2 Hours

SESSION VI

PHYSIOLOGY AND DRUGS: AN OVERVIEW

SESSION VI PHYSIOLOGY AND DRUGS: AN OVERVIEW

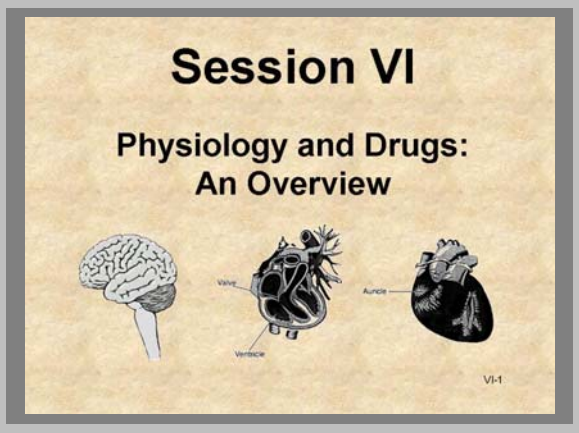
Upon successfully completing this session the student will be able to:

- Explain in layman's terms the general concept of human physiology.
- Explain in layman's terms the purpose and functions of major systems in the body (nervous system, circulatory system, respiratory system, etc.)
- Explain in layman's terms how drugs work in the body.
- Explain in general terms how the drug evaluation is used to detect signs or symptoms indicative of drug impairment.
- Correctly answer the "topics for study" questions at the end of this session.

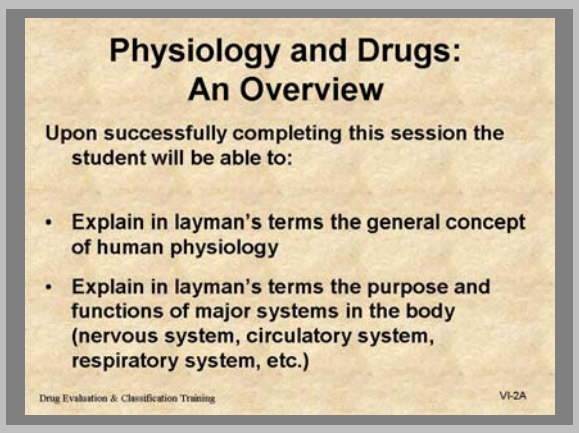
CONTENT SEGMENTS	LEARNING ACTIVITIES
A. Physiology and Drugs: An Overview	▪ Instructor-Led Presentations
B. Body Systems	▪ Reading Assignments
C. The Concept of Homeostasis	
D. A Simple View of the Heart and Circulatory System	
E. A Simplified Concept of the Nervous System	
F. How Drugs Work	
G. Medical Conditions Which sometimes Mimic Drug Impairment	

A. Physiology and Drugs: An Overview

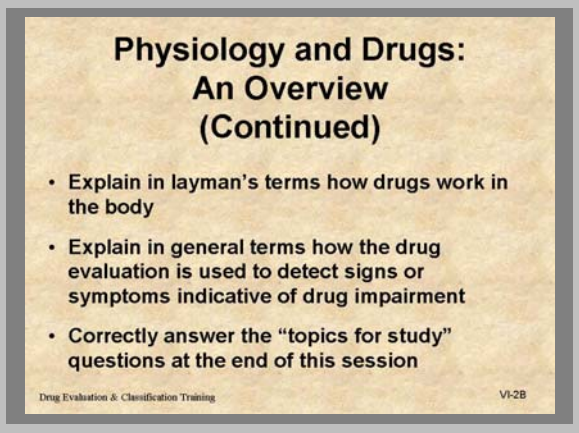
Session 6-1: Physiology and Drugs: An Overview



Session 6-2A: Physiology and Drugs: An Overview



Session 6-2B: Physiology and Drugs: An Overview (cont.)



Briefly review the content, objectives and activities of this session.

Before we can understand how drugs work, we must have a basic understanding of how the body works.

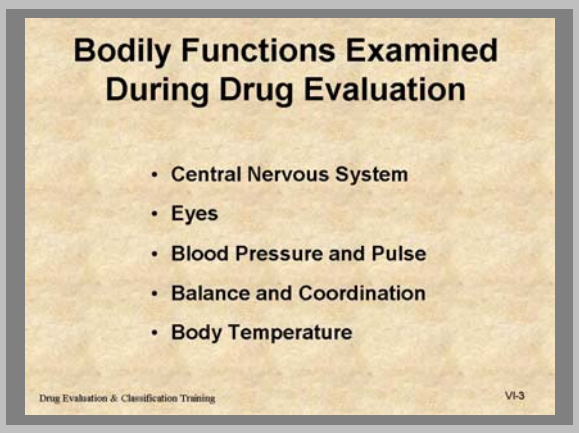
- Point out that it is not necessary to have detailed knowledge of specific functions or medical terminology. Students will not become medical specialists as a result of this limited overview, however, they should be encouraged to learn as much as possible about human physiology through additional instruction and independent reading.

We will review general concepts of how the body functions in a "normal" or "standard" human.

- Point out that all human beings are different and a "normal" or "standard" human does not exist. However, experience and scientific studies have produced a range of normal values that can be used for comparison purposes.

We will briefly review the chief functions of the body systems.

Session 6-3: Bodily Functions Examined During Drug Evaluation

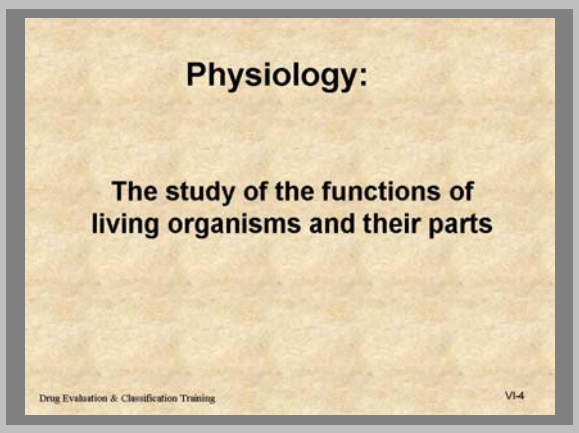


Primary focus will be on the systems or component parts of those systems that are examined during the drug evaluation.

- Central Nervous System
- Eyes
- Blood Pressure and Pulse
- Balance and Coordination
- Body Temperature

B. Body Systems

Session 6-4: Physiology



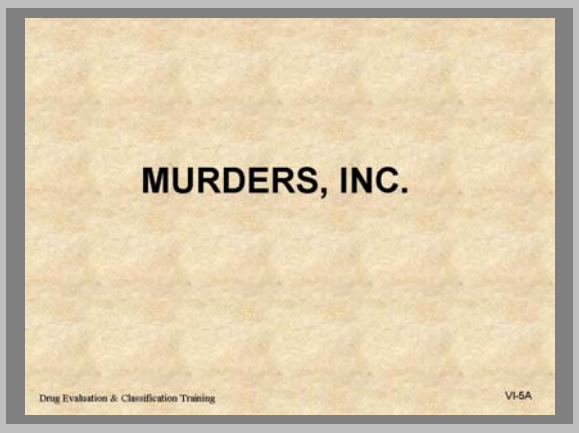
Physiology is the branch of biology that deals with the functions and activities of life or living matter and the physical and chemical phenomena involved.

For the purposes of this course, physiology is the study of the functions of living organisms and their parts.

- Source: Merriam-Webster's Medical Dictionary (2008).

<u>Point out:</u> For the purposes of this course, physiology is the study of the functions of living organisms and their parts.

Session 6-5A: Murders, Inc.

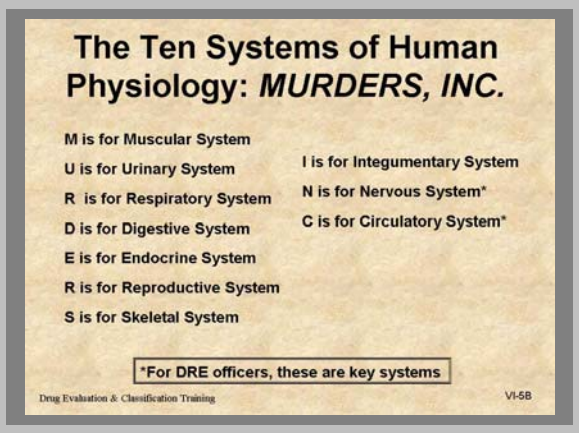


A convenient way of discussing human physiology is to list the ten major systems of the body.

- The phrase "MURDERS INC" helps us remember the names of the ten systems.

- Each letter stands for the name of one system.

Session 6-5B: The Ten Systems of Human Physiology



Muscular System

- M stands for the MUSCULAR SYSTEM
- Point out that we assess the muscular system in the drug influence evaluation when we test coordination and balance by administering divided attention tests, and when we check for muscle rigidity.

The body has three different kinds of muscles.

- The heart or cardiac muscle.
- Smooth muscles, which control the body's involuntary operations.
- Striated muscles, which carry out our voluntary movements.
    - Examples: Smooth muscles control breathing, the operation of the pyloric valve (a muscle located at the base of the stomach), dilation and constriction of pupils, and all other things that we do not consciously control.
- All three types of muscles are examined at various stages of the drug influence evaluation.

Urinary System

- U is for the URINARY SYSTEM.
- Point out that drugs can usually be detected in the urine, and that collection of a urine specimen or other suitable bodily substance is an important part of the drug influence evaluation.

- The system consists of two kidneys, the bladder, ureters connecting the kidneys to the bladder, and the urethra, which transports the urine out of the body.

- Kidneys filter waste or harmful products, such as drugs and their metabolites, from the blood, and dump these waste products into the bladder.

Respiratory System

- The first R in "MURDERS INC" stands for the RESPIRATORY SYSTEM.

- Point out that some drugs cause the user to breath slowly and shallowly, while others cause rapid breathing.

- The major parts of the Respiratory System are the lungs and the diaphragm.

- The diaphragm is a smooth muscle that draws the air into the lungs and forces it out.

- Lungs take in oxygen and transfer it to the blood, and remove carbon dioxide and some other waste products from the blood, and expel them into the outside air.

- Point out that important clues of drug use, i.e., odors of alcoholic beverages, marijuana, chemicals, etc. may be present on a suspect's breath.

Digestive System

- D stands for the DIGESTIVE SYSTEM.

- Major components of this system are the tongue, teeth, esophagus, stomach, intestines, liver, and pancreas.

- The Digestive System breaks down large particles of food, until they are of a size and chemical composition that can be absorbed in the blood.

- Remind students that, when drugs are taken orally, they might be retained in the stomach for a while, until any food that is there has been broken down sufficiently to allow passage into the small intestine.

Endocrine System

- E is for the ENDOCRINE SYSTEM.

- The Endocrine System is made up of a number of different glands that secrete hormones.

INSTRUCTOR, FOR YOUR INFORMATION: the glands that make up the Endocrine System include the Thyroid, Parathyroid, Pituitary and Adrenal glands, as well as portions of the pancreas, testes and ovaries.

- Hormones are complex chemicals that travel through the blood stream and that control or regulate certain body processes.

- Some drugs can mimic the effects of certain hormones, or can react with the hormones in ways that alter the hormones' effects.

Reproductive System

Print HORMONES on the dry erase board or flip-chart.

- The second R in "MURDERS INC" stands for the REPRODUCTIVE SYSTEM.

The functions of the reproductive system fall into two categories:

- self-producing (cytogenic), and

- hormone producing (endocrinic).

We are primarily concerned with hormone production since the hormones produced by the reproductive system aid the nervous system in its regulatory role.

- Point out that the Reproductive and Skeletal Systems are the only major components of physiology and that are not directly involved in the drug influence evaluation.

Skeletal System

- S is for the SKELETAL SYSTEM.

- Consists of bones, cartilage and ligaments.

- The Skeletal System provides support to the body, permits movement, and forms blood cells.

Integumentary System

- The I in "INC" stands for the INTEGUMENTARY SYSTEM.

- Consists of the skin, hair, fingernails and toe nails, and accessory structures.

- Point out that DREs examine the skin for hypodermic injection sites, and for sweating, clamminess, and temperature.

- The chief functions of the Integumentary System include protection of the body, control of the body temperature, excretion of wastes (i.e. through sweat) and sensory perception.

Nervous System

- N is for the NERVOUS SYSTEM.

- EMPHASIZE that the Nervous System is one of the most important components of physiology, as far as the drug influence evaluation is concerned.

- This system consists of the brain, the brain stem, the spinal cord and the nerves.

- Nerves keep the brain informed of changes in the body's external and internal environments.

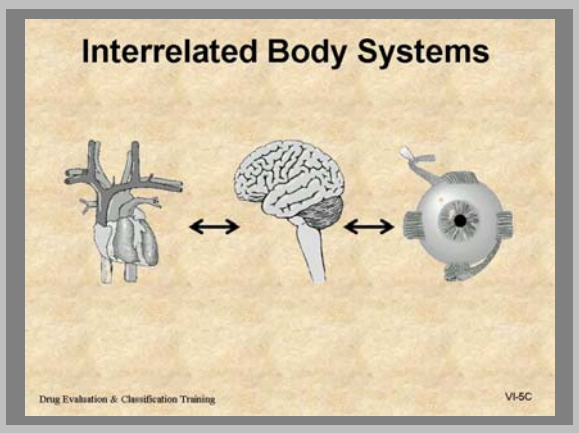
- CLARIFICATION: Nerves carry messages to the brain from the sense organs (eyes, ears, nose, etc, and also from pain sensors).

- Nerves also carry messages from the brain to the body's muscles, tissues and organs.

- CLARIFICATION: The brain uses nerves to send messages commanding the heart to beat, the fingers to move, the pupils to dilate, etc.

- The nervous system controls, coordinates and integrates all physiological processes, so that normal body functions can be maintained.

Session 6-5C: Interrelated Body Systems

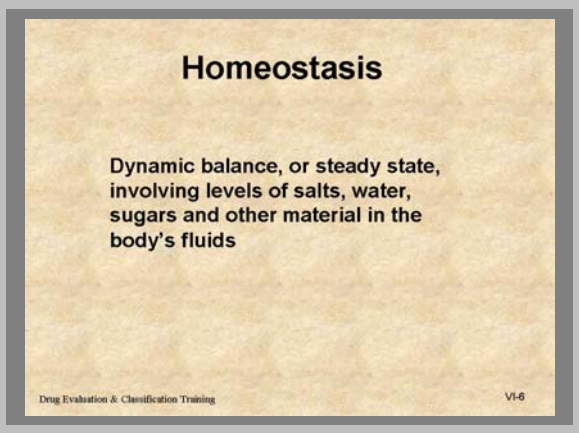


Circulatory System

- C is for the CIRCULATORY SYSTEM.
- Point out that this is another very important component of physiology, as far as the drug influence evaluation is concerned.
- For our purposes, the most important parts of the Circulatory System are the heart, the blood vessels (e.g., arteries, veins, capillaries, etc) and the blood.
- Blood is the body's primary transport mechanism: it carries food, water, oxygen, hormones, antibodies, etc. to the body's tissues and organs.
- Blood is also primarily responsible for carrying heat throughout the body.
- Blood is the main transport mechanism for bringing drugs to the brain.
- The heart, of course, pumps the blood and causes it to circulate throughout the body.

Solicit students' comments and questions about "MURDERS INC," the ten major systems of human physiology. Point out that much more will be said about the last two systems (Nervous and Circulatory) later in this session.

Session 6-6: Homeostasis



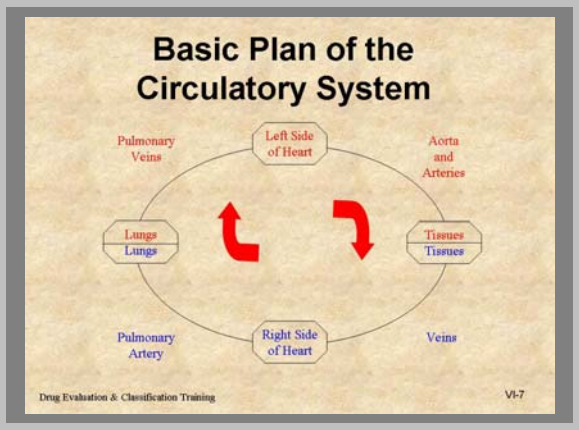
C. The Concept of Homeostasis

Homeostasis is the dynamic balance, or steady state, involving levels of salts, water, sugars and other materials in the body's fluids.

- Human body is exposed to a constantly changing external environment.
- Changes are neutralized by the internal environment – the blood.
- Oxygen, foods, water and other substances are constantly leaving bodily fluids to enter cells, while carbon dioxide and other wastes are leaving the cells to enter these fluids.
- Yet, the chemical composition of these fluids remains within very narrow limits.
- This phenomenon is called homeostasis.
- Point out that "homeo" means similar or the same elements and "stasis" means balance.
- Point out that the rhythm of the heart, breathing, constancy of body temperature, and the steady level of blood pressure under specific circumstances or conditions are all manifestations of homeostatic mechanisms at work within the body.
- Drugs interfere with the homeostatic mechanisms and produce signs and symptoms that can be recognized by a trained DRE.

D. A Simple View of the Heart and Circulatory System

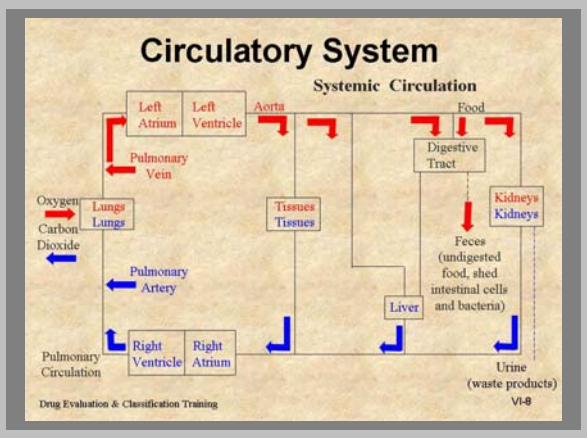
Session 6-7: Basic Plan of the Circulatory System



<u>*Heart and Circulatory System*</u>

- Circulation is a closed system, where blood is propelled by contractions of the heart.
- Blood is driven into arteries, arteries divide into smaller and smaller branches and finally into meshwork of fine capillaries which pervade body tissues.
- Point out that arteries constrict to aid distribution of blood.
- Meshwork joins up again to form small veins which become larger trunks as they travel centrally towards the heart.
- Point out that blood does not come into direct contact with the cells, but rather stays in the blood vessels.

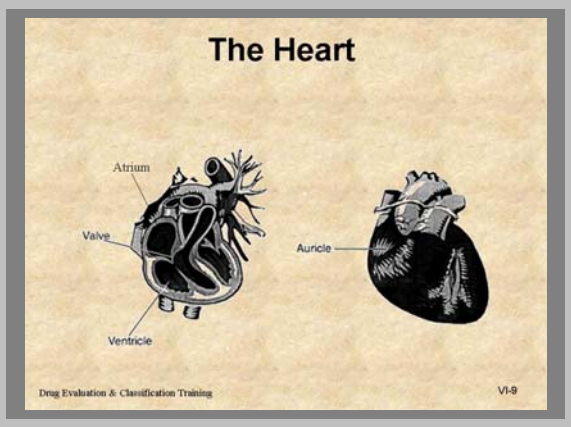
Session 6-8: Circulatory System



There are two separate circulation systems:

- Systemic system involves the whole body and is driven by the left side of the heart.
- Pulmonary system deals with the passage of blood through the lungs and is driven by the right side of the heart.

Session 6-9: The Heart



The heart is the pump and has two sides:

Consists of the left atrium and ventricle. The upper chamber (atrium) receives blood from the great veins, the lower chamber discharges blood into the great arteries.

- Left side pumps blood through the aorta and the arteries to the tissues.

- Blood, after passing through the tissues, returns via the veins to the right side.

- Right side pumps blood through the pulmonary artery to the lungs and returns it to the left side of the heart again via the four pulmonary veins.

Consists of the right atrium and ventricle.

- NOTE: The pulmonary artery is the only artery that carries de-oxygenated blood; all other arteries carry blood that has received fresh oxygen from the lungs. Likewise, the pulmonary vein is the only vein that carries blood rich in oxygen; all other veins carry blood depleted of oxygen back to the heart.

The normal heart continues to beat regularly and continuously, with a rest interval never longer than a fraction of a second.

- Heart rate is the number of beats per minute.

- Point out that heart rate is regulated by the autonomic nervous system: sympathetic nerve fibers insure that the heart beats fast enough to maintain circulation during any activity. Parasympathetic nerve fibers tend to slow the heart. This coordinated nerve supply assures that the heart does not beat too fast or too slowly.

- Pulse rate is the number of pulsations per minute.

- For the DEC program, the normal range is 60-90 pulsation beats per minute.

- Blood pressure (BP) is the force of the blood circulating in the arteries.

- Point out that some people may exhibit irregular (or arrhythmic) heart beats, i.e. where the interval between pulses varies.

- BP is categorized as systolic or diastolic BP.

Ask students to define “systolic” and “diastolic.”

- Systolic pressure is the maximum force that occurs during contraction.

- Diastolic pressure represents the minimum force that occurs when the heart relaxes.

- Point out that physical conditioning can also affect blood pressure and pulse rate.

- Point out that the normal range of BP varies widely based on a number of factors, including age. The normal range of systolic pressure is 120 to 140.

Both systolic and diastolic pressures are measured and recorded as follows:

<u>120</u> systolic
80 diastolic

The normal range of diastolic is 70 to 90.

Demonstrate proper method of recording on flip-chart or dry erase board.

<u>Control Systems</u>

The functions of the organs of the body are controlled in two ways:

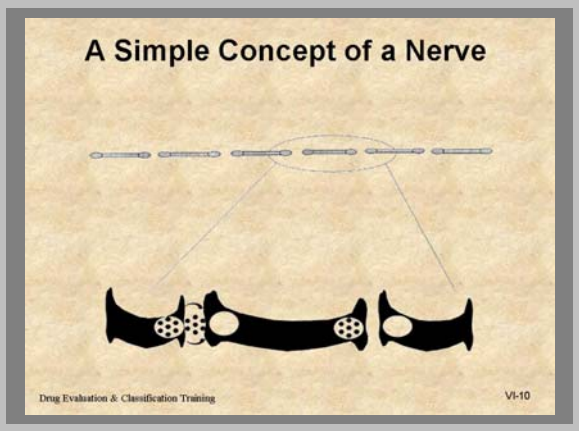
This is a function of the endocrine system.

Remind students that the hormones modify the activity of specific organs.

- One, by sending "chemical messengers" known as hormones via the blood stream from an endocrine gland where they are produced.

- Second, system of control is by means of the nervous system.

Session 6-10: A Simple Concept of a Nerve



E. Simplified Concept of the Nervous System

- Clarification: Nerves are often pictured as telephone or telegraph wires.

- The nerves that carry messages to and from the brain often are pictured as "wires" that carry electrical signals.

- A more accurate, but still simplified concept would envision a nerve as a series of broken wire segments, with the segments separated by short spaces, or gaps.

- We can imagine messages running along the "wire segments" in much the same manner that electrical impulses run along telephone wires.

- When the message reaches the end of the "wire segment," it triggers the release of chemicals that flow across the gap, and contact the next "wire segment."

Point to the close up of the gap.

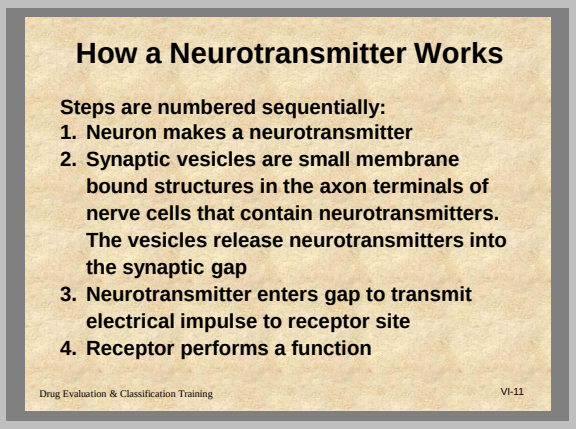
- When the chemical contacts the next wire segment, it generates an electrical impulse which runs along the wire until it reaches the next gap.

- At that gap, the message again triggers the release of chemicals that flow across to the next "wire segment," and the process continues.

- Point out that this concept of a nerve as a series of separated "wire segments" is not a true physical model. But it does accurately convey the basic idea of message transmission along nerves.

Solicit students' questions about this concept.

Session 6-11: How a Neurotransmitter Works

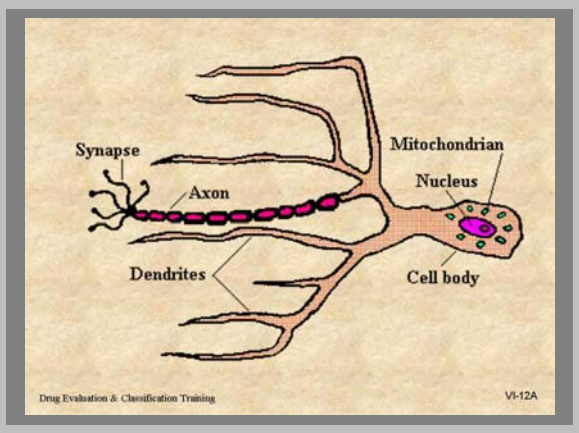


- In our simple model of nerves, each "wire segment" corresponds to a nerve cell, called a neuron.
- The chemical that flows across the gaps separating neurons is called a neurotransmitter.
  - Clarification: neurotransmitters are the body's chemical messengers.
- The body has a number of different neurotransmitters; each carries a different chemical message.

The sequence of how a neurotransmitter works:

- The neuron makes a neurotransmitter.
- Synaptic vesicles are small membrane bound structures in the axon terminals of nerve cells that contain neurotransmitters. These vesicles release neurotransmitters into the synaptic gap.
- The neurotransmitter enters the synaptic gap to transmit electrical impulse to the receptor site.
- The receptor performs a function

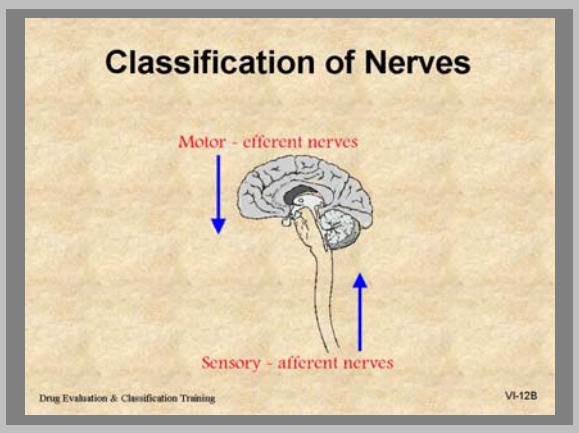
Session 6-12A: Nerve Diagram



- Each neuron, or "wire segment" has three main parts:
  - the cell body
  - the axon
  - the dendrite
- The axon is the part of the neuron that sends out the neurotransmitter, or chemical messenger.
- Point out that by using a baseball analogy, the Axon would be the "pitcher" of the neurotransmitter and the dendrite is the "catcher" of the neurotransmitter.
- The dendrite is the part that receives the neurotransmitter.
- The gap between two neurons is called a synapse, or synaptic gap.

Solicit students' questions about nerve cells (neurons).

Session 6-12B: Classification of Nerves



Classification of Nerves

Some nerves carry messages away from the brain, to the body's muscles and organs.

- These are called motor, or efferent nerves.
- The brain uses motor nerves to send commands to the heart to beat, the lungs to breathe, the muscles to contract or expand, and so forth.

Other nerves carry messages to the brain, i.e. from the eyes, ears and other senses, from the muscles, etc.

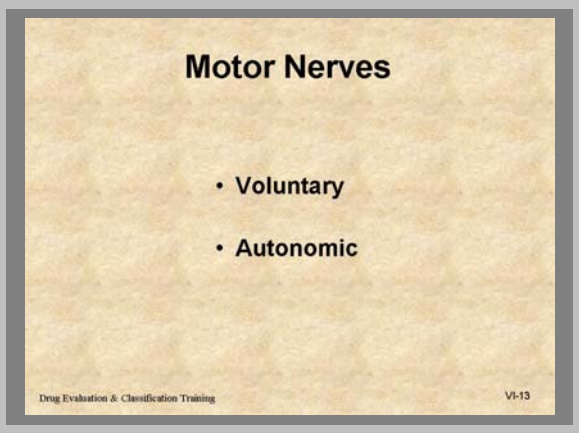
- These are called Sensory, or Afferent nerves.
- The brain decodes the messages that come along the sensory nerves to monitor the condition of the body and of the outside world.

A fundamental notion: if something interferes with the messages the brain sends along the motor nerves, the brain's control over the heart, the lungs, the muscles and other organs will be distorted.

Another fundamental notion: if something interferes with the messages the brain receives from the sensory nerves, the brain's perception of the outside world and of the body's status will be distorted.

- Point out that, basically, this is how drugs work: they interfere with transmission or reception of the messages that travel along nerves.

Session 6-13: Motor Nerves



There are two sub-systems of motor nerves.

- The voluntary nerves send messages to the striated muscles that we consciously control.
- The autonomic nerves send messages to the muscles and organs that we do not consciously control, i.e. smooth muscle and cardiac muscle.

On the dry erase board or flip-chart print the word "autonomic," and draw two lines from the word one line angling down toward the left, the other angling down toward the right.

The Autonomic sub-system is divided into two groups.

Write "Sympathetic" at the end of one line, "Parasympathetic" at the end of the other.

- The Sympathetic nerves command the body to react in response to fear, stress, excitement, etc.
- CLARIFICATION: Sympathetic nerves control the body's "fight or flight" responses.
- EXAMPLES: Sympathetic nerves carry the messages that cause: blood pressure to elevate, pupils to dilate, sweat glands to activate, hair to stand on end, heartbeat to increase and strengthen, blood vessels of the skin to constrict, the walls of the hollow viscera to relax (inhibiting digestion).
- Parasympathetic nerves carry messages that produce relaxed and tranquil activities.

- EXAMPLES: Parasympathetic nerves carry messages that cause: pupils to constrict, heartbeat to slow, peripheral blood vessels to dilate, blood pressure to decrease.

- Certain neurotransmitters (i.e. chemical messengers) aid in the transmission of messages along sympathetic and parasympathetic nerves.

- Some drugs mimic the action of these neurotransmitters: when taken into the body, these drugs artificially cause the transmission of messages along sympathetic or parasympathetic nerves.

- Drugs that mimic the neurotransmitter associated with sympathetic nerves are called sympathomimetic drugs.

- Sympathomimetic drugs artificially cause the transmission of messages that produce elevated blood pressure, dilated pupils, etc.

Write "Sympathomimetic" on the dry erase board or flip-chart.

Ask students to name a category of drugs that would be considered sympathomimetic.

- Examples: CNS Stimulants, Hallucinogens, and to some extent Dissociative Anesthetics and Cannabis.

- Drugs that mimic neurotransmitters associated with parasympathetic nerves are called parasympathomimetic drugs.

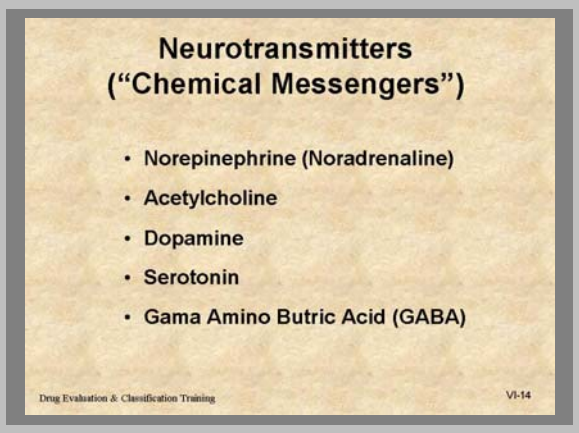
- Parasympathomimetic drugs artificially cause the transmission of messages that produce lowered blood pressure, drowsiness, etc.

Write "Parasympathomimetic" on the dry erase board or flip-chart.

Ask students to name a drug category that would be considered parasympathomimetic.

- Examples: Narcotic Analgesics and CNS Depressants.

Session 6-14: Neurotransmitters



Neurotransmitters

Although there are more than 100 chemicals in the brain, only about two dozen probably are true neurotransmitters.

Among the primary neurotransmitters that have been identified are:

Write these neurotransmitters on the dry erase board or flip-chart.

- Norepinephrine (also called Noradrenaline)
  - Point out that Norepinephrine is a neurotransmitter that produces effects on the body that are similar to the effects produced by Adrenaline (a hormone). Many neurotransmitters correspond to hormones that produce similar effects.
- Acetylcholine
  - Acetylcholine plays a role in muscle control, and affects neuromuscular or myoneural junctions.
- Dopamine
  - Dopamine plays a role in mood control and is used in treating Parkinson's Disease.
- Serotonin

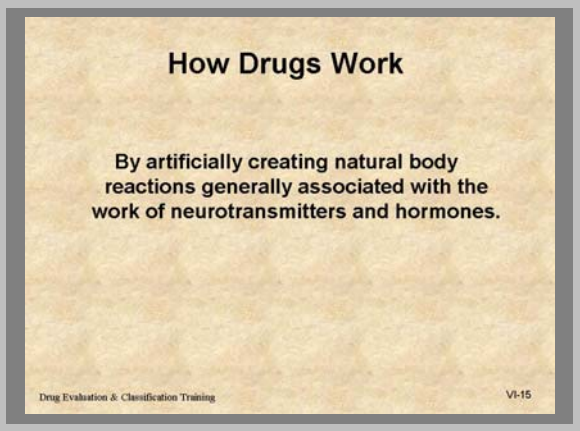
- Serotonin is a vasoconstrictor, thought to be involved in sleep, wakefulness, and sensory perception. Tryptophan is a precursor to serotonin, and has been used to treat insomnia.

- Gama Amino Butric Acid (Abbreviated GABA)
  - GABA inhibits various neurotransmitters and also causes a release of growth hormones.
- Endorphins and Enkephalins
  - These are the body's natural pain relievers.
- There are many drugs that artificially induce the effects of neurotransmitter and hormones.

Solicit students' questions and comments about nerves and neurotransmitter.

F. How Drugs Work

Session 6-15: How Drugs Work



In very simple terms, drugs work by artificially creating natural body reactions generally associated with the work of neurotransmitters and hormones.

Therapeutic doses of legitimate prescription and over the counter drugs are designed to produce mild and carefully controlled simulations of the natural action of neurotransmitters and hormones.

Ask students: What drug do many people take to overcome artificially the drowsiness they feel in the morning?

- Large, abusive doses of drugs may produce greatly exaggerated simulations of the natural action of hormones and neurotransmitters, sometimes with disastrous results.

- Example: Cocaine (a sympathomimetic drug) may artificially create a message commanding the heart to beat so rapidly that cardiac arrest results.

When a person ingests a drug and artificially simulates the natural action of hormones and neurotransmitters, the body's dynamic balance is disrupted.

- Remind students that the body struggles to maintain homeostasis, the dynamic balance of salts, sugars, and other substances.

- The body automatically responds to the presence of the drug by producing other hormones and chemicals that can oppose the drug's effects, and bring the body back into balance.

Example Number One

If a person ingests a stimulant drug that mimics neurotransmitters associated with the sympathetic nerves, the body may react by excreting hormones that depress the bodily functions that the drug is exciting.

- If a person ingested Cocaine, for example, the Cocaine would artificially stimulate the body functions. The body would then produce hormones and neurotransmitters to slow down the body functions to try to maintain homeostasis.

Example Number Two

If a person ingests a drug that depresses some bodily function, the body may pour out one of its natural chemicals that stimulate that same function.

- An interesting situation can occur when the drug is no longer psychoactive.

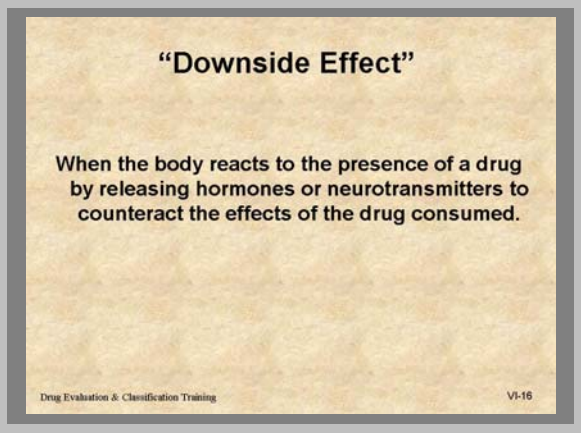
- The chemicals produced by the body in an effort to counteract the drug may still be active.

- These natural chemicals have exactly the opposite effect on the body that the drug had: after all, that is precisely why the body produced those chemicals.

- As a result, the person may feel, appear and act in a manner exactly opposite to the way he or she would feel, appear and act when under the influence of the drug.

Downside

Session 6-16: "Downside Effect"



- It is not uncommon for a DRE to encounter someone on the "downside."
- Example: Ask students if they have ever experienced this situation…After drinking several drinks, they become drowsy, go to bed and fall asleep quickly. But, after a few hours, when it is still the middle of the night, they suddenly awaken and are wide awake, unable to fall asleep again. What has happened is that the alcohol has worn off, but the natural CNS Stimulants the body produced to counteract the alcohol are still around.
- We call this situation being on the "downside" of the drug.

Write "Downside" on the dry erase board or flip-chart.

- Example: with cocaine (a drug that is metabolized, or broken down by the body fairly quickly) the user may be exhibiting drowsiness and general depression by the time the DRE is called to the scene.

The concept of "downside" will be especially important to us when we discuss the effects of CNS Stimulants and drug combinations.

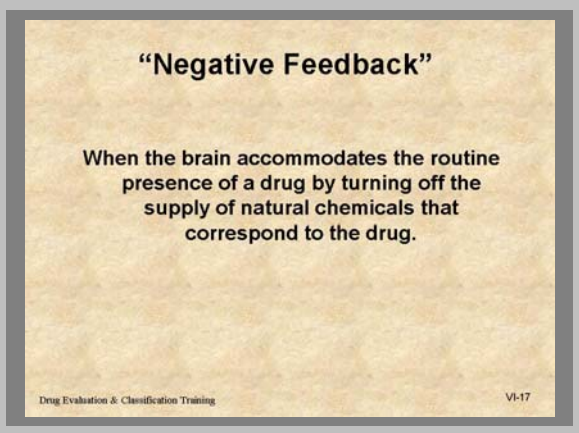
- Point out that persons on the "downside" can be dangerous when trying to operate a motor vehicle.
- Point out that two common examples of "downside" occur with Cocaine and Methamphetamine. Both drugs stimulate the body.

- Then the body attempts to "counteract" the stimulant effects. When the effects of the drug diminish, the results may mimic a CNS Depressant or a Narcotic Analgesic.

Solicit students' questions about Downside.

Negative Feedback

Session 6-17: "Negative Feedback"



Write "Negative Feedback" on the dry erase board or flip-chart.

Another interesting effect that drugs can produce is called Negative Feedback.

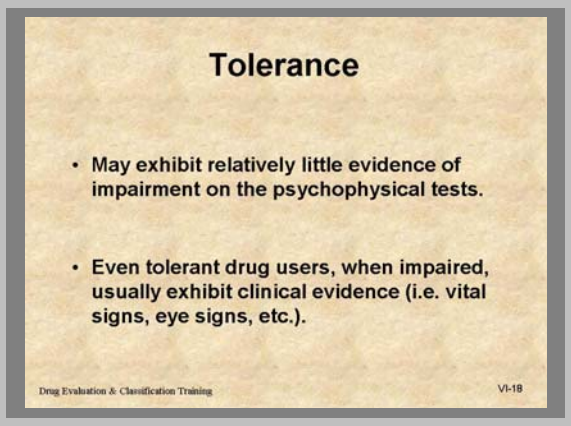
Write "The Body Quits Producing the Natural Chemicals" on the dry erase board or flip-chart.

- By taking the drug, the person artificially simulates the action of certain hormones and / or neurotransmitters.
- If the person continues to take the drug, the body may simply cease producing the natural chemicals that the drug simulates.
- In effect, the body comes to rely on the drug to supply itself with those chemicals.
- Example of Negative Feedback: when people regularly use heroin, cocaine, or marijuana, their bodies may cease producing the neurotransmitters and hormones known to be crucial for proper pain relief, stress reduction, mental stability and motivation.

- Point out that because of this Negative Feedback, the user becomes dependent on the drug to cope with the stresses and strains of daily life.

- One result of this may be increased tolerance to the drug: since the body isn't producing its own natural chemicals, it can more easily stand the drug.

Session 6-18: Tolerance



Write "Increased Tolerance" on the dry erase board or flip-chart.

- Emphasize: Habitual users of drugs may develop tolerance to the drug. As a result, they may exhibit relatively little evidence of impairment on the psychophysical tests.

- Even tolerant drug users, when impaired, usually exhibit clinical evidence (i.e., in the vital signs and eye signs – such as HGN).

Physical Dependence

Write "Physical Dependence" on the dry erase board or flip-chart.

Another result may be physical dependence, or addiction.

Pose this question to the class: Why do people take drugs? Solicit responses.

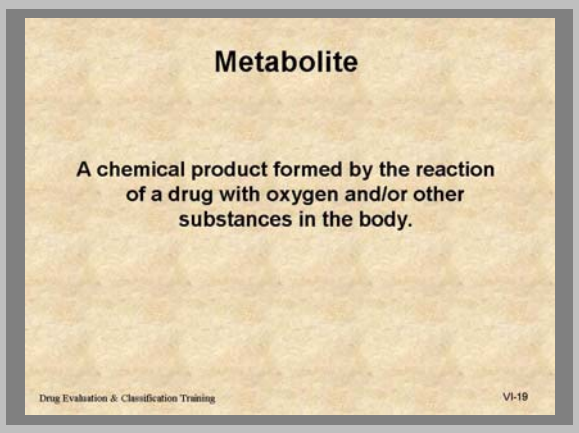
- In simplest terms, people take drugs because they like the feelings the drugs produce.
- The artificial simulation of the natural action of hormones and neurotransmitters appears to permit the user to create any feeling or mood he or she desires.

- As time goes on, and negative feedback develops, the user find that he or she can only achieve those feelings and moods if the drug is taken.

Instructor information: Metabolism is defined as the combined chemical and physical processes that take place in the body involving the distribution of nutrients and resulting in growth, energy production, the elimination of wastes, and other body functions. There are two basic phases of metabolism: anabolism, the constructive phase during which molecules resulting from the digestive process are built up into complex compounds that form the tissues and organs of the body; and catabolism, the destructive phase during which larger molecules are broken down into simpler substances with the release of energy.

Metabolite

Session 6-19: Metabolite



One final concept is important for an understanding of how drugs work.

- A Metabolite is a product of metabolism which is the chemical changes that take place when the drug reacts with enzymes and other substances in the body.

Write "Metabolite" on the dry erase board or flip-chart.

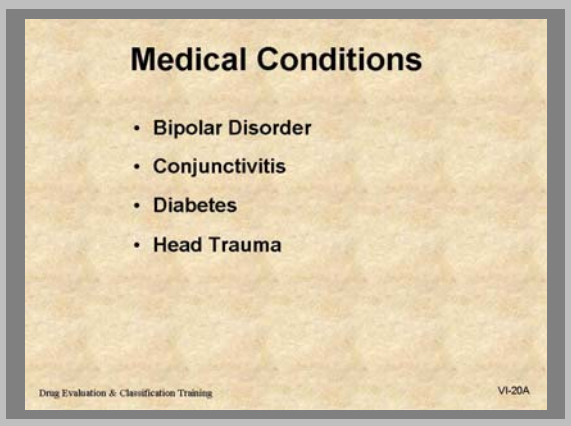
Instructor information: Metabolism is defined as the combined chemical and physical processes that take place in the body involving the distribution of nutrients and resulting in growth, energy production, the elimination of wastes, and other body functions. There are two basic phases of metabolism: anabolism, the constructive phase during which molecules resulting from the digestive process are built up into complex compounds that form the tissues and organs of the body; and catabolism, the destructive phase during which larger molecules are broken down into simpler substances with the release of energy.

- The body uses chemical reactions to beak down the drug, and ultimately to eliminate it.
- Example: when we drink alcohol, we initiate a series of chemical reactions that ultimately transform the alcohol into harmless carbon dioxide and water.
- Sometimes, metabolites of the original drug are themselves drugs, and cause impairment.
- For example, the body quickly metabolizes heroin into morphine, and it is the morphine that actually produces the effects the heroin user experiences.

Solicit students' questions and comments about how drugs work.

G. Medical Conditions Which Sometimes Mimic Drug Impairment

Session 6-20A: Medical Conditions



Certain medical conditions or injuries may cause signs and symptoms similar to those of drug impairment.
Refer students to the list contained in their manuals.

Point out that many of the conditions listed are serious enough to prevent driving:

- Bipolar Disorder (Manic Depression) – a condition characterized by the alteration of manic and depressive states.

- Conjunctivitis – inflammation of the conjunctiva.

  - Conjunctivitis is a condition caused by infection, allergy, or irritation of the mucous membrane lining of the eyes, resulting in a "pink eye" appearance. A casual observer might mistake this for the bloodshot conditions associated with Cannabis or alcohol.

- Diabetes – a condition that can result in insulin shock (taking too much insulin) which may produce tremors, increased blood pressure, rapid respiration, lack of coordination, headache, confusion, and seizures.

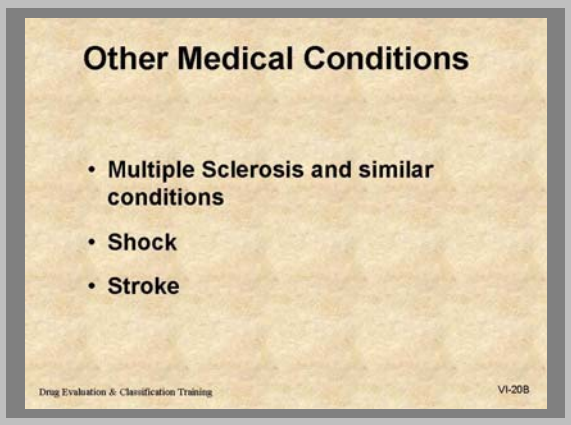
  - The most common problem with diabetics arises when they take too much insulin, so that their blood sugar levels become extremely low. They may be very confused, sweat profusely, and exhibit increased pulse rate and increased blood pressure.

- Head Trauma – normally due to a severe blow or bump to the head.

  - Head trauma may injure the brain and create disorientation, confusion, lack of coordination, slowed responses and speech impairment.

  - Point out that head trauma may produce disorientation, confusion, unequal pupil size, unequal tracking ability of the eyes, or the drooping of one eyelid while the other remains normal.

Session 6-20B: Other Medical Conditions



- Multiple Sclerosis (MS) – a degenerative muscular disorder.

- MS is a progressive disease in which the nerve fibers of the brain and spinal cord lose their myelin cover. Some signs and symptoms are abnormal sensations in the face or extremities, weakness, double vision, etc.

- Shock – a sudden or violent disturbance in the mental or emotional faculties.
  - A shock victim may be dazed, uncoordinated, non-responsive.
  - Other indicators include: extremely low blood pressure, fast but weak pulse, dizziness, moist clammy skin, profuse sweating, rapid shallow breathing, blue lips and fingernails.

- Stroke – a medical condition caused by a rupture or obstruction (as if by clot) of an artery of the brain.
  - Point out that stroke may produce many of the same indicators as will head trauma. In addition, stroke victims may have pupils that are markedly different in size, and one pupil may exhibit no visible reaction to light while the other reacts normally.
  - Point out that there will be noticeably a difference in their physical appearance and actions such as drooling and slurred speech.

- Others – Carbon Monoxide poisoning, Seizures, Endocrine disorders, Neurological conditions, Psychiatric conditions and infections.

Review physiologic changes that may be mistaken for drug induced symptoms. For example, strenuous exercise increases heart rate and rate of respiration; surprise, fear and pain dilate the pupils markedly.

Normal conditions can affect vital signs:

- Exercise
- Excitement
- Fear
- Anxiety
- Depression
- Other

F. Summary

Briefly review main points of the lesson.

Basic understanding of how the body works is necessary to:

- Understand why the drug evaluation is conducted in a systematic manner.

- Understand why the results, when viewed in their totality, provide reliable indicators of impairment within broad categories of drugs.

- Emphasize that research in drug intoxication and the interaction with neurotransmitters is in its infancy.

- This limited overview will not qualify students as medical specialists.

- The knowledge gained during this session must be supplemented by additional reading and/or instruction.

- The body of knowledge in this area is being constantly expanded.

- Point out that the best response to questions regarding bodily functions and or specific drug interactions is "I don't know. I conducted a series of evaluations and documented my observations. Based on my training and experience the results of my observations are consistent with those produced by persons impaired by _____."

- The body maintains homeostasis (equilibrium) by constantly adjusting to changes in the external and internal environment:

- Point out that the body functions as a total unit in an integrated and coordinated manner.

- When drugs are introduced into the body this process comes into play.

When drugs interact in the body they tend to:

- speed things up, or
- slow things down, or
- confuse signals, or
- block signals, or
- some combination of the above.

Point out that this is a very simplistic overview of how drugs work.

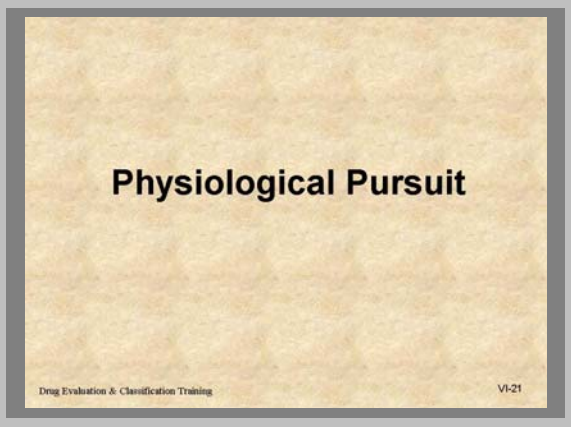
The effects of drugs can be detected and / or observed in the drug evaluation.

Drug Evaluations

Detailed instructions on procedures and expected results will be covered in following sessions.

Solicit and answer students' questions.

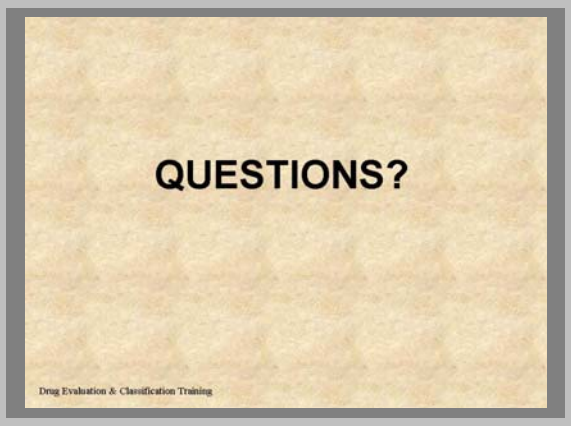
Session 6-21: Physiological Pursuit



Physiological Pursuit

- For review of the Physiology and Drugs session, questions can be asked of the students as if it were a game of Trivial Pursuit. See attachment.

Session 6-22: Questions



INSTRUCTIONS FOR PHYSIOLOGICAL PURSUIT

1. Preparation and Rules of the Game

   a. Ahead of time, secure five like items as prizes (such as lottery scratch off tickets).

   b. Select two teams of five students each. Appoint a captain for each team. (Usually home team and visitors team. Attempt to balance teams and avoid "sharks".)

   c. Appoint a time keeper.

   d. Appoint a score keeper.

   e. Select a panel of instructor judges.

   f. On a flip-chart or dry erase board, mark as follows:

Questions	Score	
	Home	Visitor
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

   g. Place the teams on opposite sides of the room in view of the screen.

   h. Selectively reveal the questions.

   i. Cover all the questions with two pieces of paper. When a question is selected, reveal the question using the two papers to cover all others and turn the projector on long enough to read the question and repeat it. Then turn the projector off. The team getting the question has 20 seconds to discuss and come up with the "correct" answer. The captain can answer the question or designate a team member to do so.

j. The judges decide if the answer is correct. If not, the other team may answer. If neither team gets the answer, no points are scored and the game goes on to the next question.

2. Playing the Game

a. To start the game, flip a coin and have the team captains call the result while the coin is in the air. The winning team captain can elect to receive or pass the first question selection to the opposing team.

b. The selected team stars with the question selection and the selection alternates until the game ends.

c. As the questions are selected, the score keeper crosses out those selected. He also awards one point to the team answering the question correctly.

d. "No coaching from the audience."

e. The team with the most points after 14 questions wins. If the score is tied, use the last question to the break tie.

QUESTIONS FOR PHYSIOLOGICAL PURSUIT

1. Name the major body systems.

   Muscular, Urinary, Respiratory, Digestive, Endocrine, Reproductive, Skeletal, Integumentary, Nervous, and Circulatory.

2. What vein carries oxygenated blood?

   Pulmonary vein. The pulmonary vein returns oxygenated blood from the lungs to the left side of the heart. The left side of the heart then pumps the oxygenated blood via arteries throughout the body. The pulmonary artery carries de-oxygenated blood from the right side of the heart to the lungs.

3. What is the function of the endocrine system?

   The endocrine system is composed of ductless glands that release chemical messengers, called hormones, into the bloodstream. The function is the regulation of various bodily processes by the production and release of hormones.

4. Explain the "downside" effect of a drug.

   The "downside" effect of a drug refers to the post euphoric stage of a drug's effects. As the effects of a drug wear off, the individual may display effects that are essentially the opposite of the "high" state that was brought about by the drug. This effect is in part due to the body's attempt to counteract the effects of a drug.

5. Define homeostasis.

   Homeostasis is basically a physiological equilibrium or dynamic balance. Homeostasis refers to the body's mechanisms that keep the levels of fluids, salts, chemicals and other internal substances in a safe balance. The regulation of temperature is an example of homeostasis at work.

6. Hair and nails are part of what system?

   The Integumentary system. This system also includes the skin.

7. Name the two circulatory systems.

   The systemic circulatory system, which is driven by the left side of the heart, and pulmonary circulatory system, driven by the heart's right side.

8. The functions of the organs of the body are controlled by what two systems?

   The endocrine and nervous system.

9. Define synapse, axon, and dendrite.

   These structures are all part of the nerve cell, or neuron. The axon is the part of the neuron that releases neurotransmitter from a terminal into the synapse. An electrical impulse causes the axon to release the neurotransmitter. The synapse is the gap between nerve cells and is also called the synaptic gap. The dendrite refers to a structure that receives the chemical message from the neurotransmitter. There are often many dendrites on each neuron. The neurotransmitter fits into receptor sites on the dendrite and causes an electrical message to be sent to the neuron's body.

10. Define neurotransmitter and hormone.

    Both are chemical messengers. Neurotransmitters are chemicals that send messages within the nervous system. Hormones are released by glands in the endocrine system into the bloodstream.

11. _____ nerves carry messages AWAY from the brain to the body's muscles and organs.

    Efferent, or Motor nerves. These nerves cause a motor response. Afferent nerves send sensory messages to the brain. The central nervous system interprets these messages and if appropriate, calls for a response through the efferent nerves.

12. The _____ nervous system commands the body to react to stress, fear, and excitement.

    The Sympathetic nervous system, a division of the Autonomic Nervous System, produces the body's "fight or flight" response to real or perceived danger. Drugs that mimic the activation of the sympathetic nervous system are "sympathomimetics". CNS Stimulants have effects closest to the effects of sympathetic nervous system activation.

13. Explain "negative feedback."

    Refers to the body's response to taking a drug that has effects similar to natural internal chemicals. After repeated exposure to the drug, the body responds by slowing, or even stopping the production of the internal chemical. In time, the body begins to rely on the drug. An example of negative feedback involving legitimate substances is insulin dependant diabetics. Once an individual begins to take insulin, the person's body will eventually stop making its own insulin. The person must obtain insulin by administering it.

14. What two types of nerves make up the autonomic nervous subsystem?

The Sympathetic and Parasympathetic nerves. The sympathetic nervous system initiates the body's "fight or flight" response to real or perceived danger. The parasympathetic nervous system parallels or balances the sympathetic nervous system. This system initiates calming and digestive processes.

15. Define metabolite.

A metabolite is the by-product of the body's chemical breakdown of various substances for elimination. Metabolites may or may not be psychoactive by themselves. Often times a toxicological analysis will disclose various metabolites of a drug, rather than the parent drug.

TOPICS FOR STUDY

1. What is a neurotransmitter? What is a hormone?

   A neurotransmitter is a chemical that passes from the axon of one nerve cell to the dendrite of the next cell, and that carry messages across the gap between the two nerve cells.

   Hormones are chemicals produced by the body's endocrine system that are carried through the blood stream to the target organ. They exert great influence on the growth and development of the individual, and they aid in the regulation of numerous body processes.

2. What is a dendrite? What is an axon? What is a synapse?

   The dendrite is the part of a neuron (nerve cell) that receives a neurotransmitter.

   The axon is the part of a neuron (nerve cell) that sends out a neurotransmitter.

   The synapse is the gap or space between two neurons (nerve cell).

3. Do arteries carry blood toward the heart or away from the heart?

   Arteries carry blood away from the heart.

4. What is unique about the Pulmonary Artery?

   The pulmonary artery is the only artery that carries blood depleted of oxygen.

5. What are the two types of nerves that make up the Autonomic Nervous Sub-System?

   Sympathetic Nerves and Parasympathetic Nerves

6. Is Cocaine sympathomimetic or parasympathomimetic? What about Heroin?

   Cocaine is a sympathomimetic drug. Heroin is a parasympathomimetic drug.

7. Explain the concept of the "downside effect." Explain the concept of "Negative Feedback."

   Downside effect occurs when the body reacts to the presence of a drug by producing hormones or neurotransmitters to counteract the effects of the drug consumed.

Negative Feedback occurs when the brain becomes accustomed to the presence of drugs and stops producing the natural chemicals that correspond to the drug.

8. What do we call the nerves that carry messages away from the brain? What do we call the nerves that carry messages toward the brain?

   The nerves that carry messages away from the brain are called the Motor Nerves, or the Efferent Nerves.

The nerves that carry messages toward the brain are called the Sensory Nerves, or the Afferent Nerves.