post-synaptic membrane.

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The Narcotics: Heroin

**Side Effects**
- Intense euphoria
- Subsequent tranquil drowsiness
- Elevated body temperature

**Withdrawal**
- Increased blood pressure
- Tearing, runny nose
- Diarrhea
- Spontaneous ejaculations
- Restlessness
- Involuntary kicking movements
- Pain and irritability
- Depression and anxiety
21st Century Drugs
Performance-Enhancing Drugs
Performance-Enhancing Drugs

- Androgenic - acting to promote masculinizing changes in the body

- Anabolic - acting to promote growth and muscular development

- Anabolic-androgenic steroids (anabolic steroids) - a group of drugs patterned after the testosterone molecule, producing anabolic and androgenic effects
Performance-Enhancing Drugs

- Shrunken testicles
- Diminished sperm count
- Enlarged breasts
- Frequent, sustained, painful penile erections (priapism)
- Acne on shoulders and back
- Increased facial hair, accelerated balding
Performance-Enhancing Drugs

- Lower voice
- Increased facial hair
- Enlarged clitoris
- Increased aggressiveness
- Increased appetite and decreased body fat
- Diminished menstruation
- Decreased breast size
- Increased body hair
- Increased loss of scalp hair
### Suspension Penalties for Steroid Use

The 2005 agreement on regulations against steroid use in major league baseball (MLB) included a ban on “all substances regarded now, or in the future, by the federal government as steroids” as well as human growth hormone and steroid precursor hormones such as androstendione. Suspension penalties for positive-test infractions under these new regulations are shown in comparison to previous MLB regulations and those of other U.S. and international athletic organizations.

<table>
<thead>
<tr>
<th></th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Fifth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major League Baseball</strong></td>
<td>counseling</td>
<td>15 days</td>
<td>25 days lifetime suspension, with right of reinstatement after two years</td>
<td>50 days</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>Pre-2005</strong></td>
<td>50 games</td>
<td>100 games</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Late 2005</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minor League Baseball</strong></td>
<td>15 days</td>
<td>30 days</td>
<td>60 days</td>
<td>1 year</td>
<td>lifetime</td>
</tr>
<tr>
<td><strong>National Football League</strong></td>
<td>4 games</td>
<td>6 games</td>
<td>1 year</td>
<td>1 year</td>
<td>1 year</td>
</tr>
<tr>
<td><strong>National Basketball Association</strong></td>
<td>5 games</td>
<td>10 games</td>
<td>25 games</td>
<td>25 games</td>
<td>25 games</td>
</tr>
<tr>
<td><strong>National Hockey League</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>World Anti-Doping Association</strong> (Olympic sports)</td>
<td>2 years</td>
<td>lifetime</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Misuse of Prescription Drugs

THE TRUTH ABOUT PAINKILLERS

Once prescribed, these drugs open the door to a tenacious addiction and a life of dependency.

“SAY NO TO DRUGS, SAY..."
Misuse of Prescription Drugs
Misuse of Prescription Drugs

Diprivan