Teaching Materials

Nothing to Rave About:

Episode Three

The Reconstructors® is a product of the Center for Technology in Teaching and Learning, Rice University and is funded by the Science Education Drug Abuse Partnership Award, R25DA11785, from the National Institute on Drug Abuse, National Institutes of Health.

Episode Three Briefing: Synopsis

OVERVIEW

We hope that you and your students extend **The Reconstructors™** adventures with additional activities designed to cover related learning objectives. The activities described in the teaching package are intended for use both **before** and **after** students have "played" **Nothing to Rave About: Episode 3** of **The Reconstructors™**. The files may be printed for classroom use ONLY.

Feel free to adapt these activities to your own classroom needs. Another resource that we suggest is the National Institutes of Health (NIH) website at http://www.nih.gov. For specific information on drugs, go to the National Institute on Drug Abuse at http://www.nida.nih.gov. The site contains some excellent resources and teaching materials.

If you have specific questions, please contact us.

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EPISODE BRIEFING

EPISODE DEBRIEFING

Episode Three Briefing: Synopsis

This synopsis is provided as an overview for TEACHERS. We advise teachers NOT to hand this out to the students prior to playing the adventure since much of the suspense will be eliminated.

Beta, Delta, and Eureka are watching a TV news report on the closing of Club Buzzko. Alpha enters and asks the trio to turn to Channel 55. They see Vera, the host of the music talk show *Cool Vibes,* who is making a plea for The Reconstructors to help her answer her viewers' questions about Ecstasy. The show ends.

The Reconstructors assess what they know about the drug by having the student match items from Episode Two to their descriptions. They are missing the information needed to answer the viewers' questions, so they search their Digital Warehousing Database for it. Two files are found: Synaptic Salvo and People Problems.

In Synaptic Salvo, the student plays a game in which one object throws yellow balls at a second object. The student must return the balls to the "pumps" or transporters of the object that released them. The game is disrupted when purple balls appear and block two of the three transporters, making it harder for the student to return all of the balls in the time allotted. As a result, balls accumulate in the gap that separates the two objects.

The database informs The Reconstructors that the game is similar to a real process in the brain. Nerve cells called neurons release chemicals known as neurotransmitters which allow neurons to communicate with each other. Ecstasy can block the transporters on neurons that release the neurotransmitter serotonin; this interferes with the return (re-uptake) of the neurotransmitter and makes it accumulate in the gap (synapse) that separates neurons.

Serotonin helps regulate mood, memory, pain, sleep, perception, appetite, thirst, body temperature, and aggression. Some of the short-term effects from increased serotonin in the brain are listed in the table below:

Brain Area	Short-term Effect
Amygdala	Elevated mood
Cerebral cortex	Altered perceptions
Hypothalamus	Increased body temperature and thirst Decreased appetite

Numerous experiments with animals have provided evidence of long-term effects of Ecstasy use. The data suggest that regular Ecstasy use decreases brain serotonin. In the rat cerebral cortex, the neurotransmitter stayed at low levels up to a year after drug use was stopped.

Episode Three Briefing: Synopsis

The student reviews the Synaptic Salvo information by completing a multiple-choice quiz generated by the database.

In People Problems, the student learns that scientists determine Ecstasy's long-term effects by doing research on both animals and regular users of the drug. This type of research can be somewhat tricky since many Ecstasy users abuse other drugs as well. Some of the human investigations include:

- Functional Magnetic Resonance Imaging (fMRI). The student sees an fMRI brain scan of a regular Ecstasy user. He/she learns that regular Ecstasy users and nonusers show different activity patterns in certain areas of the brain. The hippocampus, a part of the brain that is important for learning and memory, is one such area.

- Memory Tests. The student takes a memory test. He/she finds out that people who repeatedly take Ecstasy have poorer working, visual, and verbal memories than nonusers.

- Mood Studies. The student learns that mood disorders such as depression and anxiety occur more frequently in regular Ecstasy users than in nonusers.

The student uses the Comlink to make notes on data that he/she should mention on *Cool Vibes.* This review is in the form of a fill-in-the blank quiz.

The Synaptic Salvo and People Problems files provide The Reconstructors with the information they need. Alpha contacts Vera, and some time later The Reconstructors are seen backstage on the set of *Cool Vibes*. Alpha congratulates his team on their great work in solving the Ecstasy mystery while Vera does a sound check.

Vera leaves the group to open the show. As the curtain rises and the show begins, Delta suggests to Eureka that The Reconstructors should have their own TV show. Eureka thinks this is a great idea and states that the show should be called *The Eureka Zone*. Of course she would be a smash hit.

National Science Education Content Standard Correlation

Grades 5-8

Instructional Objective	Science Content Standard
Identify problems and approaches in studying Ecstasy.	Standard G: All students should develop understanding of the nature of science.
Comprehend the basics steps of neurotransmission.	Standard C: All students should develop understanding of structure and function in living systems.
Recognize the importance of serotonin in regulating mood, memory, and other body functions.	Standard C: All students should develop understanding of structure and function in living systems.
Know how Ecstasy alters serotonin neurotransmission.	Standard C: All students should develop understanding of structure and function in living systems.
Name short-term and long-term effects of Ecstasy use.	Standard F: All students should develop understanding of personal health. Standard F: All students should develop understanding of risks and benefits.

Episode Three Briefing: Vocabulary Terms

All of the words below are ones that students will encounter while playing **Nothing to Rave About: Episode Three**. Their definitions are contained within the adventure or in the *InfoArchives*. Teachers should alert the students to the ability to click on the *hot-linked* words in the game. After the game, teachers may want to review the new vocabulary words.

Animal research – research performed on animals from sea slugs to monkeys provides information often applicable to humans.

Antidepressant drug – medicine that elevates mood in depressed people. Often has little or no effect on people with normal mood. Untreated depression can lead to suicide.

Anxiety – feelings of uneasiness and apprehension. Short-term anxiety can be normal, such as right before a test or an interview. Strong, lasting feelings of anxiety can prevent a person from functioning.

Depression – a state of mind characterized by feelings of guilt, sadness, hopelessness, helplessness, and the inability to concentrate. Depression can be normal for some period of time after a life-altering event, such as a death in the family or a divorce. Continued depression can lead to suicide and requires treatment.

Mood-altering drug – a drug that changes someone's mood. It can be either elevating (an "upper") or depressing (a "downer").

Neuron – a cell in the nervous system responsible for nearly all functions such as thinking, moving, planning, etc. Neurons come in many different shapes. Most neurons in the human body are located in the brain and spinal cord, but small collections of neurons are also found near many organs such as the intestine.

Neurotransmitter – a small molecule used by neurons to communicate to other neurons and muscle cells.

Reuptake – a process in which neurotransmitters released in a synapse are taken back into the neuron that released them.

Serotonin – one of many neurotransmitters used in the brain. It appears to be involved in a variety of brain functions, including memory, perception, and the regulation of mood.

Synapse – a specialized area between neurons or between a neuron and a muscle cell. Most neurons are not directly connected to each other; instead they communicate across this small space.

Episode Three Briefing: Vocabulary Terms

Transporter – a protein found on many cells, including neurons, which transports ions or molecules across a membrane. Each transporter is specific for one or more related molecules. Some medicines and drugs act by blocking transporters.

Verbal memory – memory that involves use of words, either by remembering the words directly or by being able to describe the object to be remembered using words. Verbal memory can be short-term or long-term.

Visual memory – memory involving images or objects not readily described by words. Being able to tell your parent apart from other people relies on visual memory.

Working memory – memory that is used for very short-term tasks, such as remembering a phone number while writing it down or remembering the end of a sentence you are speaking.

Teacher Version

TEACHER DIRECTIONS: Ask students to complete the right-hand column as they move through the game. Answers are provided here, but page 9 has a master that can be copied for students as a handout.

Question	Answer
When Ecstasy blocks transporters, what happens to the amount of serotonin in the synapse?	It increases.
List five functions that serotonin regulates.	mood, memory, pain, sleep, perception, appetite, thirst, body temperature, aggression
What does repeated or regular Ecstasy use do to the level of serotonin in certain areas of a rat's brain?	Regular Ecstasy use decreases the level of serotonin.
What is one problem with studying Ecstasy users?	They often take other drugs besides Ecstasy.
Is the activity of the hippocampus of Ecstasy users the same as or different from that of non-users?	different from that of non-users
How do regular Ecstasy users do on working, visual, and verbal memory tests when compared with non-users?	Their performance is poorer than that of non-users.
How much depression and anxiety do regular Ecstasy users have when compared with non-users?	They have more depression and anxiety than non-users do.

Conclusions: Why is Ecstasy illegal?

Note: The answer to this question is not given explicitly in the episode. Students should come to the conclusion that the drug is illegal because the data shows that it poses a serious threat to health.

Episode Three Briefing: Mission Log

Name: _____ Class:_____ Date _____

STUDENT INSTRUCTIONS: Record your observations by correctly answering the following questions as you play **The Reconstructors™ Episode 3: Club Drugs**.

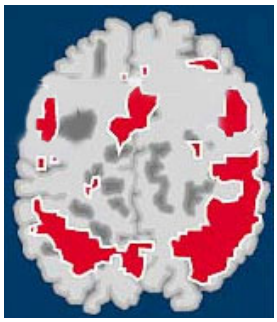
Question	Answer
When Ecstasy blocks transporters, what happens to the amount of serotonin in the synapse?	
List five functions that serotonin regulates.	
What does repeated or regular Ecstasy use do to the level of serotonin in certain areas of a rat's brain?	
What is one problem with studying Ecstasy users?	
Is the activity of the hippocampus of Ecstasy users the same as or different from that of non-users?	
How do regular Ecstasy users do on working, visual, and verbal memory tests when compared with non-users?	
How much depression and anxiety do regular Ecstasy users have when compared with non-users?	

Conclusions: Why is Ecstasy illegal?

_____

_____

_____.



ACTIVITY 1: DO YOU REMEMBER...?

Ecstasy affects memory and mood. In this activity, students try out a verbal learning task and compare their performance to how an Ecstasy user might perform.

Background

Researchers studying human memory use a variety of tests. One well-established test to check for verbal memory is called the Rey Verbal Auditory Learning Test, which was developed in the 1930s. It consists of asking subjects to recall a list of words read aloud. The list of 15 items is read, then the subject is asked to write down as many words as he/she can remember. The list is repeated five times, with the subject recalling the words after each reading. People with normal memory will recall on average 13 out of the 15 words after the fifth reading. The test then continues with further tasks.

Ecstasy has many effects on the brain, mostly because of its effects on the neurotransmitter serotonin. Users report feelings of depression shortly after use, and these feelings persist for at least several months. Memory problems involve verbal, visual, working memory. Some studies also suggest subtle impairment in frontal lobe functions, which are often called executive functions. These include mental multi-tasking, attention, and planning. On tests of verbal memory, users remember just as well as controls after the first trial, but by the fourth trial, their performance plateaus below that of controls. Applied to real world tasks, this suggests that Ecstasy users have memory problems regardless of how much they study. Since this research was performed on people who had not used Ecstasy for an average of 130 days, it suggests that memory problems can persist.

Learning Objectives

The student will:
1. participate in an experiment on human memory.
2. graph his/her own data and that of the class.
3. compare the data obtained to data from Ecstasy users.
4. draw conclusions about the effect of Ecstasy on verbal memory.

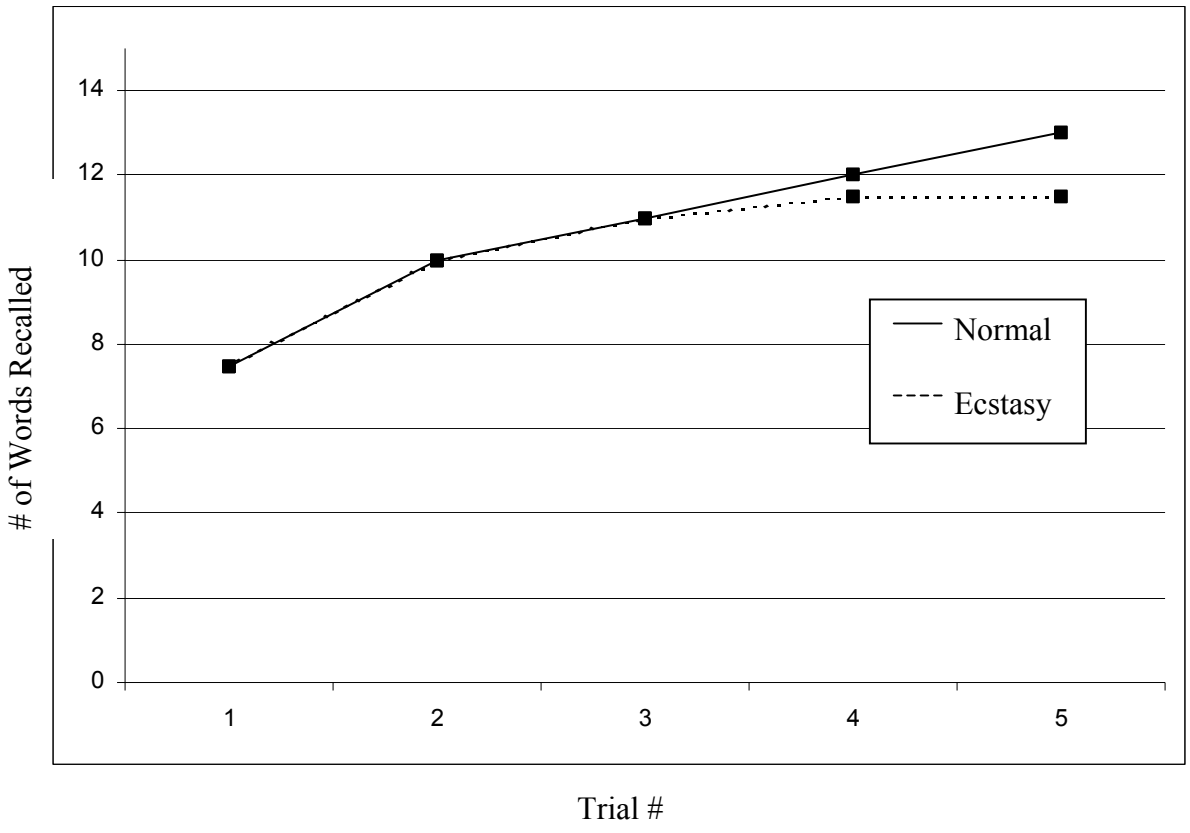
Materials

- list of words included below
- graph paper (one sheet per student), optional

Procedure

Prior to class:
1. Make a transparency of the word list, or prepare to project it from your computer.
2. Make one set of student activity sheets for each student.

During class
1. Have students take a piece of paper and divide it into five vertical columns labeled 1-5. These columns need to be big enough for students to write down 15 words.
2. Read the instructions and the list of words aloud to your students.
3. Provide time for students to write down all the words.
4. Repeat step #2, instructing students to write the words under the next heading.
5. After reading the list five times, have students follow the instructions on the student sheet while you project the list.
6. Obtain a class average for each reading of the list. Graph the results on the board. On a second line, graph the average of someone who has used Ecstasy. This line should be the same as your students for trials 1-3, then plateau about one to two words below their line (See Figure 1 below).



References

McCardle, K, Luebbers, S, Carter, JD, Croft, RJ and Stough, C. 2004. Chronic MDMA (Ecstasy) Use, Cognition, and Mood. Psychopharmacology 173: 434-439.

Rickertand, P and Senior, G. 1998. WMS-III List Learning Test and the Rey Auditory Verbal Learning Test: Comparisons and Australian Normative Data. Poster presented at the 4th Annual Conference of the College of Clinical Neuropsychologists in Lorne, Victoria, Australia , 8-11 Oct 1998. Accessed at http://usq.edu.au/users/senior/Posters/rickertposter.htm on 15 Feb 2005.

Resources

The starred entries are especially appropriate for students

http://faculty.washington.edu/chudler/neurok.html

http://www.bbc.co.uk/science/humanbody/mind/interactives/intelligenceandmemory/memorytest/index.shtml

Rey Verbal Learning Test – Read this to your students

"You will test your memory for words. Please listen carefully to the list of words that I read to you. Do not write while I am reading.

drum

curtain

bell

coffee

school

parent

moon

garden

hat

farmer

nose

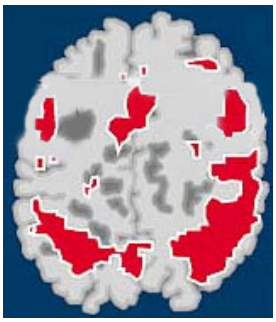
turkey

color

house

river

That's it. Now write down as many as you remember, in any order. Write them in the next blank space. Make sure that you can keep the different lists that you are writing separate. Go."



ACTIVITY 1 DO YOU REMEMBER...?

Ecstasy affects memory and mood. In this activity, you will complete a verbal learning task and will compare your performance to the performance expected of Ecstasy users.

Materials

1. paper
2. pen/pencil
3. ruler or graph paper

Procedure

1. Divide your paper into vertical columns labeled 1-5. Leave enough room below each number to write down 15 words.
2. Follow your teacher's instructions as you go through the experiment.
3. After listening to the list of words five times, count the number of words you remembered correctly after each reading and record the numbers below:

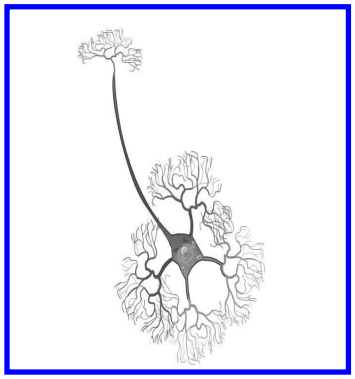
_____ Reading 1 _____ Reading 2 _____ Reading 3

_____ Reading 4 _____ Reading 5

Did the number of words you remembered change from the first to the fifth reading?

How well do you think you would do tomorrow?

How well do you think an ecstasy user would do tomorrow?



ACTIVITY 2
A NEURON PLAY

Messages travel through the nervous system by means of an electrochemical process called neurotransmission. A key component in this process is the neuron, a nerve cell that is specialized to transmit and receive information. In this activity the students will model a neuron circuit to learn how it functions.

Background

Neurons are nerve cells that are specialized to communicate with other cells. A typical neuron has a cell body that contains the nucleus and other cell organelles. Extending from the cell body are projections called dendrites that bring messages or signals into the cell from other neurons. A neuron also has a long extension called an axon that carries signals away from the cell.

The process by which signals in the nervous system move from neuron to neuron is called neurotransmission. In neurotransmission, a signal received by a neuron's dendrites can cause an electrical impulse known as an action potential to travel down the axon of the cell. Some neurons have a fatty covering on the axon called a myelin sheath. This sheath helps the action potential travel faster.

An action potential is an all-or-none event. If the difference in charge between the inside of the cell and the outside of the cell reaches a critical level (threshold), the action potential is initiated. Furthermore, the magnitude of the action potential of a specific neuron is always the same.

Neurons are separated by a gap (synapse) that the action potential cannot cross. Once the action potential reaches the end of an axon (its terminal), it stimulates the release of chemicals called neurotransmitters. The neurotransmitters exit the terminal, cross the synapse, and relay the signal to a neighboring neuron by binding to specific protein receptors. Once the signal has been received, the neurotransmitters are released back into the synapse. They are either destroyed by enzymes or taken up by the neuron that released them (reuptake).

Two different types of neurons are sensory neurons and motor neurons. Sensory neurons receive input from the environment. Motor neurons communicate with muscles and make them contract.

Ecstasy alters neurotransmission by causing an increase in three neurotransmitters in the brain: serotonin, dopamine, and norepinephrine (noradrenaline). This change is responsible for the short-term effects produced by the drug.

Learning Objectives

The student will:

1. name two different types of neurons.
2. demonstrate the process of neurotransmission.

Materials

- signs with string to go around students' necks
  - Neuron 1 (Sensory Neuron)
  - Neuron 2 (Sensory Neuron)
  - Neuron 3 (Motor Neuron)
  - Neuron 4 (Motor Neuron)
- brain model (or brain sign)
- roll of toilet paper
- lightning bolt-shaped sign (for electrical signal)
- basketball
- two bags with small objects such as marbles or eyedroppers (preferably two different objects)
- empty trash can to catch basketball at end

Procedure

Prior to class:

1. Make the signs.
2. Read through the Neuron Play script and insert your school's and a rival school's name in the appropriate blanks.

During class

1. Recruit students to take on the roles of the basketball player, neurons 1-4, the brain, and two neurotransmitters.
2. Give each neuron his/her appropriate sign. Wrap one arm of each "neuron" student in toilet paper to simulate the myelin sheath.
3. Hand the brain model to the brain person.
4. Give a bag of neurotransmitter to each neurotransmitter person.
5. Give the trash can to one student.
6. Line the students up at the front of the class with the sports player at one end of the line and the brain at the other. Put Neurons 1 and 2 between the sports player and the brain. Have the dendrites of Neuron 1 touch the player, and the axon close to but not touching the dendrites of Neuron 2. Let the other students sit down until needed.
7. Point out to the students that their unwrapped arm is the dendrite, their body is the cell body, and the wrapped arm is the axon.
8. Read the script, calling up the other players as they are mentioned in the script.

Neuron Play

"Once upon a time, a student was playing in a basketball game. The game was very close and everyone was tense. It was the final game for the coveted league championship title - _____ (your school) vs _____ (rival). One student found himself/herself out on the court in the final seconds of the game. His/her team was behind by one point. They needed a basket to win. Suddenly the student found that the basketball had somehow ended up in his/her hands. The whole world went into slow motion. Despite what some might say, this is what REALLY happened (*put ball in hands of player).*

The dendrites in the sensory neurons of his/her hands were triggered by the touch of the ball in his/her hand. An electrical signal passed from the dendrites to the cell body of the neuron (*move the lightning bolt along Neuron 1*). From there the signal traveled at up to 250 miles per hour, down the axon carrying signals away from the cell body and on to other places. Suddenly, the signal reached a synapse (*have first neurotransmitter person come up).* This was it. There was a gap and the electrical signal could not go across it. All of a sudden though, some chemicals, neurotransmitters, went across the gap and on to the dendrites of the second neuron (*have neurotransmitter person put some objects into the axon hand of Neuron 1 , then Neuron 1 hands them to the dendrite hand of Neuron 2).* The electrical signal quickly moved along the second neuron towards the brain (*move lightning bolt along Neuron 2).* When it reached the brain stem, it traveled up to the thalamus. From there it was sent to the correct part of the brain. The brain sorted out all the information and in an instant, made the decision that the player must shoot the ball if the team would have any chance of winning the game.

But wait a minute. It's not that easy (*move lightning bolt through brain*). The brain had to get the message back to the player's hands. Surely the game would be lost. But then, suddenly, from nowhere the motor neuron was located (*have Neurons 3 and 4 come up - Neuron 3's dendrites should touch the brain, and Neuron 4 is in line behind Neuron 3).* Thank goodness for the many hours the player had spent shooting and going over just such a situation in the mind. The pathways in the brain were well connected and that made a quick response possible.

The electrical signal traveled from the brain on its way to give the message to the distant body parts (*move lightning bolt along Neuron 3*). Oh no, another synapse! (*Have second neurotransmitter person come up and put neurotransmitter into the axon hand of Neuron 3. Neuron 3 then hands the objects to the dendrite hand of Neuron 4).* Fortunately, the electrical message was once again quickly translated into a chemical message and carried on to the next neuron where it changed back to an electrical signal and passed through the dendrites, a cell body, and axon (*move lightning bolt along Neuron 4*). This axon was a very long axon that went clear back to the arm muscle was sent. The message to tell the muscles to contract and the player's arm to shoot the ball. The player released the ball just as the buzzer sounded. It swished through the hoop (*have student with trashcan come up to catch the ball*). What a great moment! _____(Your school) won the championship."

Extension Activities

- *Science*: Compare and contrast the different types of neurons in the nervous system.
- *History*: Examine the history of the discovery of the neuron.
- *Science*: Investigate the chemical process that induces neurotransmitter release.

Standards

National Science Education Standards, Grades 5-8

- Science Content Standard C: All students should develop understanding of structure and function in living systems.

Books

- LeVert, Suzanne. 2002. The Brain New York: Benchmark Books/Marshall Cavendish.
- Parker, Steve. 1998. Brain and Nerves. Brookfield, Conn.: Copper Beech Books.

Web Sites

The starred sites are particularly appropriate for students:

- Understanding Addiction: Basic Science Information*
  http://www.utexas.edu/research/asrec/addiction.html

- Neuroscience for Kids*

  http://faculty.washington.edu/chudler/neurok.html

ACTIVITY 3 – THE RIGHT STUFF

In this activity, students will learn about the pros and cons of using humans and animals for research on Club Drugs.

Background

Most research performed today is intended to help humans. Animals as different as sea slugs, rats, and rhesus monkeys are used in experiments designed to teach us about humans. A lot of research can also be performed on cells in tissue cultures derived from either humans or animals, often many years ago. Each of these organisms or groups of cells is called an animal model, and different models mimic certain human functions.

Researchers use a variety of methods to study the effects of drugs. Each method has its pros and cons. The summary below lists some of the pros and cons of using different organisms.

Humans

Pro

- Results observed can be applied to humans directly
- Social effects on human function are best modeled using humans
- If part of the research protocol is designed to help humans (for example research on how to quit smoking), research subjects can benefit directly from participating in the study

Con

- Many kinds of research cannot be done on humans, such as removing parts of the brain
- Unless an illegal drug is used as part of therapy (for example, MDMA is used in post-traumatic stress disorder), researchers have to find people already using the drug
- Many illegal drug users use a variety of legal and illegal drugs, so effects observed are difficult to attribute to a single cause
- Recruiting and retaining human subjects is hard, since research participation has to be voluntary
- Research on humans is expensive; researchers have to pay subjects to participate

Animals

Pro

- Can administer drugs to animals in precise amounts and on a precise schedule
- Can look at anatomy and function of the brain as part of study
- Can breed animals with known genetic characteristics
- Small animals such as rats or mice are relatively inexpensive to house

- Small animals have short generation times, so researchers can study effects on their offspring

Con

- Animal function is not exactly the same as human function
- If an effect is seen only when taking multiple drugs, it will not show up in animals given a single drug
- Animals do not have the social pressures seen in humans (difficult to model peer pressure or family influence on behavior)

Learning Objectives

Students will:

1. Be able to name two different animal models used in medical research.
2. List two reasons for and against humans vs. animals as drug research subjects.

Materials

- *Club Drug Research Plan Student Sheet* (one per group of students)
- computers with Internet access, or books on animals in research
- stuffed animal example of animals used in medical research (rat, rabbit, dog, monkey), optional

Procedure

1. Copy the *Club Drug Research Plan Student Sheets* (one per group of students).
2. Put a stuffed animal in front of each group.
3. Ask students to follow the instructions on their sheet.
4. If students are having trouble coming up with pros and cons, guide their thinking by asking questions such as whether they can apply their results directly, how easy it would be to recruit subjects, and what can they do ethically to humans vs. animals.
5. Have students present their proposals using PowerPoint, poster boards, or verbal presentations.

References

McCardle, K, Luebbers, S, Carter, JD, Croft, RJ and Stough, C. 2004. Chronic MDMA (Ecstasy) Use, Cognition, and Mood. Psychopharmacology 173: 434-439.

Jacobsen, LK, Mencl, WE, Pugh, KR, Skudlarski, P, Krystal, JH. 2004. Preliminary Evidence of Hippocampal Dysfunction in Adolescent MDMA ("Ecstasy") Users: Possible Relationship to Neurotoxic Effects. Psychopharmacology 173: 383-390.

Resources

Foundation for Biomedical Research http://www.fbresearch.org/ *
Kids for Research http://www.kids4research.org *

Caputo, Robert 1980. More than just pets: Why people study animals. Putnam Publishing Group.

ACTIVITY 3 – THE RIGHT STUFF

In this activity, you will learn about the pros and cons of using humans and animals for research on Club Drugs.

Background

Medical researchers are always looking for the best way to study a particular problem. Researchers interested in drugs have to decide between using animals such as rats or rabbits or using people to discover more about drugs and drug abuse.

Procedure

Your group is interested in whether Ecstasy use causes brain damage in adolescents. You are trying to decide whether to study this question using humans or animals as subjects.

1. Read about the use of animals in medical research on the following web sites, or use other resources provided by your teacher:
    a. http://www.fbresearch.org/
    b. http://www.kids4research.org
2. Write three factors that might influence your decision under each heading below, and then decide which subjects are more likely to meet your needs. Defend your decision in front of the rest of the class.

Humans

_____

_____

_____

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Animals

_____

_____

_____

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ACTIVITY 4: MOOD PUZZLE

In this activity, students will use information about depression, anti-depressants, and Ecstasy in their race to solve a puzzle.

Background

Depression is a mental illness affecting about 9.5% of the population over the course of one year, including up to 6% of adolescents. Girls and women are more frequently affected than boys and men. Drug and alcohol abuse is more frequent in depressed adolescents, and their risk for suicide is greatly increased.

The causes of depression are not always easy to identify. Genetics certainly plays some role, as depression can run in families, but environment is also clearly important. Painful events or losses can cause depression. Genetics, environment, or a combination of both can lead to changes in brain chemistry, often lowering levels of serotonin in the amygdala.

Symptoms of depression include:

- persistent sad or irritable mood
- loss of interest in activities once enjoyed
- significant changes in appetite or body weight
- significant changes in sleep patterns
- difficulty concentrating
- loss of energy
- vague physical complaints such as body aches
- feelings of worthlessness or inappropriate guilt
- thoughts of suicide or death

It is often difficult for those who care about adolescents to recognize the signs of depression. Only about 30% of adolescents who have depression get treated. The most effective treatment combines "talk" therapy with antidepressant medication. The newest class of anti-depressants (brand names include Prozac, Zoloft, and Paxil) increases serotonin levels in the brain by blocking reuptake of the neurotransmitter. Recent studies have suggested that some of these drugs increase the risk for suicide in adolescents, especially early in treatment.

MDMA (Ecstasy) also increases serotonin levels by blocking neurotransmitter reuptake. However, it cannot be used as an anti-depressant long term. In addition to acting as an anti-depressant, MDMA has hallucinogen-like properties. More worrisome is the fact that MDMA use can lead to neuron damage and depression in users who have stopped using it.

Episode Three Debriefing: Teacher Guide

Learning Objectives:

Students will:
1. Be able to name one brain region involved in depression.
2. Be able to list three symptoms of depression.
3. Be able to explain the mode of action of one class of anti-depressants, selective serotonin reuptake inhibitors.
4. Compare the effect of anti-depressants and MDMA (Ecstasy).

Materials

- Small, 15-30- piece puzzles (one per group) of natural scenes such as landscapes or animals (Note: Each puzzle does not have to have the same number of pieces.)
- *"Puzzle Race" Worksheet* (one per group)
- prize for winning group

Procedure

1. Before class, copy the puzzle race worksheet and give one to each group of students.
2. Remove three pieces from each puzzle and put them on your desk.
3. Begin class with a discussion about depression. Ask students what they know about depression. Put their answers on the board without correcting any misconceptions at this time.
4. Ask students to get together in groups and follow the instructions on the worksheet.

Answer Key

Task 1: There is no single right answer. Look for words related to emotion, reaction, senses, and arousal, all of which are related to the amygdala in humans and other species.

Task 2: three (loss of interest, change in appetite, loss of energy)

Task 3: Depression

References/Resources

- NIMH web site materials on depression http://health.nih.gov/result.asp/183/16

ACTIVITY 4: MOOD PUZZLE

Are you ready for a race? Compete against your fellow students to be the first group to solve the puzzle.

Materials

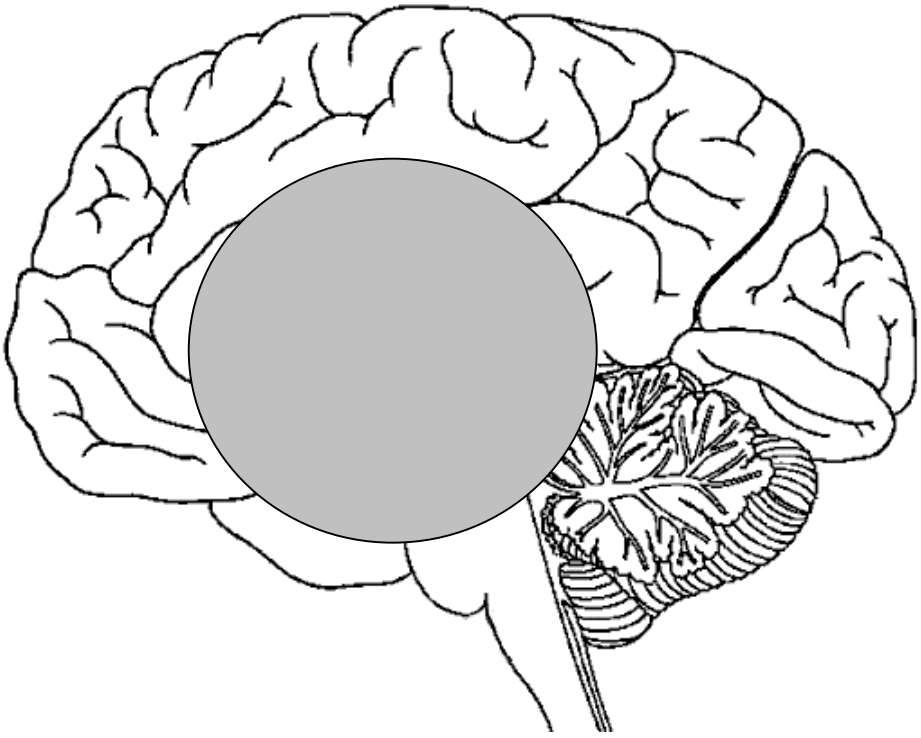
Puzzle

Procedure

1. Get together in your group and put together the puzzle.
2. Complete each of the activities below and bring the answer to your teacher to get a puzzle piece.
3. The group completing all three tasks first wins.

Task 1: What brain regions are involved in mood?

Different parts of the brain are responsible for different functions. How you feel – happy, sad, anxious- depends upon several small parts of the brain which are collectively called the limbic system. The circle indicates the general location of the limbic system.
Each structure in the limbic system is fairly small and is located deep within the brain.



Episode Three Debriefing: Student Activity Sheet

One of the structures of the limbic system is called the amygdale. It is a small almond-shaped part that is involved in emotions and in reacting to what you see.

Write an acrostic poem about the amygdala below. One letter has been done for you.
A - _____
M - _____
Y-_____
G -_____
Deep inside the brain
A-_____
L-_____
A-_____

Bring the poem to your teacher for the first puzzle piece.

Task 2: Who's Depressed?

Read Brenda's story below and circle the symptoms of depression she has.

"It was really hard to get out of bed in the morning. I just wanted to hide under the covers and not talk to anyone. I didn't feel much like eating and I lost a lot of weight. Nothing seemed fun anymore."

Symptoms of depression include:

- persistent sad or irritable mood
- loss of interest in activities once enjoyed
- significant changes in appetite or body weight
- significant changes in sleep patterns
- difficulty concentrating
- loss of energy
- vague physical complaints such as body aches
- feelings of worthlessness or inappropriate guilt
- thoughts of suicide or death

How many symptoms did you circle? _____

Report this answer to your teacher to get the second puzzle piece.

Task 3: Is MDMA (Ecstasy) an anti-depressant?

Find the following words related to depression and depression treatments in the word search below. Unscramble the remaining letters to discover the long-term effect of Ecstasy on the brain.

Serotonin Brain Paxil Guilt Suicide Sad Prozac Zoloft Garden Doctor Death Friends Thought Listless Blame Abuse Tired Pain Hopes Eat Treat Play Help Mad Drug Lost Sap

S	E	P	A	I	N	S	S	S	A	D
E	D	A	R	O	T	C	O	D	O	H
R	S	X	E	Z	O	L	O	F	T	E
O	E	I	A	N	E	T	G	R	H	L
T	P	L	T	M	P	R	U	I	O	P
O	O	R	A	A	D	E	I	E	U	P
N	H	L	S	S	R	A	L	N	G	R
I	B	M	A	D	U	T	T	D	H	O
N	I	A	R	B	G	I	L	S	T	Z
P	I	A	B	U	S	E	C	O	E	A
L	I	S	T	L	E	S	S	I	S	C
D	E	A	T	H	T	I	R	E	D	T
G	A	R	D	E	N	Y	A	L	P	E

Write down all the remaining letters here. __ __ __ __ __ __ __ __ __ __

Unscramble those letters to complete the sentence below:

Long-term use of Ecstasy causes brain damage and __ __ __ __ __ __ __ __ __ __.