

**Lesson #M1: How Your Brain Thinks Thoughts**   **Time: 50 minutes**

**Option adds 20 minutes**

Overview

This lesson is the first in a series of three lessons designed to promote a growth mindset in young people. It’s important that the mindset series of lessons is framed in a way that communicates that we need young people’s help to give advice about the growth mindset to other youth. Adults should avoid trying to “convince” young people about the growth mindset, but instead frame it as a forgone conclusion based on what we know about the brain. In this lesson, young people get an understanding of how the brain thinks thoughts, as messages are transferred from neuron to neuron through synapses. Through a PowerPoint presentation, a ball toss activity, and a short video clip, young people will learn about their brains and will be introduced lightly to the growth mindset. The lesson closes with a fun Brain Quiz Show that celebrates young people’s new learning.

Note: For 10-13 year-olds, split this lesson into two sessions.

Objectives

*By participating in this lesson, young people will:*

1. Identify basic structures of neurons and how thought patterns and learning are conducted.
2. Define growth mindset.
3. List that the brain needs proper fuel, sleep and challenge for optimal growth.
4. Describe why challenge helps your brain.

Anchor Vocabulary

* *Neuron-* a specialized, impulse-conducting cell that is the basic unit of the nervous system, consisting of the cell body and its parts, the axon and dendrites.
* *Axon-* the long thread-like part of the nerve cell (neuron) that transmits impulses out from the cell body.
* *Dendrites-* the branching process of a nerve cell (neuron) that conducts impulses from other cells into its cell body.
* *Synapse -* the space where a nerve impulse is relayed from one cell to another through chemicals called neurotransmitters. The chemicals *transfer* nerve information across the synapse just like a boat carrying a message between two shores. The electrical impulse from one cell triggers a chemical release in the *synapse* (space), and the chemical flows across the space and triggers the next cell’s electrical activity. The message flow is as follows: One cell’s axon—to synapse——to next cell’s dendrites.

Materials & Media

* Sound system or CD Player (and an upbeat song)
* Computer with MS PowerPoint installed
* One beach ball for each group of ten youth
* A timer
* LCD Projector
* Step-It-Up-2-Thrive Video Clip: Lesson #11: *Star Wars Clip*
* Step-It-Up-2-Thrive Video Clip: Lesson #11: *Neurons & Synapses*
* Step-It-Up-2-Thrive Digital Resources: Lesson #M1PowerPoint: *How the Brain Thinks Thoughts*
* Optional: small prizes or treats for everyone who participated in the Brain Quiz Show
* Youth notebooks

Optional Materials: Food On the Brain

* Coloring page for younger youth (or use table tents – see below)
* Paper Plates
* Paper
* Markers
* Toothpicks
* Licorice (1 per participant)
* Cherry tomatoes or Marshmallows (1 per participant)
* Broccoli or Grape Stems (6 per participant)
* String Cheese or Spaghetti (10 strings per participant
* Neuron Table Tents (Place pictures of neurons with their parts labeled on table tents.)

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| **Lesson Outline** | | **Lesson Description** |
| **ENROLL**  (3 min)  **EXPERIENCE** (5 min) | Opening  Framing and Enrollment Questions  Learning about the brain helps to deal with challenges. | **Build relationships with youth as they walk in the door. Use Four-At-The-Door! (Name, eyes, hand, heart)**  **Say:**  **I’m going to ask you to stand up or sit down to answer each of the following questions:**   * Stand up if you sometimes completely forget something you studied. * Sit down if you tried something hard and you gave up, because you couldn’t get it. * Stand up if you thought you were good at something, but you didn’t do as well as you expected. * Well, researchers have studied lots of youth like you around the world and they find that   these problems are extremely common.  **Slide #1: Title Slide**  **Ask Enrollment/Framing Questions:**   * What we’re going to talk about is based on research done to understand how young people can become more successful in their lives. * Many students like you have said that these were the most interesting and useful things they learned. * Believe it or not, the brain has a lot to do with success and we want to show you how to use it. * Before we start, do any of you ever think about your brain and how to use it best? Perhaps when you are studying or trying to do something well?   (Facilitator solicits a few ideas. Someone might suggest they get sleep to help their brain learn.)  **Slide #2: We Need Your Help**  **Say:**   * Excellent. We’ve learned a lot from some recent Stanford University research and now we need your help. * As scientists have discovered new things about the brain, they want us to share these messages about success with you, so you in turn will tell your peers. * These messages will mean a lot more coming from you than they will coming from adults like us. |
|  |  | **Slide #3: Kiesha**  **Say:**   * Here’s what some other young people had to say about the challenges they face… * Can someone read this for us?   **Slide #4: Alan**  **Say:**   * Who can read this one? * So we can see that these are common problems. * Fortunately, lots of scientific research shows that these problems can be overcome by learning about the brain * We’re going to start with a little movie clip that highlights two different mindsets… |
| **EXPERIENCE**  (8 min) | Star Wars Clip  (4 min)  Debrief  (4 min) | **Slide #5: Star Wars© Clip**  **Show Step-It-Up-2-Thrive Video Clips: Lesson #11: *Star Wars © Clip***  **Process activity.**  **Ask:**  What Happened?   * What did Yoda want Luke to do? * Why wasn’t Luke successful? (Answer: Yes, he had an attitude that he couldn’t do it.) * What was Yoda’s attitude or belief?   **Slide #6: The Growth Mindset**  **Ask:**  So What?   * Obviously this movie is a fantasy, but does it remind you at all of real life? How? * Who can tell me about a time in your life when you had an attitude like Yoda, and showed a growth mindset about a challenge? * How did your growth mindset help you?   Now What?   * What advice would you give? To someone who says things like:   + “Well, I’m just no good at math?” OR   + “I could never become a good athlete.” OR   + “I’m just an angry person, so I’m not going to change…” |
| **LEARN & LABEL**  (8 min) | Parts of the brain cell: the neuron  See Option at end of lesson for additional activity on the brain | **Slide #7: The Growth Mindset (continued)**  Facilitator reads and explains this slide that introduces the brain-is-like-a-muscle concept.  **Say:**   * Now we’re going to learn about what’s going on in your brain. * Please take some good notes from this PowerPoint, because at the end of this session, you’ll use your notes for a Brain Quiz Show with prizes!   **Slide #8: The Brain**  **Ask:**   * Here’s a cool picture of the brain looking at it from the side. Anyone know why it has so many folds?   (Answer: Those folds create more surface area for you to think, in that tight compartment called your skull. If we laid out those folds flat, your brain would be as large as a newspaper opened up.)  **Slide #9: The Brain**  **Say:**   * So here’s a diagram of a brain looking down from the top of your head. * Now let’s drill down deeper and take a peek.   **Slide #10: A Dense Network of Neurons**  **Say:**   * The brain, when you drill down deeper, is actually a dense network of brain cells, or neurons, that look like a circuit board on the computer. * Now let’s drill down even further to look at just one neuron.   **Slide #11: Parts of Neuron**  **Say:**  The diagram in front of you has a picture of one brain cell, a neuron, with its parts labeled. There are several important parts.   * First, let’s look at the *dendrites*. These tentacle-like structures reach out to receive chemical signals from other brain cells. Just like when you receive a tossed ball, you reach out hands to someone else and you send a signal of readiness. In a similar fashion, the brain cells have their own arms reaching out. * These dendrites change the chemical signal to an electrical one, which travels down the cell to the cell body. * Next you can see the *cell body,* which receives the signal and houses information. * Then, there's *an axon*. It's a long cable that carries the electrical signal from the cell body out to the space between cells. There, the electrical impulse becomes a chemical impulse to cross the space (synapse) to the next neuron. * When you think thoughts, this process repeats itself over and over—*chemical to electrical to chemical impulses traveling between cells.* |
| **EXPERIENCE**  (8 min) | Activity  (6 min)  Debrief  (2min) | **Beach Ball Toss**  **Slide #12: Beach Ball Toss**  **Say:**  Here’s a game. I’m going to throw a ball to one person in each group, who needs to throw it to another person in the group who is not next to him/her. The ball needs to pass through everyone’s hands. Make sure you remember the order in which you passed the ball. Raise your hands the moment the ball has passed through everyone.   * 1st time—say: “Ready, go!” Facilitator notes times of each group once hands are raised. * 2nd time—say: “I’m going to challenge all of you now to pass the ball around the circle again in the same order. Pass the ball and try to get faster tossing the ball around to everyone (facilitator records times). * 3rd time—say: “Wow. Look at how times improved. I am seeing that some teams are developing strategies to get even faster. “Let’s try it a third time and race as fast as you can against the clock and other teams.”   **Process activity.**  **Ask:**  What happened**?**   * Each time it got easier, right? (Answer: Each time was amazingly faster; learned patterns; tried different strategies; started to predict from experience; got in the “groove.”) |
| **LEARN & LABEL**  (2 min) | Back to PowerPoint | **Brain Content (continued)**  **Slide #13: How Thoughts are Transmitted**  **Say:**  Let’s look at this slide again of the brain thinking thoughts. This is all the electrical activity.   * Did you know that your brain is the most complex 3-pound mass in the known universe? * Each neuron is connected to between one and one million other cells. Overall in your brain, there are over a trillion connections. * When you have a thought, signals go from one set of neurons to another at speeds as fast as 1000 feet per second. That’s 680 miles an hour—the speed of a fast jet plane. * Then the brain turns those signals into thoughts or actions.   **Ask:**   * So What? (Answer: The more we practice something, the stronger we make those connections between brain cells.)   **Say:**   * When you try something new, it feels awkward and clumsy; practice helps your brain deepen dendrite connections with other neurons to make the pattern or activity easier. Just like a muscle, the neuron connections get stronger the more you do the activity. |
| **EXPERIENCE**  (3 min) | Youth watch how neurons transmit signals. | **Slide #14: Neurons and Synapses Video**  **Say:**   * Here’s a video of a leading brain researcher explaining how neurons work. * In this video, you will hear an additional vocabulary word called Synapse. * A synapse is the scientific name for the space between neurons. Remember we talked about the electrical signal reaching the end of the axon, where it changes to a chemical signal that flows across this synaptic space to the next cell. * You will hear how your brain cells connect with electrical and then chemical signals— over and over again, from one cell to another.   **Show Step-It-Up-2-Thrive Video Clip: Lesson #11: *Neurons & Synapses***  **Ask:**   * Who can explain what they saw in this video? |
| **LEARN & LABEL**  (8 min) | PowerPoint | **Slide #15: Sending Signals**  **Ask:**   * “What part of the neuron receives messages from other cells?” Who knows the answer to this question? (Dendrites)   **Say:**   * Let’s imagine what just happened in your brain. * Your eyes just read the words of this question and your ears heard the question. * The cells in your brain that are connected with your eyes and your ears take these words and transmit them in this electrical—to chemical—to electrical process to your reasoning center. Then the signal travels to other neurons that control your speech or hand movements if you were going to type the answer. (Reference to slide visual.) * How much energy do you think this takes up?   **Slide #16: Energy Use of the Brain**  **Say:**   * The brain is the biggest energy eater in your body, burning about 30% of the fuel your body uses.   **Slide #17: Your Brain Needs**  **Say:**   * With all that energy being used, your brain needs certain things to function well. * Fuel: Your brain needs healthy foods with Omega-3’s such as Eggs, Nuts and Fish * Sleep: Your brain needs to recharge for at least 1/3 of each day (8-9 hours of sleep). If not, you forget things more easily. * Exercise: Movement and exercise increase breathing and heart rate so that more blood flows to the brain. A recent study found that walking actually improves memory. * Challenge: This is an important point. * If you don’t use brain cells, you lose them. Nature has shaped adolescence as a particular time for making your brain stronger with challenge, and getting rid of brain cells that aren’t used. * Scientists tell us that the more you challenge your brain, the more connections you grow between cells.   **Slide #18: When you work hard at something…**   * Read slide   **Ask:**   * Has anyone ever heard the phrase: “Practice makes perfect”? That’s what happens in the brain when you practice.   **Say:**   * Everyone, turn to an elbow partner. Talk about one skill or ability that you’d like to improve over the next week or month; something that you can improve with practice, just like building a muscle.   **Slide #19: What Does Brain Science Mean for Successful Learning**   * Read slide.   **Ask:**   * If you just cram for a test the night before, and don’t study the material except at the last minute, why is your brain likely to forget the knowledge when the test is over? (Answer: You didn’t practice a lot and your brain didn’t get enough sleep.)   **Say:**   * As another useful fact, when you space your practice over time, you will remember the information better. * Excellent, now we’re going to have a quiz show so you can show off what you learned today. |
| **REVIEW AND CELEBRATE**  (5 min) | Brain Quiz Show | **Brain Quiz Show**  **Slide #20: (Brain Quiz show rules)**  **Slide #21: What is a growth mindset?**  Answer: The belief that your basic qualities and abilities are things that you can change and grow.  **Slide #22: How does your brain think thoughts?**  Answer: By sending messages across neurons.  **Slide #23: Name four parts of a neuron.**  Answer: cell body, axon, dendrites, axon transmitters  **Slide #24: What are dendrites?**  Answer: the branching process of a nerve cell (neuron) that conducts impulses from other cells into its cell body OR  The part of the neuron that receives messages from other cells.  **Slide #25: How are messages transmitted in your brain?**  Answer: From an electrical signal along the cell’s axon to a chemical signal in the synaptic space, that is picked up by the next cell’s dendrites and transferred to the nerve body electrically. (Electrical to chemical pathway)  **Slide #26: Name four things your brain needs to function well.**  Answer: Fuel, sleep, exercise, challenge  **Slide #27: How do challenges help your brain?**  Answer: The more you challenge your brain, and practice at getting better at something, the easier and faster it is for the brain to find that information and do well at the challenge.  **Slide #28: What three things would you tell your little brother or sister when they’re studying for a test?**  Answer: Practice several times, space their practice over time, get plenty of sleep, etc.  Optional: **Offer prizes as a reward to all teams for their effort.**  **Say:**   * Excellent work today. All this info you learned will be really valuable when you write your letters giving advice to other youth. |

Options:

**Food on the Brain – Optional Activity with Slide #11:**

**Time: 20 minutes**

**Purpose for activity:** To illustrate different parts of a neuron and how the brain thinks thoughts.

**Key Messages:**

1. Did you know that you can shape your own brain? New research shows how the brain works and what you can do to reach your full potential. There is rapid brain growth in adolescence.
2. The brain thinks thoughts by sending electrical and chemical impulses along pathways of brain cells called neurons. Neuronal pathways grow stronger cell connections each time you repeat a thought or action.

3) Challenge is good for your brain. Your brain is like a muscle: it grows stronger neuronal connections with challenge and effort.

**Overview:**

In this activity, young people identify the basic structures of neurons and how thought patterns and learning occurs. They build neurons with food to help them learn the basic structure of a neuron.

**Facilitator’s Guide:**

**Ask:**

* Did you know that you can shape your own brain?

**Say:**

* New research shows how the brain works and what you can do to reach your full potential.
* In adolescence, you have a unique opportunity for rapid brain growth. Therefore, let’s learn about how the brain thinks thoughts and what you can do to shape your brain.
* Your brain thinks thoughts by sending electrical and chemical impulses along pathways of brain cells called neurons. Pathways grow stronger cell connections each time you repeat a thought or action.
* To do this, we will be building our own neuron models out of food! You will be given four different types of food so that each food item can be used for a different part of the neuron.

**Facilitator discusses diagram:**

**Say:**

* The diagram in front of you has a picture of one brain cell, a neuron, with its parts labeled. There are several important parts:

a) First, let’s look at the ***dendrites*.** These tentacle-like structures reach out to receive chemical signals from other brain cells. Just like when you receive a tossed ball, you reach out hands to someone else and you send a signal of readiness. In a similar fashion, the brain cells have their own arms reaching out.

1. These dendrites change the chemical signal to an electrical one, which travels down the cell to the cell body.
2. Next you can see the ***cell body,***which receives the signal and houses information.
3. Then, there's ***an axon*.** It's a long cable that carries the electrical signal from the cell body out to the space between cells. There, the electrical impulse becomes a chemical impulse to cross the space (synapse) to the next neuron.
4. When you think thoughts, this process repeats itself over and over—***chemical to electrical to chemical impulses traveling between cells***, at a speed that is faster than a jet airplane. (680 miles an hour.)

For younger youth, there is the option to color the picture, as they plan how to build their neuron with vegetables. (See additional handout).

* Build food neurons using the following types of food as examples: licorice for the axon; marshmallows/cherry tomatoes for the cell body; broccoli/grape stems for the dendrites; and spaghetti/string cheese for the axon transmitters.

**Say:**

* After building your food neuron, label each part of the cell with toothpick flags or label the plate and draw arrows to the cell body, dendrites, axon, and axon transmitters.
* Each time you repeat a thought or put effort into something, your dendrites grow a stronger web of connections with other cells that represent that thought pattern. Therefore, just like a muscle, your brain grows stronger with challenge and effort.

**Processing Questions**

What happened?

* How are messages transmitted in your brain? Ask for responses using all four parts of the neuron labeled in the food model. Listen for understanding of key messages.

So what?

* Why is it important to learn about how the brain thinks thoughts? (Answer: Because you can shape your own brain to better reach your full potential. The brain likes challenge. Your brain is like a muscle that grows stronger with challenge and effort. The more you practice a thought or action, the more your neurons form dense connections that make those thoughts or actions easier.)

Now what?

* Can you identify some challenges that, with practice, could help you in the rest of your life?