TURNAROUND FOR CHILDREN

Stress and the Brain

OBJECTIVE: Educators will understand the impact of stress on the developing brain.

PURPOSE: A deep understanding of how adversity and stress can affect the brain creates the foundation for supporting whole-child development with a trauma-sensitive lens.

SCIENCE SIGNALS

The brain's malleability is both an opportunity and a vulnerability, depending on the context.

A shared understanding of how stress can affect the brain allows a school community to lay the foundation for healthy, whole child development with a trauma-sensitive lens.

Relationships buffer the negative impacts of chronic stress.

Similarly, knowing how positive relationships and environments can buffer the impact of chronic stress empowers a school community to prioritize these supports for all students.

This educational practice toolkit (1.1) is part of **Module 1:** *Introduction to the Science of Learning and Development*

TURNAROUND FOR CHILDREN

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Portrait of Practice

Ms. Spragins teaches seventh and eighth grade math at a middle school in Brooklyn, NY. In her teacher preparation program, she learned all about lesson planning, assessment, and the basics of classroom management. However, at the beginning of her third year, Ms. Spragins is still feeling unprepared to meet the various needs and challenges that arise in her classroom, particularly around behavior. She feels her class is often off task and her classroom climate is generally tense and easily escalated. This year, she wants to better understand what is getting in the way of her and her students' success.

After receiving a professional development session from her principal and school social worker on adversity and stress, Ms. Spragins decides to delve deeper into understanding the stress of her students – as well as her own. As she knows that her colleagues have shared similar struggles, Ms. Spragins facilitates several ACEs Research Reflections with her seventh and eighth grade team. They discuss in more depth the adverse childhood experiences study and the challenges they are seeing their students face outside of school. They also use the Brain Game to think further about how their students' stress might be getting in the way of learning in their classrooms. They reflect that stress isn't just affecting students, it affects teachers as well.

As a team, they commit to checking in briefly with each student as they enter the room, to try to become more attuned to each student, each day. They also decide to take 15 minutes of their weekly team meeting to check in with each other about their own level of stress, providing support for each other and encouraging time for self-care.

While this is a strong start, Ms. Spragins sees an opportunity to put this new lens into action more concretely by considering how all the systems, structures and practices in their school and classrooms support (or could better support) holistic student development, through a trauma-sensitive lens. She talks more with her school leader about how she can be involved in related initiatives, knowing it is a focus this year. Over time, she notices changes in the way she and her colleagues understand, talk about, address and support student behavior, as they now bring a lens grounded in the science of stress.

Science Grounding

The brain is a dynamic, living structure, made up of tissue that is the *most* susceptible to change from experience of *any* tissue in the human body (Cantor, Osher, Berg, Steyer, & Rose, 2018). As Fischer and Biddell (2006) state, "There is no separation of nature and nurture, biology and environment, or brain and behavior, but only a collaborative coordination between them" (p. 383). This idea can be seen in the way babies interact with and change in response to world around them, all the way down to the way our genes adapt to experience.

Although our DNA is composed of more than 20,000 genes, fewer than 10% are ever expressed (Gissis & Jablonka, 2011; Jablonka & Lamb, 2005; Rands, Meader, Ponting, & Lunter, 2014). Cues from our social and physical world signal a chemical process in our bodies, which determines which genes are expressed, along with how and when (Keating, 2016; Moore, 2015; Slavich & Cole, 2013; as cited in Cantor et al., 2018). This astounding malleability means that both negative and positive experiences play a key role in determining how our brains and bodies are shaped. There is no such thing as a developing child independent of context.

The most common naturally occurring example of negative context is the experience of trauma and stress. Positive stress activates the healthy production of adrenaline and cortisol – but chronic, unbuffered stress, sometimes called toxic stress, can create an *overproduction* of these hormones. Because development is malleable, a consistent and overwhelming presence of these hormones can fundamentally change the way a child's body and brain develops (Shonkoff et al., 2012). In the body, chronic, unbuffered stress leads to increased inflammation and poorer health outcomes (e.g., Felitti et al., 1998), and in the brain, key structures adapt to function in negative environments, leading to challenges for learning and behavior in other environments.

For example, stress hormones like cortisol can influence the structure and function of key brain areas for learning, like the amygdala, the hippocampus, and the prefrontal cortex – all part of the brain's limbic system (Shonkoff et al., 2012). These structures become primed to be on high alert for danger, and to react quickly. These changes affect a child's ability to regulate emotion, attention, and behavior, and to learn and remember – all key components of academic success.

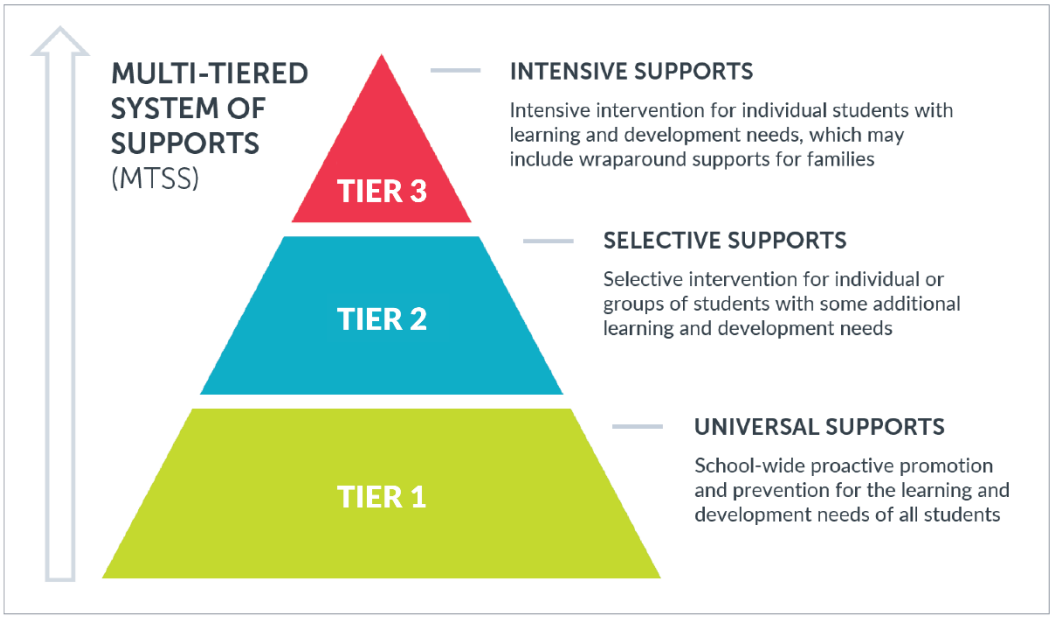
However, positive environments and relationships can buffer the potentially damaging effects of stress and catalyze learning and development (Osher, Cantor, Berg, Steyer, & Rose, 2018). Trusting relationships, like those between teachers and students, produce another type of hormone – oxytocin. Sometimes called the "love hormone," oxytocin can counterbalance the effects of the stress hormone, cortisol. Additionally, school environments that feel physically and emotionally safe by being calm, predictable and consistent are less likely to activate a hyper-alert stress response system. By creating a safe and supportive environment, and by being attuned and responsive to each student's holistic needs, educators play a critical role in students' healthy development and learning.

In fact, we can use this understanding of science to disrupt the assumptions we have about children and what they are capable of. We can use this science to design schools and classrooms that truly nurture the development of the whole child. We can design to develop the learner from any developmental starting point. By doing this, we can unleash the potential in each and every child.

Connections to Other Turnaround Tools

Tool Interconnectedness	Description
Module 3 **Educational Practice Toolkit 3.4** "Strategies to Build Relationships with Students" **Educational Practice Toolkit 3.4** "Strategies to Maintain Positive Relationships with Students"	Educational practice toolkits 3.4 and 3.5 outline how to support students in moment of escalation, when their stress response system (and possibly ours) is hyper aroused.
Module 10 **Professional Learning and Educational Practice Tools** "Self-Regulation: Emotions"	The Module 10 toolkits provide information and resources on how to understand and support adaptive self-regulation, especially when strong emotions and stress are involved.

MTSS Connection



Understanding how adversity and stress can affect the brain creates the foundation for supporting all students' holistic development through a trauma-sensitive lens, at all levels in a Multi-tiered System of Supports (MTSS). In particular, it is important for setting up effective Tier 1 systems, structures and practices that support all students, regardless of their previous experiences and developmental starting point.

Context-Setting

Skill 1: Understand the Brain's Learning Centers

You may have heard the many myths about the brain – that some people are "left-brained" while others are "right-brained," that we only use 10% of our brains, or that having babies listen to classical music will guarantee academic genius. While all of those statements have been debunked, one idea that still lingers in education is that students have a fixed IQ, and our level of intelligence and ability to learn won't change. This too, is a myth!

Our ability to learn in any given moment depends on what is happening inside our brains, which is shaped over time by the dynamic interaction between our genetic makeup and our experiences.

The Malleable Brain

MAKING MEANING OF KEY CONCEPTS

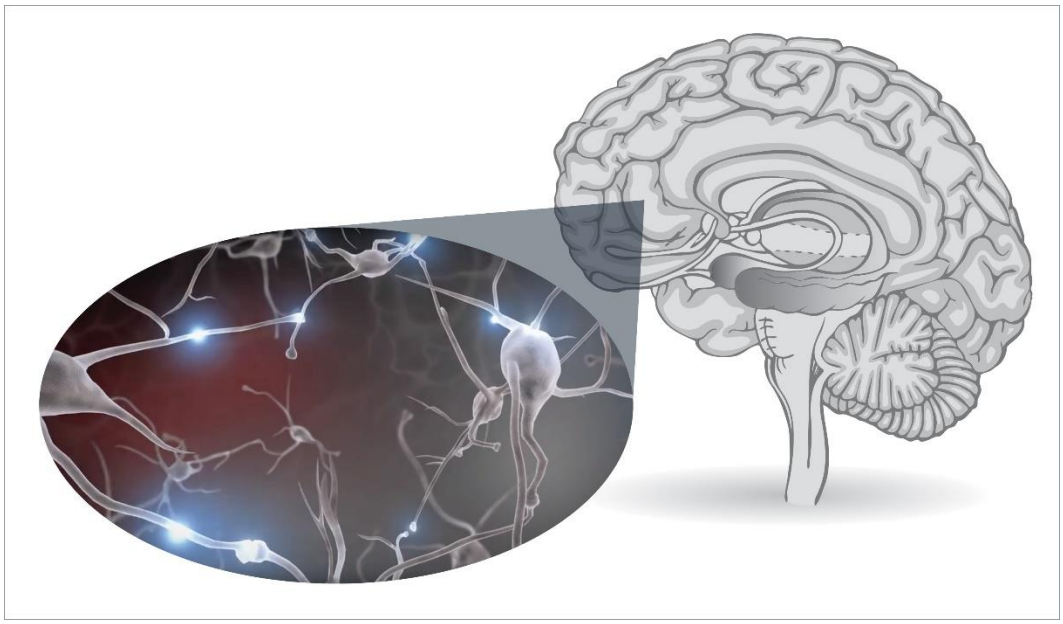
First, let's look under the microscope, zooming all the way down to our DNA. Although our DNA is composed of more than 20,000 genes, fewer than 10% are ever expressed (Gissis & Jablonka, 2011; Jablonka & Lamb, 2005; Rands, Meader, Ponting, & Lunter, 2014).

Circle 10% of the 20 genes below (each image represents over 1,000 genes in our DNA):

Cues from our social and physical world (our environments, relationships, etc.) signal a chemical process in our bodies, which determines which genes are expressed, along with how and when (Keating, 2016; Moore, 2015; Slavich & Cole, 2013; as cited in Cantor et al., 2018). This process, known as epigenetic adaptation, means that both positive and negative experiences play a key role in determining how our brains and bodies are shaped.

Neurons That Fire Together, Wire Together

Zooming out to the cellular level, we see that experiences create, strengthen and reorganize connections between neurons (or nerve cells in the brain), and eliminate unused neural pathways. Called neuroplasticity or neural malleability, this process allows the human brain to be shaped and changed during development and throughout a lifetime (Hebb, 2949, Cantor et al., 2018).



These connections between neurons create increasingly integrated and specialized networks. One network in the brain, known as the limbic system, is incredibly important for our ability to learn.

The Brain's Learning Centers

EDUCATOR TOOL

The Brain Game
p. 19

While the entire brain is implicated in the learning process, several key structures in the brain's limbic system – the prefrontal cortex, the amygdala, and the hippocampus – must work together seamlessly to facilitate effective learning, and in turn are shaped by our learning. To engage in an activity to understand how these three structures work together, see **The Brain Game** tool on p. 19.

The **prefrontal cortex**, located just behind our forehead in the brain's frontal lobe, regulates thoughts, emotions and behavior. For example, it is critical for carrying out a specific set of skills called executive functions, which include working memory, cognitive flexibility, inhibitory control, complex problem-solving, planning, etc.

The **amygdala**, two small, almond-shaped structures located in either side of the brain's temporal lobe, reacts to stress and emotional arousal. This means the amygdala facilitates emotional reactions, including responding to stress, fear and danger by cueing the body's "fight, flight or freeze" response. The amygdala also plays an important role in modulating emotional memories.

The **hippocampus**, two symmetrical seahorse-shaped structures located on either side of the brain's medial temporal lobe, are responsible for storing our learning and memory.

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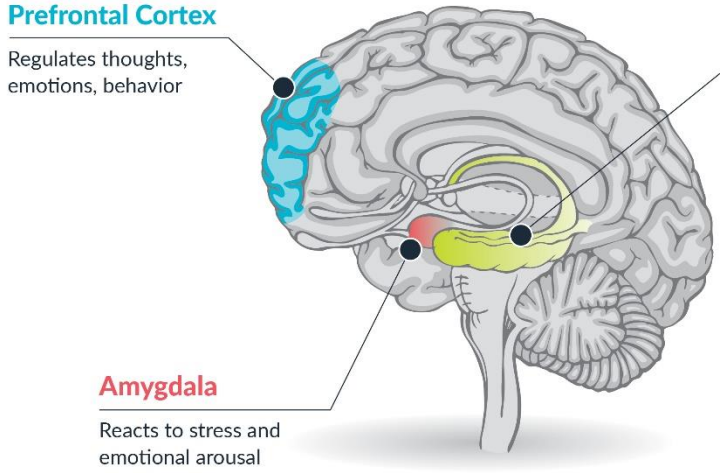
EDUCATOR TOOL

Lessons on the Learning Brain
p. 13

These three interconnected regions of the brain's limbic system communicate with one another during the learning process. To help students understand how these structures work to facilitate effective learning, see **Lessons on the Learning Brain** on p. 13.



MAKING MEANING OF KEY CONCEPTS

In the boxes below, consider how you would explain the role of these three important structures by using metaphors. See the example below.

Structure:	Metaphor:
Example: Prefrontal Cortex	Example: The prefrontal cortex is like the brain's air traffic control system, because it helps us to coordinate and regulate our thinking, emotions, and behaviors so we can be successful.

Skill 2: Identify Types and Causes of Stress

The incredible malleability of the human brain, including the brain's learning centers, is both an opportunity and a vulnerability, depending on the context. One of the most commonly occurring examples of negative context is stress – but did you know that not that not *all* stress is bad?

Types of Stress

The amount of stress we experience, in combination with the supports we have available to help us cope, determine how that stress might affect our brains and bodies (National Scientific Council on the Developing Child, 2014).

- **Positive Stress** is characterized by a mild stress response, including brief increases in heart rate and mild elevations in stress hormone levels. This type of stress alerts and prepares us – it can benefit us in situations where we need to be focused and energized. This type of stress actually builds healthy response systems to cope with future stress.
- **Tolerable Stress** is characterized by a more serious but temporary physical stress response, consistently buffered by supportive relationships. These experiences would have the potential to negatively affect development, but with support from trusting relationships, they do not have long-term impact on the brain and body.
- **Toxic Stress** is characterized by an intense, frequent, or chronic activation of the stress response system, in the absence of protective relationships. It is this type of stress that can change the way a child's brain and body develops.

For all children, positive relationships and environments buffer the effects of stress and catalyze healthy development.

MAKING MEANING OF KEY CONCEPTS

Using the definitions above, categorize the examples below by type of stress:

Example:	Circle the Stress Type:		
1. Falling out of a tree and breaking a bone, then going to the hospital with a parent	Positive	Tolerable	Toxic
2. Feeling nervous while traveling to school to take an important math test	Positive	Tolerable	Toxic
3. Coping with the loss of a grandparent, with the support of parents and other family	Positive	Tolerable	Toxic
4. Performing in a dance recital in front of a large audience	Positive	Tolerable	Toxic
5. Experiencing ongoing abuse, with no intervention or support from adults	Positive	Tolerable	Toxic

Answers: 1. Tolerable, 2. Positive, 3. Tolerable, 4. Positive, 5. Toxic

You'll notice that the only instance of toxic stress involves serious, prolonged stress and is *not* buffered by support of caring adults.

The Adverse Childhood Experiences (ACEs) Study

EDUCATOR TOOL

ACEs Research Reflections for Educators
p. 23

In 1998, a public health study was published in the American Journal of Preventative Medicine reporting on the relationship between childhood abuse and household dysfunction to many of the leading causes of death in adults (Felitti et al., 1998). The study's authors, including Dr. Vincent Felitti of Kaiser Permanente's Department of Preventative Medicine and Dr. Robert Anda of the Centers for Disease Control, correlated the number of adverse childhood experiences (ACEs) of more than 17,000 adults with their long-term health outcomes. The original ACEs surveyed included seven types of experiences:

- (1) Physical, (2) sexual, or (3) psychological abuse
- (4) Drug or alcohol abuse by someone in the home
- (5) Mental illness of someone in the home
- (6) Witnessing domestic violence toward the mother
- (7) Criminal behavior of someone in the home

In subsequent research conduced on ACEs, other experiences have been included, such as experiencing community violence.

The original study found that individuals who experienced four or more ACEs were at 2–3x greater risk for developing heart disease and cancer, 10–12x greater risk for intravenous drug use and attempted suicide, and 32x more likely to have learning and behavioral problems. In fact, individuals with six or more ACEs, on average, had a life expectancy that was shortened by nearly 20 years (Felitti et al., 1998).

Why did this pattern occur? The connection is explained when we understand that adversity doesn't just happen to children, it happens inside their brains and bodies through the biological mechanism of stress.

Skill 3: Explain How Stress Affects the Brain

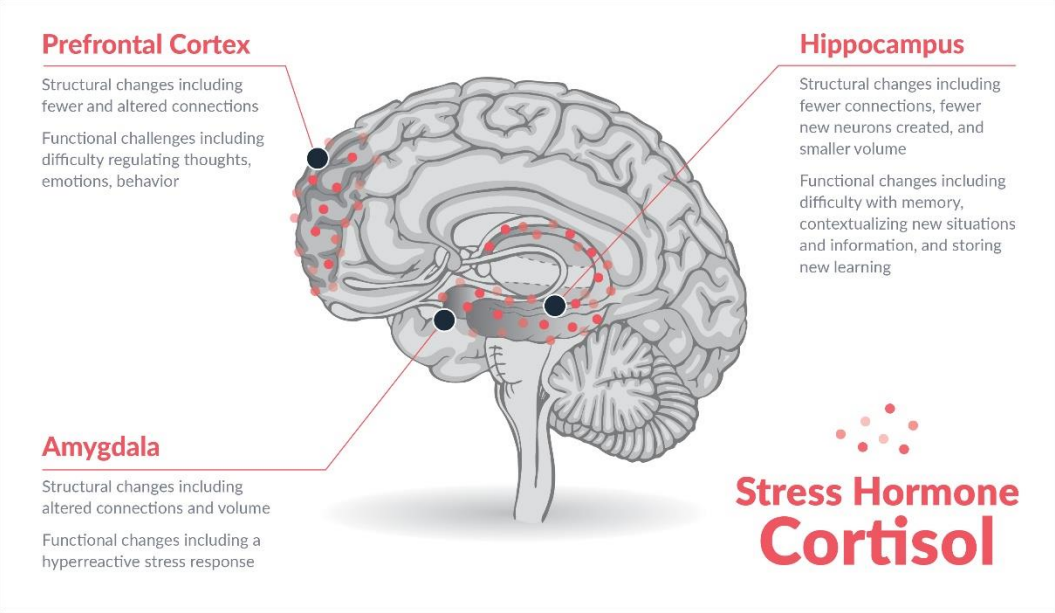
EDUCATOR TOOL

The Brain Game
p. 19

As discussed above, not all stress is created equal. The body's stress response (driven by the HPA, or hypothamic-pituitary-adrenocortical axis) activates the healthy production of adrenaline and cortisol, triggering the body's "fight or flight" response, but toxic stress (chronic and unbuffered stress) can create an *overproduction* of these hormones. Because development is malleable, a consistent and overwhelming presence of these hormones can fundamentally change the way a child's brain and body develop. In the body, stress leads to increased inflammation, which leads to negative health outcomes; in the brain, key structures adapt, leading to challenges for learning and behavior in other environments.

This Is Your Brain on Stress

The neural architecture most vulnerable to the impact of the stress hormone cortisol – the prefrontal cortex, the hippocampus, and the amygdala – is also critical for learning. When the brain is experiencing too much stress in the moment, these structures have difficulty working together to effectively facilitate the learning process. To engage in an activity to understand how these three structures work together under conditions of elevated stress, see **The Brain Game** tool on p. 19. Under conditions of toxic (chronic, unbuffered) stress, these structures become primed to be on high alert for danger, and to react quickly.



Under conditions of toxic stress, the **amygdala** becomes hyperreactive, with some research indicating that the amygdala may also change in size (e.g., Luby et al., 2013). This hyperactivity can mean that a child is in a constant state of high alert, becoming extremely sensitive to potential triggers.

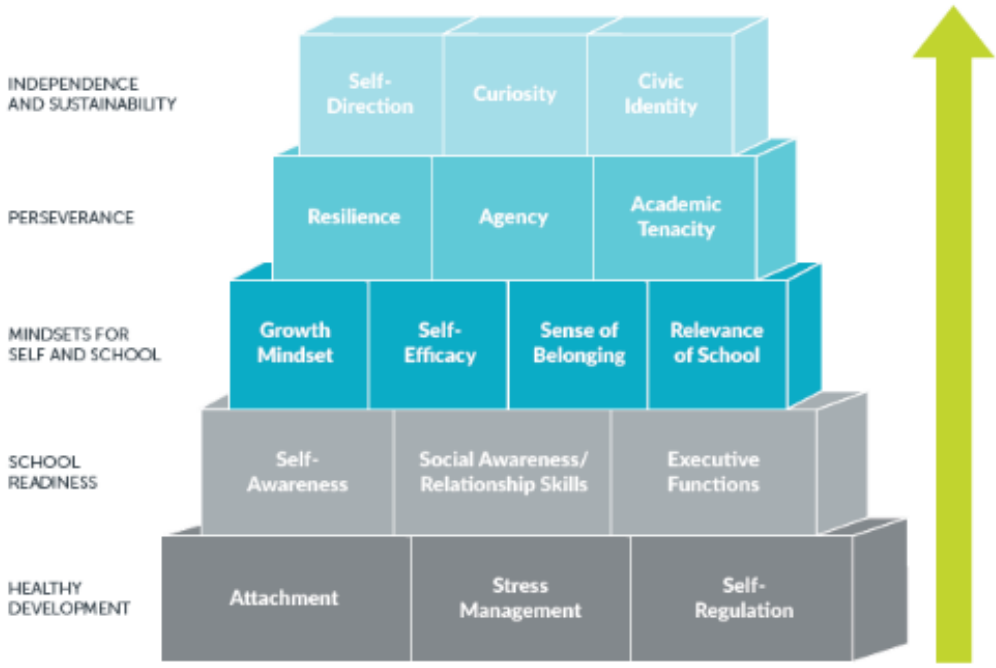
Connections within the **prefrontal cortex**, as well as connections between the prefrontal cortex and other regions, deteriorate under conditions of toxic stress (Shonkoff et al., 2012). This makes it difficult for this region to carry out its typical cognitive control functions and to down-regulate arousal from the amygdala. Deficits in these executive functions can result in "impulsivity, poor performance monitoring, reduced ability to regulate performance, impaired planning, reduced reasoning ability, difficulty generating strategies, inflexibility, inability to use feedback, and reduced working memory" (Carlson, Zelazo, & Faja, 2013, p. 715).

Toxic stress may also result in reduced **hippocampal** volume on both the left and right sides (Luby et al., 2013). Additionally, although the hippocampus is one of the few regions of the brain known to continuously generate new neurons, elevated levels of cortisol have been shown to inhibit this neurogenesis, again diminishing its functional capacity (Shonkoff et al., 2012). Impairment of the hippocampus damages the ability to create, store and retrieve memories. This also means that children who have experienced toxic stress may have difficulty contextualizing new information and assessing new situations.

Not only do structural and functional changes occur within each structure, but the necessary balance between regions – the up-regulation from the amygdala and the down-regulation from the prefrontal cortex and hippocampus – can be interfered with. As the amygdala frequently or consistently sounds the alarm, the prefrontal cortex and hippocampus are effectively turning down its response (Shonkoff & Garner, 2012).

Together, these changes from the experience of chronic, unbuffered stress may affect a child's ability to regulate emotion, attention and behavior, and to learn and remember.

Notice below the foundational bottom three rows of the Building Blocks for Learning. How do these skills and mindsets relate to the way that stress can affect the brain?



EDUCATOR TOOL

Support System Map
p. 25

STUDENT TOOL

Support System Map
p. 28

You may notice that impact of stress on the brain implicates the same skills that serve as foundational building blocks to healthy development and learning. For example, changes to the amygdala, prefrontal cortex and hippocampus influence a child's ability to manage stress and develop strong self-regulation skills. Additionally, relationships with primary caregivers and other caring adults can serve to buffer stress – which is related to attachment.

The Power of Relationships

As discussed, the deciding factor for whether a stress experience is tolerable or toxic is the presence of caring and supportive adults.

This buffering relationship can be seen on both the behavioral and biological level. On the surface, we may see an adult comforting a child during a stressful experience, or actively teaching them coping skills.

What we may not see is the biological impact of a buffering relationship. Trusting relationships, like those between parents and children, or teachers and students, produce another type of hormone – oxytocin. Sometimes called the "love hormone," oxytocin can counterbalance the effects of the stress hormone, cortisol. By being attuned and responsive to each individual and supporting them to become independent and autonomous, adults, including educators, play a critical role in students' healthy development and learning.

Similarly, environments that feel physically and emotionally safe by being calm, predictable and consistent are less likely to activate a hyper-alert stress response system.

To reflect on the network of relationships that support your own stress or your students' stress, see the **Support System Map** tool on p. 25, as well as the corresponding student tool on p. 28.

Educator Tools

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Lessons on the Learning Brain

PURPOSE

These lesson plans are meant to facilitate activities and discussions to help students understand how their brain learns.

DIRECTIONS:

Use the lesson plans below to teach students about how their brains learn. Select the appropriate lesson plan (elementary or secondary) and student activity from the following pages.

Elementary Lesson Plan (60 mins)

Materials:	Vocabulary:
• *Your Fantastic Elastic Brain* by JoAnn Deak, PhD (book) • Printed copies of student activity sheet (either activity A or B) • Rubber bands (optional)	• Brain • Elastic • Stretch • Prefrontal Cortex • Hippocampus • Amygdala

Hook (5 minutes)

1. **Question**: What is one thing you learned in [previous grade], and one thing you want to learn in [current grade]?
2. **Collaborative Structure**: Use Turn and Talk to have students share their responses with a peer.
3. **Facilitate a Discussion**: Allow several students to share something they learned in [previous grade], and comment on how exciting that must have been. Then, ask several students to share something they want to learn about in [current grade]. Use their responses to transition to today's activity.

Name the Learning (5 minutes)

Objective: Students will be able to explain how they can "stretch" their brains to learn something new.

1. **Explain**: Today, we are going to be learning about how we can STRETCH our brains to learn new things, build new skills, and make ourselves smarter every day!
    - Revisit one student's response about what they learned last year, and explain that they actually stretched and grew their brain to do that. Emphasize that they changed their own brain.
    - Ask students to "kiss their brain" (kiss the palm of their hand and then touch their forehead) for the hard work it did to learn that thing last year.

Active Engagement (25 Minutes)

1. **Read Aloud**: *Your Fantastic Elastic Brain* by JoAnn Deak, PhD
    - Before reading, tell students their job is to think about what the author is trying to teach us about our brains in this book.

Road Map of Questions:	High-Level Student Responses:	Addressing Misconceptions:
ASK *(before reading)* "We are going to read a book to understand more about our brain. It's titled *Your Fantastic Elastic Brain*, by JoAnn Deak. Hmm … That's an interesting word to describe a brain. What is an elastic? What does it do?"	*An elastic is like a rubber band or a hair tie, and it stretches/changes shape/gets bigger when you pull it, without breaking.*	*If students do not know the term "elastic," explain the term. This would be a good time to have a rubber band handy, to show them how it stretches.*
ASK *(after p. 6, "everything you dream")* "What does your brain do?"	*Your brain controls everything! What you think, do and feel.*	*If students are struggling to grasp the idea that the brain controls everything do you, try asking follow-up questions – "Does your brain help you solve math problems? Yes. Feel*

		happy or sad? Yes. Taste an apple? Yes. Dream at night? Yes. Play basketball? Yes."
ASK *(pp. 7–9, after each description)* "What is one thing your [part of the brain] helps you do?"	*Your prefrontal cortex could help you … plan what to do at recess or decide what strategy to use during math.* *Your hippocampus could help you … remember what you learned yesterday or what your teacher's name is.* *Your amygdala could help you … feel excited about a field trip or frightened on a roller coaster.*	*If students are struggling to come up with examples, provide an example yourself and then ask them to create a second example.*
ASK *(p. 13, after "practice really does make perfect … or, at least, much better")* "This example makes me think about all the things you said you learned last year. I bet you all had to work really hard to get better and better before you were a master at it! Would someone share with us what it was like to practice and practice? Were you good at it right away? How did that stretch your brain?"	*(1–2 students share how they practiced and got better at something over time, or learned something new over time)*	*If a student shared that they were able to "master" something the first time they tried it, remind them that sometimes we need a little bit of practice, and sometimes we need a lot of practice. Then, ask another student to share a time when they needed a lot of practice.*
THINK ALOUD *(p. 17, after "like diving into the water")* "This makes me think that we can actually learn not just how to do new things like swimming, but how to deal with hard feelings, too." [Share an example of how you stretched your brain to deal with a difficult feeling]		
ASK *(after last page)* "Why did the author write this book?"	*The author wrote this book because she wanted to teach us that we can grow our brain and learn to do so many new things. Our brain is like an elastic, we can stretch it.*	*If students respond that the author "likes writing" or "likes the brain," prompt them to think about what the author was trying to teach us in this book.*

Independent Practice (15 Minutes)

1. **Guide**: Have students complete one of the "My Fantastic Elastic Brain" worksheets – either A or B, considering the developmental range of your group (see pp. 15–16).
    - While students work, prompt them to consider all the ways they are going to "stretch" their brains.

Closing (10 minutes)

1. **Facilitate a Discussion**: Ask students to share with a partner, or ask a few students to share with the group the ways they are going to "stretch" their brains this year.
    - If possible, hang up students' work, and refer back to it when students need some motivation to keep stretching their brains.
    - (Optional) Give each student a rubber band to keep on their desk or on their wrist as a reminder.

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My Fantastic Elastic Brain (Student Activity A)

Name:	Date:

I want to learn ...

To STRETCH my brain and learn that, I will ...

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My Fantastic Elastic Brain (Student Activity B)

Name:	Date:

Something I want to learn this year:

How I will STRETCH my brain to learn something new:	
I will stretch my **Prefrontal Cortex!**	**To learn something new, I will PLAN to:**
I will stretch my **Hippocampus!**	**To learn something new, I will need to REMEMBER:**
I will stretch my **Amygdala!**	**While I'm learning something new, I might FEEL:**

Secondary Lesson Plan (80 mins)

Materials:	Vocabulary:
• 1 printed copy of The Brain Game • Printed copies of Headlines Activity sheet (for all students) • Computer access for students (at least 3 – one per group)	• Prefrontal Cortex • Hippocampus • Amygdala • Structure

Hook (8 minutes)

1. **Question**: Ask students, "What actually happens in your brain when you learn?" If appropriate, you may ask students to explain their idea to their partner using a metaphor.
2. **Collaborative Structure**: Use Turn and Talk to have students share their responses with a peer.
   - While students discuss, listen for students who share (1) that their brains can change, (2) that many parts of the brains work together to learn, and (3) any mention of the structures students will be learning about. Expect responses to vary significantly based on what students might have previously learned, for example in science class.
   - Strategically ask students to share out with the whole group, highlighting these ideas.

Name the Learning (2 minutes)

Objective: Students will be able to explain how three key parts of their brains work together to help them learn, and how stress can affect those structures.

1. **Explain**: Today, we are going to be learning about how our brains learn. While most every part of our brains are involved in the process of learning, we are going to zoom in on three key structures in our brains – the prefrontal cortex, hippocampus, and amygdala.

Active Engagement (30 Minutes)

1. **Collaborative Structure:** Facilitate a Headlines* Activity in small groups, to learn about three important parts of the brain.
   - Divide students into three groups.
   - Direct each group to research and summarize the functions of the (1) prefrontal cortex, (2) amygdala, or (3) hippocampus, using the Headlines Activity sheet (see p. 18).
     - Note: Depending on the amount of time available, your students' level of comfort with doing research, and their reading levels, you may opt to have each group research independently or direct them to a specific set of resources.
   - Facilitate each group sharing their "headline" about their brain structure, while the other groups take notes.

Discussion (25 Minutes)

1. **The Brain Game**:
   - To prompt discussion about how these structures work together, lead students through The Brain Game (see p. 19), following the instructions for facilitation and discussion.
   - Guide students' discussion to enable them to understand that (1) these three parts of the brain work together to help us learn effectively, and (2) too much stress can get in the way of that learning.

Closing (15 minutes)

1. **Wrap-Up**: Reinforce key takeaways from the discussion.
   - Show the TED Ed video "How Stress Affects Your Brain," from Madhumita Murgia (4 mins).
   - Ask students to share key takeaways from the discussion and video.

*Adapted from "Headlines" by Visible Thinking, Harvard Project Zero is licensed under CC NC 4.0.

TURNAROUND FOR CHILDREN

The Learning Brain (Headlines Activity)

Name:	Date:

Directions:

If you were to write a headline about this structure in the brain that captured its most important role, what would that headline be? Record it in the table below.

My group's structure:	
Notes:	

As each group shares their headline, record it below.

Brain Structure:	Headline:
Prefrontal Cortex	
Hippocampus	
Amygdala	

TURNAROUND FOR CHILDREN

The Brain Game

PURPOSE
The Brain Game is a way to reflect on the way your brain works in an integrated way to allow you to focus, think clearly and flexibly, and recall important information – and also how the brain's stress response makes that difficult!

DIRECTIONS:

Follow the instructions below to facilitate The Brain Game with educators or students.

Launch

Using the chart below, assign a role to each group member for the game. It's okay if there are members who do not have assigned roles; they can still be active participants in the observation and discussion. You may want to show The Brain's Learning Centers visual (p. 21) for reference.

Role:	Description:	Participant:
Prefrontal Cortex	The brain's "air traffic control," helping it to focus, think clearly and flexibly, plan, decide, and resist impulses and distractions.	
Hippocampus	The brain's memory center, storing and recalling information and past experiences.	
Amygdala	The brain's alarm system, alerting the rest of the brain and body to signs of emotional significance, stress, and danger.	
Teacher	This participant provides the brain with the information it needs to complete the task.	

Engage

- Introduce each participant to the group, stating their role and description (as above).
- Give each participant the slip of paper with their set of directions **(see next page for directions)**. Ask participants to silently read their directions to themselves, without telling the rest of the group.
- Explain, "For this game, each part of the brain will need to work together to accomplish a task! We are going to do two rounds: the first when the brain is calm and focused, and the second when it is stressed."
- Cue participants to begin round 1, and then round 2.

Reflect

Ask:

- In the first round, how did the parts of the brain work together to accomplish the task?
- In the second round, what was different? How did the amygdala's response change the way the brain was able communicate?

Discuss

Explain, "This is what happens when the brain experiences significant stress. Hyperarousal of the amygdala interferes with effective communication between all of the structures, which normally facilitates effective thinking and learning."

Ask:

- What would it be like for a student sitting in class to be experiencing significant stress?
- To a teacher, what might it look like if a student is experiencing significant stress?

The Brain Game *(contd.)*

Cut out each set of directions and give them to participants:

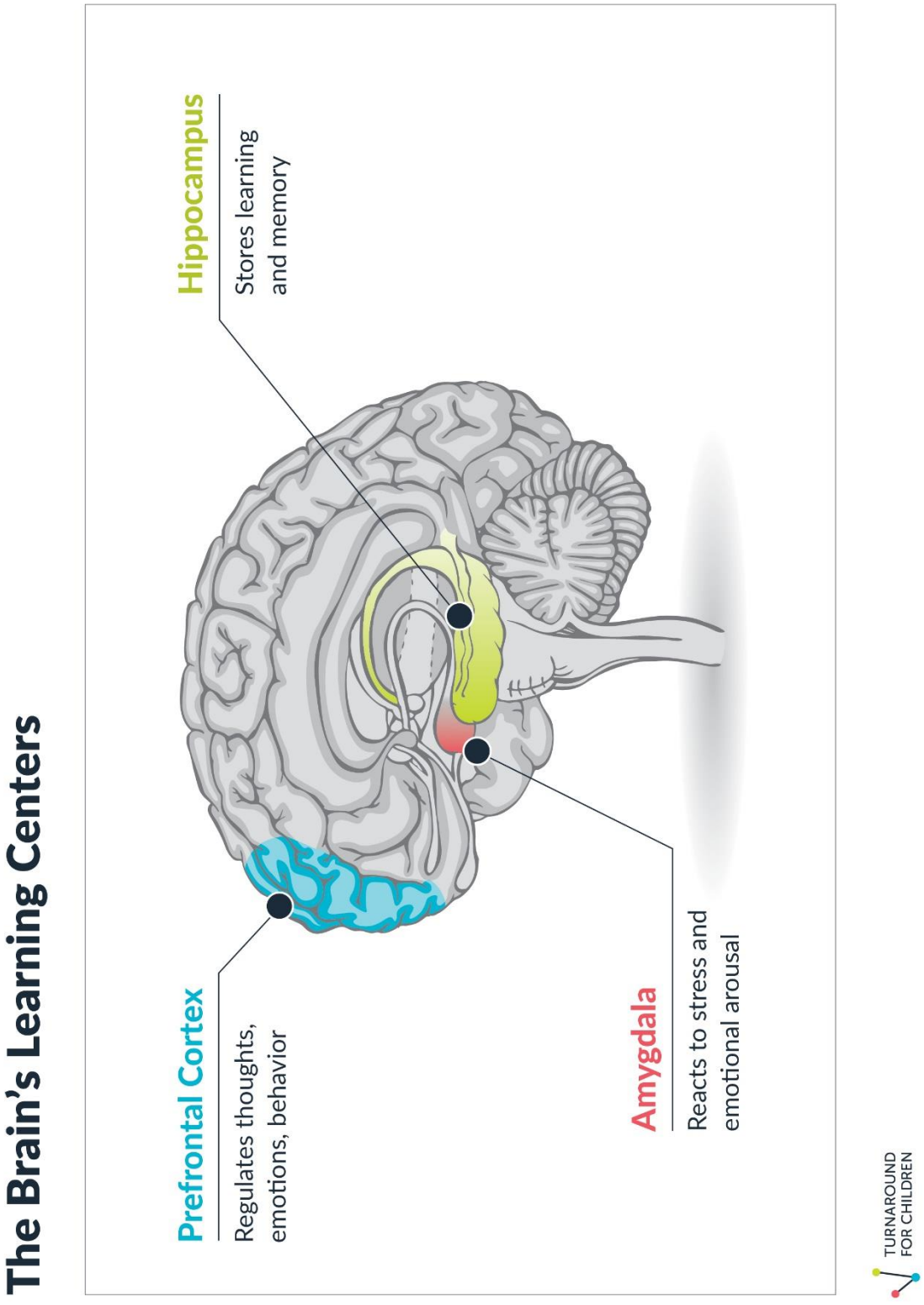
Role:	Round 1: Calm and Engaged	Round 2: Stressed
Teacher	Ask the prefrontal cortex the following questions, in order. Do not tell them if they are right or wrong. 1. What is pear plus lemon? 2. Now, take that and multiply it by blue. 3. Now, take that and subtract pink. 4. Now, take that and divide it by red. 5. Now, name that many things in the violet category. 6. Now, put those things in blueberry order.	Ask the prefrontal cortex the following questions, in order. Do not tell them if they are right or wrong. 1. What is purple plus banana? 2. Now, take that and multiply it by green. 3. Now, take that and subtract apple. 4. Now, take that and add yellow. 5. Now, name that many things in the orange category. 6. Now, put those things in grapefruit order.

Role:	Round 1: Calm and Engaged	Round 2: Stressed
Prefrontal Cortex	Listen to the teacher and answer their questions as best you can.	Listen to the teacher and answer their questions as best you can.

Role:	Round 1: Calm and Engaged	Round 2: Stressed
Hippocampus	Tell the prefrontal cortex the information they need from the list below: • Blue = 2 • Red = 3 • Pear = 4 • Blueberry = Alphabetical • Violet = Types of candy • Lemon = 3 • Pink = 5	Tell the prefrontal cortex the information they need from the list below: • Purple = 2 • Banana = 3 • Orange = Underwater animals • Green = 3 • Grapefruit = Size • Apple = 12 • Yellow = 1

Role:	Round 1: Calm and Engaged	Round 2: Stressed
Amygdala	Cheer the prefrontal cortex on, without being too distracting! Say things like, "You're doing great, this is so exciting," or "Wow, nice work," to motivate them.	Be LOUD and DISTRACTING! Yell, "Danger!" "Alert!" and try to distract them by jumping around or waving your arms.

The Brain Game *(contd.)*



TURNAROUND FOR CHILDREN

Stress Thermometer

PURPOSE

The purpose of the Stress Thermometer activity is for educators to reflect on how stress affects their brain and body.

DIRECTIONS:

Using the guiding questions below, consider how your body reacts to stress. Record your thinking in the My Body's Stress Response column. Then, reflect on what you notice.

Guiding Questions:

When you feel stress, what is your body's physical response? Consider what happens to your …

- Heart rate
- Breathing
- Muscles
- Stomach
- Hands and feet
- Skin
- Energy level
- Hunger level
- Other feelings or sensations in your body

My Stress Level:		My Body's Stress Response:
HIGH		
MEDIUM		
LOW		

Reflect:

What happens inside your body when you feel stress? What happens when you feel that stress over time? When do you see these physical stress responses in students?

TURNAROUND FOR CHILDREN

ACEs Research Reflections for Educators

PURPOSE

The purpose of the ACEs Research Reflections is to provide several different activities to allow educators the opportunity to learn about and reflect on the Adverse Childhood Experiences (and related) research.

DIRECTIONS:

Below, follow the directions to facilitate an ACEs Research Reflections activity, with a group of educators and/or school leaders. Each activity includes either a video or reading, to allow participants to dig deeper into the research. Each activity is designed to be a stand-alone session.

Activity A: ACEs and Health Outcomes

The purpose of this activity is to **learn about how childhood adversity can have lifelong effects on health and well-being**. The key takeaway is that adversity doesn't just happen to children – it happens inside their brains and bodies.

1. **LAUNCH**: Have participants fill out the Stress Thermometer tool (p. 22). Then, ask participants, "How do stressful situations affect your body in the moment? What about stressful situations over the course of time?"
2. **ENGAGE:** Have participants watch Dr. Nadine Burke Harris's TED talk**: How childhood trauma affects health across a lifetime**[1] (16 min).
3. **REFLECT:** Independently or in pairs, ask participants to reflect on the video:
    - What resonated with you from the video? What surprised you?
    - What connections did you hear between the launch activity about your body's stress response and what Dr. Burke Harris explained?
4. **DISCUSS:** As a group, share key takeaways using the "I Used to Think… But Now I Think…" protocol.* It might be helpful to chart these sentence stems for participants:
    - I used to think _____, but now I think _____.
    - I already knew _____, but now I also know _____.
    - I used to wonder _____, but now I understand _____.

Activity B: Prevalence of ACEs

The purpose of this activity is to **reflect on the prevalence of ACEs**, to underscore the idea that ACEs are incredibly common. The key takeaway is that many students experience stress from adversity, and schools need to be prepared to meet all of their holistic needs.

1. **LAUNCH**: Briefly review the key findings from ACEs research, leveraging slides 21–32 from Module 1.
2. **ENGAGE:** Have participants review the brief from the research journal *Child Trends* on the prevalence of ACEs: **Adverse Childhood Experiences: National and State-Level Prevalence**[2] (Sacks, Murphey, & Moore, 2014).
3. **REFLECT:** In pairs, have participants reflect together on the research brief using the Countdown (3, 2, 1) protocol:
    - What are 3 things you notice?
    - What are 2 things that resonated with you?
    - What is 1 thing you are wondering?

4. **DISCUSS:** As a group, discuss takeaways and wonderings from the research brief. Some questions for discussion include:
    - What did you notice? What resonated with you? What were you wondering?
    - What types of adverse childhood experiences are NOT captured by this research? What else might students in our community be experiencing that causes them significant stress?
    - How can we as a school community ensure that we remember the wide range of experiences students come to school carrying?

Activity C: ACEs and Stress in Schools

The purpose of this activity is to **consider how stress from ACEs shows up in schools, and what we can do about it.** The key takeaway is that positive environments and relationships can buffer the damaging effects of stress from ACEs.

1. **LAUNCH**: Ask participants to do a Turn and Talk with their partner, sharing:
    - A moment recently when you (an educator) felt stressed, and how that affected you at school
    - A moment recently when a student seemed stressed, and how that affected them at school
2. **ENGAGE:** Have participants watch the video with Dr. Pam Cantor from Turnaround for Children: **The Science of Adversity**[3] (10 min).
3. **REFLECT:** Ask participants to reflect on the video in pairs using the Connect, Extend, Challenge** protocol:
    - *Connect*: How do the ideas and information presented connect to what you already knew?
    - *Extend*: What new ideas did you get that extended or pushed your thinking in new directions?
    - *Challenge*: What is still challenging or confusing for you to get your mind around? What questions or wonderings do you now have?
4. **DISCUSS:** Ask participants as a group to think back to the stress moments they shared:
    - For yourself, what are the relationships you draw on to help you deal with your stress? What are the environments that bring your stress levels down?
    - For that student, what relationships are available to them to help them deal with their stress? Is the environment we are creating helping to bring their stress level down?
    - What can we do to ensure that every student experiences relationships and environments at school that buffer their stress?

[1] URL: https://youtu.be/95ovIJ3dsNk

[2] URL: https://childtrends-ciw49tixgw5lbab.stackpathdns.com/wp-content/uploads/2014/07/Brief-adverse-childhood-experiences_FINAL.pdf

[3] URL: https://www.turnaroundusa.org/what-we-do/the-science/

TURNAROUND FOR CHILDREN

Support System Map

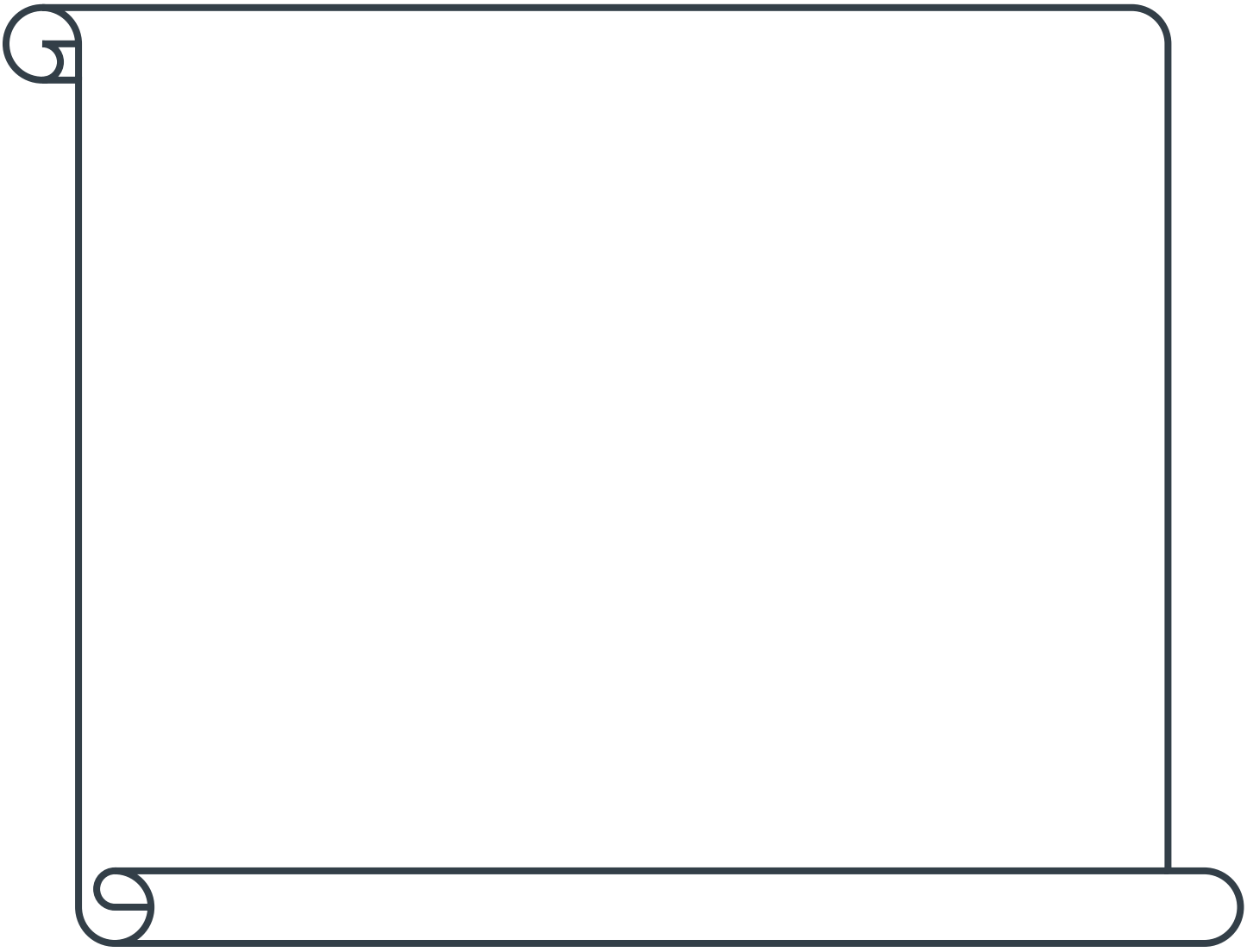
PURPOSE

The purpose of this tool is to prompt educators to reflect on the relationships they can draw upon to buffer their own stress, as well as the relationships that students can draw upon while they are at school.

DIRECTIONS:

Using the space below:

1. Complete your map by drawing 3–4 places where you most often feel stress. These might be physical locations, or situations you are often in.
2. Create your support system map by labeling the relationships you can rely upon to help you with that stress in each place. That might include a person actively helping you to cope with stress, a person doing something to make the situation less stressful, or a person just showing their friendship, care, or support for you.



Reflect:

If students were to complete this tool, what might they list as their most stressful places or situations while at school? How do or how can buffering relationships support them in each place?

Student Tools

TURNAROUND FOR CHILDREN

Stress Thermometer

DIRECTIONS:

How does your body feel when you are a little bit stressed? What about when you are VERY stressed? Write your answers in the column labeled My Body's Stress Response.

When you feel stress, what happens to your … ?

- Heart rate
- Breathing
- Muscles
- Stomach
- Hands and feet
- Skin
- Energy level
- Hunger level
- Other feelings or sensations in your body

My Stress Level:		My Body's Stress Response:
HIGH		
MEDIUM		
LOW		

Talk to a partner about:

What happens inside your body when you feel stress?

What happens when you feel that stress for a few days or weeks in a row?

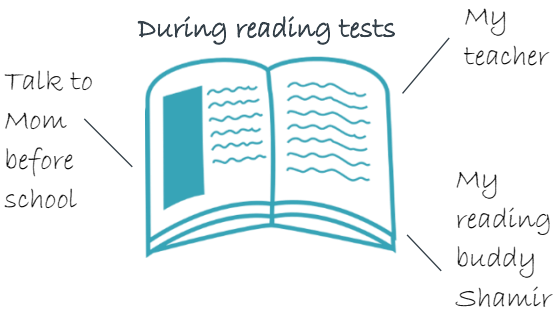
TURNAROUND FOR CHILDREN

Support System Map

DIRECTIONS:

1. **On the map, draw 3 or 4 places where you feel stress.** These might be actual places, like in the classroom or at basketball practice, or situations, like when you are with friends or when you need to take a test.
2. **In each place, write the names of people who help you to feel better.** They could …
   - Talk with you about why you are feeling stressed
   - Teach you ways to help yourself feel less stressed
   - Cheer you up or take your mind off the thing you are stressed about
   - Just show that they care about you!

Here's an example:



Think about how these important people help you:

Look at your map – wow! You have so many people who support you. Think about the things that they do to help you feel less stressed. Can you do the same thing for other people when they are feeling stressed, nervous, or upset?

Summary of Understandings

Understand the Brain's Learning Centers

- The brain is malleable, shaped by both our genetics and our experiences.
- The brain creates increasingly integrated networks by creating, strengthening, and reorganizing connections between neurons.
- The structures in the brain called the prefrontal cortex, hippocampus, and amygdala (the "learning centers") are part of a particularly important network needed for the learning process, known as the limbic system.

Identify Types and Causes of Stress

- Not all stress is bad – in fact, some stress can alert and prepare us, and build healthy brain architecture to cope with future stress.
- Unlike positive or tolerable stress, toxic stress in the absence of protective relationships can have a negative effect on development.
- Research on adverse childhood experiences shows that toxic stress can lead to increased risk of negative health outcomes, as well as learning and behavioral challenges at school.

Explain How Stress Affects the Brain

- Adversity does not just happen to children, but inside their brains and bodies through the biological mechanism of stress.
- The stress hormone cortisol can influence the structure and function of key brain areas for learning, like the amygdala, the hippocampus, and the prefrontal cortex.
- These changes affect a child's ability to regulate emotion, attention and behavior, and to learn and remember (the foundational building blocks) – all key components of academic success.
- Positive environments and relationships buffer stress and catalyze learning and development.

References

"Building Blocks for Learning" [video]. (n.d.). Turnaround for Children. Retrieved from https://www.youtube.com/watch?v=iQDKKsoKY1E

Cantor, P., Osher, D., Berg, J., Steyer, L., & Rose, T. (2018). Malleability, plasticity, and individuality: How children learn and develop in context. *Applied Developmental Science*, 1–31. https://doi.org/10.1080/10888691.2017.1398649

Carlson, S. M., Zelazo, P. D., & Faja, S. (2013). Executive function. *The Oxford Handbook of Developmental Psychology*, 42.

Deak, J. M., & Ackerley, S. (2010). *Your fantastic elastic brain: Stretch it, shape it* (first edition). San Francisco, CA: Little Pickle Press.

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., … Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. *American Journal of Preventive Medicine*, *14*(4), 245–258. https://doi.org/10.1016/S0749-3797(98)00017-8

Fischer, K. W., & Bidell, T. R. (2007). Dynamic development of action, thought, and emotion. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology*: *Vol. Theoretical models of human development*. https://doi.org/10.1002/9780470147658.chpsy0107

Fox, S. E., Levitt, P., & Nelson III, C. A. (2010). How the timing and quality of early experiences influence the development of brain architecture. *Child Development*, *81*(1), 28–40. https://doi.org/10.1111/j.1467-8624.2009.01380.x

Gissis, S., & Jablonka, E. (Eds.). (2011). *Transformations of Lamarckism: From subtle fluids to molecular biology*. Cambridge, MA: MIT Press.

Hebb, D. O. (1949). *The organization of behavior* (Vol. 50). Retrieved from http://linkinghub.elsevier.com/retrieve/pii/S0361923099001823

Jablonka, E., & Lamb, M. J. (2005). *Evolution in four dimensions: Genetic, epigenetic, behavioral, and symbolic variation in the history of life*. In *Life and Mind*. Cambridge, MA: MIT Press.

Johnson, S. B., Riis, J. L., & Noble, K. G. (2016). State of the art review: Poverty and the developing brain. *PEDIATRICS*, *137*(4), e20153075–e20153075. https://doi.org/10.1542/peds.2015-3075

Keating, D. P. (2016). Transformative role of epigenetics in child development research: Commentary on the special section. *Child Development*, *87*(1), 135–142. https://doi.org/10.1111/cdev.12488

Luby, J., Belden, A., Botteron, K., Marrus, N., Harms, M. P., Babb, C., … Barch, D. (2013). The effects of poverty on childhood brain development: The mediating effect of caregiving and stressful life events. *JAMA Pediatrics*, *167*(12), 1135. https://doi.org/10.1001/jamapediatrics.2013.3139

Moore, D. S. (2017). *The developing genome: An introduction to behavioral epigenetics* (First issued as paperback). New York, NY: Oxford University Press.

National Scientific Council on the Developing Child. (n.d.-a). *Early experiences can alter gene expression and affect long-term development: Working paper no. 10*.

National Scientific Council on the Developing Child. (n.d.-b). *Excessive stress disrupts the architecture of the developing brain: Working paper 3* (p. 12).

Osher, D., Cantor, P., Berg, J., Steyer, L., & Rose, T. (2018). Drivers of human development: How relationships and context shape learning and development. *Applied Developmental Science*, 1–31. https://doi.org/10.1080/10888691.2017.1398650

Rands, C. M., Meader, S., Ponting, C. P., & Lunter, G. (2014). 8.2% of the human genome is constrained: Variation in rates of turnover across functional element classes in the human lineage. *PLoS Genetics*, *10*(7), e1004525. https://doi.org/10.1371/journal.pgen.1004525

Shonkoff, J. P., Garner, A. S., Siegel, B. S., Dobbins, M. I., Earls, M. F., Garner, A. S., … Wood, D. L. (2012). The lifelong effects of early childhood adversity and toxic stress. *PEDIATRICS*, *129*(1), e232–e246. https://doi.org/10.1542/peds.2011-2663

Slavich, G. M., & Cole, S. W. (2013). The emerging field of human social genomics. *Clinical Psychological Science*, *1*(3), 331–348. https://doi.org/10.1177/2167702613478594

Stafford-Brizard, K. B. (2016). *Building blocks for learning: A framework for comprehensive student development*. Turnaround for Children.

Zatorre, R. J., Fields, R. D., & Johansen-Berg, H. (2012). Plasticity in gray and white: Neuroimaging changes in brain structure during learning. *Nature Neuroscience*, *15*(4), 528–536. https://doi.org/10.1038/nn.3045