**How drugs get to the brain**

3 things seem to matter

- __________ the drug gets there
- How __________ the drug gets there
- What they do __________ __________ get there

**Strength depends on administration technique**

Five main ways to administer drugs

- __________
  - Injecting
  - __________ membrane __________
  - Oral ingestion
  - __________ absorption

**Inhaling**

Absorbed into blood vessels through the __________

- Moves to the heart
- Pumped to the rest of the body including the brain
- __________ seconds to get to the brain
- __________ technique
  - Most control during the technique (inhaling deeper or not)

**Injecting**

3 methods

- __________
  - Directly into the bloodstream (vein)
- __________
  - Into muscle mass
- __________
  - Under the skin

**Injection: continued**

- __________ is fastest
  - 15-30 seconds to get to the brain
  - 3-5 minutes for intramuscular and subcutaneous

Largest “rush”

- Gets __________ amount of the drug into the system fast

Most dangerous method

- Bypasses all of the body’s natural mechanisms of __________
  - Higher chance of overdose

**Mucous membrane absorption**

- __________ in the nose
Under the _______________
Suppositories and _______________ absorption
  Through the nose is fastest technique (30-45 seconds)
  Suppositories is the slowest (10-15 min)

Oral Ingestion
Into the ______________________________
  Absorbed through the intestine walls and into blood vessels
  Goes to the _______________ first, then the heart, then the body
  Lose some of the active ingredients in the liver
  20-30 minutes for effects to occur

Contact Absorption
Patches on _______________
Usually very slow (days)
Usually to help _______________
  Some addicts chew the patches to get the drugs faster and further abuse

Once the drug is in the body…

______________
  The amount of drug that becomes available to the body after administration
    Injecting _______________: very high bioavailability
    Ingesting _______________: lose 10-20% of the active substances when
      the liver metabolizes the beverage

How much blood the user has matters
  More _______________: less effects
  Less blood: _______________ effects

Where there is blood there are effects
  Little blood in the bones; no real effects there

Blood-brain barrier
Cells surround the _______________ _______________ and form a close linked
arrangement to stop substances from crossing into the brain
  _______________ frequently are stopped
  Unfortunately, antibodies are stopped too
Psychoactive drugs can cross the barrier

The brain
The brain is predominantly _______________ tissue
  Fat soluble substances easily enter the brain
    Heroin: _______________ _______________ soluble
    Morphine: _______________ _______________ soluble
  Passive transport
    Goes from where there is a lot of the drug to where there isn’t much
    _______________ soluble substances don’t enter quite as easily
      Attach to proteins to get into the brain: Active transport
Getting rid of the drug

The way the body processes, uses and inactivates substances in the body
Liver is the key organ

Process of eliminating the substance from the body
Kidneys are the key organs

How does excretion and metabolism play a role in the effect of the drug?

Inactive substances until the body metabolizes them into an active substance
(Valium is a prodrug)
If it is eliminated quickly, effects are felt for a _______________ time
If it is eliminated slowly, effects may be felt for a while
Many factors affect how quickly a drug is metabolized
__________________ (after 30, liver doesn’t work as fast)
Race (different ethnicities break down drugs at different rates)
Heredity (genes affect everything)
__________________ (usually larger effects on women than men
Health, Emotional State, Presence of other drugs, allergies

The nervous system

Central Nervous System
and Spinal Cord
Peripheral Nervous System
2 parts
__________________ Nervous System
Controls involuntary responses
Sympathetic (arouses) and Parasympathetic (calms) branches
__________________ Nervous System
Deals with information coming from the skin, muscles and joints

The brain

Divided in two main portions
“_______________ brain”
Brain stem
__________________
Midbrain
Contains the ______________ system
Does basic physiological functions
Basic emotions and cravings
Survival memories
“_______________ brain”
Responsible form speech, reasoning, creating and remembering
_______________ brain
The reward centers
Mesolimbic dopaminergic reward pathway
  Mesolimbic = _______________
  Dopaminergic = uses _______________
  Divided into 2 parts
    “More”
      Nucleus accumbens, ventral tegmental area, lateral hypothalamus, amygdala
    “_____________”
      Orbitofrontal cortex

Relating to drug abuse
Abusers may have an overactive “more” system and the “stop” system cannot shut off the _______________

Three phases:
  Craving and initial use
  Activation of pleasure and a desire to repeat use
  Reinforcement _______________ from the “more” to the “stop” system get stuck in “more” mode

The Nucleus Accumbens: the most important piece to the reward circuit
Olds (1956)
  _______________ were placed in the rat’s nucleus accumbens / hypothalamus
Rats were taught to press a bar to turn on the electrode and stimulate their brains
In experiments, rats would do nothing but push the bar
Up to _______________ times
Only stopped when they dropped from exhaustion
Food deprived rats given the choice of food or stimulation: chose stimulation

Main points about the Nucleus Accumbens studies
The longer the use, the stronger the “do-it-again” message becomes
Most psychoactive drugs stimulate this area
  Those that don’t may not be _______________
Rats and humans seem to respond the same to drugs
  Same order of _______________ to the drugs as well

The “stop” system
The “_____________” system (orbitofrontal cortex) changes as addiction develops
  Messes with memories of ____________________________ events
  Drugs seem more pleasurable than all life events
    Normal activities are less pleasurable

Why doesn’t the “stop” system work?
3 theories
point to a substance that was never essential to the body
On/off switch becomes _______________
On/off switches are _______________ by a desire to continue the euphoria
Drugs disrupt connections between the new and old brains

The new brain cannot think well and process things enough to know to stop using

The Neuron
3 main parts

Receive information from other neurons
Soma (cell body)
Cellular maintenance

Transmits information to other neurons

The Action Potential
The signal inside a _______________
Uses Sodium and Potassium

The Action potential
The signal moves down the _______________ until it reaches the end

The synapse
At the end of one axon is the _______________ of a different neuron
A small gap exists between the two neurons called the _______________

At the synapse
The Action Potential causes the neurotransmitters to leave the current neuron and _______________ the signal to the next neuron

Neurotransmitters and receptors
Many different kinds
Some _______________ (start a new signal), others _______________ (stop a signal from happening) the receiving neuron
The effects of a drug primarily are due to which neurotransmitter is affected

Down regulation and up regulation
______________ regulation: If there are too many neurotransmitters, the receiving neuron will get rid of some of the receptors
Causes an increase in the amount of drug taken to try and achieve a “high”
______________ regulation: If there are not enough neurotransmitters available, the receiving neuron will increase the number of receptors
Both of these deal with tolerance and dependence: dealt with later
Agonists and Antagonists
Without neurotransmitters and neurotransmitter receptors, drugs would do ________________________________

Drugs either enhance the effects of a neurotransmitter or they reduce the effect of a neurotransmitter
Agonists: ________________
Antagonists: ________________