695DV

ADDICTION AND THE HUMAN BRAIN

DVD Version

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Addiction and the Human Brain

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Teacher's Resource Book

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Addiction and the Human Brain

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- TEACHER'S RESOURCE GUIDE

A file of the accompanying Teacher's Resource Guide is available on the DVD. To open the file you need to load the DVD onto a computer that has a DVD-ROM and Adobe Acrobat Reader. Right click on the DVD icon and then double click on the file titled "Teacher's Resource Book."

INTRODUCTION

Drug addiction has an undeniable stigma. To many, an addict is a weak, reckless person who refuses to acknowledge the damage she is doing to her body and her life—someone who chooses to use drugs and values her next drug fix above all else. But cutting-edge research has found that addiction is not a matter of choice at all. In fact, drugs cause chemical and physiological changes in the brain that can make it next to impossible for addicts to stop using them without help. Though the decision to start using drugs is obviously voluntary, over time drugs like alcohol, cocaine, marijuana, heroin and Ecstasy can hijack the brain's ability to make a decision NOT to use. According to the latest studies, addiction is a brain disease.

Researchers like Stephen Dewey, Senior Scientist in the Chemistry Department at Brookhaven National Laboratories, Aaron White, Assistant Research Professor in the Department of Psychiatry at Duke University Medical Center, and Leslie S. Prichep, Associate Director of Brain Research Laboratories in the Department of Psychiatry at the New York University School of Medicine, have spent years studying the way drugs act on the brain. Among their findings is the fact that drugs begin to change a user's brain the very first time a drug is tried, with the drug-induced release of a key brain neurotransmitter called dopamine. At first, dopamine causes an intensely pleasurable feeling, but as time—and drug use—progresses, the brain begins to rely upon this release of dopamine without any of the pleasurable side effects. With time, drugs actually alter the way the brain uses dopamine. When a person becomes addicted, it means that his brain has been changed to the point that he needs the drug just to maintain a minimal or "normal" level of functioning.

All this has a special significance for teenagers. New studies have also discovered that teens are more vulnerable to addiction than adults. The teenage brain is a wonderful thing, changing and developing in response to experiences and environment. Because the teen brain is still building itself, it is easy for a young person to learn new things quickly. But that ability to be molded by outside influences also carries a serious risk when a teen experiments with drugs because such use can cause permanent damage. On top of that, research has shown that a teen's frontal lobes, the area of the brain responsible for decision-making and planning, is still immature—making teens less likely to consider the consequences of their actions and thus more likely to take dangerous risks like using drugs.

The program ***Addiction and the Human Brain*** delves into the latest medical findings about drugs and the way they act on the brain, giving teens the new information they need to fully realize the consequences of drug use. Drug addiction is a major problem in society. The better we understand the physical effects of drugs, the better prepared we are to help drug addicts recover—and perhaps more importantly, to ensure teens never take those first steps down the path to addiction.

LEARNING OBJECTIVES

After watching the video ***Addiction and the Human Brain*** and participating in the class activities included in this Teacher's Resource Book, your students will be able to:

- discuss the concept of addiction as a brain disease
- explain how different parts of the brain correspond to different life functions
- understand the implications of new research finding that the teenage brain is still developing
- grasp how drugs interfere with neuron communication in the brain
- explain how dopamine and the reward pathway reinforce both survival behavior and drug use
- identify reasons why teenagers are more vulnerable to drug addiction than adults
- distinguish between tolerance, dependence and addiction
- give neurologically based reasons for common drug user behavior
- describe the compulsive nature of addiction
- understand that drug use as a teenager makes one more likely to use drugs as an adult
- explain why cravings and relapses often occur for recovering addicts

Addiction and the Human Brain opens with several former drug addicts, now recovering at New York City's Phoenix House, talking about their experiences with addiction. "I didn't think of drugs as addictive. I just thought they were just something you did," one former addict, Chris, tells viewers. Scientist Stephen Dewey of Brookhaven National Laboratories then shares his view that addiction is a brain disease.

The program introduces the brain as the most complex organ of the human body, responsible for thinking, behavior, memory, emotions, sensations—and response to drugs. Viewers meet Dr. Aaron White of Duke University who, along with Dr. Dewey, is one of the country's most prominent researchers focusing on the causes and consequences of drug use, especially among teenagers. Dr. White reveals that the teen brain is very "moldable," or able to be permanently shaped by experiences. Dr. Dewey adds that recent studies have shown the brain changes a great deal during adolescence, making it particularly vulnerable to drugs or changes in the environment.

The narrator poses a question: "Are teens more susceptible to the risk of becoming addicted?" Dr. White explains that a teen's frontal lobes, the part of the brain responsible for planning and decision-making, are still maturing. "The fact that the frontal lobes are not fully mature in the teenage brain may help explain why teenagers take greater risks and act more impulsively than even people only a few years older," the narrator says.

The program then zeroes in on the role of neurons. Dr. White explains that neurons communicate with each other by releasing chemicals called neurotransmitters. Dr. Dewey tells viewers that hundreds of different neurotransmitters exist in the brain, each one with its own specific role. One neurotransmitter, dopamine, plays a role in euphoric feelings. Viewers then learn that researchers use PET scans to observe and measure changes in dopamine levels, allowing them to image the ways that drugs affect the brain.

Next, the program addresses reward pathways. Two recovering addicts describe how their first experiences with drugs felt; the narrator explains that drugs feel good at first because they raise dopamine levels in the brain's reward pathway, a chain of nerve fibers running from the brain stem to the prefrontal cortex. Dr. Dewey adds that all addictive drugs raise dopamine levels, but to different degrees.

The narrator points out that the reward pathway is activated by many beneficial things too, like favorite foods, music or a kiss. The surge of dopamine that accompanies such behavior is important to survival because it reinforces essential acts, like eating. But, the narrator tells viewers, drugs subvert the reward pathway in harmful ways. "All these drugs, the one thing they have in common is that they all trick the reward system into becoming activated. So you think you did something good when you didn't," Dr. White says. Dr. Dewey describes a study in which laboratory rats chose cocaine instead of food until they starved. The recovering addicts show how drugs take over a human's reward pathway as well. "You don't have a life. When I was using drugs, I didn't even eat," Amanda recalls.

Next, Dr. White explains that a natural dip in the reward system during the teen years may make teenagers even more susceptible to experimenting with drugs. "One of the things that is really common during adolescence is…for teens to feel a little blah, a little bit bored, slightly depressed on a regular basis," he says. That dip can make teens more likely to take risks and try new things. Dr. White gives two reasons: a dampened reward system leads teens to take risks and explore, and drugs probably makes teenagers feel better than they would as adults with normal reward pathways. On top of that, he says, a teen's immature frontal lobes make it harder for him to think about the negative consequences of drug use and therefore keep taking the drug.

The program then discusses tolerance. The narrator explains that drug use actually changes the brain, leading to a reduction in the response to the drug after prolonged use. Some of the Phoenix House recovering addicts describe how they had to begin to take higher doses to get the same effect; "When I first started using heroin, one bag would last me like a day or two. At the end of my heroin use I was [up to] 10, 20 bags. You just have to keep doing more and more," Chris says. The narrator explains this effect by saying that alcohol, methamphetamine and Ecstasy kill neurons while cocaine causes a reduction in the number of dopamine receptors. "If you lose dopamine receptors, then you lose the ability to feel pleasure from things," Dr. Dewey tells viewers. That means a cocaine user no longer enjoys things that used to be fun, causing her to take more and more cocaine to compensate for the loss. Nicotine works in a similar way, Dr. Dewey adds, causing the body to adjust to the drug and release less dopamine as time goes on. "There's no question that chronic use alters not only the reward pathway, but the ability of the reward pathway to respond," he says.

Viewers learn that continued use can also lead to dependence. Dr. White explains that the brain becomes accustomed to the drug until it can't function without the drug, making the user feel horrible without it. "I had to have it. If I didn't have any heroin in my system, I didn't feel normal at all," recovering addict Rachelle shares.

The program next moves to addiction; viewers learn that prolonged drug use can change not only the body, but also a user's behavior. Drugs become central to the user's life—taking them is no longer voluntary. The narrator explains that addiction is the compulsive physiological need for a habit-forming substance; the brain has been changed to the point where drugs matter more than anything else. Several addicts tell viewers they prostituted themselves or robbed their friends for drug money. Dr. Dewey adds that addicts' brains can change even more than the brains of people with schizophrenia or Alzheimer's. "I feel very strongly that addiction is a brain disease," he says.

Next, the program explores new research about teen brains and addiction. Dr. White tells viewers that a teenager's brain is capable of changing with experience and learning things quickly—but that ability can make teens become addicted quickly, too. "The body learns that this drug is on board all the time, so it learns to function while the drug is still there,"

he shares. Dr. Dewey points out that statistics show teen drug users are likely to be users as adults; "there's no question that the adolescent period, the period when the brain is changing a great deal, is particularly vulnerable to the insult caused by drugs," he adds.

The program moves on to recovery, or "reprogramming" an addict's brain. Several recovering addicts share their struggles with quitting, emphasizing the power of cravings. The narrator tells viewers that cravings and relapsing are major obstacles to getting better. Dr. Dewey tells viewers that certain "triggers," or people, places or things associated with drug use, cause a strong craving for the drug. He describes studies in which addicted animals that go to an environment where they used to get drugs actually experience an increase in dopamine. Some of the addicts agree, talking about their own triggers.

Viewers then meet Dr. Leslie Prichep of the New York University School of Medicine. Dr. Prichep describes her work using EEGs to measure the electrical activity in the brains of recovering teen and adult addicts. She reveals that adult addict brains display significant healing after nine months of abstinence from drugs, but that teen brains showed little recovery. "It looked as if the damage done to their brains by the exposure to drugs was irreversible," she says.

The narrator then reassures viewers that teen addicts are not necessarily doomed; the ability of the brain to change and adapt may help compensate for the damage. Dr. Prichep explains that the brain is plastic—when one region of the brain is damaged, another region can often take over. So while there may have been harm done by drug abuse, she says, the brain can often rebuild its circuitry to get around that damage.

Next, recovering addicts discuss how they must change their behavior in order to successfully quit. Jose Diaz, a former addict who is now a counselor at Phoenix House, talks about his experiences as both a recovering addict and a counselor.

Finally, the program wraps up with Dr. White emphasizing the importance of preventing addiction instead of treating it. "That the brain is changing so much during the teen years means that the decisions teenagers make about what to do with their time have a direct impact on how they shape their own brains," he says. As the video draws to a close, the recovering addicts tell viewers that they never imagined they would become addicted when they started taking drugs.

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STUDENT ACTIVITIES

Name: _____

Pre/Post Test

Decide whether the following statements are true or false.

1. TRUE or FALSE: Your brain is completely developed by the time you're a teenager. _____
2. TRUE or FALSE: Dopamine is a neurotransmitter associated with pleasure. _____
3. TRUE or FALSE: The reward pathway is an area of your brain that makes you feel good in response to certain behaviors, like eating or listening to your favorite music. _____
4. TRUE or FALSE: Tolerance is a reduced response to a drug after prolonged use. _____
5. TRUE or FALSE: Teens who use drugs are no more likely to become drug abusers as adults as anyone else. _____
6. TRUE or FALSE: Over time, drugs like cocaine make it harder to get pleasure from things and activities you used to enjoy. _____
7. TRUE or FALSE: Addiction is characterized by compulsive drug use. _____
8. TRUE or FALSE: A drug addict could quit without any extra help if she really wanted to. _____
9. TRUE or FALSE: People and places that a drug addict associates with drugs can trigger strong cravings for the drug. _____
10. TRUE or FALSE: Teen and adult drug addicts show the same amount of brain recovery after they quit using drugs. _____

Answers to this test appear on the next page.

Name: _____

ACTIVITY 1B

PRE/POST TEST

Answer Key

1.	TRUE or FALSE: Your brain is completely developed by the time you're a teenager.	FALSE
2.	TRUE or FALSE: Dopamine is a neurotransmitter associated with pleasure.	TRUE
3.	TRUE or FALSE: The reward pathway is an area of your brain that makes you feel good in response to certain behaviors, like eating or listening to your favorite music.	TRUE
4.	TRUE or FALSE: Tolerance is a reduced response to a drug after prolonged use.	TRUE
5.	TRUE or FALSE: Teens who use drugs are no more likely to become drug abusers as adults as anyone else.	FALSE
6.	TRUE or FALSE: Over time, drugs like cocaine make it harder to get pleasure from things and activities you used to enjoy.	TRUE
7.	TRUE or FALSE: Addiction is characterized by compulsive drug use.	TRUE
8.	TRUE or FALSE: A drug addict could quit without any extra help if she really wanted to.	FALSE
9.	TRUE or FALSE: People and places that an addict associates with drugs can trigger strong cravings for the drug.	TRUE
10.	TRUE or FALSE: Teen and adult drug addicts show the same amount of brain recovery after they quit using drugs.	FALSE

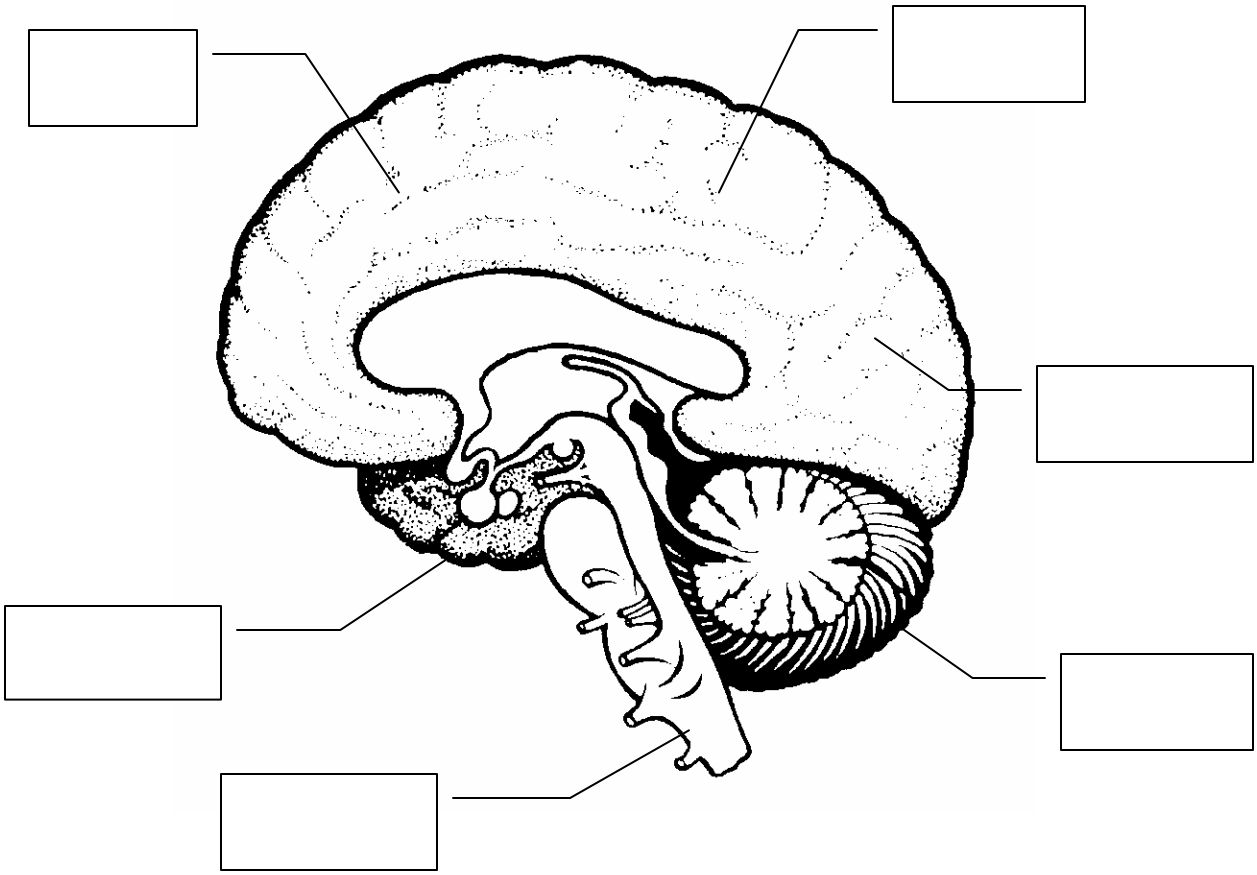
Name: _____

ACTIVITY 2A

BRAIN SCAN

PART ONE

Different parts of the brain are in charge of different tasks. Label the different parts on the diagram below.



1. The frontal lobe is responsible for decision-making, problem solving and planning.
2. The temporal lobe deals with memory, emotion, hearing and language.
3. The occipital lobe deals with vision.
4. The parietal lobe deals with the reception and processing of sensory information from the body.
5. The cerebellum is responsible for coordination, skilled movement, balance and posture.
6. The brainstem coordinates heart rate, breathing, eating and sleeping.

This activity is continued on the next page.

Name: _____

ACTIVITY 2B

BRAIN SCAN

PART TWO

A specific part of the brain is in charge of what each person below is doing. Using the descriptions of the parts of the brain from the previous page, decide which part of the brain is being used for each action below. A sample has been provided for you.

Angelica is in a very happy mood. *Temporal lobe*

1. Kyra is planning a camping trip for next weekend. _____
2. Beth is learning a new routine on the balance beam. _____
3. Andy squints to look at a small diagram. _____
4. Yun has a regular heartbeat. _____
5. Leah looks at painting in an art museum. _____
6. Matty remembers a good time with his friends. _____
7. Sophia decides whether to take French or Italian. _____
8. Owen touches a burner on the stove and feels heat. _____
9. Jake breathes at a normal rate. _____
10. Sam tries to solve a geometry problem. _____
11. Tina learns how to kick a soccer ball. _____
12. Jeff is really mad at his brother. _____

PART THREE

Certain parts of the brain are still developing in teenagers. Put a star **(☆)** next to the parts of the brain that are not yet fully developed in teenagers.

Answers to this activity appear on the next page.

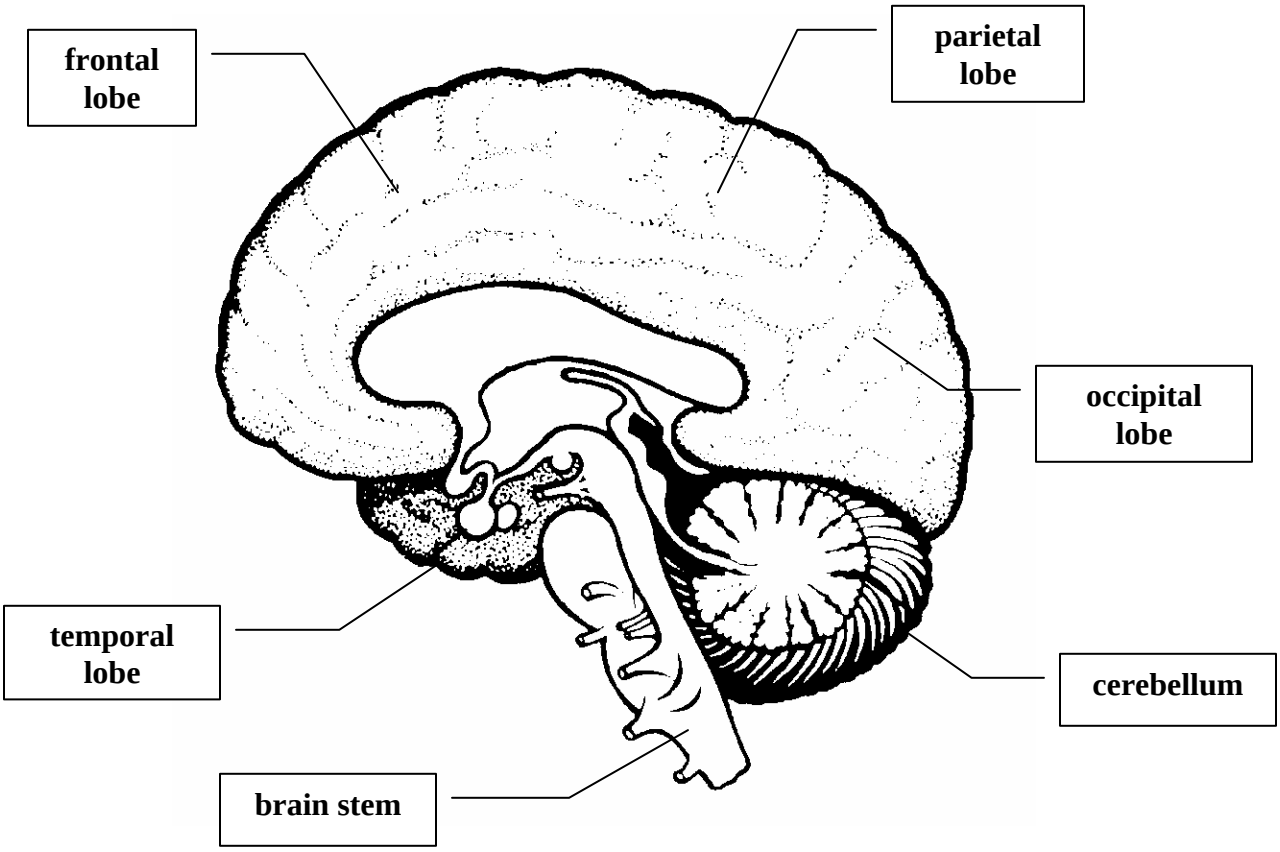
Name: _____

ACTIVITY 2C

BRAIN SCAN

Answer Key

PART ONE



PARTS TWO and THREE

1. Frontal lobe ☆
2. Cerebellum
3. Occipital lobe
4. Brainstem
5. Occipital lobe
6. Temporal lobe
7. Frontal lobe ☆
8. Parietal lobe
9. Brainstem
10. Frontal lobe ☆
11. Cerebellum
12. Temporal lobe

Name: _____

ACTIVITY 3A

DRUGS AND THE BRAIN

As you learned in the video, many drugs do more than cause a temporary high—they actually change the way that neurons in the brain communicate with each other. Take a closer look by reading each description below, and then draw your own diagram, identifying each of the words in bold.

NOTE: You will need to consult *The Brain*, *The Neuron* and *Neurotransmitters* fact sheets in order to complete this activity.

1. The Normal Brain

Neurons in the brain communicate with each other by sending chemical "messages." The space where the "sending" end of one neuron, or **axon**, meets the "receiving" end of another neuron, or **axon**, is called a **synapse**. To send a message, one neuron releases a chemical called a **neurotransmitter** into the synapse. The neurotransmitter finds specific **receptors** on the other neuron and binds to them, like a lock in a key. When the message has been sent, the neurotransmitter is either broken down in the synapse or taken back into the sending neuron through **dopamine transporters** to be used again.

Diagram 1:

This activity is continued on the next page.

2. The Brain of a First-Time Drug User

All addictive drugs cause a feeling of euphoria. This feeling is strongest when someone first begins using the **drug**. The euphoric "high" happens because the drug causes a flood of the neurotransmitter **dopamine** to be released into the **synapses** of the reward pathway. Certain drugs, like cocaine or methamphetamine, actually block the **dopamine transporters** of the **axons** so that the dopamine stays active in the brain for an extended amount of time.

Diagram 2:

3. The Brain of an Addict

Long-term use of a **drug** like cocaine actually causes the brain to lose **receptors** for the neurotransmitter **dopamine**. That means that it's much harder for an addict to feel pleasure from normal things, like hanging out with friends. Other drugs, like alcohol, methamphetamine and Ecstasy kill **neurons**. The addict now must take increasing amounts of the drug to just feel normal.

Diagram 3:

Name: _____

ACTIVITY 4A

EXPLAIN WITH THE BRAIN

New research has uncovered many brain-based explanations for why drug users and addicts feel and behave the way they do. Using the facts you learned in the video about the brain, explain why the following things might happen.

1. Henry experiences a very strong craving for heroin whenever he sees a needle.

2. Samantha has to drink three glasses of wine to get the same effect she used to get with just one glass of wine.

3. Teens are more likely to experiment with drugs than adults are.

4. Jon doesn't do cocaine to feel good anymore; he does it just to feel normal.

This activity is continued on the next page.

Name: _____

EXPLAIN WITH THE BRAIN

5. The brains of teen drug addicts recover less than the brains of adult addicts after they stop using drugs.

6. Kate feels intense pleasure the first time she tries methamphetamine.

7. Keenan stops eating, showering, and talking to his family because he's focusing on getting drugs instead.

8. Lara simply can't control her drug use anymore.

Answers to this activity appear on the next page.

Name: _____

Answer Key

1. Certain people, places or things that are associated in an addict's mind with taking drugs actually cause a surge of dopamine in the brain. This dopamine triggers a powerful craving for the drug.

2. Repeated drug use leads to tolerance, meaning that the body's reward pathway begins to adapt to the drug and doesn't respond as strongly as it did when the drug was new to the system. Alcohol kills neurons, reducing the ability of the brain to transmit dopamine. The brain then needs more and more of the drug to get the same pleasurable feeling.

3. Teens may experience a natural dip in their reward pathways, making them more likely to seek out extreme things to get a rush. At the same time, the frontal lobe of a teenager—the part of the brain that is in charge of problem solving, decision-making and planning—is not fully developed, so they are less likely to think through their decision to use drugs and anticipate the consequences.

4. When someone uses drugs for a long time, he can become dependent on them. Cocaine reduces the number of dopamine receptors in the brain, so it's harder to feel pleasure from normally fun things. The brain is also tricked into thinking that the drug is part of its normal state. As a result, the addict feels terrible unless he has the drug in his system.

5. The teen brain is still developing and able to change with experience. When a teen becomes addicted to drugs, the brain adapts itself to functioning with that drug present. Since the brain did not develop completely without interference from drugs, the damage those drugs caused can be irreversible.

6. Trying a drug like methamphetamine for the first time causes a surge of dopamine in the brain, which gives the user a great feeling. Meth also blocks the dopamine transporter from pumping the dopamine back inside the neuron to be used later, causing an extended high.

7. Drugs can take over the reward pathway of the brain, tricking the addict into thinking that getting the drug is more important than other things that used to activate the reward pathway, like food or spending time with family.

8. Addiction is characterized by compulsive drug use—the addict cannot control the cravings for the drug. Prolonged drug use changes the brain so much that it doesn't function properly without the drug.

Name: _____

ACTIVITY 5

VIDEO QUOTES

The quotes below are from the recovering addicts and scientists featured in ***Addiction and the Human Brain***. Choose one of the quotes and write a brief essay responding to it.

> *"I feel very strongly that addiction is a brain disease. I think there's ample evidence, compelling evidence that there are profound changes that occur in the brains of people who are addicted to certain substances."*
>
> —Dr. Stephen Dewey

> *"When I first started using crack, it made me feel strong, it made me feel powerful. It gave me confidence that I didn't have before and it was fun."*
>
> —Amanda

> *"One of the things that is really common during adolescence, particularly early in the teen years, is for teens to just feel a little blah, a little bit bored, slightly depressed on a regular basis. It's just a natural part of teenage development."*
>
> —Dr. Aaron White

> *"My whole life revolved around how and where I was going to get drugs. I didn't care about anything... my family, my girlfriend... nothing."*
>
> —Chris

> *"So this wonderful thing that happens during adolescence—the mold ability of the brain—can actually backfire for us. It can actually harm us by increasing the likelihood that we learn negative things too—bad habits as well as good habits."*
>
> —Dr. Aaron White

> *"The cravings, the feeling for the drugs is way too strong. The power of the drugs is just way too strong for anybody to quit on their own."*
>
> —Amanda

Keep these questions in mind as you write your essay:

Do you agree or disagree with the speaker? Why?

Does the quote remind you of a situation in your own life, concerning you or someone you know? In what way?

What would you say to the speaker if you could? What questions would you ask?

Name: _____

ACTIVITY 6A

RESEARCH PROJECT

Find out more about addiction by choosing one of the topics below and writing a brief research paper on your findings. You can gather information at your school or local library or on the Internet. Use a *Resource Tracker* to keep track of your sources.

Who Becomes an Addict?

Not everyone who uses drugs will become an addict; researchers have pointed to differences in genetics, environment, and social context of drug use to try to explain why. How are these factors related to addiction? What other reasons could explain who becomes addicted to drugs and who does not?

Overcoming Cravings

Certain people, places or things that are associated with drug use in an addict's mind can trigger uncontrollable cravings for drugs. Why do these cravings occur? How do counselors and therapists help addicts overcome these cravings in rehab?

Addiction and Society

An addict's compulsive desire for drugs has a number of repercussions for society as a whole. How are people affected by drug addiction? Think about crime, health care costs, drug trafficking, and economic factors.

Addictive or Not?

People often assume that certain drugs are addictive while other drugs are not. Consider drugs like cocaine, heroin, Ecstasy, methamphetamine, alcohol, nicotine and marijuana. Which produce physical withdrawal symptoms? Which cause psychological dependence? Which would you say qualify as addictive?

New Findings

Recent studies have discovered lots of new information about how drugs act on the brain, using methods such as PET scans and animal experiments. Find one study on the brain and drug addiction, and then summarize it in plain language. Who performed the study? What did this study find? Do others agree with the findings? What implications does the study have for treating addiction?

Name: _____

ACTIVITY 6B

RESOURCE TRACKER

Title of book or article:	Title of book or article:
Author(s):	Author(s):
Published by / web URL:	Published by / web URL:
Copyright date:	Copyright date:
Subject covered:	Subject covered:
Quote(s):	Quote(s):
Notes:	Notes:

Name: _____

ACTIVITY 7

MYTHS VERSUS FACTS

There are all kinds of myths swirling around the topic of drug addiction. Some are hurtful, some are unfair—and all of them tend to mask the truth about addiction and the brain. Imagine you have heard one of your friends repeat the drug myths below. Using what you learned in the video, set your friend straight.

1. "A drug addict would just stop using drugs if he really wanted to."

2. "Marijuana is 'natural,' so it can't be addictive."

3. "Anybody who does drugs will become an addict."

4. "Experimenting with drugs is just a natural part of growing up—it doesn't mean you'll get addicted."

5. "People do drugs because drugs always make them feel good."

6. "Drugs don't cause any long-term damage to the brain."

7. "Recovering addicts who relapse are weak."

8. "The reason why drug addicts care more about drugs than their friends and family is because addicts are selfish."

9. "Only trashy people get addicted to drugs."

Name: _____

ACTIVITY 8A

TOLERANCE, DEPENDENCE AND ADDICTION

As you learned in the video ***Addiction and the Human Brain***, a drug user's brain changes in response to the drugs. Typically a user moves from casual experimentation with a drug to tolerance, and then onto dependence before finally reaching addiction.

Read the scenarios below, and then write down whether they represent *tolerance*, *dependence* or *addiction*.

1. Jen has to take twice as much heroin to get the same high she used to get with just one needle. _____
2. Neurons and dopamine receptors begin to die. _____
3. Ryan has a compulsive need to drink alcohol. _____
4. Stan will do anything, including steal from his friends, to get drugs. _____
5. The brain adjusts to the drug to the point that it needs the drug to function normally. _____
6. Sierra's reward pathway doesn't respond as strongly as it used to when she smokes a cigarette. _____
7. Jon experiences overwhelming physical withdrawal symptoms when he doesn't take heroin. _____
8. Instead of a good feeling, taking the drug only produces relief. _____
9. The drug user's brain cells become more resistant to the effects of the drug. _____
10. Lia cannot control her cocaine use anymore. _____

Answers to this activity appear on the next page

Name: _____

ACTIVITY 8B

TOLERANCE, DEPENDENCE AND ADDICTION

Answer Key

1. Tolerance
2. Dependence
3. Addiction
4. Addiction
5. Dependence
6. Tolerance
7. Addiction
8. Dependence
9. Tolerance
10. Addiction

Name: _____

ACTIVITY 9

A FRIEND IN NEED

For this activity, imagine that Miguel is your friend. Read Miguel's story, and then answer the questions below.

> *You and Miguel have been friends since middle school, and you've always spent a lot of time together. You were there when Miguel's parents got divorced, and you listened when he confided in you that he was worried his dad was an alcoholic. But after Miguel's girlfriend broke up with him, he got really depressed and started sneaking drinks from his dad's liquor cabinet. At first you didn't think it was a big deal, but soon Miguel began getting drunk more and more often. Now, he even cancels his plans to hang out with you so he can drink in his room. You've noticed that he needs to drink more and more to get drunk. Lately, it seems like Miguel is very moody and anxious whenever he isn't drinking. The only time he seems remotely happy is after several drinks.*

1. Why is Miguel acting this way? What changes do you think might have occurred in his brain?

2. Is Miguel showing signs of dependence on alcohol? If so, what are the signs?

3. What can you do to help Miguel?

4. On the back of this page, write a letter to Miguel in which you tell him about your concerns and explain to him how his brain is being damaged by alcohol.

Name: _____

ACTIVITY 10

IN SIMPLE TERMS

Addiction and brain chemistry can be complicated subjects. Pretend that you need to explain some facts about drug addiction to your eight-year-old cousin. Read each fact below, and then rewrite it in your own words so that your young cousin can understand.

1. The frontal lobes of the brain are responsible for planning, problem solving and decision-making. They are immature in teenagers, making teens more likely to indulge in risky behavior without considering the consequences.

2. Taking drugs causes a release of the neurotransmitter dopamine in the reward pathway of the brain, leading to a very pleasurable feeling.

3. Certain drugs reduce the number of dopamine receptors in the brain, making it more difficult to feel pleasure from normally pleasurable activities. Therefore, the user has to take increasing amounts of the drug to feel normal.

4. Addiction is the compulsive physiological need for a habit-forming substance.

5. Chronic drug use alters not only the reward pathway, but also the reward pathway's ability to respond to drugs.

6. Certain "triggers," or things associated with a drug, make an addict experience intense cravings by causing a release of dopamine in the brain.

Name: _____

ACTIVITY 11

GETTING BETTER

There is no single right way to treat drug addiction. Some people respond to group therapy, some may prefer one-on-one counseling, and some may feel they need medication to help them kick the habit completely. Find out more about rehabilitation methods by choosing a recent article from a newspaper, magazine, journal or reliable Internet source about treating drug addiction. Make a photocopy of the article and attach it to this sheet.

Article Title: _____

Author: _____

Publication/Website: _____

Date of Publication: _____

Page(s): _____

Read the article carefully, and then answer the questions below on a separate sheet of paper.

1. What is the treatment method described in your article?

2. Who is involved in the treatment—psychiatrists, psychologists, peer counselors, etc?

3. Does the treatment have a certain time-frame? Are medications required?

4. How long has the treatment been used? Is it a new method or has it been used successfully for years?

5. How successful is the treatment? Are there any statistics available about what percent of addicts are helped?

6. Given what you know about drug addiction, do you think this is a good treatment? Why or why not?

Name: _____

ACTIVITY 12A

THE ROOTS OF ADDICTION

The following excerpt is condensed from a longer article about new addiction research. Read the excerpt, and then answer the questions below.

Addicts' own stories confirm neuroscience

by Rita Rubin, USA TODAY

"The inability to stop is the essence of what addiction is," says Nora Volkow, director of the National Institute of Drug Abuse, part of the National Institutes of Health.

Caffeine can be habit-forming, but Starbucks devotees won't risk jail time or divorce to feed their habit. Nor is addiction the same as dependence, although the American Psychiatric Association's diagnostic says it is, according to Volkow, who's pushing to drop that wording. "Addiction is much harder to treat. Everybody given an opiate (such as morphine) will become physically dependent, but not everybody will become an addict.

But some do. Why? For many, alcohol or drugs offer a quick fix, [Dr. George] Koob says. "You're using the drug to fix something that should be fixed by perhaps getting a good night's sleep or pacing yourself."

If you want to know whether a child will turn to alcohol or drugs for a quick fix, look at his parents, says Mark Willenbring, director of treatment and recovery research at the National Institute of Alcohol Abuse and Alcoholism.

If the parents are abusing drugs, chances are high that the child will too, Willenbring says. Having only one or no parent in the home or a psychiatric illness also raises a child's risk of addiction, he says.

As Daniel Payne, 27, recalls, "My favorite drug was more and all." Payne says he began "experimenting" with his father's beer when he was about 10. He got marijuana from older kids. "In the neighborhood that I grew up in, everybody was doing it," he recalls.

Scientists have known for decades that separating young laboratory animals from their parents made them much more likely to take alcohol. A rodent study published this year found that contact between offspring and parent is necessary to activate a gene involved in the animal's response to stress, Volkow says.

Research has shown that stress is a major contributor to addiction. People who repeatedly take drugs may end up with an exaggerated response to stress, so minor stresses become major ones, says Frank Vocci.

Payne actually graduated in 1999 from the Virginia Military Institute. Despite the school's strict anti-drug policy, Payne says, as a senior he smoked marijuana daily and used cocaine three or four times a week.

In March 2001, he was placed on probation for setting fire to a vacant dorm room. According to an account in *The Roanoke Times*, Payne told the judge that the "spontaneous acts of stupidity" leading to the fire were fueled by 30 beers, five shots of liquor and his anger at a friend's dismissal from VMI.

Payne always figured that drugs or alcohol or both would kill him by age 25. At 24, he says, he found himself alone in a Richmond hotel room with a gun in his hand. The experience, he says, was "an awakening," and he hasn't used drugs since.

Source: "Addicts' Own Stories Confirm Neuroscience." Rita Rubin, USA Today 10/10/2005

This activity is continued on the next page.

Name: _____

ACTIVITY 12B

THE ROOTS OF ADDICTION

1. According to the article, what do a child's parents have to do with whether or not he will become an addict later in life?

2. What have researchers discovered about separating young animals from their parents? What implications does this have for explaining addiction?

3. What factors contributed to Daniel Payne becoming a drug addict?

4. What is the difference between addiction and dependence?

5. What events led up to Payne's decision to stop using drugs? What kind of help do you think he needed to follow through with that decision?

FACT SHEETS

Name: _____

FACT SHEET 1A

GLOSSARY OF TERMS

Addiction: Continual physiological need for a habit-forming substance. Addiction causes people to pursue that substance even when it is associated with negative health or social consequences.

Axon: Long fiber-like extension of a neuron that sends information to other neurons.

Cell body: The main part of a neuron, which contains the cell nucleus.

Chronic: A disease or condition that exists over a long period of time.

Compulsion: The strong urge to carry out a given act, such as take drugs.

Craving: Intense desire for a drug, often triggered by people, places or things that an addict associates with the drug. The trigger becomes so connected with the drug in the addict's brain that exposure to it causes a release of dopamine, priming the addict's brain for more of the drug.

Dendrite: The finger-like branches coming out of the cell body of a neuron that receive messages from other neurons.

Dependence: A state in which a drug user's brain has adjusted to the presence of the drug and needs it to function normally. Someone who is dependent on a certain drug no longer uses it to feel good, but simply to feel normal.

Dopamine: A neurotransmitter that plays a role in movement and feelings of pleasure. Drugs of abuse cause a release of dopamine in the brain, causing the user to feel euphoric or "high."

Frontal lobes: A section in the front of the brain that deals with planning, problem solving and decision-making. The frontal lobes enable us to think beyond the present and anticipate consequences of our actions. New research has found that the frontal lobes are not fully mature until the early 20s.

Neuron: A brain cell. Neurons are the foundation of the nervous system that enable the brain to control all life's functions. Neurons communicate with each other by releasing chemicals to neighboring neurons. The part of the neuron that sends messages to other neurons is called the axon; the many parts of the neuron that receive messages from other neurons are called dendrites.

Name: _____

FACT SHEET 1B

GLOSSARY OF TERMS

Neurotransmitter: A brain chemical that relays information from one neuron to another. When a neuron communicates with another neuron, it releases a specific neurotransmitter through its axon; the neurotransmitter then binds to receptors on a neighboring neuron's dendrite and causes changes in the body of that neuron. Different neurotransmitters have different functions.

PET scan: Abbreviation for Positron Emission Tomography scan. A PET scan is a tool that allows scientists to observe changes in the brain and visually image brain activity. PET scans are very useful in drug and addiction research because they let scientists see how a drug affects certain parts of the brain.

Plasticity: A quality of the brain that allows it to change according to experiences and the environment. If a part of the brain is injured or damaged, its plasticity may allow other parts of the brain to take over and compensate for that damage.

Recovery: Overcoming drug addiction. Counseling, group therapy and even medications are used to help addicts quit using drugs. Part of recovery is the physical healing of any parts of the brain damaged by drug use.

Relapse: Sliding back into drug use while trying to overcome addiction. Relapsing is very common among recovering addicts. It does not mean the person is weak.

Reuptake: The process by which neurotransmitters are removed by the synapse by being pumped through transporters back into the axon terminals that released them.

Reward pathway: A central part of the brain, stretching from the brain stem to the front of the cerebral cortex. The reward pathway is stimulated by dopamine in response to actions related to survival—like eating—as well as other pleasurable activities, like spending time with friends or listening to music. Drugs also cause an increase in dopamine levels in the reward pathway.

Synapse: The space between the axon of one neuron and the dendrite of another. When a neuron needs to communicate, it releases a neurotransmitter into the synapse that travels to the receptors of the receiving neuron. New synapses are constantly being made or strengthened in response to life experiences.

Tolerance: The reduction in response to a drug after prolonged use. Some drugs kill neurons and others cause a drop in dopamine receptors, but all make it harder for a drug user to feel the same rush of pleasure he did at first; higher and higher doses of the drug are required to reach that level of pleasure.

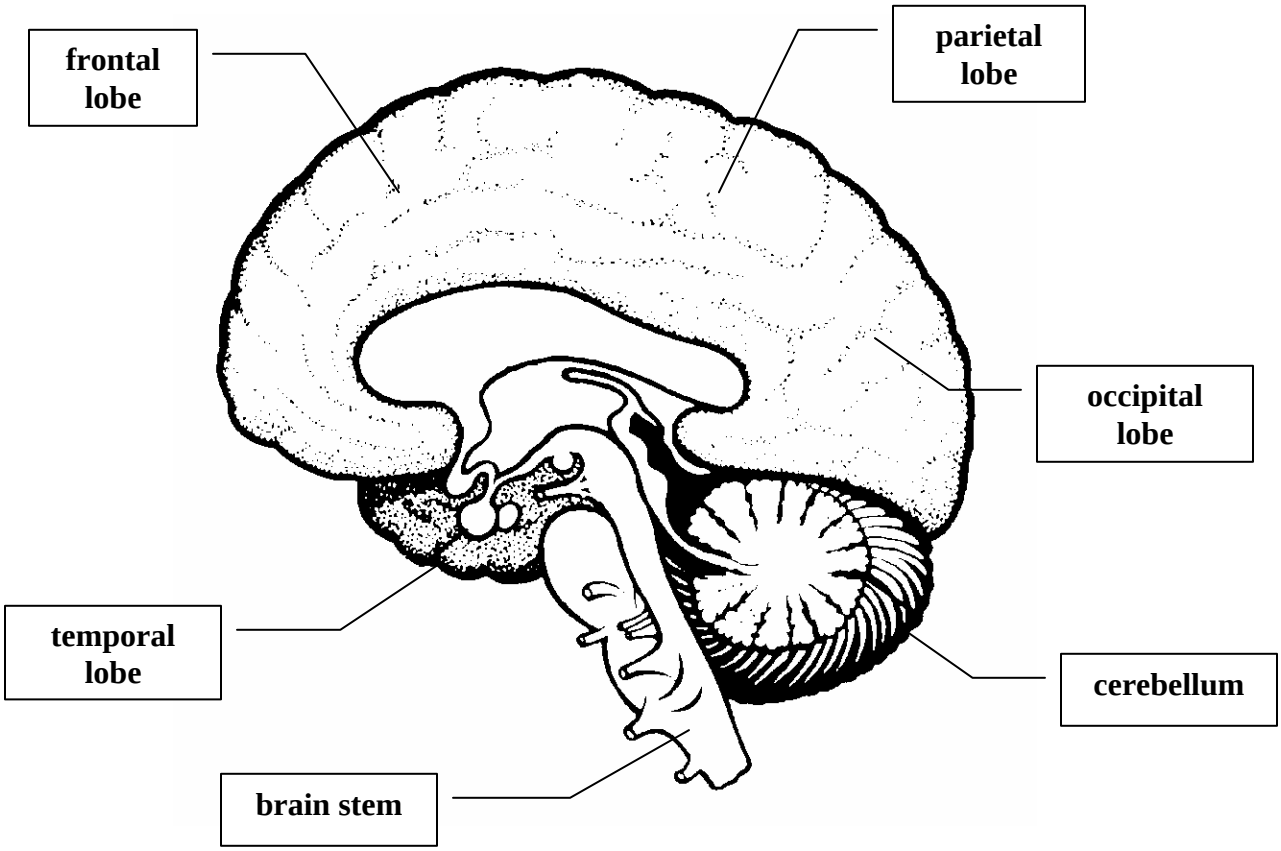
Name: _____

FACT SHEET 2

THE BRAIN

Certain parts of the brain coordinate different life functions. The **frontal lobe** is responsible for thinking ahead: planning, making decisions and solving problems. The **parietal lobe** receives and processes sensory information from the body. The **occipital lobe** coordinates vision. The **temporal lobe** deals with memory, emotion, hearing and language. Together, these lobes are called the **cerebral cortex**. Other parts of the brain include the **cerebellum**, which is responsible for coordination, skilled movement, balance and posture, and the **brainstem,** which coordinates heart rate, breathing, eating and sleeping.

Another important section of the brain is the **reward pathway**. The reward pathway regulates feelings of pleasure related to certain behaviors that are good for survival, like eating. It works like this: eating a favorite food activates certain nerve cells at the top of the brainstem. These nerve cells produce a sensation of pleasure. The cells pass that pleasurable feeling through a midbrain structure called the **nucleus accumbens** through to the front of the cerebral cortex. Together, those sections make up the reward pathway, and the good feelings it produces serve to reinforce life-sustaining behavior.



Name: _____

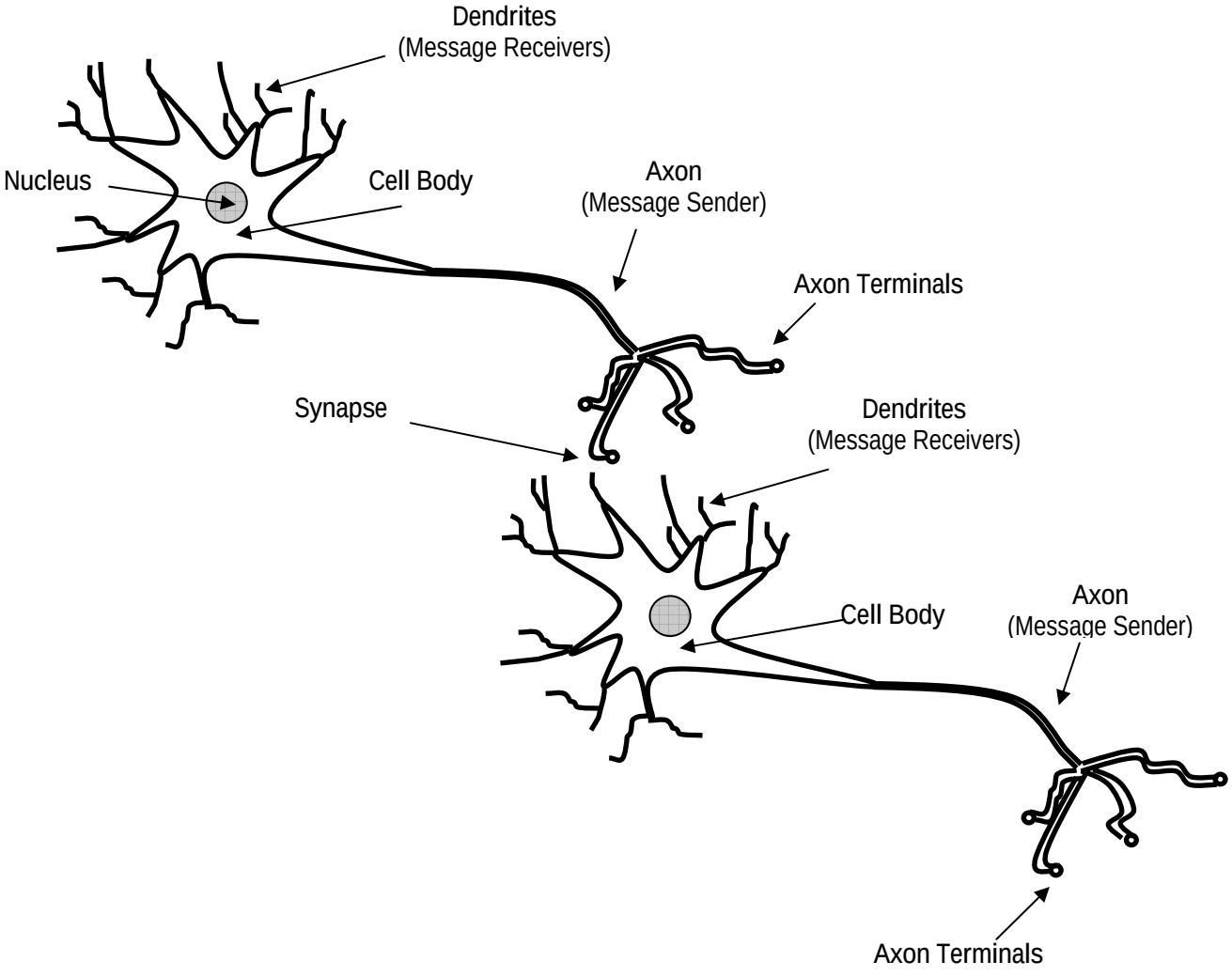
FACT SHEET 3

THE NEURON

Your brain is made up of billions of nerve cells called ***neurons***. Neurons communicate with each other and let us do all kinds of things—like think, feel emotions and move. Each neuron is made up of three main parts:

1. a central cell body, which is also called a ***soma***
2. dendrites
3. an axon

The central cell body (or ***soma***) is the main part of the neuron. On one side of the cell body are ***dendrites***, short, finger-like fibers that receive messages from other neurons and send them to the cell body. On another side of the cell body is the ***axon***, a long single fiber that sends messages to other neurons. The space between the axon of one neuron and the dendrite of another is called the ***synapse***.



Name: _____

FACT SHEET 4A

NEUROTRANSMITTERS

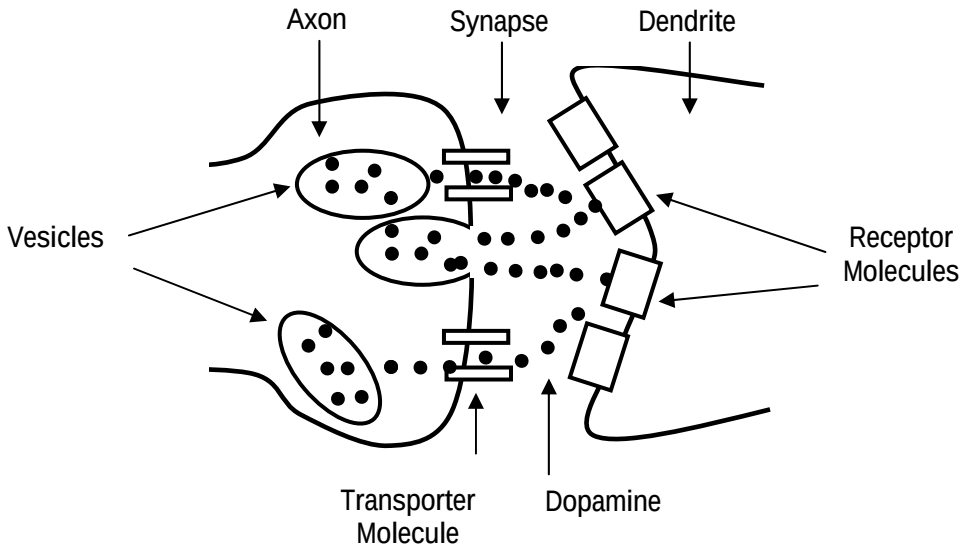
Neurons produce chemicals called ***neurotransmitters***. Neurotransmitters are stored in the axon in sacs called ***vesicles***. Neurotransmitters are basically the "mail carriers" of the nervous system. They deliver messages from one neuron to another. This process is called ***neurotransmission***.

During neurotransmission, an electrical impulse is sent from the cell body to the axon. This triggers the release of neurotransmitters from the axon into the synapse. The "mail carriers" or neurotransmitters go across the synapse and deliver their message to special molecules called ***receptors*** in the dendrites of another neuron. This "message" either stimulates or inhibits an electrical response in the receiving neurons dendrites.

Once the message has been received, the neurotransmitter is "turned off" in one of two ways. It may be broken down by an enzyme inside the synapse. Or the neurotransmitter may by carried by transporter molecules across the synapse back into the original axon so it can be recycled and used again. This is called ***re-absorption*** or ***reuptake***.

There are many different kinds of neurotransmitters. The primary neurotransmitter affected by drug use is ***dopamine***. Dopamine sends messages about pleasure, mood and movement. When pleasurable things happen—like when you eat chocolate or win a sporting event— neurons containing dopamine release their dopamine and the dopamine neurotransmitters pass this "pleasure message" onto the dendrites of other neurons. Other neurotransmitters that are affected by drug use include ***norepinephrine*** (which controls anger and fear and is part of our bodies' fight-or-flight response) and ***serotonin*** (which affects mood, appetite and body temperature).

NORMAL BRAIN ACTIVITY



Name: _____

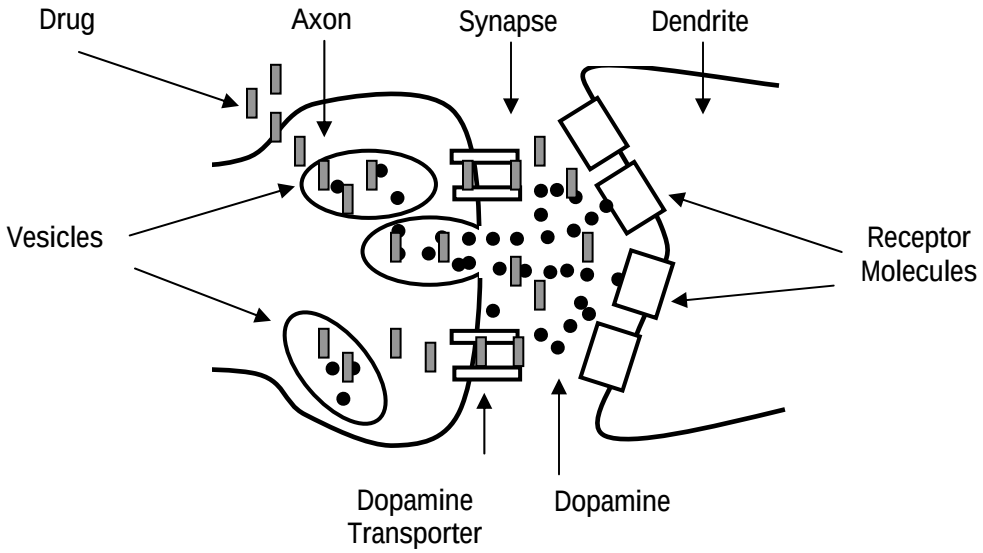
FACT SHEET 4B

NEUROTRANSMITTERS

Drugs enter a neuron in two ways. The drug can pass directly through the cell membrane of the axon, or it can also hitch a ride on a transporter molecule. All addictive drugs cause a feeling of euphoria, strongest when someone first begins using the drug. This happens because the drugs cause a flood of the neurotransmitter ***dopamine*** to be released into the ***synapses*** of the reward pathway. Certain drugs—such as cocaine or methamphetamine—actually block the ***dopamine transporters*** of the ***axon*** so that the dopamine stays active in the brain for an extended amount of time.

Long-term use of a drug like cocaine actually causes the brain to lose ***receptors*** for the neurotransmitter ***dopamine***. That means that it's much harder for an addict to feel pleasure from normal things that used to be enjoyable, like watching a movie or hanging out with friends. Other drugs—such as alcohol, methamphetamine and Ecstasy—actually kill the brain's ***neurons***. The addict's brain is now so altered that he or she must take increasing amounts of the drug to just feel normal.

BRAIN ACTIVITY WHEN DRUGS ARE ABUSED



Name: _____

FACT SHEET 5

FROM USE TO RECOVERY

Drugs change the way the brain works. Let's use Michelle for an example. Michelle is a 17 year-old drug user who started out just "experimenting" with a drug, then moved into occasional use, and ultimately progressed into addiction. Now that she is recovering from addiction, her brain is constantly adapting to the environment she created with the drug.

It all begins when Michelle takes the drug for the first time. Drugs make people feel great at first by causing a rush of dopamine to the brain's reward pathway. Some drugs, like cocaine or methamphetamine, even block the dopamine transporters in the brain from taking the dopamine back into the cells, causing an extended high.

After Michelle takes a drug for some time, though, her brain adjusts to the drug. Alcohol, methamphetamine and Ecstasy kill neurons while cocaine reduces the number of dopamine receptors in the neurons—either way, it becomes harder for Michelle to get high, so she has to take more and more of the drug to get the original effect. This is called tolerance.

As Michelle's drug use continues, her brain is tricked into believing that the drug's presence is "normal"—her brain cannot function without the drug. At this point, dopamine receptors have been so reduced that it becomes very hard for Michelle to feel pleasure from things she used to enjoy. She doesn't take the drug to feel good anymore; she takes it just to feel normal. This is called dependence.

Some people move on from dependence to addiction, the compulsive need for the drug. Michelle's dependence progresses into full addiction. She can't control her drug use any longer, and she begins to neglect everything else in her life—like family, personal responsibilities, hygiene or even eating—in order to take the drug. Michelle's brain has been so changed by the drug that it takes over every facet of her life.

With help, an addict can recover. Rehabilitation centers and therapy groups help Michelle learn to control her strong urges for the drug. Over time, the damage the drug did to Michelle's brain heals; and though evidence suggests that teenage brains do not recover as fully as adult brains do, the teen brain is still remarkably plastic and able to compensate for damage.

Name: _____

FACT SHEET 6

LEARNING MORE

Check out these resources for more information about drug addiction and the brain.

The Brain: Understanding Neurobiology through the Study of Addiction

http://science.education.nih.gov/supplements/nih2/addiction/default.htm

Explore tons of lessons, diagrams, and interactive activities on this National Institute on Drug Abuse site.

Brookhaven National Laboratory

www.bnl.gov/CTN/addiction.asp

Browse the latest studies on addiction and the brain.

Frontline: Inside the Teenage Brain

www.pbs.org/wgbh/pages/frontline/shows/teenbrain

Learn more about teen brain development, read interviews with experts, or even watch a *Frontline* special online.

Moyers on Addiction: Close to Home

www.pbs.org/wnet/closetohome/science

Janet Firshein's detailed report covers addiction, cravings, relapses, drugs' effects on the brain, vulnerability to addiction, and recovery.

The Neurobiology of Drug Addiction

http://www.nida.nih.gov/pubs/teaching/Teaching2/Teaching.html

View slides explaining brain function and the effects of drugs.

Name: _____

FACT SHEET 7

RESOURCES

"The Brain: Understanding Neurobiology through the Study of Addiction." National Institutes of Health Office of Science Education, Curriculum Supplement Series. http://science.education.nih.gov/supplements/nih2/addiction/default.htm

"Bringing the Power of Science to Bear on Drug Abuse and Addiction." National Institute on Drug Abuse. www.nida.nih.gov/pubs/teaching/Teaching5/Teaching.html

Firshein, Janet. "Moyers on Addiction: Close to Home." www.pbs.org/wnet/closetohome/science

"Inside the Teenage Brain." *Frontline* website. www.pbs.org/wgbh/pages/frontline/shows/teenbrain/

Leshner, Alan I. "Addiction is a Brain Disease." *Issues in Science and Technology* online, Spring 2001. www.issues.org/17.3/leshner.htm

"Study Examines Role of Cannabinoid Receptors in Alcohol Abuse." Brookhaven National Laboratory, September 9, 2005. www.bnl.gov/bnlweb/pubaf/pr/PR_display.asp?prID=05-85

"Two Studies Offer Clues about How Alcoholic Behavior is 'Switched' On." Brookhaven National Laboratory, May 9, 2005. www.bnl.gov/bnlweb/pubaf/pr/PR_display.asp?prID=05-49

White, Aaron M. "Alcohol and the Adolescent Brain." www.duke.edu/~amwhite/Adolescence/index.html

OTHER DRUG EDUCATION PROGRAMS FROM HUMAN RELATIONS MEDIA

Athletes, Alcohol and Steroids: What's Wrong with this Picture?	video/print or DVD/print
"Legal" But Deadly: Abusing Prescription Drugs	video/print or DVD/print
Abusing Over-the-Counter Drugs	video/print or DVD/print
New Club Drugs: Users Beware	video/print or DVD/print
Party Smart: Avoiding Party Meltdowns	video/print or DVD/print
The Marijuana Papers: Research Update	video/print or DVD/print
Methamphetamines: The Hard Facts	video/print or DVD/print
The Truth about Hallucinogens	video/print or DVD/print
GHB: The Facts	video/print or DVD/print
Club Drugs: The Real Deal	video/print or DVD/print
Underage Drinking: Know the Facts, Know the Risks	video/print or DVD/print
Confronting Drunk Driving	video/print or DVD/print
Dying High: Teens in the ER	video/print or DVD/print
Curriculum in a Box 2005: Substance Abuse	video/print curriculum
The Dangers of Secondhand Smoke	folding display

Visit our website for detailed descriptions of the above programs.

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