UNIT A: LESSON 9

LEARNING TARGETS

INSTRUCTIONS FOR TEACHERS: • Refer students to the standards and objectives. • Review the standards and objectives with students one at a time. • At the end of the lesson, ask students what they did in class to meet the standards.	
INSTRUCTIONS FOR STUDENTS: Listen as your teacher reviews the standards and objectives. Your teacher will call on an individual or pair to explain what they mean.	
Learning Target: I can **analyze** the **main** ideas and **supporting details presented** in in a video clip. Learning Target: I can **compare and contrast** written and digital presentations of ideas.	***analyze*** – study something and explain it ***main*** – central or most important ***supporting details*** – helping ideas ***present*** – show ***compare and contrast*** – show how two things are the same or different

ACQUIRING AND USING VOCABULARY

INSTRUCTIONS FOR TEACHERS:

- Review student instructions.
- Familiarize students with their glossary. It is located in Appendix A (Glossary; labeled "Appendix: Glossary" in the student version). Tell students to use the glossary throughout the lesson.
- Pre-teach the vocabulary selected for extended instruction, provided as word cards in Appendix B (Teacher Resources). This vocabulary is abstract and critical to understanding the text.

INSTRUCTIONS FOR STUDENTS:

Your teacher will pre-teach several key words. Use your glossary for the rest of the lesson to find meanings for words you don't know. Words that are **bolded** in the text and word banks can be found in the glossary. The glossary is located in the Appendix at the end of the lesson.

THINKING LOG

INSTRUCTIONS FOR TEACHERS:

- Read the guiding question aloud to students, then play the indicated section of video. Make sure that the closed captioning is on so that students can read along as they watch.
- At the end of the section, have students answer supplementary questions.
- Repeat this routine for each section of the other three sections until the video concludes.
- Discuss the guiding question(s) as a group and then have students write the answer in their student chart.

INSTRUCTIONS FOR STUDENTS:

You will watch a video called "Insights Into the Teenage Brain." The video is divided into four sections, or parts. Your teacher will ask you a guiding question for each section that you will think about as you watch and listen to the video. After you have watched each section, or part, of the video, you will answer supplementary questions and then answer the guiding question with your teacher and the class. Use your glossary to help you. Your teacher will review the answers with the class. You will then discuss the guiding question(s) with your teacher and the class. Finally, you will complete a written response to the guiding question(s).

GUIDING QUESTION:

How are teen brains different from the brains of adults and children, and how do we know?

WORD BANK:

adaptive	changes	like	**snapshot**
adults	consequences	**mature**	**social**
adventures	**decisions**	money	special
actions	**dopamine**	moving	**striatum**
Affiliate with	**emotional**	people	sugar
back	**excitement**	prefrontal cortex	teen
beneficial	**experiences**	**responded**	**teenagers**
better	front	**reward**	teens
biased	ideas	rewards	**thrills**
brains	information	**risks**	twenties

Watch Part 1 of the video. Pay attention to what the speaker says about teens and decision making. Then work individually or with a partner to answer the supplementary questions.

Insight Into the Teenage Brain
PART 1: 00:00 – 02:39

Hi. Thank you. I love, love, love your enthusiasm. Your energy and excitement is what really makes me love my job, and my job is to study the adolescent brain. I'm a scientist at UCLA, as Jake said.

Scientists have studied the brain for centuries, but it's only been in the last 15 years or so that we've discoved one of the most fascinating things. And that is that your brain changes every single day. As you sit in this room, your brain is changing in response to my voice, in response to the person next to you. And your experiences and the people you affiliate with shapes the way your brain ultimately develops. We also know that the brain matures and continues to do so past childhood and into the teenage years and well into your mid-twenties. So most of you in this room today, as middle- and high-school students, don't yet have a fully mature brain.
But that's actually really beneficial. If we think about one of the functions of adolescence, which is to establish your independence from a caregiver. Because your brain as an adolescent is built to help you do that, compared to children and adults, the teenage brain is really good at seeking out new experiences, enjoying thrills, and seeking out risks. It's also really good at recognizing, or being sensitive to, social and emotional information. And so for that reason the teenage brain is really responsive to rewards and emotions when making decisions. And at my laboratory at UCLA, and in laboratories all around the world, we're interested in uncovering that very question: how does the teenage brain make decisions?

One of the first discoveries relevant to this topic was made when we discovered that the part of your brain in the very front, called the prefrontal cortex, which is the last brain region to develop, because your brain develops from the back to the front. It continues to change up until the mid-20s. The reason this is relevant is because the prefrontal cortex is the part of your brain that helps you think about the consequences or potential consequences of your actions before you do them. It helps you regulate your behavior and your emotions.

And so it makes sense that if this part of the brain isn't fully available until well past adolescence, then teenagers may make more impulsive decisions with less regard for the potential future consequences.

SUPPLEMENTARY QUESTIONS:

1. What is different about the teenage brain?

The teenage brain changes every day. It is not fully mature (developed).

2. What shapes the way your brain ultimately, or finally develops?
Your experiences and the people you affiliate with, or spend time with, shape your brain.

3. How long does it take for your brain mature?
Your brain continues to mature until your mid-twenties.

4. Is it beneficial (good for you) or detrimental (bad for you) to have an immature brain?
It is (beneficial/detrimental) beneficial to have an immature brain.

5. What four things is the teenage brain really good at doing?
The teenage brain is really good at:

A. seeking, or looking for, new experiences
B. enjoying thrills, or excitement
C. seeking risks
D. recognizing, or being able to sense, social and emotional information

6. Why is the prefrontal cortex the last brain region, or area, to develop?
The brain develops from back to front, and the prefrontal cortex is in front of your brain.

7. What does the prefrontal cortex do?
The prefrontal cortex helps you think about the consequences of your actions.

Watch Part 2 of the video. Pay attention to the graphs and images (pictures). The graphs and images will help you understand who liked sugar the most. Then work individually or with a partner to answer the supplementary questions.

Insight Into the Teenage Brain
PART 2: 02:40 – 06:37

But we now know that the story is far more interesting and complicated than that. And in fact what we really need to do is think about how brain regions that are not at the surface of your brain, but in the deeper layers, how they change. One region we focus on is called the striatum, and the striatum is the key component of the reward system. So when you receive something that you find rewarding, your striatum is very responsive and it releases something called dopamine. And this is the case not just in humans, but in kids, and in mice, and rats, and monkeys. All of these

organisms respond, really, with a lot of excitement in their brain when they get something they like.

So in my lab we we study this reward system across development, and especially in teenagers. And we do that by asking people to come to the laboratory and perform what's called an functional magnetic resonance imaging scan, or fMRI. And the beauty of fMRI is that you can take a snapshot of the brain in motion. So while you are experiencing something you like, or while you are making a decision, we capture how your brain is responding to that—how your brain is active.

And so to study the reward system, what we did is, not simply show people pictures of reward, which is what mostly happens in brain imaging studies, but instead what we did is we actually gave someone a reward. And what's something that people find rewarding? Sugar! So what we did is we asked people to come to the lab; we asked a group of teenagers and a group of adults. And while they were in the MRI, we hooked them up to a straw and we fed them squirts of sugar water every so often. And first we asked them whether they liked it. Maybe they weren't going to like the sugar as much as we thought. But they actually did.

This is a rating scale asking them, how much do you like the sugar? And the average response is is in red for the teenage group, and the adults is shown in white. And you can see that everybody liked it, but it's a teenage age group who showed this exaggerated sensitivity. They *really* liked it. So we started to wonder whether there was something neurobiological that represented this difference.

So instead of focusing on the prefrontal cortex, which is what a lot of brain scientists who study adolescents do, we looked at the deeper layers of the brain. So in this image, which is actually a real human brain image averaged together among all our participants, we saw that in the deeper layers, here represented with this red, or sorry this yellow activation, the striatum was really excited to the sugar water. And this was across all age groups, but the really cool thing was observed when we looked at the differences between the teenagers and the adults.

Here again I'm showing you the magnitude of activation—that is, how excitable the brain was in the teenagers compared to the adults to this very simple reward of sugar. And you can see that the teenagers were much more excited to the same exact stimulus and in the same exact region of the brain. It's a teenage brain that was going crazy. It was really excited to get it. And when we associated that with their ratings of

the sugar, it was only in the teen age group where we saw that people who showed greater activation in the brain in response to the sugar also told us they liked it more.

So that means that in real-time at the very moment your brain gets something that it likes, it will make you think that it's better. And you can think or imagine that in future circumstances your brain will encode that information and remember that you liked it. It will bias your decisions toward getting more rewards, and that's what happens during adolescence.

SUPPLEMENTARY QUESTIONS:

8. What key component, or part, of the brain is the striatum?
The striatum is a key component of the rewards system.

9. What does the striatum do when you receive, or get something rewarding?
The striatum releases dopamine.

10. What happens when kids, mice, rats, or monkeys get something they really like?
All of these animals respond, or react with excitement in their brains when they get something they really like.

11. What is special about the functional magnetic resonance imaging scan (fMRI)?
The fMRI can take a snapshot, or picture of the brain while it is moving. That means researchers can take a snapshot of your brain while you are doing something you like.

12. What did the researchers do to study the brain's reward system?
The researchers gave people a reward.

13. What was the reward the researchers gave people to study the brain?
The researchers gave people sugar.

14. When the researchers asked people if they like sugar, who liked sugar the most? (Hint: look at the graph.)
Teenagers liked sugar the most.

15. Whose brains were the most excited by the sugar? (Hint: look at the brain images.)
Teens' brains were the most excited by the sugar.

16. What do these findings, or results mean?

These findings mean that when teens get something they like, their brains make them think they like it better. It means that teens are biased, or like rewards.

Watch Part 3 of the video. Pay attention to the graphs and images. The graphs and images will help you understand who liked money the most. Then work individually or with a partner to answer the supplementary questions.

Insight Into the Teenage Brain
PART 3: 06:38 – 07:33

But to ensure that this wasn't just specific to something as simple as sugar, we gave people something else that everybody likes. And we did this while they were in the MRI. And what's something else that everyone loves to get? Money! Right? Everybody likes money. So we brought in a whole separate group of teenagers and adults, and this time we threw in a group of kids in there who were between about seven and ten. And we found that again, the part of the brain that was most responsive was the striatum, shown here on the left. This is a brain scan showing the average activation but what you can see really clearly is that, not only were the teenagers more reactive to the money than the adults, which you might argue is because maybe they have less of it—they like it more. But that's not the case, because the kids probably have even less than the teenagers, and the teens still showed this exaggerated response.

SUPPLEMENTARY QUESTIONS:

17. What did the researchers do to make sure the findings weren't specific to, or limited to sugar?
The researchers gave people something else everyone likes. They gave everyone money.

18. What part of the brain was the most responsive, or reactive to money?
The striatum was the most responsive to money.

19. Whose brains responded most strongly to getting money?
The teens' brains responded to the money most strongly.

Watch Part 4 of the video. The researcher talks about teens and decision making. She talks about why teen brains are special. She talks about what is negative, or bad, about this. She also talks about what is positive, or good, about this. Then work individually or with a partner to answer the supplementary questions.

Insight Into the Teenage Brain
PART 4: 07:44 – 09:42

So this is telling us that there's something really special about the teenage brain. There's a sharp increase in sensitivity to rewards and novel information from childhood to adolescence. But then this is a sharp decrease from adolescence to adulthood. And that probably has something to do with the fact that the prefrontal cortex is starting to come online as people transition into adulthood, and regulating the emotional response to the rewarding information.

So what does this all mean for behavior and for your everyday life? Well there are a few things. From my perspective this is really exciting time to study the teenage brain. Although scientists have made significant progress in understanding what makes a teenage brain unique, we still have a lot to learn.

For instance, we're just now starting to appreciate that this sensitivity in the brain, to rewards and to emotions, might lead teenagers to make poor choices sometimes. But it also presents an excellent opportunity to seek out new adventures, to meet new people, and to confront interesting challenges in ways that people don't typically do later in life. And I predict that as we continue to conduct more of this research we will learn how to take advantage of the sensitivity of the brain during adolescence to generate new ideas and to promote creative thinking. There's a lot that we can and will learn from the adolescent brain, and from adolescents in general in the coming decade. And perhaps we'll learn that taking risks and seeking out rewards are really adaptive behaviors in many contexts that actually lead to really good decisions, and that help individuals navigate the often challenging and intimidating transition from childhood to adulthood.

So with that I encourage you to savor the excitability of your teenage brain and to enjoy all the new people you meet and all the adventures you take. Thank you.

SUPPLEMENTARY QUESTIONS:

20. What does this research tell us?
This research tells us that teen brains are special. Teens more responsive to rewards and new information.

21. Why might adults be less responsive to rewards?
The prefrontal cortex is more developed in adults. The prefrontal cortex helps regulate, or control emotional response to rewards.

22. *What is something negative, or bad, about the teenage brain?*
Teenagers sometimes make bad decisions.

23. What are positive, or good, things about the teenage brain?

A. Teenagers can have adventures.
B. Teenagers meet new people.
C. Teenagers have new ideas.

24. What might we learn from the teenage brain?
We might learn that taking risks and seeking, or looking for, rewards are adaptive behaviors.

RESPONSE TO GUIDING QUESTION:
How are teen brains different from the brains of adults and children, and how do we know?
Suggested Response: Teen brains are far more responsive to rewards than adults and children. We know this from the studies the researcher did using brain images. She studied what happened in teens' and adults' brains when she gave people sugar. Teens were the most responsive to sugar. She also studied what happened in teens', adults', and children's brains when she gave people money. Again, teens were the most responsive to money. This means that teen brains are more open to new adventures and ideas than adult brains.

NEUROLOGIST NOTEBOOK

INSTRUCTIONS FOR TEACHERS:

- Review student instructions.

INSTRUCTIONS FOR STUDENTS:

Work with a partner. Use your neurologist notebook to write down key, or important, information from the video. You will write down main ideas and some details, or specific information, about each main idea. You can use information from your Thinking Log. Some information is already filled in for you.

WORD BANK:

adult, adults, a**dventures**, **challenges**, children, **decisions**, **experiences**, information, money, people, **positive**, **rewards**, sugar, teens

Main Idea:

Teenage brains are different than the brains of children and adults.

Support 1:

Teenage brains have a stronger response to rewards than adult brains. In the study, teens' brains **responded** to sugar more strongly than adults. In the study, teens' brains **responded** to money more strongly than adults or children. This may lead teens to poor choices sometimes.

Support 2:

Teens are more open to new information and experiences. This presents an excellent opportunity for them to seek out new adventures, to meet new people, and to confront interesting challenges in ways that people don't typically do later in life.

Conclusion:

The differences in teen brains may lead them to make poor decisions but also are positive because they help teens have new experiences that help them become adults.

PREPARE FOR WRITING—COMPARE AND CONTRAST

INSTRUCTIONS FOR TEACHERS:
Review student instructions.

INSTRUCTIONS FOR STUDENTS:
Work with a partner to fill out the graphic organizer about teen brains.

- Use information from the Lesson 8 graphic organizer for the column on the left. Use information from today's video for the column on the right.
- Write ideas from the text and the video that are similar, or the same.
- Then write ideas from the text and video that are different, or not the same.
- Write what the author's and speaker's perspective, or point of view, is.
- Finally, write what you think.

WORD BANK:
adventures, brains, challenges, changing, **dangerous**, decisions, **excitement**, experiences, **imitate**, **judgment**, **mature**, new, people, rewards, **risks**, thinking, trouble

	Text: "You Trouble"	**Video: *Insight Into the Teenage Brain***
Ideas that are similar	The area of the teen brain that exercises judgment is not well-developed. Teens naturally desire new experiences. Teens' brains are the reasons teens take risks.	Teens brains are changing. They are not fully mature. Teens are good at having new experiences. Teens sometimes make bad decisions.
Ideas that are different	Teens take risks to imitate others. Teens think ahead about decisions they make. But they do dangerous activities anyway because they think it is worth the excitement.	Teens respond strongly to rewards. Teens make decisions without thinking. Teenage brains help teens seek out new adventures, meet new people, and confront interesting challenges.

What do you think the author's/speaker's perspective, or point of view, is?	This is a dangerous time for teens. Teenagers get into trouble.	Sometimes teens make bad decisions but it is also a time when teens learn and try new things.
What is your perspective? And why?	This is a(n) _____ time for teens. I think this because _____ _____ _____ _____.	

Appendix A: Glossary

Word	Definition	Example
adaptive	something that can adjust or get used to something new	And perhaps we'll learn that taking risks and seeking out rewards are really **adaptive** behaviors in many contexts that actually lead to really good decisions, and that help individuals navigate the often challenging and intimidating transition from childhood to adulthood.
adolescent	teenager	There's a lot that we can learn from the **adolescent** brain.
adults	a grown-up person	Because your brain as an adolescent is built to help you do that, compared to children and **adults**, the teenage brain is really good at seeking out new experiences, enjoying thrills, and seeking out risks.
adventure	an new or exciting journey or activity	I encourage you to enjoy all the new people you meet and all the **adventures** you take.
affiliate with	become closely connected	And your experiences and the people you **affiliate with** shapes the way your brain ultimately develops.
average	the mathematical mean (obtained, or gotten, by adding several numbers or things together and dividing by the total quantity)	This is a real human brain image **averaged** together among all of the teenagers.
beneficial	good or positive; favorable	Most teenagers don't yet have a fully mature brain, but that's actually really **beneficial**.
biased	an opinion or liking	Teen's brains are **biased** towards rewards.

challenges	interesting or difficult tasks	But it also presents an excellent opportunity to seek out new adventures, to meet new people, and to confront interesting **challenges** in ways that people don't typically do later in life.
circumstance	a particular incident or event	In future **circumstances** your brain will remember that you liked something.
dangerous	not safe; likely to cause harm	The teen years are a dangerous time for some teenagers.
decisions	choices	And so for that reason the teenage brain is really responsive to rewards and emotions when making **decisions**.
dopamine	is a chemical the brain produces, or makes, when a person is doing something fun or exciting	So when you receive something that you find rewarding, your striatum is very responsive and it releases something called **dopamine**.
emotional	having to do with strong feeling or emotion	It's also really good at recognizing, or being sensitive to, social and **emotional** information.
exaggerated	larger than normal	Everybody liked the sugar, but it's the teens who showed this **exaggerated** sensitivity.
excited	extremely happy or thrilled	The teenage brain was really **excited** to get sugar.
experiences	events that you have lived through	Your **experiences** and the people you affiliate with shapes the way your brain ultimately develops.
imitate	copy	Teens take risks to imitate others.
impulsive	without thinking	Teenagers may make more **impulsive** decisions.
judgment	careful thought	The area of the teen brain that exercises **judgment** is not well-developed.

mature	grown or developed	So most of you in this room today, as middle- and high-school students, don't yet have a fully **mature** brain.
positive	good or valuable	The differences in teen brains can be **positive** because they help teens have new experiences. The new experiences help teens grow in adults.
regulate (regulating)	control or adjust	The prefrontal cortex helps you **regulate** your behavior and your emotions.
responded	react	Teen's brains responded to money very strongly.
rewards	things that please you or makes you feel good	And so for that reason the teenage brain is really responsive to **rewards** and emotions when making decisions.
risks	things that may be unsafe	Because your brain as an adolescent is built to help you do that, compared to children and adults, the teenage brain is really good at seeking out new experiences, enjoying thrills, and seeking out **risks**.
sensitive (sensitivity)	very responsive to something or strongly affected by it	Everybody liked the sugar, but it's the teens who showed this exaggerated **sensitivity**.
snapshot	a photograph	And the beauty of fMRI is that you can take a **snapshot** of the brain in motion.
social	enjoying the company of other people	It's also really good at recognizing, or being sensitive to, **social** and emotional information.
striatum	a striped mass of white and grey matter in the brain which controls movement and balance	One region we focus on is called the **striatum**, and the **striatum** is the key component of the reward system.

teenagers	13--19 year olds	So in my lab we we study this reward system across development, and especially in **teenagers**.
thrills	something that makes you suddenly excited or happy	Because your brain as an adolescent is built to help you do that, compared to children and adults, the teenage brain is really good at seeking out new experiences, enjoying **thrills**, and seeking out risks.
transition	changing from one thing to another	The prefrontal cortex is starting to mature as teens **transition** into adults.

Italicized words are from the Academic Word List