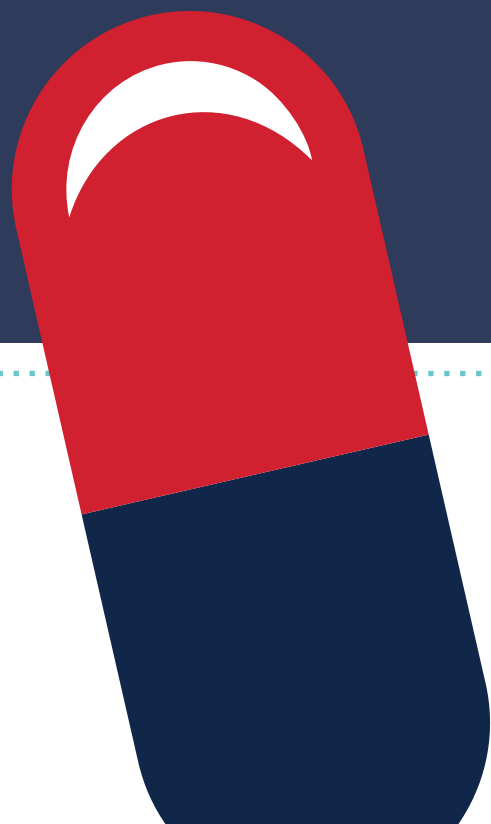


HIGH  
SCHOOL  
#1

# DIGITAL LESSON EDUCATOR GUIDE



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# INTRODUCTION TO OPERATION PREVENTION

The misuse of opioids such as heroin, morphine, fentanyl, and prescription medications is a serious national problem that affects the health, social, and economic welfare of communities. In 2017 there were approximately 192 drug overdose deaths per day in the United States with nearly 68% of those deaths related to pharmaceutical opioids or heroin. About 11.1 million people indicated misusing or abusing prescription painkillers in 2017 while nearly one in seven teens say they have used prescription medicine at least once in their lifetimes to get high. To address this complex problem, federal agencies are working to inform patients, parents, teens, pharmacists, and educators about the dangers of opioid misuse.

This guide was created to give educators ideas and strategies for presenting the content in the digital lesson. It provides slide-by-slide details for educators to be prepared to engage, explain, discuss, and effectively facilitate the content in the presentation. The presentation is designed to cover three to four 45-minute class sessions, but it is flexible, depending on the student's needs and time available.

During the lesson, students will learn that opioids are drugs that are derived from the opium poppy plant or are synthetic equivalents, such as methadone and fentanyl. Heroin is an illegal opioid, but many opioids are legal. Opioids are commonly prescribed in forms of medications that relieve pain and reduce the intensity of pain signals reaching the brain. Prescription opioid misuse is the use of a medication without a prescription. This may mean taking more than prescribed or for the feeling of being high. Prescription medications that are examples of opioids include hydrocodone (e.g., Vicodin®), oxycodone (e.g., OxyContin®, Percocet®), morphine (e.g., Kadian®, Avinza®), and codeine. Opioids act by attaching to specific opioid receptors. Endorphins are naturally produced in our bodies to help manage pain. When opioid drugs attach to these receptors, they also reduce the awareness of pain.

After considering several facts vs. misconceptions, students will examine the adverse effects of opioids on the nervous system. They will learn that opioids act upon the opioid receptors in our nervous system, and many parts of our nervous system are affected by opioid misuse. Different messages are communicated through our bodies using neurotransmitters. They take the messages across the synaptic gap to the next neuron. When they are released, the body receives a message that inhibits pain messages—we basically do not get the pain messages with as much strength because the endorphins block pain signals. A person's experiences when misusing a drug match to a specific neurotransmitter whose activity it disrupts.

Simply put, when opioids enter the body, they make us feel extremely happy. That positive feeling may make someone want to take the substance again. What is not obvious, is how opioids are hijacking the pleasure center of the brain. This region is normally activated by healthy activities, like eating and sleeping, but it is also activated during the misuse of opioids. Opioids target this part of the brain by flooding it with dopamine, a type of chemical signal that makes people feel good. Long-term misuse can lead the body to produce less dopamine over time, causing cravings.

Students will begin to uncover that, with all these changes in the human nervous system, drug misuse is no longer a choice. When opioids are misused for pleasure they can lead to physical and chemical changes in our bodies. These changes can prevent us from controlling the impulse to continue misusing opioids. The initial decision is typically voluntary but can lead to tolerance and dependence. Students then will apply what they learned by reviewing different case studies and explaining the science behind some of the signs and symptoms of opioid misuse.

At different points in the lesson, students may be tempted to share personal information about opioid misuse by themselves or others. As always, be sure to follow school or district policies about the sharing of personal information about minors.

# INTRODUCTION TO OPERATION PREVENTION

## HOW DO THE SESSIONS WORK?

**Teaching Sequence:** The Operation Prevention High School Educator Guide is a series of seven 45-minute sessions designed to be taught in sequence and used with ninth through twelfth grade students. This guide was created to give educators ideas and strategies for presenting the content in the digital lessons. It provides slide-by-slide details for educators to prepare them to engage with students as they explain, discuss, and effectively facilitate the content in each of the sessions.

In addition to the Educator Guide, an accompanying presentation was created with PowerPoint to be used in a variety of classrooms. If you are using a laptop with an LCD projector, simply progress through the PowerPoint by clicking to advance. All of the interactive aspects of the presentation are set to occur on click. The corresponding videos link to the slides. Click on the images to play the videos. If you are using an interactive whiteboard, tap on each slide with your finger or stylus to activate the interactive aspects of the presentation. It does not matter where you tap, but you can make it appear as if you are making certain things happen by tapping them. Teacher notes are included for each slide that include information on how to proceed.

**Setting Up Norms/Rules:** It is a good idea before starting the Operation Prevention sessions with high school students to set up norms or rules for the lessons. Norms are standards or procedures that your class will follow while they are participating in the Operation Prevention sessions. You may already have established class rules/norms and may choose to incorporate them into these sessions as well. However, you will want to consider adding some additional norms due to the more sensitive information that these sessions will discuss. Here are a few suggested norms you may want to consider:

- We value participation by everyone.
- We are open to hearing opinions that may be different than ours.
- We will respect what others have to share and allow them to share it without judgement.
- What we share will be kept confidential. We will not use names when sharing stories.\*

\*In the case of mandated reporting issues, we recommend you follow your school or organizational guidelines and make sure that students are aware of them.

It is essential to create a safe and comfortable classroom atmosphere for students to engage in the content of the Operation Prevention sessions. Be sure to revisit the agreed upon norms/rules regularly with your students and remind them that the purpose is to have a safe place where everyone can feel comfortable sharing and learning. At different points in the lesson, students may be tempted to share personal information about opioid misuse by themselves or others. As always, be sure to follow school or district policies about the sharing of personal information about minors.

**Session Structure:** Each Operation Prevention High School session provides the following information to guide the teacher through its implementation and provide them with information to teach the necessary skills and content.

- **Objectives:** Each session includes its overall goals as well as specific behavioral and cognitive objectives for students.
- **Required Materials:** Any materials necessary for the session are clearly outlined and included when possible to facilitate easy implementation of the session.
- **Student Responses:** Guidance for the teacher is provided for acceptable student responses for activities and questions on corresponding slides.
- **Key Points to Make:** To help the teacher guide discussion and reinforce key concepts, key points to make are listed as part of each session on corresponding slides.
- **Definitions:** Any terms that can be used as vocabulary words will be defined for the teachers.
- **Summary/Wrap Up:** The summary/wrap up is provided for the teacher to bring the session to a conclusion and provide reinforcement of key concepts.

# SESSION 1 OVERVIEW

SLIDES  
1-4

## ENGAGE

### Fact or Misconception

#### Overview:

In this session, students will identify and justify their beliefs about a series of facts and misconceptions related to opioid misuse.

#### Content Areas

Life Science, Anatomy and Physiology, Biology, Health and PE, Sports, Exercise, and Health Science

#### Activity Duration

3-4 class sessions (45 minutes each)

#### Grade Level

Grades 9–12

#### Objectives:

- Students will examine and articulate their knowledge of opioids.

#### Materials:

- Chart paper and markers
- Note cards
- Handout  
<https://www.asam.org/docs/default-source/advocacy/opioid-addiction-disease-facts-figures.pdf>

#### Definitions:

- **Misconception** - an idea or opinion that is incorrect because it is based on a mistaken thought or understanding.
- **Myth** - a widely held but false belief or idea

# SESSION 1

WHAT DO YOU KNOW ABOUT OPIOIDS? DISCUSS

- In 2017, there were approximately 192 drug overdose deaths per day in the United States.
- 68% of those deaths are related to pharmaceutical opioids or heroin.
- About 11.1 million people indicated misusing prescription painkillers in 2017.
- Nearly one in seven teens say they have used prescription medicine at least once to get high.

OPERATION PREVENTION

## SLIDE 1

Arrange students in small groups (3-4) and hang a blank sheet of chart paper for each group in different areas of the room.

Depending on the size of your groups, use Cooperative Learning Roles and assign or have students choose their role:

- **Leader** – Makes sure everyone’s voice is heard.
- **Time Keeper** – Encourages the group to stay on task.
- **Recorder** – Compiles group members’ ideas and writes them down
- **Presenter** – Shares the group’s work with the larger group
- **Errand Monitor** – Leaves group to get supplies or to request help from the facilitator

Ask: “What do you know about opioids?” and instruct student groups to list everything they know or think they know about opioids, using the chart paper to capture their ideas.

At set intervals, ask students to rotate to the different charts posted around the room. Ask them to put an “A” by items they agree with and put an “D” by the items they disagree with. They should decide whether they agree or disagree with the information as a group, not individually. They will need to come to a consensus in order to “vote A or D” for each statement on the chart.

Introduce the concept of a misconception by asking students how they define it. A **misconception** is an idea or opinion that is incorrect because it is based on a mistaken thought or understanding. Ask students to define myth. A **myth** is a widely held but false belief or idea.

Invite students to revisit their chart papers and identify what they think the biggest misconceptions or myths are about opioids. Have them mark the top five with an “M”.

Review each chart and have students share out what they designated as their top five misconceptions or myths about opioids.

Click on the slide to reveal statistics about America’s opioid epidemic. Explain to students that opioids are drugs that influence the nervous system to reduce feelings of pain. Heroin is an illegal opioid, but many opioids are legal. Opioids are commonly prescribed in forms of medications. Students might have heard of Vicodin®, OxyContin®, Percocet®, morphine, and codeine. These are all types of prescription opioids.

If time allows, students can review <https://www.asam.org/docs/default-source/advocacy/opioid-addiction-disease-facts-figures.pdf> and compare their statements to the facts in the document.

# SESSION 1

WHAT DO YOU THINK?

**FACT**

**MISCONCEPTION**

- Addiction is rare.
- When used to treat pain, prescription opioid drugs are not addictive.
- Only certain people are at risk of misusing opioid drugs.
- Prescription opioids are the most rapidly growing class of misused drugs.

OPERATION PREVENTION

## SLIDES 2-3

Combine the small groups to form two large groups of students.

Explain that there are many misconceptions about opioid misuse. It is important to be able to separate truth from misconception.

Distribute two index cards to each group: one with “Fact” written and one with “Misconception.”

WHAT DO YOU THINK?

**FACT**

**MISCONCEPTION**

- Opioids work in your body the same way that over-the-counter pain relief medications do.
- It is easy to quit opioid dependency if you are disciplined.
- Prescription opioids and heroin affect your body the same way.
- Heroin affects the body but not the brain.

OPERATION PREVENTION

Read aloud the first statement on slide 2 and invite students to discuss their response as a group. Invite each group to hold up the card they think is correct. Reveal the correct answer and explain using statements below. Repeat for each statement.

**Fact or Misconception:** Addiction is Rare

**Misconception:** Anyone can be affected by drug misuse and abuse. There are no barriers that make anyone safe from this issue.

**Fact or Misconception:** When used to treat pain, prescription opioid drugs are not addictive.

**Fact:** Prescription drugs are the most rapidly growing class of abused drugs.

**Fact or Misconception:** Only certain people are at risk of abusing opioid drugs

**Misconception:** Many factors determine the likelihood that someone may become addicted to a drug. This includes both inherited and environmental factors.

**Fact or Misconception:** Prescription opioids are the most rapidly growing class of abused drugs.

**Fact:** Opioids have been linked to nearly 68 percent of drug overdoses in the U.S. In 2017, there were 192 drug overdose deaths per day in the United States. 68% of those deaths are related to pharmaceutical opioids or heroin.

**Fact or Misconception:** Opioids work in your body the same way that over-the-counter pain relief medications do.

**Misconception:** Prescription pain relief medication interacts with your body differently than over-the-counter (OTC) medications.

# SESSION 1

WHAT DO YOU THINK?

**FACT**

- Addiction is rare.
- When used to treat pain, prescription opioid drugs are not addictive.
- Only certain people are at risk of misusing opioid drugs.
- Prescription opioids are the most rapidly growing class of misused drugs.

**MISCONCEPTION**

2

OPERATION PREVENTION

## SLIDES 2-3 CONT.

**Fact or Misconception:** It is easy to quit opioid dependency if you are disciplined.

**Misconception:** Addiction to opioid prescription drugs and/or heroin is very strong. It alters the body and the mind, and professional help is often necessary to get away from the addiction.

**Fact or Misconception:** Prescription opioids and heroin affect your body the same way.

**Fact:** Prescription opioids and heroin both interact with our body by attaching to a specific receptor in the brain.

**Fact or Misconception:** Heroin affects the body but not the brain.

**Misconception:** Heroin affects both brain and body and can cause people to become physically and psychologically dependent on it to perform normal daily functions.

WHAT DO YOU THINK?

**FACT**

- Opioids work in your body the same way that over-the-counter pain relief medications do.
- It is easy to quit opioid dependency if you are disciplined.
- Prescription opioids and heroin affect your body the same way.
- Heroin affects the body but not the brain.

**MISCONCEPTION**

3

OPERATION PREVENTION

After all of the statements have been reviewed, lead a discussion using the following guiding questions:

- Which fact or misconception statement is most surprising?
- What misconception do you think is most common with teens your age, and why?
- Which misconception do you think is most important for teens your age to understand, and why?
- How can you use this information to make better decisions for yourself?

If time allows, invite students to respond to the final guiding question in writing.



# SESSION 1

## SESSION SUMMARY

- Anyone can become addicted to opioids.
- We should be cautious about information we hear about opioid use and analyze it as fact or misconception.
- Knowledge about misconceptions and myths around opioid use can help us make pro-healthy decisions about opioid use.
- Teens can make pro-healthy decisions about opioid use if they have accurate information.

## SLIDE 4

### Summary/Wrap of Session:

- Anyone can become addicted to opioids.
- We should be cautious about information we hear about opioid use and analyze it as fact or misconception.
- Knowledge about misconceptions and myths around opioid use can help us make pro-healthy decisions about opioid use.
- Teens can make pro-healthy decisions about opioid use if they have accurate information.

## SESSION 2 OVERVIEW

SLIDES  
5-8

# ENGAGE

### So What is an Opioid?

#### Objectives:

- Students will be introduced to what an opioid is, the different types of drugs that are classified as opioids, and common reasons why they are taken.
- Students will begin to learn how opioids impact the human body

#### Materials:

- Index cards
- Chart paper and markers
- Student Activity Sheet: [Types of Opioids](#) (one per student)

#### Definitions:

- **Natural Opioids** – Alkaloids that appear in plants such as the opium poppy.
- **Semi-synthetic/man-made opioids** – Created in labs from natural opioids.
- **Fully synthetic/man-made opioids** – Completely man-made.

# SESSION 2



## SLIDE 5

Do a quick review of the chart papers from the session before as you begin this next session and highlight the key facts about opioids from Slide 3.

Have students get back into their small groups. Invite students to use the information from their chart papers, and information they obtained from reviewing the statements on slides 2-3, to develop a definition of what an opioid is. Students can capture this information on an index card or on the same chart paper.

Next, ask each group to share their definition of opioid. Invite students to vote and pick the three answers that best describe what opioids are and where they come from.

Then, click to display the definition of opioids. Compare the definition on the slide to student answers. Ask about potential discrepancies between their definitions and the one provided. Could any of these stem from misconceptions?

Have students brainstorm why someone their age might be prescribed an opioid. Anticipated responses include:

- After surgery
- After dental work
- After a serious injury (i.e., car accident)
- After a sports injury
- Cancer
- Illness that causes pain

# SESSION 2

TYPES OF OPIOIDS		
Type of opioid	Where they come from	Examples
natural opioids (made from the plant)	alkaloids, that occur in plants such as the opium poppy	morphine codeine
semi-synthetic, man-made opioids	created in labs from natural opioids	hydrocodone, oxycodone, heroin
fully synthetic man-made opioids	completely man-made	fentanyl methadone, tramadol

## SLIDE 6

It's important for students to know that synthetic and natural opioids work in our bodies the same way. Invite students to discuss the following questions with a partner:

- Do you think there are any differences between synthetic and natural opioids?
- Do you think one is safer than the other?

The table shows the different types of opioids, how they are derived, and examples. But some of the information is missing. Ask students to fill in the chart on the slide using the word bank provided.

Missing words for students to choose from:

- Poppy
- Morphine
- Opioids
- Heroin
- Fully synthetic
- Opioids
- Man-made
- Fentanyl

Students can use the slide or the [Types of Opioids student activity sheet](#) to complete the chart.

Then, reveal the correct answers by clicking on the slide. Discuss why opioids that are synthetic can be a problem (they are made much stronger than natural opioids, and street manufacturers can mix dangerous ingredients with them.)

### Key Talking Points:

- Legal synthetic opioids are better, quicker acting, or longer acting, which can make them more addictive more quickly.
- Street manufacturers can tamper with synthetic opioids and make them more potent or rapid acting, which can cause problems.
- Crushing tablets and snorting them makes them much more dangerous.
- Synthetic opioids can be used safely if patients follow their doctors' orders and instructions.

# SESSION 2

**GIVE ME A DESCRIPTION**

What might someone who is addicted to opioids look like?

Are there certain features?

How could you tell?

OPERATION PREVENTION

## SLIDE 7

Challenge students to close their eyes and create a mental picture of what they think someone who is addicted to opioids might look like. Invite them to describe or sketch their mental image.

Have them think about these different aspects of someone who is addicted to opioids: What do they look like physically? How old are they? How do they act? What kinds of jobs or activities do they do? Where do they live?

Ask students to share their lists and/or pictures.

- Write the descriptions on a whiteboard for all students to see.
- What similarities or differences in the images can students identify?

Tell students that you are going to examine a common misconception that “addiction is a choice” by watching a video.

### VIDEO LINKS:

- Anyone Can Become Addicted to Drugs – English  
<https://vimeo.com/188196247>
- Anyone Can Become Addicted to Drugs – Spanish  
<https://vimeo.com/188178805>

Discuss the descriptions on the whiteboard after viewing the video using the following guiding questions:

- Would you change your description after viewing the video? If so, why?
- Why might people think that addiction is a choice?

**SESSION SUMMARY**

- Anyone can become addicted
- Risk factors that can influence addiction - family members who are addicted, starting drugs at a young age, having mental health issues, and hanging around other people who use drugs are things that we should be aware of.
- If you become addicted, you can be treated and recover.
- Knowing your risk factors for addiction is a way to help you make pro-healthy choices.

OPERATION PREVENTION

## SLIDE 8

### Summary/Wrap of Session:

- Anyone can become addicted
- Risk factors that can influence addiction - family members who are addicted, starting drugs at a young age, having mental health issues, and hanging around other people who use drugs are things that we should be aware of.
- If you become addicted, you can be treated and recover.
- Knowing your risk factors for addiction is a way to help you make pro-healthy choices.

# SESSION 3 OVERVIEW

SLIDES  
9-13

## EXPLORE

### How does the Nervous System Interact with Opioids? Part 1

#### Overview:

Through a series of investigations, students will learn the science behind prescription opioid misuse and heroin use, overdose, and withdrawal. Students will discover that opioid use may start off as a choice, but it can become a chemical dependency. They will apply what they learn to explain the science behind authentic stories of prescription opioid misuse and heroin use.

#### Objectives:

- Students will compare and contrast models of a healthy nervous system with the natural release of endorphins to prescription opioid misuse and heroin use.
- Students will be able to explain the chemical imbalances in each to describe why opioids are prescribed.
- Students will understand the effects of opioids on the brain and the body.

#### Materials:

- Video – The Brain Reward System  
Link here: <https://www.youtube.com/watch?v=DMcmrP-BWGk>
- Student Activity Sheet: [Parts of the Human Nervous System](#) (one per student)
- Student Activity Cards: [Keeping Balance](#) (one per pair of students)
- Student Activity Sheet: [Opioid Misuse Case Studies](#) (one per student)
- Student Activity Sheet: [Brain Basics](#) (one per student)

#### Definitions:

- **Synapse** – a gap between two nerve cells
- **Dopamine** – a neurotransmitter that helps control the brain's reward and pleasure centers
- **Dopamine Receptor** – a neurotransmitter protein that dopamine binds to, communicating messages across the brain and body.
- **Dopamine Transporter** – protein that pumps dopamine out of the synapse back into the neuron

# SESSION 3

ON YOUR NERVES:  
**COMPARING**  
TWO SYSTEMS

What do you notice about the two brains in each image?

How are they different?

How do you think these differences might be impacting the human body?

VIDEO

Discovery OPERATION PREVENTION

## SLIDE 9

Ask students: Do you know which system of the body helps you learn? Or which system your dreams come from? (It is anticipated students will be able to identify the nervous system or the brain.)

Invite students to make observations of the two brain scans on the slide, at least one of which has been influenced by drugs. Instruct students to note the differences between the brains in the image. Then, challenge them to answer the three questions that appear on the slide:

- What do you notice about the two brains?
- How are they different?
- How do you think these differences might be impacting the human body?

Invite students to share their observations, and discuss as a class.

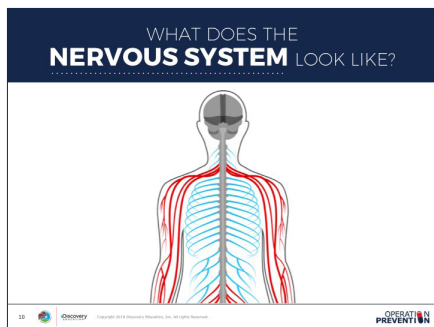
Next, play the video “The Reward Circuit: How the Brain Responds.” <https://www.youtube.com/watch?v=DMcMrP-BWGk>

Ask students: What role did the nervous system likely play in drug addiction in this video? It is anticipated that students will identify the brain as part of the nervous system. Clarify with students that when opioids enter the body, they make us feel extremely happy. That positive feeling may make someone want to take the substance again.

### Key Talking Points:

- The brain responds to opioids just like it responds when you exercise or do something that makes you feel good naturally - it floods your brain with dopamine.
- Limbic system contains the reward circuit. (our ability to feel pleasure)
- Feeling pleasure motivates us to repeat behaviors.
- Reward circuit influences individual cells.
- Drugs can hijack the brain reward system and contribute to unhealthy behaviors
- Opioids are incredibly addictive due to the prolonged sense of euphoria

# SESSION 3



## SLIDE 10

Clarify with students that our nervous system is very complicated because it helps us control so much of what we do every day. The diagram identifies the parts of the human nervous system. The image is color-coded but not labeled.

Provide small groups of students a set of descriptions of the nervous system using the [Parts of the Human Nervous System student activity sheet](#). Invite students to match each part of the nervous system to the color they think it corresponds with on the slide.

Clarify with students that opioids act upon the opioid receptors in our nervous system. This is important because the nervous system controls all the different parts of the body.

Ask students to identify parts of the nervous system that could be affected by opioid misuse and to explain their reasoning. It is anticipated students will be able to conclude that all parts of the nervous system could be disrupted by opioid misuse. This may include the brain, spinal cord, and nerves.

### Key Talking Points:

- Opioids act upon the opioid receptors in our nervous system.
- The nervous system controls all the different parts of the body.
- All parts of the nervous system could be disrupted by opioid misuse.



# SESSION 3



## SLIDE 11

This slide introduces the biological messages, sent through the nervous system, that can cause a person to misuse prescription drugs.

Begin by asking students: “How do you think disruptions or changes in the nervous system might impact our behavior?” Students may want to revisit slide 8. Discuss their responses as a class.

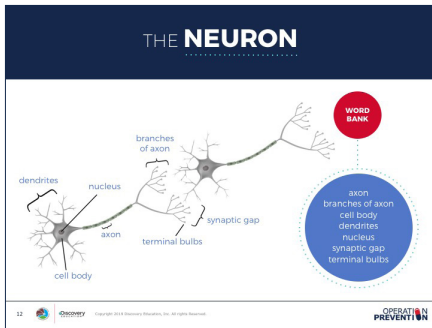
Click the [embedded link](#) in the slide to watch a clip (6:47-10:19) from the 2018 Virtual Field Trip “Opioids: Real People. Real Stories. Real Science.” The video clip highlights the biological processes that cause opioid misuse and addiction.

When students finish watching, ask: “How do you think what we learned about the nervous system can help explain the challenges faced by the people that want to stop misusing prescription opioids or using heroin?”

### Key Talking Points:

- When opioids enter the body, they hijack the reward center of the brain.
- The reward center of the brain is a region normally activated by healthy activities, like eating and sleeping, but it is also activated during the misuse of opioids.

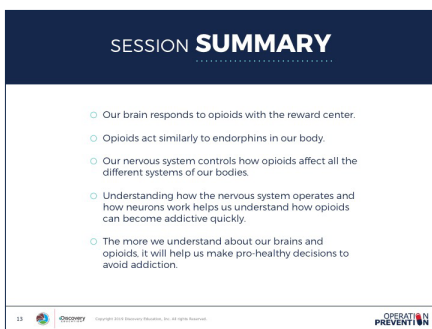
# SESSION 3



## SLIDE 12

Invite students to take a look deeper inside the nervous system to learn how pain and pleasure messages travel to and from the brain. Remind students that they saw how the brain is impacted by opioid misuse and that our brain is part of a larger system in our bodies: the nervous system. We also know the nervous system helps us communicate information throughout our bodies.

- Ask students: “How are messages sent throughout our bodies?” and invite students to share out their ideas. The slide shows a diagram of two neurons. Remind students there are millions of neurons in our bodies communicating information through a vast network.
- Distribute the [Parts of a Neuron student activity sheet](#). Explain that each term in the word bank completes one of the blanks in the diagram. Challenge students to identify where in the diagram to place the corresponding labels. Answers will be revealed with click of slide.
- Point out that the two neurons are not touching each other in the image. But, messages (like pain or pleasure messages) still have to get from one neuron to another to be able to travel to and from the brain. Ask: How do you think that happens?
- The answer? The synaptic gap (synapse). This is the small space between neurons, which the message must cross as it makes its way to and from the brain. The synaptic gap is where our body has receptors to transfer the messages of pain and pleasure throughout our bodies.



## SLIDE 13

### Summary/Wrap of Session:

- Our brain responds to opioids with the reward center.
- Opioids act similarly to endorphins in our body.
- Our nervous system controls how opioids affect all the different systems of our bodies.
- Understanding how the nervous system operates and how neurons work helps us understand how opioids can become addictive quickly.
- The more we understand about our brains and opioids, it will help us make pro-healthy decisions to avoid addiction.

# SESSION 4 OVERVIEW

SLIDES  
14-19

## EXPLAIN

### How does the Nervous System Interact with Opioids? Part 2

#### Objectives:

- Explain information processing by following sensory information through neural transmission.
- Understand what neurons and neurotransmitters are, and what part they play when opioids enter the body
- Use feedback mechanisms to explain the reinforcement given by chemical processes in opioid misuse.

#### Materials:

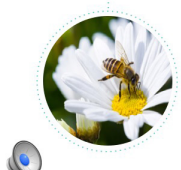
- Video - NIMH Brain Basics
- Speakers for listening to sounds from slides
- Student Activity Sheet: [Parts of a Neuron](#) (one per student)

#### Definitions:

- **Endogenous Opioids** - are natural opioid-like chemicals produced by the body
- **Dopamine** - a neurotransmitter that communicates with the brain's reward system and activates the reward center
- **Gamma-aminobutyric Acid (GABA)** - a neurotransmitter that slows neuron activity to reduce anxiety
- **Neurotransmission** - Information is communicated in the brain via a process called neurotransmission. Neurotransmission involves a variety of chemical substances called "neurotransmitters." One such neurotransmitter is called "dopamine." In the normal communication process, dopamine is released by a neuron into the synapse (the small gap between neurons). The dopamine then binds with specialized proteins called "dopamine receptors" (see image) on the neighboring neuron, sending a chemical signal to that neuron.

# SESSION 4

**BOTTOM-UP AND TOP-DOWN PROCESSING**



What do you think when you hear the sound of buzzing?

1. We hear the sound.
2. Our auditory processes relay the message to the brain.
3. The brain determines what the sound is and what should be done.
4. The brain then sends a message to the rest of the body telling it what to do.
5. The body responds.

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## SLIDE 14

Take this opportunity to help students understand how neurons actually work in our bodies to send and receive messages.

The slide will automatically start with the sound of an insect buzzing. Ask students to break down what is happening into three parts:

- How are you detecting the noise? (the stimuli)
- What is the noise and where is it coming from? (interpretation)
- How did you respond? (response)

Click slide for an image of a bee to appear and click again for text to appear. (It is anticipated that students will identify their ears hearing the sound of buzzing, that it is coming from an insect, and they swatted at it or moved away.)

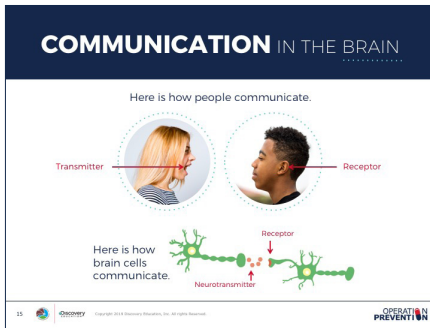
Now, invite students to think about which parts of this series are being relayed from the stimulus to the brain (bottom-up) and from the brain to the rest of the body (top-down).

- The ears pick up the sound of buzzing. The message is relayed to the brain from the senses through bottom-up processing.
- The brain, in turn, determines what the buzzing means and relays messages to the rest of the body to move away from the buzzing; this is top-down processing.

### Key Talking Points:

- Sensory neurons help us transmit information about sight, sound and feelings (such as feelings of pain and pleasure).
- Neurotransmission is the process of our bodies sending and receiving messages.

# SESSION 4



## SLIDE 15

Ask students to compare and contrast the diagram of the people talking with how neurons are communicating. Point out that neurotransmitters are like the words we use to talk to another person and give them instructions. The neurotransmitter that moves from one neuron to the next is specific to certain messages, the strength of these messages, and how long these messages continue to be conveyed.

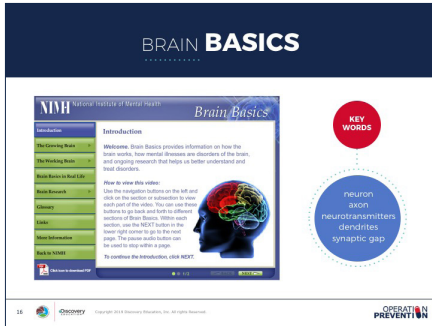
Ask: “Based on what you have learned; how do you think drugs affect this process of messaging in the brain?” Anticipated responses include:

- Drugs interfere with the way neurons send, receive, and process signals.
- They can activate neurons because they act like similar natural neurotransmitters.
- They may activate the neurons differently and lead to abnormal messages.
- Could cause the brain to release large amounts of neurotransmitters.
- Disrupts normal communications.
- Can make us do things that we wouldn't normally do.

### Key Talking Points:

- The messages that are sent from one neuron to the next are altered by the actions of the drugs on the neurotransmitters.
- Opioids put us at risk for causing damage to our brains and affecting neurotransmission.
- Drugs act on the messengers to change the message.
- Opioids attach to the same receptors as endorphins.

# SESSION 4



## SLIDE 16

The video on this slide shows how neurons transmit messages and what is actually happening in the synaptic gap. This is important because the synaptic gap is where the opioid receptors are located. <https://www.nimh.nih.gov/brainbasics/index.html>

- Watch the “neurotransmitter” segment in the video chapter, “The Working Brain”.
- Guide students to create a simple flow chart illustrating the process by which neurons and neurotransmitters send messages through the body using the following keywords as a guide: neuron, neurotransmitters, axon, dendrites, and synaptic gap.
- When they finish, ask students to share and explain their flow charts, either to the class or in small groups.
- If time allows, have students respond in writing to the following question: What do you think might happen if neurotransmission is disrupted?

MEET THE NEUROTRANSMITTERS AFFECTED BY OPIOIDS		
Neurotransmitter	How is it affected by opioids?	Functions Affected
Dopamine	Enhances and increases neurotransmitters released in the reward pathway	Pleasure and reward, movement, attention, memory
Endogenous opioids (endorphin and enkephalin)	Reduces excitability of neurons and creates the euphoric effect	Moderates hunger, thirst, and pain reactions, also involved in mood control
Gamma-amino butyric acid (GABA)	Reduces its ability to stop the amount of dopamine produced	Slows neuron activity to reduce anxiety

## SLIDE 17

The chemical messages that travel across a synaptic gap are called neurotransmitters. Different neurotransmitters are specific to different types of messages. Explain to students that opioids mimic neurotransmitters and either excite or inhibit a response like euphoria or moodiness in the body.

This slide displays a chart that identifies and describes the neurotransmitters most often affected by prescription opioids, which functions they normally affect, and how they are affected by opioids.

Invite students to consider how each of the neurotransmitters, affected by opioids, could impact the human body by reviewing the chart and answering the following guiding questions:

Answers are in red:

- Which neurotransmitter could cause dry mouth or an irritable mood? **endogenous opioids**
- Which neurotransmitter is responsible for overstimulating the nervous system creating a euphoric effect? **dopamine**
- Which neurotransmitter could cause sleepiness? **gamma-aminobutyric acid**

# SESSION 4

**THREE TRUTHS AND ONE LIE**

1. Everything we do relies on neurons communicating with one another.
- FALSE** 2. At the end of the axon, most neurons release a neurotransmitter across the dendrites.
3. Opioids mimic neurotransmitters by binding to the same receptors as endorphins.
4. Opioids can alter the brain and affect emotions, memory, and pain reactions.

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## SLIDE 18

This activity will reinforce what students have learned about how neurons transmit and receive messages.

Present four statements using the slide. Explain to students that three of the statements are true while one is false. Guide students to identify the false statement and correct it. False statement will reveal with click.

### True statements:

- Everything we do relies on neurons communicating with one another.
- Opioids mimic the body's natural opioids by binding to the same receptors as endorphins.
- Opioids can alter the brain and affect emotions, memory, and pain reactions.

### False statement:

- At the end of the axon, most neurons release a neurotransmitter across the dendrites. (correct answer: At the end of the axon, most neurons release a neurotransmitter across the synapses)

**SESSION SUMMARY**

Neurotransmission is a key process in our brains for sending messaging and communicating through our bodies.

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## SLIDE 19

### Summary/Wrap of Session:

- Neurotransmission is a key process in our brains for sending messages and communicating through our bodies.

# SESSION 5 OVERVIEW

SLIDES  
20-24

## EXPLORE

### Opioid Influence on the Adolescent Brain

#### Overview:

Students will analyze images produced by brain mapping to explain how drug misuse can cause changes in areas of the brain related to judgment, decision making, learning and memory, and behavior control. Students will construct an explanation of how this is evidence of a brain disease. Students will learn and be able to explain how brain development during adolescence leads to additional risks on their bodies.

#### Objectives:

- Explore the sections of the brain and their vulnerabilities to opioids.
- Connect brain health and development to pro-healthy decisions and avoidance of opioid use and abuse.

#### Materials:

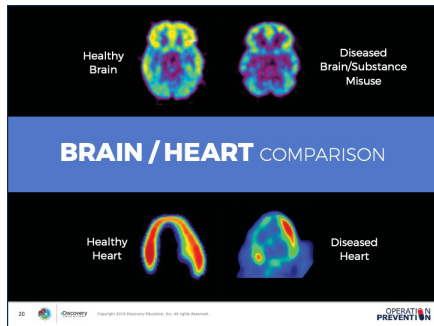
- [Brain Basics Student Handout](#)

#### Definitions:

- **Central nervous system** – part of the nervous system that consists of the brain and spinal cord
- **Peripheral nervous system** – part of the nervous system outside the brain and spinal cord
- **Somatic nervous system** – part of the peripheral nervous system associated with the voluntary control of body movements
- **Autonomic nervous system** – controls the bodily functions not consciously directed
- **Parasympathetic motor system** – promotes calming of the nerves
- **Tolerance** – when the body becomes less responsive to a drug
- **Physical Dependence** – when the brain adapts to the effect of a drug and develops tolerance
- **Cerebral cortex** - the outermost layer of the brain. It is divided into the frontal lobe, the parietal lobe, the temporal lobe, and the occipital lobe.
- **Pre-frontal cortex** - the front part of the frontal lobe of the brain.
- **Limbic system** - many different brain structures that together control and regulate how we experience pleasure.
- **Brain stem** - the central trunk of the brain that controls involuntary basic functions, such as breathing, sleeping, and maintaining a heart rate.



# SESSION 5



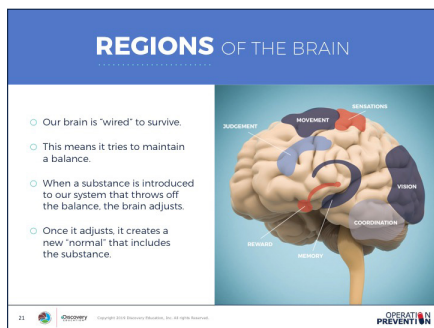
## SLIDE 20

Ask students to consider how addiction is a disease by comparing the brain and heart images.

As students view the images on the slide, ask: “How are the diseased heart and the diseased brain similar?”

### Key Talking Point:

- Disease reduces the ability of the organ to use energy, making it less effective in the body.

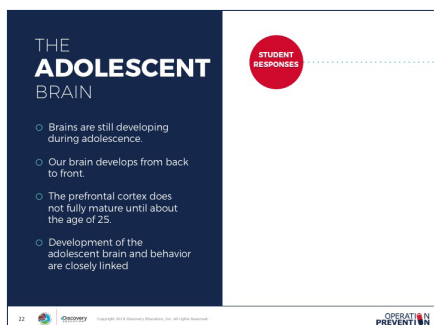


## SLIDE 21

Review slide with students. Facilitate their understanding of the role each part of the brain plays and the processes for which it is responsible.

Distribute the [Brain Basics student activity sheet](#) to provide students with information about the different parts of the brain.

Invite students to use this information to review the diagram in the slide and identify which parts of the brain are responsible for the highlighted processes. (For example, in the highlighted parts, 'judgment' is controlled by the frontal lobe, and 'sensations' are controlled by the parietal lobe.)



## SLIDE 22

Divide the class into pairs of students.

Invite students to use their completed Brain Basics student activity sheet as a reference and have each pair look at the information on the slide. Ask the students to come up with as many factors that might influence risk based on adolescent brain development.

### Anticipated Student Responses:

- difficulty controlling emotions
- poor planning and judgment
- risky, impulsive behavior

Ask students to share their lists with the whole class. Capture student ideas using chart paper or the provided space on the slide. If your students have access to technology, you could invite them to create a word cloud with the responses (<https://www.wordclouds.com>). Have students rank them in order from “most influential” to “least influential,” giving reasons for their rankings.

# SESSION 5

TOLERANCE	&	DEPENDENCE
<p><b>Tolerance</b> occurs as more of a substance is needed to produce the same effect as the first time it is taken.</p> <ul style="list-style-type: none"><li>○ Receptors are being filled on a regular basis.</li><li>○ Brain chemistry alters to accept this change.</li><li>○ To feel the same level of euphoria, an individual takes more and more.</li></ul>		<p><b>Dependence</b> occurs as removal of the substance causes negative physical effects to the body.</p> <ul style="list-style-type: none"><li>○ Individual's body begins to need the drug for their body to feel normal.</li><li>○ If the individual stops, they often feel sick and achy.</li></ul>

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## SLIDE 23

Share with students that we have learned opioids can have many different impacts to our brain and body. When opioids are misused they can lead to physical and chemical changes in our bodies. These changes can lead to a lack of impulse control resulting in the continued misuse of opioids. The initial decision is typically voluntary but can lead to tolerance and dependence.

Invite students to use the slide to identify similarities and differences in a person that has developed a tolerance to one that is dependent on the misuse of opioids.

### Anticipated Student Responses:

- When the body adapts to the drug, and requires more of it to achieve a certain feeling, an individual has developed a tolerance.
- A person that is dependent on a drug will experience withdrawal symptoms when use of the drug is suddenly reduced or stopped.

Ask students: “How could you now explain their challenges with withdrawal?”

### Anticipated Student Responses:

- Opioids flood the brain with dopamine, resulting in a signal causing people to feel good.
- Long-term misuse can lead the body to produce less dopamine over time, causing cravings that can lead to tolerance or physical dependency.
- Opioids can change our brain chemistry.
- Opioids can lead us to make bad decisions or be impulsive.

# SESSION 5

## SESSION SUMMARY

- Opioid use can cause changes in your brain.
- Judgment, decision making, learning and memory, and behavior control are areas of the brain influenced by opioid use.
- The adolescent brain is more at risk for addiction since it is still developing.
- Tolerance and dependence are key terms we should understand about why we can become addicted.

## SLIDE 24

### Summary/Wrap of Session:

- Opioid use can cause changes in your brain.
- Judgment, decision making, learning and memory, and behavior control are areas of the brain influenced by opioid use.
- The adolescent brain is more at risk for addiction since it is still developing.
- Tolerance and dependence are key terms we should understand about why we can become addicted.

# SESSION 6 OVERVIEW

SLIDES  
25-27

## ELABORATE

### The Physiological Reason Why People Become Addicted

#### Overview:

In this section, students will apply the information they obtained to compare and contrast homeostasis and allostasis during opioid misuse and to explain withdrawal cycles and overdose. Students will uncover how we can become physically dependent to opioids.

#### Objectives:

- Understand how we can become dependent or addicted to opioids.
- Explain withdrawal cycles and overdose.
- Explore the devastating effects of addiction.

#### Materials:

- Virtual Field Trip Video
- [Keeping Balance Cards](#) (one set per each pair or small group of students)

#### Definitions:

- **Homeostasis** – the tendency of the human physiological system to maintain internal stability
- **Allostasis** – adaptive process of maintaining homeostasis in the body
- **Withdrawal** – the act or process of ceasing to use an addictive drug, and the symptoms that creates
- **Overdose** – an excessive and dangerous dose of a drug that can harm the body or cause death

# SESSION 6

**HOMEOSTASIS & ALLOSTASIS**

- **Homeostasis** is the balance that occurs in the body.
- **Allostasis** refers to the adaptive processes used to maintain homeostasis in the body.
- The balance can change based on different factors, including introduction of new substances.

25 | |

## SLIDE 25

Review the terms homeostasis and allostasis with students by showing the slide. Allostasis refers to the adaptive processes used to maintain homeostasis in the body. This occurs as neurotransmitters mediate changes and deal with stressors. They seek to help the body adapt.

Explain how stress to our body systems can lead to adaptation. When a stressor or change occurs, such as ingesting opioids, the body seeks to adapt and create stability through change. When someone overuses a substance, the body changes to balance out with the presence of the substance. As it changes, tolerance and dependence occur.

Divide the class into pairs or groups of three. Distribute one set of the [Keeping Balance student activity cards](#) to each pair/group.

Direct students to work together to put the cards in the correct order of how our bodies can change to balance out the presence of an opioid. The correct order should be:

- An outside agent is introduced through regular or prolonged use.
- The body system becomes stressed.
- The system stability is upset.
- Changes occur in system based on allostasis.
- Tolerance and physical dependence occur.
- Homeostasis is restored with a new “normal.”

Ask a volunteer pair/group to present their card order to the class and explain why they put the steps in this order. Survey the other groups to see if any groups put them in a different order and reach consensus as a class.

### Key Talking Points:

- Neurotransmitters mediate change in our brains and bodies when dealing with stressors or different drugs/medications.
- When someone takes an opioid, the brain works to adapt and create stability.
- If someone overuses opioids or other prescription drugs, the brain/body changes to balance out the presence of the substance.
- Tolerance and dependence can happen as the brain/body adjusts.

# SESSION 6

**HOMEOSTASIS AND HEROIN**

How would heroin affect allostasis?  
How would homeostasis occur when heroin is used?  
What do you think would happen?

MOOD  
DRUG

OPERATION PREVENTION

## SLIDE 26

Invite students to apply the processes of homeostasis and allostasis to developing a physical dependency on heroin.

Distribute six blank note cards to the same pairs/groups of students. Alternatively, students can write on the back of the previous set.

Instruct students to create a set of notecards that explain how an individual could become physically dependent on heroin. They can use the previous set of cards as guidance.

### Anticipated response:

- A person takes heroin. At first, the person feels good.
- Then, the body system becomes stressed.
- The system stability is upset.
- Changes occur in system based on allostasis.
- A tolerance of physical dependence develops.
- Homeostasis is restored with a new “normal.” This normal is a less “happy” feeling than the first use.

Ask a volunteer pair/group to present their notecards and explain how heroin affects allostasis and how homeostasis would occur. Discuss as a class what they think would happen if the person continued to use heroin over an extended period of time. Students should understand how adaptation leads to heroin addiction as the body seeks to create a “new normal,” or a homeostatic system.

**SESSION SUMMARY**

- There are physiological changes that occur in our brain and body that help us understand why people become addicted to opioids.
- By understanding the physiological impact of opioids on the brain and body, we can use that information to make good decisions about using opioids and other drugs.
- Information that helps us to know about how opioids impact our bodies provides us with knowledge to make pro-healthy choices.

OPERATION PREVENTION

## SLIDE 27

### Summary/Wrap of Session:

- There are physiological changes that occur in our brain and body that help us understand why people become addicted to opioids.
- By understanding the physiological impact of opioids on the brain and body, we can use that information to make good decisions about using opioids and other drugs.
- Information that helps us to know about how opioids impact our bodies provides us with knowledge to make pro-healthy choices.

# SESSION 7 OVERVIEW



SLIDES  
28-29

## ELABORATE

### Apply Our Knowledge to Real World Scenarios

**Overview:**

In this section, students will examine case studies modeled after real-world stories of prescription opioid misuse and heroin use and apply what they learned throughout the lesson to explain the science behind one of them. Their explanation will include at least one fact or misconception from the beginning of the lesson.

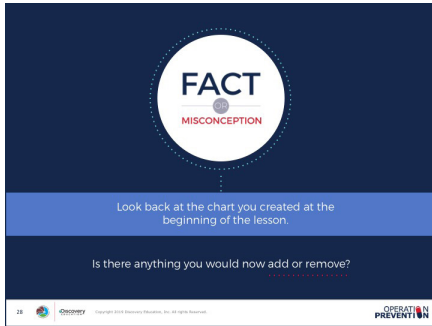
**Objectives:**

- Apply knowledge that has been learned about opioids, tolerance, withdrawal and addiction to real world case studies.

**Materials:**

- [Opioid Misuse Case Studies](#) (one per student group)
- Computer access/presentation software

# SESSION 7



## SLIDE 28

Revisit the discussion on facts and misconceptions by reviewing slides 1–4. (Session #1 Fact or Misconception) Invite students to return to their original groups to reevaluate their earlier charted facts and misconceptions. If you originally assigned cooperative learning roles, review expectations and provide time limits.

Ask student groups to discuss changes to their list and add at least three big takeaways they would want other teens to know. If time permits, invite students to share their groups' three key takeaways.



# SESSION 7

**CHOOSE YOUR STUDY**

**Can you help Brandon's parents?**

- What solutions would you suggest?
- What about cutting off the prescription?

**Can you help Sarah's doctor?**

- What do you think is happening?
- How would you treat her?

## SLIDE 29

Invite students to read the two case studies using the [Opioid Misuse Case Studies student activity sheet](#).

Have students select one case study to analyze in groups of 2-3. These can be the same groups used previously or new groups. You may choose to assign specific cooperative learning roles to each group member or provide specific instructions to students about time limits and product expectations.

Guide students to review the case studies and apply what they learned from the lesson to explain the signs and symptoms described. Students should be encouraged to include at least one fact or misconception in their explanation.

### Teacher notes:

In the first case study, students will help Brandon's parents understand what has been happening to Brandon. They will use facts from the lesson to explain why cutting off the prescription might not solve the problem and suggest a better solution.

### Anticipated responses include:

- Relied on drugs to help him move: His body changed chemically to balance out the presence of an opioid through allostasis.
- Gradually increased the number: His opioid misuse went from tolerance to dependency.
- Mood changed: The endogenous opioids were impacted by opioid misuse. Opioids reduce excitability of neurons impacting mood.

In the second case study, students will help the doctor determine why Sarah is in the hospital. They will use facts from the lesson to explain what might be happening to Sarah and suggest how to treat her.

### Anticipated responses include:

- Shaking and vomiting: Signs of overdose or withdrawal.
- Lost consciousness and her breathing fell: Signs of overdose or withdrawal.
- Used the bathroom frequently: The dopamine neurotransmitter was impacted by opioid misuse. Opioids overstimulate the system creating a euphoric effect. She was likely taking opioids when she was in the bathroom.
- Wanted a refill on her medication: She developed a dependency to opioids.

Invite students to share their analyses with their peers.

# TYPES OF OPIOIDS

## Directions:

The table below shows the different types of opioids, how they are derived, and examples. But some of the information is missing. Using the word bank, complete the chart with the correct answers.

## Word bank:

- poppy
- morphine
- opioids
- heroin
- fully synthetic
- opioids
- man-made
- fentanyl

Type of opioid	Where they come from	Examples
Natural opioids (made from the plant)	Alkaloids, that occur in plants such as the opium  .....	..... codeine
Semi-synthetic, man-made  .....	Created in labs from natural opioids	Hydrocodone, oxycodone,  .....
..... man-made  .....	Completely  .....	..... methadone, tramadol

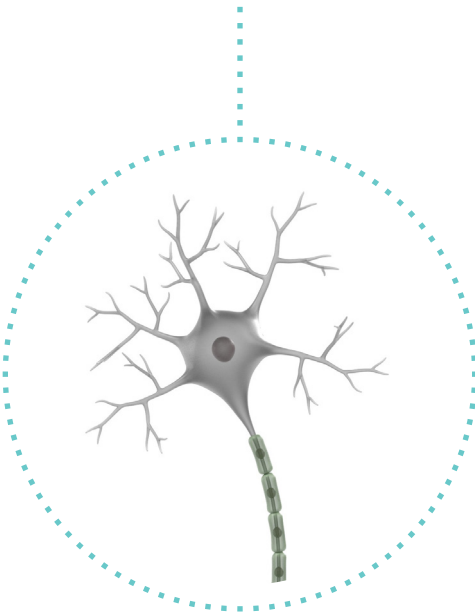
# PARTS OF THE HUMAN NERVOUS SYSTEM

**Directions:**

Listed below are descriptions of the nervous system. Match each part of the nervous system to the color it corresponds with on the slide.

Description	Color
<p>The central nervous system consists of the brain and spinal cord. The systems in the brain regulate certain functions that are affected by drugs.</p>	
<p>The peripheral nervous system consists of everything other than the brain and spinal cord. The peripheral nervous system regulates voluntary and involuntary responses, including sensory input.</p>	
<p>The somatic nervous system within the peripheral nervous system deals with voluntary responses, including input from sensory organs.</p>	
<p>The autonomic nervous system regulates involuntary responses, such as muscle and gland operation.</p>	
<p>The autonomic nervous system contains the sympathetic motor system that puts a person into a state of high alert when a threat is present.</p>	
<p>The parasympathetic motor system, also in the autonomic nervous system, calms the body by releasing neurochemicals that relax the system.</p>	

# PARTS OF A NEURON



## Directions:

Each term in the word bank completes one of the blanks in the diagram on the slide. Using the following definitions, identify where in the diagram to place the corresponding labels.

## Word bank:

- Axon
- Branches of axon
- Cell body
- Dendrites
- Nucleus
- Terminal bulbs
- Synaptic gap

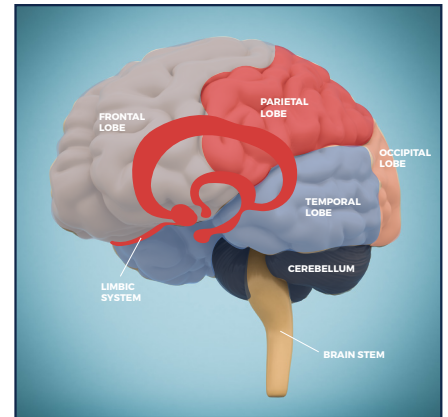
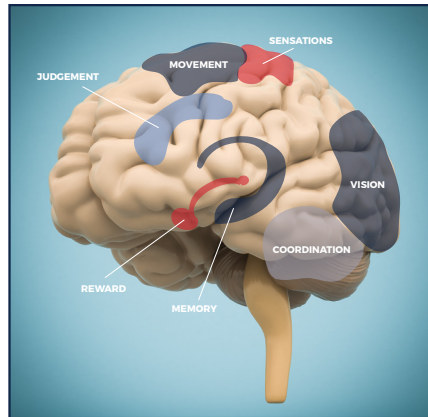
## Definitions:

- The cell body contains the nucleus, which determines whether the message will continue down the axon to be sent to another neuron.
- Dendrites receive the impulse, or message, from another neuron and send it to the cell body.
- The axon is the long part of the neuron that takes the message from the cell body to the terminal bulbs.
- The terminal bulbs are at the sending end of the neuron. They release the neurotransmitters into the synaptic gap.

# BRAIN BASICS

## Directions:

Listed below are descriptions of different parts of the brain. Using this information and the image on slide 21, identify which parts of the brain are impacted by opioid misuse.



Description	Does this system appear to be impacted by opioid misuse? Why or why not? Use evidence from the brain scan in your response.
<p>The brainstem controls basic functions that humans need to survive. These include breathing, sleeping, and maintaining a heart rate. These functions are involuntary, which means they happen without our thinking about them.</p>	
<p>The cerebral cortex is divided into several areas. Different areas control different functions. For example:</p> <ul style="list-style-type: none"> <li>○ Thinking and reasoning happen in the frontal lobe of the cerebral cortex. Processes in the frontal lobe allow us to plan, make decisions, and solve problems.</li> <li>○ Other areas in the cerebral cortex process sensory information. These processes allow us to see, feel, hear, taste, and touch.</li> </ul>	
<p>The limbic system consists of many different brain structures. Together, they control and regulate how we experience pleasure. When a behavior causes us to feel pleasure, we are likely to repeat that behavior. This “reward circuit” in the brain reinforces behaviors that are necessary to our survival. Processes in the limbic system also shape how we experience positive and negative emotions.</p> <ul style="list-style-type: none"> <li>○ Eating, socializing, and other healthy behaviors activate the limbic system and give us pleasure. However, misusing and abusing drugs also activate the limbic system.</li> <li>○ Using drugs can also affect our moods by changing processes in the limbic system that shape emotions.</li> </ul>	

# KEEPING BALANCE

**Teacher preparation:**

Cut a set of six notecards for each pair of students.

An outside agent is introduced through regular or prolonged use.

Changes occur in system based on allostasis.

The body system becomes stressed.

Tolerance and physical dependence occur.

The system stability is upset.

Homeostasis is restored with a new “normal.”

# OPIOID MISUSE CASE STUDIES

**Directions:**

Select one of the case studies below that shares the story of a teen who misused prescription opioids. Use scientific knowledge gained from the lesson to explain what is happening to the student in the case study. Provide an explanation that includes at least one fact or misconception from the beginning of the lesson to explain the science behind the signs and symptoms described. Plan to present your analysis using presentation software or an online platform.

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## CASE STUDY #1: BRANDON

Brandon is a 17-year-old student in high school who enjoys dancing. Several months ago, he fell while performing a dance move and hurt his back. He could not move without feeling sharp twinges of pain, and he could not bend over. He was in a lot of pain, and the doctor gave him hydrocodone to help ease the pain. Brandon began to rely on the drugs to help him move, and he gradually increased the number of pills he used daily. He requested refills on the prescription, and he became anxious when his medication was almost gone. His mood varied: he would be happy when he took the pills, but he became angry and upset when the pills began to wear off. Recently his parents and doctor caught onto this and they have taken Brandon off of the prescription.

## CASE STUDY #2: SARAH

Sarah is a 17-year-old girl who was rushed to the hospital, via ambulance, after she began shaking and vomiting in class at school. She lost consciousness and her breathing fell to a dangerously low rate. The doctors have been trying to piece the facts together so they can treat her. Her friends told the emergency workers that Sarah had recently been in treatment with her doctor for severe pain in her back after a fall during soccer practice. The fall occurred about one month ago, and Sarah began acting differently about two weeks ago. One friend said that Sarah had a lot of pain while sitting in class at school and had recently begun going to the lavatory for longer periods of time more frequently during the day. When she would come back from the lavatory, she seemed to feel better and was in a better mood. Her parents reported similar behaviors, and noted that she asked the doctor for a refill on her medication two times in the last month.

# NATIONAL STANDARDS

This lesson plan has been developed based on the following national standards:

## Next Generation Science Standards

### LS1.A: Structure and Function

Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

### PS1.B: Chemical Reactions

Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. (HS-PS1-4),(HS-PS1-5)

### LS1.D: Information Processing, Grade Band Endpoints

By the end of grade 12: In complex animals, the brain is divided into several distinct regions and circuits, each of which primarily serves dedicated functions, such as visual perception, auditory perception, interpretation of perceptual information, guidance of motor movement, and decision making about actions to take in the event of certain inputs. In addition, some circuits give rise to emotions and memories that motivate organisms to seek rewards, avoid punishments, develop fears, or form attachments to members of their own species and, in some cases, to individuals of other species (e.g., mixed herds of mammals, mixed flocks of birds). The integrated functioning of all parts of the brain is important for successful interpretation of inputs and generation of behaviors in response to them.

## National Health Education Standards Addressed

8.12.3 Work cooperatively as an advocate for improving personal, family, and community health.

1.12.9 Analyze the potential severity of injury or illness if engaging in unhealthy behaviors.

## CCSS.ELA-LITERACY

### CCSS.ELA-LITERACY.RST.11-12.1

Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

### CCSS.ELA-LITERACY.RST.11-12.7

Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

### CCSS.ELA-LITERACY.RST.11-12.9

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.