NURTURING EARLY BRAIN CONNECTIONS
Capstone Family Literacy Center
2018
**CAPSTONE COMMUNITY ACTION**
Capstone Community Action serves Washington, Orange, and Lamoille counties and believes everyone should have the opportunity to realize their potential. We support this by stabilizing lives, nurturing children, supporting individuals to live in affordable, healthy, and efficient housing, providing ways to achieve economic stability and rise out of poverty. For more about our programs, visit [http://capstonevt.org/](http://capstonevt.org/).

**CAPSTONE HEAD START**
Capstone Head Start has a 51-year history of providing high quality early childhood education to children from low income families. Our design takes a two-generational service approach to elevate families out of poverty. By combining early childhood development for children with goal directed services for their parent(s), Head Start creates a stronger and more sustainable pathway to success.

The Family Literacy Center, an education provider approved by the Vermont Agency of Education, is a Head Start program that provides full-time education services for pregnant and parenting high school students.

**CURRICULUM AUTHOR**
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**CONTACT**
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**PERMISSIONS**
Where noted, the material in this curriculum is from the Center on the Developing Child at Harvard University, [http://developingchild.harvard.edu](http://developingchild.harvard.edu).
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Nurturing Early Brain Connections

COURSE OVERVIEW

The Nurturing Early Brain Connections curriculum was developed by Capstone Community Action’s Family Literacy Center, an education provider approved by the Vermont Agency of Education. The Center, a Head Start program located in Barre, provides full-time education services for pregnant and parenting high school students.

Nurturing Early Brain Connections is designed to encourage parents to embrace their role in providing an environment for their young children’s brains to thrive, particularly through verbal and physical interactions between them and their children. A young child’s brain is wired to develop millions of new neural pathways but needs experiences to do so. This course includes instruction about the basic structure of the brain and how unique sections of the organ function. We also explore the relationship between nature and nurture, three core concepts in early development, information on the consequences of delayed development, and caregiving strategies to nurture brain development.

Any provider or parent wanting to learn more about this topic can access the incredible materials available on the Center on the Developing Child at Harvard’s website. This site has a rich collection of working papers, videos, and articles derived from research specifically targeting how caregivers influence the brain development of infants and toddlers through one-on-one interactions. The site also details the damage caused by toxic stress — a term that refers to the unrelenting stress caused by extreme poverty, neglect, abuse, or severe maternal depression. Without caring adults to buffer children from these influences, the architecture of the developing brain can be weakened, resulting in long-term consequences for learning, behavior, and both physical and mental health.

Much of the material for this course, including the working papers, articles, graphics, and YouTube videos, are readily accessible online. Helpful materials that can be purchased include a 3D model/puzzle of the brain, the PBS video series Secret Life of the Brain (includes copious printouts and activities), and the Brain Architecture Game from the Center on the Developing Brain at Harvard.

Nurturing Early Brain Connections complements the Family Literacy Center’s Raising Readers curriculum. Raising Readers promotes reading as a valued family activity, assists parents in supporting their children’s language and literacy development, and fosters an appreciation for lifelong learning for both parent and child.

Nurturing Early Brain Connections is made possible by a generous grant from the A.D. Henderson Foundation.
Nurturing Early Brain Connections
Curriculum Lesson 1: Introductory Lesson

TIME
90 minutes

OBJECTIVES
At the end of the lesson, students will be able to do the following:
• Evaluate their assumptions about the brain and its characteristics.
• Connect concepts from the book Mindset to the concept of brain architecture.
• Name and define scientific terminology about the brain and its functions.
• Increase fluency with terminology through game play.
• Recognize the importance of environment and relationships in the development of their child's brain.

MATERIALS
• Student Handout: Mindset Quiz and Scoring Key
• Student Handout: The Developing Brain: Key Vocabulary
• Teacher Handout: The Developing Brain: Key Vocabulary
• Each vocabulary word written on a separate slip of paper
• A basket or container for the slips of paper
• A large sheet of paper and markers, chalkboard and chalk, or an interactive white board
• Introduction to Growth Mindset video link
• Brain Architecture Overview: Experiences Build Brain Architecture video link
• Journal for each student to write in

INSTRUCTIONAL PROCEDURES
Anticipatory (30-45 minutes)
1. Mindset and the Developing Brain
   A. Carol Dweck wrote the book Mindset to summarize her years of research into the characteristics that foster resiliency. It is a valuable resource for any teacher. This course refers to concepts from Dweck's research and uses quotes from the book.
   B. Have students take the Mindset quiz individually. (Depending on the reading abilities of the students, it may be helpful to read at least the first few statements aloud and talk through the choices.)
   C. Help students calculate their scores and read the corresponding description.
   D. Have students share their reactions to the scores: Do the descriptions seem to fit their beliefs? Why or why not? Allow students time to record the scores and reflect in their journals.
   E. Read the extreme descriptions aloud. 0-20 points represents a strong fixed mindset and 45-60 represents a strong growth mindset.
   F. Watch introduction to Growth Mindset.
   G. Discuss this idea of growing a stronger mind through challenging work.
   H. The teacher can connect the information in the Growth Mindset video to the concepts students will learn in this course. This course offers scientific, research-based evidence that parents’ interactions with their children can make a difference in their children’s brain development.

Presentation (60-75 minutes)
2. The Developing Brain: Key Vocabulary Activity
This activity introduces students to the key vocabulary words referenced throughout the course. It is similar to the game “hangman,” but students call out whole words instead of individual letters. While the group works together to identify words on chart paper, students also write the letters, words and definitions individually on their handouts (Developing Brain: Key Vocabulary).

For example, the first key vocabulary word is “architecture”. On their handout, the students will see 12 blanks. The teacher displays the same visual representation of the word on chart paper and writes the letter “A.”

A _ _ _ _ _ _ _ _ _ _

As students guess words that begin with “A,” listen for words that start with “Ar”, for example, “arrive.” When an “Ar” word is called out, add the next letter, r.

A r _ _ _ _ _ _ _ _ _ _

As more letters are filled in, someone will guess the entire word. At this point, define the word and have students work together to summarize it.

A. The student handout has visual representations of each word and space to write the definition.
B. The teacher handout includes the definitions.
C. The key vocabulary words on the word list are: architecture, neurons, circuits, synapses, connectivity, plasticity, nurture, pruning, nature, toxic stress.
D. At the end of this activity, students will have heard and seen these key words and talked about their meanings.

*You may find this link to a PDF of a similar vocabulary activity helpful.

3. Brain Architecture
A. Watch the overview video called, Experiences Build Brain Architecture.
B. As students watch, have them tally the use of vocabulary words from the above key vocabulary activity.
C. Share the tally totals. Which words were used most frequently?

4. Play “Draw a Word”
A. Divide students into two teams. A student from one team selects one of the key vocabulary words from the basket and draws a pictorial representation of the word without using any letters. Teams take turns calling out words, with the drawer’s team getting first guess. Team members can confer for 10 seconds before guessing. Meanwhile the artist can continue to add to the drawing. The first team to call out the correct word earns a point. Whichever team has the most points when time is called wins.
B. Require correct pronunciation to earn the point.
C. The winning team may earn a bonus point by explaining the meaning to the teacher’s satisfaction.
D. Determine how the game ends before play starts. Set a period of time, a number of turns, or a number of words drawn per person.
E. Modification: Allow the drawers to have a partner from his/her team to help think of ways to show the word.
“Draw a Word” Activity
1. Divide students into two teams.
2. One student from one team draws a word from the basket and draws a pictorial representation of the word without using any letters.
3. Teams take turns calling out words, with the drawer’s team getting first guess.

EVALUATION PROCEDURES
Have students write at least 5 lines in their journals on how the concepts in this lesson might affect their parenting. This concluding activity will give you a snapshot of how well students are comprehending the concepts and provides a closure for the lesson.

Check that each student makes an entry before leaving the classroom. Teacher response can take any of several forms:
• Simply glance at the length and ask a student who wrote less than 5 lines to add to their response before they leave.
• Randomly collect a sampling of student journals to read more critically and comment on before the next class.
• Collect all the journals at the end of class to read more critically and comment on before the next class.

FOLLOW-UP
Read any journals collected.
## Mindset Quiz

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Your intelligence is something very basic about you that you can’t change very much.</td>
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<tr>
<td>2. No matter how much intelligence you have, you can always change it quite a bit.</td>
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<tr>
<td>3. You can always substantially change how intelligent you are.</td>
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<tr>
<td>4. You are a certain kind of person and there is not really anything that can be done to change that.</td>
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<tr>
<td>5. You can always change basic things about the kind of person you are.</td>
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<tr>
<td>6. Musical talent can be learned by anyone.</td>
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<tr>
<td>7. Only a few people will be truly good at sports. You have to be “born with it.”</td>
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<tr>
<td>8. Math is much easier to learn if you are male.</td>
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<tr>
<td>9. The harder you work at something, the better you’ll be at it.</td>
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<tr>
<td>10. No matter what kind of person you are, you can always change substantially.</td>
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<tr>
<td>11. Trying new things is stressful for me, and I avoid it.</td>
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<tr>
<td>12. Some people are good and kind, and some are not. It is not often that people change.</td>
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<tr>
<td>13. I appreciate when parents, teachers, coaches give me feedback about my performance.</td>
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<tr>
<td>14. I often get angry when given feedback about my performance.</td>
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<tr>
<td>15. All human beings without a birth defect or brain injury are capable of the same amount of learning.</td>
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<tr>
<td>16. You can learn new things, but you can’t really change how intelligent you are.</td>
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<tr>
<td>17. You can do things differently but the important parts of who you are can’t really be changed.</td>
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<tr>
<td>18. Human beings are basically good but sometimes make horrible decisions.</td>
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<tr>
<td>19. An important reason why I do my schoolwork is that I like to learn new things.</td>
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<tr>
<td>20. Truly smart people do not need to try hard.</td>
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<tr>
<td>21. Math is much easier to learn if you come from a culture that values math.</td>
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</tbody>
</table>
Handout Lesson 1
Scoring Key

**KEY**
1. Ability mindset – fixed
2. Ability mindset – growth
3. Ability mindset – growth
4. Personality/character mindset – fixed
5. Personality/character mindset – growth
6. Ability mindset – growth
7. Ability mindset – fixed
8. Ability mindset – fixed
9. Ability mindset – growth
10. Personality/character mindset – growth
11. Ability mindset – fixed
12. Personality/character mindset – fixed
13. Ability mindset – growth
14. Ability mindset – fixed
15. Ability mindset – growth
16. Ability mindset – fixed
17. Personality/character mindset – fixed
18. Personality/character mindset – growth
19. Ability mindset – growth
20. Ability mindset – fixed
21. Ability mindset – fixed

**SCORING**

**Growth Questions**
1. Strongly agree – 3 points
2. Agree – 2 points
3. Disagree – 1 point
4. Strongly disagree – 0 point

**Fixed Questions**
1. Strongly agree – 0 points
2. Agree – 1 points
3. Disagree – 2 points
4. Strongly disagree – 3 points

Strong Growth Mindset = 63-45 points
Growth Mindset with some fixed ideas = 44-34 points
Fixed Mindset with some growth ideas = 33-21 points
Strong Fixed Mindset = 20-0 points
Handout Lesson 1
The Developing Brain – Key Vocabulary

1. _ _ _ _ _ _ _ _ _ _ _
   Define it

2. _ _ _ _ _ _ _ _ _ _ _
   Define it

3. _ _ _ _ _ _ _ _ _ _ _
   Define it

4. _ _ _ _ _ _ _ _ _ _ _
   Define it

5. _ _ _ _ _ _ _ _ _ _ _
   Define it
6. __ __ __ __ __ __ __ __

Define it

7. __ __ __ __ __ __

Define it

8. __ __ __ __ __ __

Define it

9. __ __ __ __ __

Define it

10. __ __ __ __ __ __ __

Define it
Teacher Handout Lesson 1
The Developing Brain – Key Vocabulary

1. (Brain) Architecture

**Define it:** comprised of billions of connections between individual neurons across different areas of the brain. The basic architecture is constructed through an ongoing process that begins before birth and continues into adulthood.

2. Neurons

**Define it:** a specialized cell transmitting nerve impulses.

3. (Neural) Circuits

**Define it:** interconnected neurons that regulate their own activity using a feedback loop. For example, a smell is detected, then transmitted to the brain that responds and sends an impulse to another circuit.

4. Synapses

**Define it:** a junction between two nerve cells, consisting of a minute gap across which impulses pass.

5. Connectivity

**Define it:** a pattern of links between distinct units within a nervous system.
6. Plasticity

**Define it:** the brain’s ability to reorganize itself by forming new neural connections throughout life. This ability is similar to how plastic can be formed to fit a mold and then recycled into another shape. It allows the brain to make up for injury and disease and to adjust to new situations or changes in environment.

7. Nurture

**Define it:** The belief that human personality, physical and character traits are primarily determined by early environment, development, and experience. For example, behavioral psychologists believe a person can be conditioned to learn a new behavior or eliminate an undesirable one.

8. Pruning

**Define it:** the process by which unused neurons and synaptic connections are eliminated. This compares to how a gardener’s trimming (pruning) of a rose bush allows the plant’s energy to be focused on the flower.

9. Nature

**Define it:** the belief that human personality, physical and character traits are pre-disposed by a person’s DNA or genetic influence. For example, genetic influence has proven to be an important factor in mental health conditions, such as depression and bipolar.

10. Cognitive

**Define it:** relating to the mental process of perception, memory, judgment, and reasoning. Scientists now understand that cognitive processes of the brain are highly intertwined with the emotional and social processes.
Curriculum Lesson 2:
Three Core Concepts in Early Development

TIME
90 minutes

OBJECTIVES
At the end of this lesson, students will be able to do the following:
• Recognize the importance of parent/child interactions in the development of their child’s brain.
• Conclude that experiences build brain architecture.
• Choose to incorporate serve and return into their daily interactions with their children.

MATERIALS
• Carol Dweck quote: “More and more research is suggesting that, far from being simply encoded in the genes, much of personality is a flexible and dynamic thing that changes over the life span and is shaped by experience.”
• Student Handout: “Key Concepts: Brain Architecture”
• Student Handout: “Five Numbers to Remember about Early Childhood Development”
• Video: The Science of Early Childhood Development
• Student Handout: Review of the video The Science of Early Childhood Development
• Student Handout: Brain Trivia
• Teacher Handout: Brain Trivia answers
• In Brief: The Science of Early Childhood Development, an online summary article, is a good resource for teachers or for students who wants to read more.

INSTRUCTIONAL PROCEDURES
Anticipatory (10-15 min)
1. Dweck Quote. Have students write responses in their journals to the quote by Carol Dweck.
   Have students share their responses aloud or in pairs.

Presentation (80 minutes)
2. Read the article on brain architecture together. This article explains one of the key concepts of brain development as defined by The Harvard Center for the Developing Brain. This site is rich with information regarding how care-givers can influence a child’s brain development. The article, although short, discusses complex concepts and uses precise vocabulary that could be skipped over or misinterpreted without careful reading. For this reason, it should be read aloud, either by the teacher or by students who are strong readers taking turns by paragraph.
   A. While listening to the article being read aloud, have students highlight concept words from Lesson 1 that appear in the article.
   B. At the conclusion of the article, have the class review highlighted vocabulary.
   C. Discuss these two questions:
      1) Were there any surprises in the reading? Questions?
      2) How could this information change the way you interact with your child?
D. Have students write in their journals for 2 minutes about the contents of the article and ideas for interaction.

3. Activity using handout based on “Five Numbers to Remember About Early Childhood Development”

A. Five Numbers to Remember About Early Childhood Development

1) Tell students this information comes from the Center on the Developing Child at Harvard University. The numbers are related to the brain research presented in the lessons so far. Each of the 5 numbers on the handout represents a statistic about the importance of early childhood to the learning, behavior, and health later in life. This activity helps students access their memory while preparing the brain to process the new vocabulary and store it with related previous knowledge.

2) Talk through what the first number might represent. Ask, “1,000,000, of what”? Encourage each student to make his/her own guess and record it on the worksheet. For example, one student may write 1,000,000 brain cells at birth and another student might write this represents the neurons created in the first year.

3) The next number on the handout is 18. Discuss what brain-related word might complete this statistic. Each student writes his/her guess on the handout by the number 18. Continue until each student has recorded a guess for all five numbers.

B. First Number: More than 1 Million New Neural Connections Per Second. This explains the brain-related science around the number 1,000,000.

1) Have students compare their answers to the correct one. How did they do?
2) Read the explanation and discuss. Possible questions: Are babies born with completely developed neural connections? How can parents and care-givers help build these connections?

C. Second and Third Numbers: 18 months is the age at which disparities and vocabulary begin to appear and 90-100% is the chance of development delays when children experience 6 to 7 risk factors.

1) Compare their answers to the correct ones. How did they do? These were more difficult to guess.
2) Read the explanation for number 18. This section of the article makes a correlation between a child’s vocabulary size and the education level and income of the parent. Be aware of the sensitive nature of this information. While brainstorming possible reasons behind the research, stress that the research is based on statistics and not true for every child. How can parents from all backgrounds help their child build a bigger vocabulary?

3) Read the explanation for the 90-100%. It can be hard for parents to recognize risk factors within their child’s life. Emphasize that having a risk factor does not mean that a child will have a delay. Talk about the effects of having multiple risk factors and the relationship to brain architecture and cognitive, language and emotional development.

D. Fourth and Fifth Numbers: explains the 3:1 odds of adult heart disease after 7 to 8 childhood experiences and $4 to $9 in returns for every dollar invested in early childhood programs.

1) Compare their answers to the correct ones. How did they do?
2) Read the explanation for the number 3:1. Possible discussion questions could be: Is this surprising? Why or why not? What might an “adverse experience” be?

3) Read the explanation for the number $4-$9. Possible discussion questions could be: Is this surprising? Why or why not? What groups should know about this statistic?

4) Focus students’ attention on what these 5 numbers tell us. Create a list of positive and negative take-aways from these statistics and explanations. Have each parent share one way this information can apply to his/her parenting.
E. At this point, provide time for writing in their journals about parenting. Encourage students to set a goal of having a specific, positive interaction with their child before the next class.

4. Watch *Science of Early Childhood Development* overview video
   A. After watching video, hand out the review sheet with blanks to fill in key terms and concepts.
   B. Allow students time to read and fill in the blanks. Encourage students to fill in synonyms or descriptive phrases if they can’t think of the “right” word. This is about learning the concepts.

5. **Hand out the Brain Trivia page** and tell the students they may complete this during any time remaining at the end of the class, but that it needs to be completed before the next lesson. Students should make their best guesses and not use the Internet to search for answers.

**EXIT CARD**
Near the end of class, pass out an index card or piece of scratch paper and have each student write his/her name at the top and one of the numbers from the article and its meaning. Have them pass their “card” in before they leave.

**EVALUATION PROCEDURES**
Use journals, exit cards and completed work to determine students’ grasp of the 3 core concepts.

**FOLLOW UP**
Remind students to complete the Brain Trivia homework.
Student Handout Lesson 2
Key Concepts: Brain Architecture

Early experiences affect the development of brain architecture, which provides the foundation for all future learning, behavior, and health. Just as a weak foundation compromises the quality and strength of a house, adverse experiences early in life can impair brain architecture, with negative effects lasting into adulthood.

Brains are built over time, from the bottom up. The basic architecture of the brain is constructed through an ongoing process that begins before birth and continues into adulthood. Simpler neural connections and skills form first, followed by more complex circuits and skills. In the first few years of life, 700 to 1,000 new neural connections form every second. After this period of rapid proliferation, connections are reduced through a process called pruning, which allows brain circuits to become more efficient.

Brain architecture is comprised of billions of connections between individual neurons across different areas of the brain. These connections enable lightning-fast communication among neurons that specialize in different kinds of brain functions. The early years are the most active period for establishing neural connections, but new connections can form throughout life and unused connections continue to be pruned. Because this dynamic process never stops, it is impossible to determine what percentage of brain development occurs by a certain age. More importantly, the connections that form early provide either a strong or weak foundation for the connections that form later.

The interactions of genes and experience shape the developing brain. Although genes provide the blueprint for the formation of brain circuits, these circuits are reinforced by repeated use. A major ingredient in this developmental process is the serve and return interaction between children and their parents and other caregivers in the family or community. In the absence of responsive caregiving—or if responses are unreliable or inappropriate—the brain’s architecture does not form as expected, which can lead to disparities in learning and behavior. Ultimately, genes and experiences work together to construct brain architecture.

It is easier and less costly to form strong brain circuits during the early years than it is to intervene or “fix” them later. Graph Source: Pat Levitt (2009).
Cognitive, emotional, and social capacities are inextricably intertwined throughout the life course. The brain is a highly integrated organ and its multiple functions operate in coordination with one another. Emotional well-being and social competence provide a strong foundation for emerging cognitive abilities, and together they are the bricks and mortar of brain architecture. The emotional and physical health, social skills, and cognitive-linguistic capacities that emerge in the early years are all important for success in school, the workplace, and in the larger community.

Toxic stress weakens the architecture of the developing brain, which can lead to lifelong problems in learning, behavior, and physical and mental health. Experiencing stress is an important part of healthy development. Activation of the stress response produces a wide range of physiological reactions that prepare the body to deal with threat. However, when these responses remain activated at high levels for significant periods of time, without supportive relationships to help calm them, toxic stress results. This can impair the development of neural connections, especially in the areas of the brain dedicated to higher-order skills.


### Student Handout Lesson 2
Five Numbers to Remember about Early Childhood Development

| +1,000,000 | 18 | 90-100 | 3:1 | 4-9 |

This feature highlights five numbers to remember about the development of young children. This feature is also available in a web-based slideshow available at [WWW.DEVELOPINGCHILD.HARVAR.D.EDU](http://WWW.DEVELOPINGCHILD.HARVAR.D.EDU)
These five numbers illustrate the importance of early childhood to the learning, behavior, and health of later life and explain why getting things right the first time is easier and more effective than trying to fix them later.

More Than 1 Million New Neural Connections Per Second

The early years matter because, in the first few years of life, more than 1 million new neural connections are formed every second.* Neural connections are formed through the interaction of genes and a baby’s environment and experiences, especially serve and return interaction with adults, or what developmental researchers call contingent reciprocity. These are the connections that build brain architecture – the foundation upon which all later learning, behavior, and health depend.


18 Months: Age at Which Disparities in Vocabulary Begin to Appear

Early experiences and the environments in which children develop in their earliest years can have lasting impact on later success in school and life. Barriers to children’s educational achievement start early and continue to grow without intervention. Differences in the size of children’s vocabulary first appear at 18 months of age, based on whether they were born into a family with high education and income or low education and income. By age 3, children with college-educated parents or primary caregivers had vocabularies 2 to 3 times larger than those whose parents had not completed high school. By the time these children reach school, they are already behind their peers unless they are engaged in a language-rich environment early in life.

Nurturing Early Brain Connections

90-100% Chance of Developmental Delays When Children Experience 6-7 Risk Factors

Significant adversity impairs development in the first three years of life—and the more adversity a child faces, the greater the odds of a developmental delay. Indeed, risk factors such as poverty, caregiver mental illness, child maltreatment, single parent, and low maternal education have a cumulative impact: in this study, maltreated children exposed to as many as 6 additional risks face a 90-100% likelihood of having one or more delays in their cognitive, language, or emotional development.

Source: Barth et al. (2008)

3:1 Odds of Adult Heart Disease After 7 - 8 Adverse Childhood Experiences

Early experiences actually get into the body, with lifelong effects—not just on cognitive and emotional development, but on long-term physical health as well. A growing body of evidence now links significant adversity in childhood to increased risk of a range of adult health problems, including diabetes, hypertension, stroke, obesity, and some forms of cancer. This graph shows that adults who recall having 7 or 8 serious adverse experiences in childhood are 3 times more likely to have cardiovascular disease as an adult. And, children between birth and three years of age are the most likely age group to experience some form of maltreatment—16 out of every thousand children experience it.

Source: Dong et al. (2004)
Nurturing Early Brain Connections

$4 - $9 in Returns for Every Dollar Invested in Early Childhood Programs

Providing young children with a healthy environment in which to learn and grow is not only good for their development—economists have also shown that high-quality early childhood programs bring impressive returns on investment to the public. Three of the most rigorous long-term studies found a range of returns between $4 and $9 for every dollar invested in early learning programs for low-income children. Program participants followed into adulthood benefited from increased earnings while the public saw returns in the form of reduced special education, welfare, and crime costs, and increased tax revenues from program participants later in life.

What These Five Numbers Tell Us

1. Getting things right the first time is easier and more effective than trying to fix them later.
2. Early childhood matters because experiences early in life can have a lasting impact on later learning, behavior, and health.
3. Highly specialized interventions are needed as early as possible for children experiencing toxic stress.
4. Early life experiences actually get under the skin and into the body, with lifelong effects on adult physical and mental health.
5. All of society benefits from investments in early childhood programs.


*The number “more than 1 million new neural connections per second” updates an earlier estimate of 700-1,000 new connections (which still appears in some of the Center’s printed publications, but as of April 2017 has been updated online and in all PDFs). All of these numbers are estimates, calculated in a variety of different ways, but we are making this change in our materials after a careful review of additional data that were called to our attention. The Center is deeply committed to a rigorous process of continuous refinement of what we know and an ongoing pledge to update that knowledge as additional data become available.
Student Handout Lesson 2
Review of The Science of Early Childhood Development
Videos

Video from Harvard Center for the Developing Child

1. _____________________________ shape our learning capacity and brain circuitry.

   The **brain** is built from the bottom up.

2. Which pathways begin before birth?

3. Which pathways are largely completed between ages 5-7?

4. Which continue to form into the teen years?

5. Brain development involves __________________________ between genetics (nature) and experience (nurture).

6. The brain is __________________________ - different areas perform different functions.

7. Emotional interference, __________________ and __________________ can impair learning no matter how gifted a child might be.

8. Cannot separate ___________________________ development from ______________________ and cannot have one without the other.

9. Three levels of stress have very different impacts on the brain.

   ___________________________: Brief increases in heart rate, mild elevations in stress hormone levels.

10. ____________________________: Serious, temporary stress responses, buffered by supportive relationships.

11. ____________________________: Prolonged activation of stress responses systems in the absence of protective relationships.

12. Significant adversity ___________________________ development in the first _____________ years

13. How many risk factors give a child over 50% chance of having developmental delays?

14. Note the difference between the 6-year-old brain and the 14-year-old brain. What has happened to the connections by age 14?
Student Handout Lesson 2
Brain Trivia

1. The average human brain is _____% water.
   a. 5%
   b. 20%
   c. 80%

2. The brain can stay alive _____ minutes without oxygen.
   a. 4 to 6
   b. 10 to 12
   c. 1 to 3

3. The slowest speed information can travel in the brain is _____ mph.
   a. 80
   b. 20
   c. 260

4. Your brain is 2% of your total body weight, but uses _____% of your body's energy.
   a. 35%
   b. 20%
   c. 2%

5. More electrical impulses are generated in one day by a single brain than by all the _____ in the world.
   a. Radio frequencies
   b. Telephones
   c. Televisions

6. About _____ full soda cans of blood flow through the brain every minute.
   a. 3
   b. 8
   c. 10

7. After age _____, the brain shrinks a quarter of a percent (.25%) in mass each year.
   a. 55
   b. 30
   c. 25

8. The brain feels _____ pain compared to the rest of the body.
   a. Less
   b. More
   c. No
   d. About the same
9. An average person’s short-term memory can only hold _____ digits at a time.
   a. 7
   b. 10
   c. 15

10. A yawn serves to
    a. Show we are tired
    b. Wake us up
    c. See who is paying attention

11. There are about _____ neurons in the human brain, the same number of stars in our galaxy.
    a. 1 trillion
    b. 100 million
    c. 100 billion

12. Albert Einstein’s brain weighed 2.7 pounds, significantly (more / less) than the human average of _____ pounds.
    a. Less, 3
    b. More, 1
    c. Less 5

13. An estimated _____ thoughts are produced by the brain on an average day.
    a. 700
    b. 7,000
    c. 70,000

14. The world record for being fluent in the most languages is held by Ziad Fazah. He can speak _____ languages.
    a. 23
    b. 74
    c. 56

15. The energy used by the brain is enough to light a _____ watt light bulb.
    a. 150
    b. 75
    c. 25

16. Your brain thinks more _____ (time of day) than any other time.
    a. At night
    b. During the day
    c. In the morning

17. Your emotions are believed to come from the
    a. Cerebellum
    b. Medulla oblongata
    c. Amygdala
    d. Heart
18. Which part of the brain keeps you breathing?
   a. Amygdala
   b. Brain stem
   c. Pituitary gland

19. What is the biggest part of your brain?
   a. Brain stem
   b. Cerebellum
   c. Cerebrum

20. A fetus’s neural plate forms_____ after conception.
   a. 16 days
   b. 30 days
   c. 6 weeks

Teacher Resource Lesson 2
Brain Trivia Answer Key

1. The average human brain is _____% water.
   a. 5%
   b. 20%
   c. 80%

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   b. 30 days
   c. **6 weeks**

Curriculum Lesson 3:
Serve and Return

TIME
90 minutes

OBJECTIVES
At the end of the lesson, students will be able to do the following:
• Recognize the importance of parent/child interactions in the development of their child’s brain.
• Recognize and apply brain-building vocabulary terms.
• Identify facts about the brain and its functions.
• Identify characteristics of serve and return in a game of toss and in interactions with their child.
• Analyze their own interactions with their child for examples of serve and return.
• Select 1 to 2 steps of the serve and return process to apply with their child.

MATERIALS
• Students bring to class their answers to the Brain Trivia questions
• One tennis ball for every two students
• Student journals
• Highlighters
• Overview video: Serve and Return Interaction Shapes Brain Circuitry
• Student Handout: “Five Steps for Brain-Building Serve and Return” online article found in PDF
• Student Handout: Serve and Return Plan

INSTRUCTIONAL PROCEDURES
Anticipatory (15 minutes)
1. Review Brain Trivia handout from Lesson 2
   A. Read through the questions and identify the correct answers.
   B. Discuss surprises and answer questions as they arise.
   C. Ask students which trivia facts seem to be closely connected to the brain research concepts studied so far. Answers will vary. The related answers are those that have to do with the brain changing over time. Help students make connections between the facts presented in the trivia quiz and the concept of infant brain development through positive interactions with caregivers.

Presentation (80 minutes)
2. Serve and Return Tennis Ball Activity
   A. Ask students to count off consecutively from one and write their number in their journal.
   B. Distribute a tennis ball to students with an odd number. Ask: “What activities can you do by yourself with this ball?” Allow some discussion.
   C. Move the group to an open area, such as a hallway or playground area outside. Have each student with an odd number pair with the student who has the next highest even number. Ask, “Now that you have a partner, what are ways you can safely play with the ball?”
   D. Allow students to play catch as you observe the pairs.
E. Based on your observations, ask the student pairs to demonstrate various ways to play catch. Some possibilities include bouncing the ball, tossing it overhand or underhand, counting consecutive catches.

F. Ask how playing with a partner and a ball is different than having the ball without a partner – or not getting a ball at all! Which is more engaging?

G. Stress the interactions involved in playing catch, how partners must talk, come to agreement, adjust once play begins. Discuss the following questions:
   1) How did partners respond to different ways of tossing or throwing the ball?
   2) Who initiated the action? Was it always the same person? Should it be?
   3) How did partners adjust to each other?
   4) Did any pairs change the game when it became too easy or repetitive?

H. Discuss connections between playing catch and the brain development model of serve and return. As a class, create a list of ideas for serve and return interactions between care givers and 0-5 aged children.

3. Discussion of Five Steps for Brain-Building: Serve and Return

A. Watch the overview video: Serve and Return Interaction Shapes Brain Circuitry. During the video, have students listen for terms from Lessons 1 and 2 and note them in their journals. The intent is to get students to slow down and recognize these words as a means of incorporating them into their own spoken vocabularies.

B. After the video, use a round robin sharing of terms students recognized. Point out terms students may have missed, such as brain architecture, interactions, serve and return, neural connections, development, back and forth, relationship, caring adult, stress, and care-givers.

C. Ask students to name the five areas of the brain mentioned in the video: Behavioral Control, Motor Skills, Language, Memory, Visual.

D. Ask students, “How many of these areas did the baby access while reading the book with the caregiver?” Answer: ALL of them.

E. Encourage students to discuss how reading aloud with their infants is not just a language activity. An infant’s brain is building connections among all 5 areas. Also encourage students to connect the interactions shown on the video with the catch activity. Both participants toss the ball. Both react by catching. Help parents recognize that the infant also “serves” in various ways during interactions with an adult. Part of serve and return is the parent acknowledging the child’s serves.

F. Handout the article: “Five Steps for Brain-Building Serve and Return.”
   1) Have students read the article independently, highlighting interactions described in the article that are similar to ones they’ve had with their child. Also highlight “ah ha” information; this might be an explanation that makes sense or an activity they want to try with their child. As individual students finish, ask to see their highlighted articles. Comment on at least one of the details highlighted.
a. What “ah-ha” details did students have in common? Record these in public notes.
b. What were some of the interactions that seemed familiar?
c. What suggestions from the article could make familiar interactions more meaningful? These questions are very important. Many parents read to their children, but they might be impatient with the child’s wanting to stay on one page after the words have been read. This discussion is an opportunity for you to help students notice the type of little suggestions that are made throughout this article.

2) The article ends the description of each of the five steps with the question “Why?” followed by an explanation of how this interaction helps the child. Review these with students. Ask students to comment on whether these explanations motivate them to use serve and return.

3) To conclude the discussion, ask students to write their reflections about this discussion and how deliberately applying the 5 steps might enrich their interactions with their children. Encourage students to record the 5 steps and note highlights about each.

   - **Step 1:** Notice the serve and share the child’s focus of attention.
   - **Step 2:** Return the serve by supporting and encouraging.
   - **Step 3:** Give it a name!
   - **Step 4:** Take turns…and WAIT. Keep the interaction going back and forth.
   - **Step 5:** Practice endings and beginnings.

4. Set a Goal
   A. Refer back to the public notes from the tennis ball activity. Select one of the interactions they suggested and discuss which of these 5 steps could be applied to that activity. Repeat with more as time allows.
   B. Have the students refer to the class notes in their journals and then try to answer the following questions. Which types of interactions happen with your child regularly? Which would you like to practice more frequently? Be sure to tell the students to include in their journal entries detailed descriptions of interactions. For example, if you have a routine with your child, when does it happen? What are you trying to accomplish? What does your child do? How do you interact?
   C. Ask the students to select one or two of the 5 steps of serve and return to intentionally apply with their child before the next class. Discuss possibilities as a group. Plan the activity on the Serve and Return Plan handout:
      - What activity will you do?
      - Who will participate?
      - When, what time of day?
      - Does this activity need a quiet place? An open space?
      - Certain toys?
      - How will you begin and end?
      - Observe your child during the interaction.
      - Record your observations on the handout.

**EXIT CARD**
Before leaving, complete the plan portion of the serve and return handout.

**FOLLOW-UP**
Check in with students around completion of the serve and return interactions with their child.
Handout Lesson 3
“Five Steps for Brain-Building Serve and Return” Article

5 Steps for Brain-Building Serve and Return

Child-adult relationships that are responsive and attentive—with lots of back and forth interactions—build a strong foundation in a child’s brain for all future learning and development. This is called “serve and return,” and it takes two to play! Follow these 5 steps to practice serve and return with your child.

Serve and return interactions make everyday moments fun and become second nature with practice.

By taking small moments during the day to do serve and return, you build up the foundation for children’s lifelong learning, behavior, and health—and their skills for facing life’s challenges.

For more on serve and return:
tinyurl.com/serve-return

Filming Interactions to Nurture Development (FIND) is a video coaching program that aims to strengthen positive interactions between caregivers and children. FIND was developed by Dr. Phil Fisher and colleagues in Eugene, Oregon.

For more about FIND:
tinyurl.com/find-program

1. Notice the serve and share the child’s focus of attention.

Is the child looking or pointing at something? Making a sound or facial expression? Moving her arms and legs? That’s a serve. The key is to pay attention to what the child is focused on. You can’t spend all your time doing this, so look for small opportunities throughout the day—like while you’re getting him dressed or waiting in line at the store.

WHY? By noticing serves, you’ll learn a lot about a child’s abilities, interests, and needs. You’ll encourage her to explore and you’ll strengthen the bond between you.

2. Return the serve by supporting and encouraging.

You can offer comfort with a hug and gentle words, help him, play with him, or acknowledge him. You can make a sound or facial expression—like saying, “I see!” or smiling and nodding to let him know you’re noticing the same thing. Or you can pick up the object he’s pointing to and give it to him.

WHY? Supporting and encouraging rewards a child’s interests and curiosity. Never getting a return can actually be stressful for a child. When you return the serve, the child knows that his thoughts and feelings are heard and understood.
5 Steps for Brain-Building Serve and Return

Did you know that building a child’s developing brain can be as simple as playing a game of peek-a-boo?

3. Give It a name!

When you return a child’s serve by naming what she is seeing, doing, or feeling, you make important language connections in her brain, even before she can talk or understand your words. You can name anything—a person, a thing, an action, a feeling, or a combination. If a child points to her feet, you can also point to them and say, “Yes, those are your feet!”

WHY? When you name what a child is focused on, you help her understand the world around her and help her know what to expect. Naming also gives her words to use herself and lets her know you care.

4. Take turns... and wait. Keep the interaction going back and forth.

Every time you return a serve, give the child a chance to respond. Taking turns can be quick (from the child to you and back again) or go on for many turns. Waiting is crucial. Children need time to form their responses, especially when they’re learning so many things at once. Waiting helps keep the turns going.

WHY? Taking turns helps children learn self-control and how to get along with others. By waiting, you give the child time to develop his ideas and build his confidence and independence. Waiting also helps you understand his needs.

5. Practice endings and beginnings.

Children signal when they’re done or ready to move on to a new activity. They might let go of a toy, pick up a new one, or turn to look at something else. Or they may walk away, start to fuss, or say, “All done!” When you share a child’s focus, you’ll notice when she’s ready to end the activity and begin something new.

WHY? When you can find moments for a child to take the lead, you support her in exploring her world—and make more serve and return interactions possible.
Handout Lesson 3
Serve and Return Plan

What will you try?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Monitor the interaction. This happens DURING the activity. Pay attention to your child’s reactions to the activity.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Evaluate the interactions: Record what you actually did and how your child responded. Include details!

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

How did it go?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
Curriculum Lesson 4: Brain Anatomy

TIME
90 minutes

OBJECTIVES
At the end of the lesson, students will be able to do the following:

- Review steps of serve and return interactions and explore how these steps lead to meaningful interactions that develop brain architecture.
- Apply serve and return steps with their children at home.
- Believe that these interactions aid the development of their child's communication and social skills.
- Develop sensitivity to their child's signals and needs and provide an environment full of supportive, responsive interactions.

MATERIALS

- Each student brings completed Serve and Return Plan
- 5 pieces of chart paper with “Looks Like/Sounds Like/Feels Like” Y-chart drawn on each
- Student Handout: Packet of five Y-charts for each student
- Chart paper and markers
- Basket to hold questions
- Teacher Handout: Questions for Sharing Serve and Return Plan
- The Brain Tour video
- Basket or container to hold questions
- Student Handout: Brain Tour Video Note-taking Guide
- Teacher Handout: Brain Tour Video Note-taking Guide Answer Key
- Link to Learning Strategies online quiz

INSTRUCTIONAL PROCEDURES
Anticipatory Set (30 minutes)

1. Serve and Return Plans
   A. Ask students to bring their completed Serve and Return Plans.
   B. Display 5 pieces of chart paper with a blank Y chart on each. The Y charts have space to record details: Looks Like, Sounds Like, Feels Like.
   C. Ask students to recall the 5 steps of Serve and Return. Write one step at the top of each chart paper.
   D. Provide a packet of 5 blank Y charts for each student. Label one step of the 5 “Serve and Return” process at the top of each page.
   E. Explain to students they will share their experiences with the Serve and Return Plan by drawing from a basket random questions about Serve and Return. (Questions are found on the Teacher Resource Handout.) One at a time, have each student draw a question and answer it from his/her experience completing the Serve and Return Plan with his/her child. Allow students the choice of passing the first question and drawing a second. Students may also open the question to the group.
   F. After each answer, refer to the chart paper.
      1) Ask students to decide, “Which step of Serve and Return does this question promote?”
      2) Record the experience on the corresponding chart paper. Although most fit best within a particular step, it’s not important to determine the perfect spot to record the answer. The point is
to promote discussion about and review of the Serve and Return process.

G. Continue until each student has drawn a question and shared an experience with Serve and Return. (Depending on the size of the class, each question may be kept out after it’s been answered, or, if the class is large, may be returned to the basket. The questions are open-ended enough to solicit different answers if drawn twice.)

H. Note to teachers: challenging students to mindfully apply Serve and Return steps is an effective way to reinforce these brain-building habits. The Serve and Return Plan could be repeated during the course with students, encouraging them to practice a different step.

Presentation (45-60 minutes)

2. Anatomy of the Brain: Parts and Functions

A. Explain to students that during each of the Serve and Return activities they do with their children, the brain is creating connections (neural pathways) across many areas of the brain that perform specific functions. Movement is initiated in one part of the brain and recognized in another. Language must be heard in one part of the brain and interpreted in another. Vision is also recognized and interpreted in different areas. Each hemisphere of the brain controls the opposite side. This lesson will provide an overview of the basic parts of the brain and their functions. The main purpose is to promote an understanding of the complexity of the brain to encourage parents to interact with their children in ways that promote healthy brain development.

B. Record on chart paper what students know about the anatomy of the brain. Encourage students to access any brain terminology they can remember.

C. To learn more about the human brain, students will watch the Brain Tour video from The Thinking Brain website. This site has a wealth of information about the brain in a section called The Brain Zone. The site also provides a text version of the video. This video emphasizes the development of neural pathways which is a focus of the course.

D. Provide students with the “Brain Tour Note-taking Guide” handout. Students can watch the Brain Tour video individually or in pairs. Watching individually gives each student control of the pace while watching and taking notes on the video. It also allows each student to repeat a section as often as necessary for his/her own understanding.

3. Independent or Group Practice (approximately 120 minutes)

A. In pairs, have students pull apart and play with the 3D brain puzzle. Together, they should identify the parts of the brain described in sections 1-5 of the video notes. Then put the puzzle back together.

B. Have students independently take the Learning Strategies online quiz and print the results. They should retake the quiz until they get 100%.

EXIT CARD

On the way out, students can hand you a card with 3 facts they learned about the brain.

FOLLOW-UP

The practice activities in the lesson are very individualized. Check in with each student on their progress before the next lesson.
1. Notice the serve and share the child’s focus of attention.

2. Return the serve by supporting and encouraging.
Cut the questions apart and then place only the questions in a basket so students can randomly draw one question at a time. Do not include the label “Questions for Steps 1, Questions for Steps 2,” etc. on the paper with the questions as these labels are only a guide for the teacher. During the discussion, students are asked to match each question to a particular Serve and Return step.

**QUESTIONS FOR STEP 1: NOTICE THE SERVE AND SHARE THE CHILD’S FOCUS OF ATTENTION.**

- What’s an example of a “serve” your child has made?
- When and where did you deliberately notice your child’s serve and share their focus of attention?

**QUESTIONS FOR STEP 2: RETURN THE SERVE BY SUPPORTING AND ENCOURAGING.**

- What’s an example of what you did to “return the serve”?
- What’s a nonverbal return of serve?
- What can it feel like for a child to never get a return?
- When might you deliberately NOT return a serve?

**QUESTIONS FOR STEP 3: GIVE IT A NAME!**

- What’s a benefit of naming things for your child?
- What can you name that isn’t an object?
- Should you wait to name things until your child is able to talk? Why or why not?

**QUESTIONS FOR STEP 4: TAKE TURNS...AND WAIT. KEEP THE INTERACTION GOING BACK AND FORTH.**

- Why is it important to wait and give your child the chance to return?
- What’s an example of a back and forth exchange that could continue for many turns?
- What is a favorite song or game that allows you and your child to have several back and forth exchanges?
- What does your child learn from taking turns?

**QUESTIONS FOR STEP 5: PRACTICE ENDINGS AND BEGINNINGS.**

- How did your child signal she/he was ready to move on from the activity?
- What does your child learn when you take your child’s lead on when she/he’s ready to move onto another activity?
Teacher Resource Lesson 4
Brain Tour Video Note-taking Guide

1. BRAIN STEM
   - When is it developed?
   - Also known as _____________________
   - Where is it? Describe this in relation to other parts of the brain and the brain stem's position.
     ____________________________________________________________________________
   - Vehicle for ________________________
   - Controls what basic functions?

2. CEREBELLUM
   - When was it developed?
   - Also known as _____________________
   - Where is it?
   - Controls what functions?

3. LIMBIC BRAIN
   - When is it developed?
   - Where is it?
   - Also known as:
     • Most ____________________ active portion of the brain
     • Center for ___________________________
   - Functions to maintain:
     ____________________________________________________________________________
   - Other functions:
     ____________________________________________________________________________
   - Brain structures in limbic system
     Thalamus
     Functions: ___________________________________________________________________
     Hypothalamus
     Decides: ___________________________________________________________________
     Regulates: ___________________________________________________________________
     Hippocampus
     Functions: ___________________________________________________________________
     Connected to what problems? ___________________________________________________________________
     Amygdala
     Where? ___________________________________________________________________
     What does it control? ___________________________________________________________________
4. CEREBRAL CORTEX
When was it developed?
___________________________________________________________________________________
How much of the brain? ________________________________________________________________

P_____________ Lobe
Controls: ________________________________________________________________

O_____________ Lobe
Controls: ________________________________________________________________

T_____________ Lobe
Controls: ________________________________________________________________

F_____________ Lobe
Controls: ________________________________________________________________

5. HEMISPHERES

Left
Associated with ________________________________________________________________
Controls ____________ side of the body

Right
Associated with ________________________________________________________________
Controls ____________ side of the body

Corpus callosum
Where ________________________________________________________________
What is it? ________________________________________________________________
Function? ________________________________________________________________

6. NEURONS

How small are they? ________________________________________________________________

Cell body
How is an axon different than a dendrite?
_________________________________________________________________________________
Why does the Myelin Sheath help neuron function?

What do terminal buttons do?

**Types of Neurons**

**Sensory**
In which direction do these neurons carry information?

**Motor**
In which direction do these neurons carry information?

**Relay**
Why are these called “relay” neurons?
Which of the 3 types is most common?

**Electro-Chemical Process**
Why is this such an important process?

**Excitatory Neurotransmitter**
Name?

**Inhibitory Neurotransmitters**
Name?
**Neural Networks**

What makes neural networks stronger?

Explain how building neural networks is like these examples:

- Walking through a dense forest

- Riding a bike

**Cognitive patterns**

Why are cognitive patterns helpful?

What does the brain do with NEW thoughts and ideas?
Teacher Handout Lesson 4
Brain Tour Video Note-taking Guide Answer Key

1. **BRAIN STEM**
   - When is it developed? First
   - Also known as lower brain or reptilian brain
   - Where is it? Describe this in relation to other parts of the brain and the brain's stem's position.
     At the base of the brain; extends up from the spinal cord
   - Vehicle for sensory information
   - Controls what basic functions?
     Heart rate
     Breathing
     Sleeping
     Eating

2. **CEREBELLUM**
   - When is it developed? Second part of the brain to develop (400 million years ago)
   - Also known as the hind brain
   - Where is it? Above and attached to the brain stem; below the occipital lobe
   - Controls what functions?
     Body position
     Poise
     Balance
     Stores memories for vital functions
     Sends vital information to the brain via the brain stem

3. **LIMBIC BRAIN**
   - When is it developed? Third part to develop (200 million years ago)
   - Where is it? Below the cerebrum; in the center of the brain
   - Also known as the mid-brain
   - Most chemically active portion of the brain
   - Center for emotions
   - Functions to maintain:
     Blood pressure
     Heart rate
     Body temperature
     Blood sugar levels
   - Other Functions:
     Critical to learning
     Short and long-term memory
• Brain structures in Limbic System

Thalamus
Functions: Relays motor and sensory signals to the cortex; regulates consciousness and sleep

Hypothalamus
Decides which information gets your attention
Regulates:
- Hormones
- Sexual desire
- Emotions
- Eating
- Drinking
- Body temperature
- Chemical balances
- Sleeping and waking

Hippocampus
Functions: stores long-term memory, controls movement
Connects to what problems? Alzheimer's; mental illness

Amygdala
Where? Located deep within temporal lobe of brain
What does it control? Emotions:
- Fear and anger
- Pleasure
- Survival instincts
Also decides which memories are stored and where

4. CEREBRAL CORTEX
• When? Evolved 200 million years ago
• How much of the brain? Makes up 80% of the brain

Parietal Lobe
Controls: Movement, orientation, calculation recognition

Occipital Lobe
Controls: Visual processing

Temporal lobe
Controls: Sound, speech comprehension, some aspects of memory

Frontal Lobe
Controls: Thinking, planning, conceptualizing, conscious appreciation of emotion

5. HEMISPHERES
• Left, associated with: Words, logic, numbers, analysis, lists, sequencing
Controls right side of the body

Right, associated with: Creativity, rhythm, color, imagination, music
Controls left side of the body

• Corpus callosum
Where? Between the right and left hemisphere
What is it? Thick band of nerve cells
Function? Connects the two sides of the cortex; allows continuous conversation between the sides; forms a neural bridge
6. NEURONS

• How small are they? 60,000 neurons in the size of a pin head

Cell body
How is an axon different than a dendrite? An Axon carries impulses away from the cell body toward other neurons while a dendrite carries impulses toward the cell body
Why does the Myelin Sheath help neuron function? Protects the axon and speeds transmission of electrical impulses
What do terminal buttons do? Located at the end of an axon, they fire impulses across the synaptic gap to another neuron

Types of Neurons
Sensory. In which direction do these neurons carry information? FROM the sense organs to the Central Nervous System (CNS)
Motor. In which direction do these neurons carry information? Carry information TO muscles and glands
Relay. Why are these called “relay” neurons? They move information between sensory and motor neurons and the CNS.
Which of the three types is the most common? Relay is at 95%

Electro-Chemical Process
Impluses move across the synaptic gap via chemical substances called neurotransmitters released at the arrival of a nerve impulse. Examples: dopamine and serotonin.
Why is this such an important process? These pathways create networks that become habits, like walking and talking.

Excitatory Neurotransmitter
Name: Dopamine

Inhibitory Neurotransmitters
Name: Serotonin

Neural networks.
What makes neural networks stronger? When a thought is repeated.
Explain how building neural networks is like these examples:
Walking through a dense forest: The first time through overgrown grass and shrubs makes it difficult to walk. However, the more often you walk the same way, the easier it gets until a path is created.
Riding a bike: Riding a bike is difficult at first because you have to be consciously aware of doing each part of the process. With practice, you don’t have to think about it.

Cognitive patterns
Why are cognitive patterns helpful? Hard wired patterns are triggered quickly and easily when required.
What does the brain do with NEW thoughts and ideas? New thoughts and ideas require new associations and connections. You have to think about them repeatedly before they become new habits.
Curriculum Lesson 5:  
The Baby Brain

TIME  
90 minutes

OBJECTIVES  
At the end of the lesson, students will be able to do the following:  
• Recognize the importance of parent/child interactions in the development of their child’s brain.  
• Understand how interactions build brain architecture.  
• Recognize differences between nurture versus nature.  
• Follow scientific question and interpretation in an experiment.  
• Recognize the interaction between a child’s inherited genetics and the environment to which the child is exposed.

MATERIALS  
• Two segments of the DVD The Secret Life of the Brain: Episode 1: “The Baby’s Brain Wider Than the Sky.” (Episodes may also be found online.)  
  Important Note to Teachers: The second section of this video deals with babies born prematurely, describing how hospitals might implement brain research to improve the neo-natal experience. This could be triggering for a parent of a preemie as most hospitals do not provide the kind of environment described in the video. A teacher should be sensitive to this.  
• Student Handout: Plus/Minus/Interesting (PMI) chart and video questions.

INSTRUCTIONAL PROCEDURES  
Anticipatory (5-10 minutes)  
1. Reflect on brain anatomy in Lesson 4. Ask students to share stories about their children learning a new skill, like crawling or holding a toy. What part of the skill did the child master first? How does this relate to what they learned about neural pathways in lesson 4?  

Presentation (80 minutes)  
2. Distribute PMI chart handout.  
   A. Review the form with students. Briefly discuss the headings. How would you define a positive detail? Negative? Why is the interesting column included?  
   B. Stress that this is a tool to aid in thinking about the material presented. Students will have their own reactions to the video and may place similar details in different columns than their classmates.  

3. As a class, watch “The Baby’s Brain Wider than the Sky.”  
   A. Begin with the “Nurture versus Nature” segment of the video (first 29 minutes). Have students take individual notes in the PMI chart.  
   B. Have students share reactions to this section of the video. Ask each student to share a detail from the plus column and explain why it fits in that column. Go around again sharing something from the interesting column. Have a brief discussion. Did students share similar details? Were some details in different columns? Did one person’s “plus” end up in another person’s “minus”?
C. Refer students to the video questions that accompany the PMI chart. Ask students to write sentence answers for questions 1, 2 and 3, working in pairs or independently. When working in pairs, one partner writes the answer for odd numbered questions, the other partner answers even numbered ones. Remind students to refer to their notes.

D. Watch the next segment of the video, “Vision and the Baby Brain” (minutes 29-49). Have students add more details to the PMI chart.
   1) Ask students to share one detail from either the plus or interesting column.
   2) Note similarities and differences in details shared.

E. Again, refer students to the video questions. Ask students to write sentence answers for questions 4 through 7, again working in pairs or independently.

F. Bring class together to review key concepts.
   1) How would you describe brain “plasticity” to someone not in this class (a partner, for example)? Develop a group definition.
   2) Share answers to question 6. Encourage students to add to their notes.

EVALUATION PROCEDURES
One can assess individual understanding of the material by collecting student answers to the video questions. The PMI chart can also be collected and reviewed by the teacher.

EXIT CARD
On their way out have students hand you a card with one take away from the video that they will share with someone outside the class.

FOLLOW-UP
Check that students completed the questions on the back of the PMI chart handout.
## Student Handout Lesson 5
PMI Chart (Plus, Minus, Interesting)

<table>
<thead>
<tr>
<th>CHARACTERISTICS OF A PLUS</th>
<th>CHARACTERISTICS OF A MINUS</th>
<th>INTERESTING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>How might these details be different than those in the “plus” column?</td>
</tr>
</tbody>
</table>
As we watch the video, record your reactions within the PMI Chart.

**VIDEO QUESTIONS**

1. Briefly describe the ferret experiment. How did this demonstrate the brain’s plasticity? What problems resulted?

2. Based on the ferret experiment, what did the scientists conclude about nurture versus nature?

3. How are brain cells different from other types of cells?

4. How is a newborn’s vision different from an adult’s? Why might vision be the last to develop?

5. Explain why Holly needed surgery quickly. What interventions helped develop the visual connections in her brain?

6. What are some ways the world influences the developing brain?

7. If a baby is born three months early, what are some of the challenges he or she might face?
Curriculum Lesson 6: Toxic Stress

TIME
90 minutes

OBJECTIVES
At the end of the lesson, students will be able to do the following:
• Recognize the physical effects of stress.
• Differentiate among the three levels of stress.
• Monitor their child’s environment.

MATERIALS
• Visual examples of items that buffer
• Student Handout: Vocabulary Graphic Organizer for the Word “Buffer”
• Student Handout: Where Do I Feel Stress Body Chart
• Student Handout: “Key Concepts: Toxic Stress” found online
• Student Handout: Stress: Positive, Tolerable, Toxic
• Student Handout: “Helping Kids Cope with Stress” and Student Responses
• Highlighters

ANTICIPATORY SET
(10 minutes)
1. Display different images that demonstrate the concept of a buffer. Ideas are listed below and corresponding images can be easily found online. Access to an interactive whiteboard makes display easy. Another option is to print various pictures to pass among students.

A. Introduce the word “buffer.”
   - Boxing glove
   - Hedge between a yard and walkway
   - Cushion on a chair
   - Shield
   - Fence in a zoo
   - Helmet
   - Trees along a highway
   - Traffic barriers during construction
   - A person trying to stop an argument
B. Ask students these questions about the various pictures: What do these pictures have in common? What purpose does each item, or person, serve? Record the answers.
C. Write the word buffer on display paper or the interactive whiteboard. Gauge students’ grasp of the concept: Have you heard of this word? If so, in what context? Elicit student examples. It’s fine if they mention images from the beginning of the lesson.
D. Work on a group definition.
   1. Point out that a buffer can be a thing OR a person.
   2. Dictionary definition: A person or thing that prevents incompatible or antagonistic people or things from coming into contact with or harming each other.
E. Encourage students to list synonyms: cushion, shield, barrier, guard, safeguard.
F. Handout the Vocabulary Graphic Organizer for the word “buffer” and allow students time to fill it out based on the discussion and public notes.
G. Tell students to keep the word “buffer” in mind as they begin the lesson.

Presentation (80 minutes)

3. Display the words “toxic” and “stress.” Ask students what each word means. Some may remember the term from earlier lessons.

4. Ask students, what does being stressed feel like? What physical changes does your body go through when stressed? Provide the handout: “Where Do I Feel Stress Body Chart.” Ask students to mark on the body chart where their body feels stress.

5. Ask students to share and comment on similarities and differences.

6. Tell students that while there are typical symptoms, each person feels stress in his/her own way.
   Examples of symptoms:
   - Rapid heart rate and chest pain
   - Headaches
   - Upset stomach, including nausea, constipation or diarrhea
   - Tense muscles, aches and pains
   - Insomnia
   - Lessened ability to fight off colds and infections
   - Anxiety
   - Depression
   - Increased blood pressure

7. Ask the students, can stress be positive? Encourage students to come up with examples of ways stress could be helpful. Tell students that research shows a little bit of short-term stress can benefit your brain and body. Below are some examples:
   A. Think of weight lifting - the body responds by adding muscle.
   B. Think about a deadline - when viewed as a challenge the stress can help get the job done.
   C. Think about a child learning to crawl - putting something just out of reach creates a little stress that motivates the child to move.
   D. Stress can temporarily boost memory and learning scores.
   E. Successfully handling stressful situations can create resilience.

8. Here are two good resources on stress: Peter Jaret, The Surprising Benefits of Stress, Greater Good Magazine, October 20, 2015 and 5 Weird Ways Stress Can Actually Be Good for You, an online article.

9. Provide the handout: “Key Concepts: Toxic Stress” and highlighters. Read this article aloud together, stopping to discuss words and concepts as necessary. Encourage students to highlight surprising details. Note that the article describes the body’s response to stress and does not refer to actual stressful events. Why? Possible answer: Each person finds different things stressful. For example, while some students enjoy reading aloud in class, others hate it. Note: Discussion of this article can be a trigger for students. It can be easy for students to get caught up in personal examples of stressful situations. Be mindful to emphasize varying levels of stress. Make the distinction between being “nervous” and “anxious.”
10. Distribute the handout “Stress: Positive, Tolerable, Toxic.”
A. Within the colored circles on side one, ask students to describe physical characteristics they personally feel for each type of stress. Stress is very personal. The article describes tendencies.
B. Within the blank boxes on side one, ask students to describe situations in which they feel each type of stress.
   1) Can you give some examples of the most difficult types of stress you experience? And can you explain why?
   2) What kinds of events cause your child stress? (It’s interesting if a student has more than one child to ask him/her to share how each child has different stressors.)
C. On side two, have students record what helps them overcome stress. Here are some possible answers:
   1) Getting away from the situation
   2) Seeking friends and relatives
   3) Being allowed time to finish a difficult task
D. Review the idea of buffers. How can supportive, responsive relationships with caring adults be a buffer for a child? Can students think of examples from their own lives when a caring adult reduced the stress of a situation?

EVALUATION PROCEDURES
Circulate during the work phase and monitor completion of the handout “Stress: Positive, Tolerable, Toxic.”

ASSIGNMENT
Distribute the handout “Helping Kids Cope with Stress,” and ask the students to read the article before the next class and complete the accompanying handout.

EXIT CARD
Write one specific action a parent can take to buffer a child from stress.

FOLLOW-UP
Remind students of the homework.
Student Handout Lesson 6
Vocabulary Graphic Organizer for the Word “Buffer”

Different forms of the word

BUFFER

What does it look like?

Synonym

Example

Example

Example

Example

Synonym

Synonym

Synonym
Student Handout Lesson 6
Where Do I Feel Stress?
Student Handout Lesson 6
Key Concepts: Toxic Stress

From The Center on the Developing Child, Harvard University Press

The future of any society depends on its ability to foster the healthy development of the next generation. Extensive research on the biology of stress now shows that healthy development can be derailed by excessive or prolonged activation of stress response systems in the body and brain. Such toxic stress can have damaging effects on learning, behavior, and health across the lifespan.

Learning how to cope with adversity is an important part of healthy child development. When we are threatened, our bodies prepare us to respond by increasing our heart rate, blood pressure, and stress hormones, such as cortisol. When a young child’s stress response systems are activated within an environment of supportive relationships with adults, these physiological effects are buffered and brought back down to baseline. The result is the development of healthy stress response systems. However, if the stress response is extreme and long-lasting, and buffering relationships are unavailable to the child, the result can be damaged, weakened systems and brain architecture, with lifelong repercussions.

It’s important to distinguish among three kinds of responses to stress: positive, tolerable, and toxic. As described below, these three terms refer to the stress response systems’ effects on the body, not to the stressful event or experience itself:

**Positive stress response** is a normal and essential part of healthy development, characterized by brief increases in heart rate and mild elevations in hormone levels. Some situations that might trigger a positive stress response are the first day with a new caregiver or receiving an injected immunization.

**Tolerable stress response** activates the body’s alert systems to a greater degree as a result of more severe, longer-lasting difficulties, such as the loss of a loved one, a natural disaster, or a frightening injury. If the activation is time-limited and buffered by relationships with adults who help the child adapt, the brain and other organs recover from what might otherwise be damaging effects.

**Toxic stress response** can occur when a child experiences strong, frequent, and/or prolonged adversity—such as physical or emotional abuse, chronic neglect, caregiver substance abuse or mental illness, exposure to violence, and/or the accumulated burdens of family economic hardship—without adequate adult support. This kind of prolonged activation of the stress response systems can disrupt the development of brain architecture and other organ systems, and increase the risk for stress-related disease and cognitive impairment, well into the adult years.

When toxic stress response occurs continually, or is triggered by multiple sources, it can have a cumulative toll on an individual’s physical and mental health—for a lifetime. The more adverse experiences in childhood, the greater the likelihood of developmental delays and later health problems, including heart disease, diabetes, substance abuse, and depression. Research also indicates that supportive, responsive relationships with caring adults as early in life as possible can prevent or reverse the damaging effects of toxic stress response.
QUESTIONS & ANSWERS

Is all stress damaging?
No. The prolonged activation of the body’s stress response systems can be damaging, but some stress is a normal part of life. Learning how to cope with stress is an important part of development. We do not need to worry about positive stress, which is short-lived, or tolerable stress, which is more serious but is buffered by supportive relationships. However, the constant activation of the body’s stress response systems due to chronic or traumatic experiences in the absence of caring, stable relationships with adults, especially during sensitive periods of early development, can be toxic to brain architecture and other developing organ systems.

What causes stress to become toxic?
The terms positive, tolerable, and toxic stress refer to the stress response systems’ effects on the body, not to the stressful event itself. Because of the complexity of stress response systems, the three levels are not clinically quantifiable—they are simply a way of categorizing the relative severity of responses to stressful conditions. The extent to which stressful events have lasting adverse effects is determined in part by the individual’s biological response (mediated by both genetic predispositions and the availability of supportive relationships that help moderate the stress response), and in part by the duration, intensity, timing, and context of the stressful experience.

What can we do to prevent damage from toxic stress response?
The most effective prevention is to reduce exposure of young children to extremely stressful conditions, such as recurrent abuse, chronic neglect, caregiver mental illness or substance abuse, and/or violence or repeated conflict. Programs or services can remediate the conditions or provide stable, buffering relationships with adult caregivers. Research shows that, even under stressful conditions, supportive, responsive relationships with caring adults as early in life as possible can prevent or reverse the damaging effects of toxic stress response.

When should we worry about toxic stress?
If at least one parent or caregiver is consistently engaged in a caring, supportive relationship with a young child, most stress responses will be positive or tolerable. For example, there is no evidence that, in a secure and stable home, allowing an infant to cry for 20 to 30 minutes while learning to sleep through the night will elicit a toxic stress response. However, there is ample evidence that chaotic or unstable circumstances, such as placing children in a succession of foster homes or displacement due to economic instability or a natural disaster, can result in a sustained, extreme activation of the stress response system. Stable, loving relationships can buffer against harmful effects by restoring stress response systems to “steady state.” When the stressors are severe and long-lasting and adult relationships are unresponsive or inconsistent, it’s important for families, friends, and communities to intervene with support, services, and programs that address the source of the stress and the lack of stabilizing relationships in order to protect the child from their damaging effects.

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https://developingchild.harvard.edu
URL to page: https://developingchild.harvard.edu/science/key-concepts/toxic-stress/
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Student Handout Lesson 6
Side 1 of Stress: Positive, Tolerable, Toxic

- POSITIVE
- TOLERABLE
- TOXIC

Situations:
Student Handout Lesson 6
Side 2 of Stress: Positive, Tolerable, Toxic

Buffers:

Buffers:

Buffers:
Nurturing Early Brain Connections

Student Handout Lesson 6
“Helping Kids Cope with Stress”

To adults, childhood can seem like a carefree time. But kids still experience stress. Things like school and their social life can sometimes create pressures that can feel overwhelming for kids. As a parent, you can’t protect your kids from stress — but you can help them develop healthy ways to cope with stress and solve everyday problems.

Kids deal with stress in both healthy and unhealthy ways. And while they may not initiate a conversation about what’s bothering them, they do want their parents to reach out and help them cope with their troubles.

But it’s not always easy for parents to know what to do for a child who’s feeling stressed.

Here are a few ideas:

**Notice out loud.** Tell your child when you notice that something’s bothering him or her. If you can, name the feeling you think your child is experiencing. (“It seems like you’re still mad about what happened at the playground.”) This shouldn’t sound like an accusation (as in, “OK, what happened now? Are you still mad about that?”) or put a child on the spot. It’s just a casual observation that you’re interested in hearing more about your child’s concern. Be sympathetic and show you care and want to understand.

**Listen to your child.** Ask your child to tell you what’s wrong. Listen attentively and calmly — with interest, patience, openness, and caring. Avoid any urge to judge, blame, lecture, or say what you think your child should have done instead. The idea is to let your child’s concerns (and feelings) be heard. Try to get the whole story by asking questions like “And then what happened?” Take your time. And let your child take his or her time, too.

**Comment briefly on the feelings you think your child was experiencing.** For example, you might say “That must have been upsetting,” “No wonder you felt mad when they wouldn’t let you in the game,” or “That must have seemed unfair to you.” Doing this shows that you understand what your child felt, why, and that you care. Feeling understood and listened to helps your child feel supported by you, and that is especially important in times of stress.

**Put a label on it.** Many younger kids do not yet have words for their feelings. If your child seems angry or frustrated, use those words to help him or her learn to identify the emotions by name. Putting feelings into words helps kids communicate and develop emotional awareness — the ability to recognize their own emotional states. Kids who can do so are less likely to reach the behavioral boiling point where strong emotions come out through behaviors rather than communicated with words.

**Help your child think of things to do.** If there’s a specific problem that’s causing stress, talk together about what to do. Encourage your child to think of a couple of ideas. You can start the brainstorming if necessary, but don’t do all the work. Your child’s active participation will build confidence. Support the good ideas and add to them as needed. Ask, “How do you think this will work?” Listen and move on. Sometimes talking and listening and feeling understood is all that’s needed to help a child’s frustrations begin to melt away. Afterward, try changing the subject and moving on to something more positive and relaxing. Help your child think of something to do to feel better. Don’t give the problem more attention than it deserves.
Nurturing Early Brain Connections

Limit stress where possible. If certain situations are causing stress, see if there are ways to change things. For instance, if too many after-school activities consistently cause homework stress, it might be necessary to limit activities to leave time and energy for homework.

Just be there. Kids don’t always feel like talking about what’s bothering them. Sometimes that’s OK. Let your kids know you’ll be there when they do feel like talking. Even when kids don’t want to talk, they usually don’t want parents to leave them alone. You can help your child feel better just by being there — keeping him or her company, spending time together. So if you notice that your child seems to be down in the dumps, stressed, or having a bad day — but doesn’t feel like talking — initiate something you can do together. Take a walk, watch a movie, shoot some hoops, or bake some cookies. Isn’t it nice to know that your presence really counts?

Be patient. As a parent, it hurts to see your child unhappy or stressed. But try to resist the urge to fix every problem. Instead, focus on helping your child, slowly but surely, grow into a good problem-solver — a kid who knows how to roll with life’s ups and downs, put feelings into words, calm down when needed, and bounce back to try again.

Parents can’t solve every problem as kids go through life. But by teaching healthy coping strategies, you’ll prepare your kids to manage the stresses that come in the future.

Reviewed by: D’Arcy Lyness, PhD  Date reviewed: January 2013
Online publication: Helping Kids Cope with Stress

Student Response to Helping Kids Cope
1. Highlight three suggestions in the article to try with your child.
2. Be prepared to share ONE time you were a buffer for your child.
   What happened?
   Which level of stress do you think your child experienced?
   What, specifically, did you do?
   How did it help?
Curriculum Lesson 7:
The Child’s Brain

TIME
90 minutes

OBJECTIVES
At the end of the lesson, students will be able to do the following:
• Recognize the importance of parent/child interactions in the development of their child’s brain.
• Recognize the interaction between a child’s inherited genetics (nature) and the environment to which the child is exposed (nurture).
• Believe that experiences build brain architecture.

MATERIALS
• Student Handout: Vocabulary Graphic Organizer for the Word “Differentiation”
• Student Handout: Fill-in-the-Blank Video Notes for Secret Life of the Brain, Episode 2
• DVD: The Secret Life of the Brain, Episode 2 “The Child’s Brain Syllable from Sound.” (Episodes may also be found online.)
• Teacher Handout: Answers to Fill-in-the-Blank Video Notes

INSTRUCTIONAL PROCEDURES

Anticipatory (15-20 minutes)
   A. Ask students to compare situations that generated positive stress. Ask them to consider personal differences regarding how situations are perceived. For example, what one person considers positive another might categorize as tolerable. What conditions might contribute to those differences? Can situations listed as toxic also be perceived differently by different individuals? Why or why not?
   B. Allow students to share their experiences when they acted as buffers for their children.
   C. How helpful is it to be aware that they are able to be a buffer for their children?

Presentation (70 minutes)
2. In the lesson on brain anatomy, students learned how the brain is structured so that different areas specialize in certain functions. While the newborn brain is equipped with 100 BILLION neurons, it is experience that refines these neurons, pruning unused ones and strengthening ones that are used. Not only individual neurons but entire sections of the brain can be trained through use. An infant’s brain is less specialized than that of an adult’s. While most adults process language in the left hemisphere, babies respond to language with their whole brains. The process of developing a specific part of the brain for language develops over years facilitated by the acquisition of language itself. The word differentiation is used in the video; it’s worth exploring the meaning before watching the video.

   A. Distribute the Differentiation Graphic Organizer. The format of this graphic organizer should be familiar to students as it was used to explore the word buffer in Lesson 6. Vocabulary acquisition is very individualized and dependent on the breadth of each student’s personal working vocabulary. Students with a broad vocabulary acquire additional words more quickly. It can take more than 10 exposures for a student to learn a word. This graphic organizer fosters many connections to help embed the target word into the student’s lexicon.
B. The teacher may choose to complete the vocabulary graphic organizer as a class so students can benefit from each other’s background knowledge.

C. Encourage students to use these circle prompts provided on the graphic organizer:
   1) Different forms of the word: Take away the suffixes for the words “different” or “differentiate.”
   2) Antonyms: link, mix up, leave
   3) Synonyms: discrimination, distinction, separation
   4) Sentence: Little differentiation can be found in a simple, unicellular organism.
   5) Example: In this circle students can write a sample sentence in which the word is used.
      Students can also record here a particular usage, for example, using a label to differentiate between two sandwiches in an order.
   6) Definitions
      a. General: The act of distinguishing between two or more things or people.
      b. How does this fit into what we know about the brain?
      c. Possible Answer: Neurons become specialized to certain tasks or parts of the body.

4. Watch “The Child’s Brain”

A. Distribute the handout Fill-in-the-Blank Video Notes.

B. As a class, watch the first 20 minutes of the video. This segment, “Syllable from Sound,” focuses on language development.
   1) Stop the video as needed for discussion and clarification as students complete the handout.
   2) Take time to compare the information in this episode with that presented in episode one “The Baby’s Brain” (Lesson 5).

C. What similarities do students notice?

D. Any differences?

E. Watch the next section of the video that follows two children being treated for epilepsy. (Stop at minute 38).
   1) Pause the video as needed for discussion and clarification as students complete the handout.
   2) Discuss the difficult decision these parents faced.
      a. What reasons did Katie’s and Michael’s parents give for agreeing to the radical surgery?
      b. How did Katie and Michael’s experience demonstrate the brain’s plasticity?

F. Watch the final section of the video about reading acquisition.
   1) Pause the video as needed for discussion and clarification as students complete the handout.
   2) Discuss the challenges of learning to read. How is it different than learning to speak?
   3) Do any students have dyslexia or know someone who does? How does their experience compare to those documented in the video?

G. Note that these children represent extreme cases. Ask students these questions: How can those experiences help a parent understand a child who’s experiencing more typical development? What’s a take-away from this video?
Nurturing Early Brain Connections

WHY USE FILL-IN-THE-BLANK NOTES?
When presenting information to students, whether via video or text, look for ways to engage students in the content by encouraging their interaction with the material. That’s why the lessons use various comprehension strategies, like metacognition, graphic and semantic organizers, and answering and asking questions. Some of the lessons also include fill-in-the-blank type notes. When used while watching a video, this technique provides structure for recording important words or summarizing key concepts. It takes the focus away from writing down everything and allows students to engage more of the brain by writing as well as hearing important and unfamiliar terms. Teacher-generated notes also model how to take notes. The rationale is different when the lesson is structured so students fill-in-the-blanks after watching or reading source material. This style is based on a reading teaching technique called the cloze procedure. In a cloze activity, words are omitted from a reading passage and students are required to fill in the blanks using context clues. In Literacy Techniques for Building Successful Readers, the authors recommend cloze activities for all grade levels because they “help to build a number of skills exhibited by strong, fluent readers. They focus on contextual cueing systems, strengthening the readers’ abilities to anticipate the text to make the most sense.” To be most effective, the emphasis is on strategies for word completion over getting it “right.” When done in a group, students generate, compare and debate possible solutions. Reviewing material in this way fosters recall of new terms and improves comprehension of concepts.

1 Literacy Techniques for Building Successful Readers and Writers, David Booth and Larry Swartz. Pembroke Publishers, 2004

2 Interactive Cloze, New Zealand Ministry of Education, ESOL Online, June 9, 2009

EXIT CARD
On a notecard, have students answer this question: What is one specific way you can interact with your own child to develop speech or reading?

FOLLOW-UP
Check that each student completed the Fill-in-the-Blank Video Notes handout. Encourage students to complete the homework.

HOMEWORK
Have students use their take-away idea with their child before the next class and be prepared to share the experience.
Student Handout Lesson 7
Vocabulary Graphic Organizer for the Word “Differentiation”

Different forms of the word

Synonym

Synonym

Synonym

Antonym

Antonym

Example

Example

Definition Paraphrased
Student Handout Lesson 7
Fill-in-the-Blank Video Notes

*The Secret Life of the Brain*, Episode 2 “The Child’s Brain – Syllable from Sound”

Miracle of Language: The Brain’s Dynamic First Years

Brain Development and Differentiation

1. Learning to ___________________ is the first step of language development. Example of language delay: Five-year-old Michael struggles to be understood.

2. At __________ he started to pick up words, but this was much later than is typical.

3. At University of Oregon Helen Neville tries to understand what’s going on in Michael’s brain. He wears a bonnet with electrodes that record brain activity while he listens to a puppet show laced with __________________________ ____________________.

4. The connections between s_________________, l___________________ and u________________________ are closely linked parts of the brain’s language system.

5. Neville evaluates what’s __________________________.

6. Michael has difficulty __________________________ sounds. Through repetition and practice Michael is becoming proficient. He is shaping his own brain. He is excited to learn how to say words — and be understood!

7. The young human brain is even more a__________________ than older brains.

8. System of neurons in the brain produces language that provides __________________________ possibilities to create sentences no one has ever heard before that others can understand.

9. Babies are born with the _____________________ to learn any of the world’s thousands of __________________________.

9a. We begin by __________________________ and distinguishing individual sounds amid a BABBLE of sounds.

Pat Cool studies the vowels and consonants that make up language.

9b. Chinese Mandarin is a tonal language with ____________ differences in pronunciation. Americans can’t hear a __________________________ between the sounds. Can the baby?

9c. At birth, and for a short period thereafter, a baby has the ability to hear differences in the sounds used in __________________________ of the world’s languages.

9d. At _____ months, babies are still citizens of the ____________.

9e. By _______ months, they are citizens of a single country, specialists in ________ language. We are ______________ bound listeners.

9f. From ____________ months, babies behave like their ______________ and show no reaction to the difference in sounds not associated with their language. We are not responding to the ________sounds of language, we are listening through a ______________ that was developed early in life.
Nurturing Early Brain Connections

9g. Babies have a keen ability to hear distinctions. During language development, the baby forms __________________ and __________________ some of the distinctions that are great for a ________________ language but not the one the baby is learning. The 11-month-old baby has a very different brain than the one it had ________ months earlier.

9h. The brain becomes more and more ______________________ as we get older.

10. Language is processed in the ________________ Cerebral Hemisphere

When does language develop? How? Is it there already? Scientists try to answer these questions by looking at activity within parts of the brain.

10a. In a study at the University of California at San Diego, three-month-old Debbi Mills listens and hears with __________ cerebral hemispheres. By 20 months, she speaks a dozen words a day. Language center has begun to shift to the ________________ hemisphere.

Children who understand more than one language help researchers understand language development.

10b. Researchers studied a two-year-old girl who understands more ________________ than English.

11. The researchers hoped to determine whether ________________or _______________ drives language specialization.

11a. If age drives specialization, then by age two both English and Spanish should have begun to shift into Ariel’s ________________ hemisphere.

11b. If increasing __________________ drives specialization, then Spanish should be in the left, while English will provoke a response everywhere in her brain.

11c. The experiment findings showed that Ariel’s brain has begun to specialize with regard to ________________, the language she knows best. English words provoke a more ________________ response. This tells scientists that ________________ (not age) drives the development and differentiation of the brain.

Epilepsy

12. Katie suffers debilitating seizures to the point she can’t talk. Doctors recommend removing the part of the brain initiating the seizures. She will have the left ________________ removed. She has been on _________________________ to reduce seizures her whole life.

13. Michael had the left part of his brain removed ________ years ago. Every two years he attends a ________________ of kids who have had this procedure. It left half his body paralyzed and he had to __________________________ many skills.

13a. When tested for language separate from his ability to ________________, Michael performs on age level. The right hemisphere _________________________ as well as the left would have.

13b. ________________ is the hard part for him. His ________________ is fine. He loves math.

13c. Michael’s parents made the decision to go ahead with the surgery because on even a good day, he was having ________________ .

13d. Six months after surgery, he had recovered speech __________________ abilities at the level he had been before surgery. He was producing one - to two- ________________ utterances.
13e. Very slowly, over the course of a couple of years, the ability to produce __________________ comes back. ________________ depends on the child.

13f. Researchers scan Michael’s brain activity to determine what areas of the_________________ brain are recruited for language. Are they the same areas as would have been used in the left? Larger areas?

13g. The results of the research: The two areas used do __________________________, but language requires __________ areas of the right hemisphere. Michael’s personality, his drive and determination remain after the surgery.

14. Back to Katie, six months after surgery she had ______________ seizures. She’s more ______________ of what’s going on around her than she had been before.

14a. Language __________________ is a work in progress for her.

The Challenge of Reading

15. ________________ is natural and just happens for most people. Reading never just happens! It is one of the most complex activities in the human brain.

15a. ______________ and ______________ information have to go together. Reading must be explicitly __________________________.

• Letter ______________,
• P__________________,
• W________________ perception,
• R________________________ words,
• C____________________________

All these abilities utilize a different part of the brain!

15b. When one part of the brain doesn’t function normally, parts of the brain that developed for other functions adapt. Areas for vision, hearing, judgement, memory ____________.

15c. Where does reading happen in the brain?

______________________

15d. A single ______________ can set off a complex reaction throughout the child’s brain.

Dyslexia

16. A dyslexic brain is unable to connect squiggles to _______________. Every other brain function is ________________.

16a. Look how tiring __________________________ is for Russell!

16b. ______________ words are easier. Longer words and more ___________________ concepts are harder for Russell’s brain to process.

Brain scans determine the mechanism of dyslexia. Areas of the brain that are ___________ in good readers are not active in dyslexics.

16c. For some dyslexics, the area of the brain responsible for dissecting words into corresponding _______________________ is not active.
16d. The word C–A-T actually has ___________ - sounds. We blend them together quickly AND can recognize the letters in words.

16e. Russell may use ______________________ parts of the brain than a child who reads normally.

**Conclusion**

17. Each of these studies demonstrate the brain’s ability to change with experience and reorganize itself by forming new connections between brain cells. The word for this is P ________________________ !
Teacher Handout Lesson 7
Answers to Fill-in-the-Blank Video Notes

Brain Development and Differentiation

1. Learning to **speak** is the first step of language development. Example of language delay: Five-year-old Michael struggles to be understood.
2. At **3-1/2** he started to pick up words, but this was much later than is typical.
3. At University of Oregon Helen Neville tries to understand what’s going on in Michael’s brain. He wears a bonnet with electrodes that record brain activity while he listens to a puppet show laced with **grammatical errors**.
4. The connections between **speaking, listening, and understanding** are closely linked parts of the brain’s language system.
5. Neville evaluates what’s **deficient**.
6. Michael has difficulty **pronouncing** sounds. Through repetition and practice Michael is becoming proficient. He is shaping his own brain. He is excited to learn how to say words and be understood!
7. The young human brain is even more **adaptable** than older brains.
8. System of neurons in the brain produces language that provides **infinite** possibilities to create sentences no one has ever heard before that others can understand.
9. Babies are born with the **capacity** to learn any of the world’s thousands of languages.
   9a. We begin by **listening and** distinguishing individual sounds amid a BABLE of sounds. Pat Cool studies the vowels and consonants that make up language.
   9b. Chinese Mandarin is a tonal language with **subtle** differences in pronunciation. Americans can’t hear a **distinction** between the sounds in Chinese. Can the baby? **Yes**.
   9c. At birth, and for a short period thereafter, a baby has the ability to hear differences in the sounds used in **all of** the world’s languages.
   9d. At **7** months, babies are still citizens of the **world**.
   9e. By **11** months, they are citizens of a single country, specialists in **one** language. We are **culture bound** listeners.
   9f. From **11** months, babies behave like their **parents** and show no reaction to the difference in sounds not associated with their language. We are not responding to the **real** sounds of language, we are listening through a **filter** that was developed early in life.
   9g. Babies have a keen ability to hear distinctions. During language development, the baby forms **categories** and ignores some of the distinctions that are great for a **foreign** language but not the one the baby is learning. The 11-month-old baby has a very different brain than the one it had **4** months earlier.
   9h. The brain becomes more and more **complex** as we get older.
Nurturing Early Brain Connections

10. Language is processed in the Left Cerebral Hemisphere

When does language develop? How? Is it there already? Scientists try to answer these questions by looking at activity within parts of the brain.

10a. In a study at the University of California at San Diego, three-month-old Debbi Mills listens and hears with both cerebral hemispheres. By 20 months, she speaks a dozen words a day. Her language center has begun to shift to the left hemisphere.

Children who understand more than one language help researchers understand language development.

10b. Researchers studied a two-year-old girl who understands more Spanish than English.

11. The researchers hoped to determine whether age or vocabulary drives language specialization.

11a. If age drives specialization, then by age two both English and Spanish should have begun to shift into Ariel's left hemisphere.

11b. If increasing vocabulary drives specialization, then Spanish should be in the left hemisphere, while English will provoke a response everywhere in her brain.

11c. The experiment findings showed that Ariel’s brain has begun to specialize with regard to Spanish, the language she knows best. English words provoke a more general response. This tells scientists that experience (not age) drives the development and differentiation of the brain.

Epilepsy

12. Katie suffers debilitating seizures to the point she can’t talk. Doctors recommend removing the part of the brain initiating the seizures. She will have the left hemisphere removed. She has been on drugs to reduce seizures her whole life.

13. Michael had the left part of his brain removed seven years ago. Every two years he attends a reunion of kids who have had this procedure. It left half his body paralyzed and he had to relearn many skills.

13a. When tested for language separate from his ability to speak, Michael performs on age level. The right hemisphere understands as well as the left would have.

13b. Speaking is the hard part for him. His memory is fine. He loves math.

13c. Michael’s parents made the decision to go ahead with the surgery because on even a good day, he was having 50-60 seizures.

13d. Six months after the surgery, he had recovered speech understanding abilities at the level he had been before surgery. He was producing one- to two-word utterances.

13e. Very slowly, over the course of a couple of years, the ability to produce speech comes back. Fluency depends on the child.

13f. Researchers scan Michael’s brain activity to determine what areas of the right brain are recruited for language. Are they the same areas as would have been used in the left? Larger areas?

13g. The results of the research: The areas used do correspond, but language requires larger areas of the right hemisphere. Michael’s personality, his drive and determination remain after the surgery.

14. Back to Katie, six months after surgery she had no seizures. She’s more aware of what’s going on around her than she had been before.

14a. Language formation is a work in progress for her.
The Challenge of Reading

15. **Speaking** is natural and just happens for most people. Reading never just happens! It is one of the most complex activities in the human brain.

   15a. **Sounds** and **visual** information have to go together. Reading must be explicitly **taught**.
   - Letter **name**
   - **Perception**
   - Word **perception**
   - Recognizing **words**
   - **Comprehension**

All of these abilities utilize a different part of the brain!

15b. When one part of the brain doesn’t function normally, parts of the brain that developed for other functions adapt. Areas for vision, hearing, judgement, memory **overlap**.

15c. Where does reading happen in the brain? **In 17 different regions of the brain**.

15d. A single **letter** can set off a complex reaction throughout the child’s brain.

Dyslexia

16. Dyslexic brain is unable to connect squiggles to **letters**. Every other brain function is **adequate**.

   16a. Look how tiring **reading** is for Russell!

   16b. **Short** words are easier. Longer words and more **complex** concepts are harder for Russell’s brain to process.

   Brain scans determine the mechanism of dyslexia. Areas of the brain that are **active** in good readers are not active in dyslexics.

   16c. For some dyslexics, the area of the brain responsible for dissecting words into corresponding **sounds** is not active.

   16d. The word C–A-T actually has **three** sounds. We blend them together quickly AND can recognize the letters in words.

   16e. Russell may use **more** parts of the brain than a child who reads normally.

Conclusion

17. Each of these studies demonstrate the brain’s ability to change with experience and reorganize itself by forming new connections between brain cells. The word for this is **Plasticity**!
Curriculum Lesson 8: Executive Function and Self-Regulation (EF/SR)

TIME
90-100 minutes

OBJECTIVES
At the end of the lesson, students will be able to:
• Recognize the importance of parent/child interactions in the development of their child’s brain.
• Define executive function and self-regulation.
• Recognize that EF/SR skills can be developed at any age through interactions and practice.
• Appreciate the benefits of establishing routines as a family.
• Initiate a routine with their children around a daily task.

MATERIALS
• Student Handout: Vocabulary Graphic Organizer for the word “Executive”
• Student Handout: Vocabulary Graphic Organizer for the word “Regulation”
• Video Link: Overview of Executive Function and Self-Regulation
• Student Handout: Executive Function and Self-Regulation article
• Student Handout: Executive Function and Self-Regulation Article Fill-in-the-Blank Notes
• Teacher Handout: Executive Function and Self-Regulation Article Fill-in-the-Blank Answer Key
• Student Handout: Deep Dive, link to “The Science of Adult Capabilities”

INSTRUCTIONAL PROCEDURES
Anticipatory (15 minutes)
1. Have students share one observation they made while doing the Lesson 7 homework.

2. Make a connection between the students’ lives and the lesson.
   A. Ask students to share a routine they remember from childhood. It might be something that happened daily at home, school, during a holiday or with their grandparents.
   B. Encourage each student to share.
   C. Ask students to reflect on why that particular routine was memorable.
      1) It’s likely that answers will involve caring people, which is closely connected to the theme of the whole course. Positive interactions with adults come from nurturing relationships.
      2) It’s also possible the routine made a task easier to accomplish. This previews the idea of executive function: being in control of oneself and one’s resources to reach a goal. Routines are key to helping children achieve goals.

Presentation (60-90 minutes)
3. Introduce vocabulary for the lesson. This lesson incorporates the vocabulary graphic organizer used in previous lessons. The words “executive” and “regulation” were selected because, while the words may be familiar from other applications, they have a specific meaning when applied to the brain. Half of the students will receive the vocabulary graphic organizer for the word “executive.” The other half will receive one for the word “regulation.” Students may work alone or in pairs to complete as many circles as possible in 5 minutes.
4. Below are ideas for completing the graphic organizer handouts.
   A. These are ideas for the word “executive:”
      1) Different forms of the word: Take away the suffix to get the word “execute.”
      2) Possible antonyms: subordinate, minor, disorganized, dependent
      3) Possible synonyms: governing, managerial, ruling, managing, decision-making
      4) In the example circle, students might write a sample sentence using the word “executive.” Students could also record a particular usage, for example, a president or governor can give an executive pardon.
      5) When reviewing this graphic organizer, emphasize that the aspect of the word “executive” used in this lesson is the concept of “advanced” or “upper level.”
   B. These are ideas for the word “regulation:”
      1) Different forms of the word: Take away the suffixes for the word “regulate.” Change the suffix for related words, “regulating” and “regular.”
      2) Possible antonyms: deregulation, lawlessness, anarchy, disorganization
      3) Possible synonyms: rule, control, law, order, command, guidance
      4) In the example circle, students might write a sample sentence with related words. For example: The thermostat regulates the room’s temperature.
      5) When reviewing this graphic organizer, emphasize that the aspect of the word regulation used in this lesson is the idea of being in control.
   C. After 5 minutes, bring the students together. Ask those who received the “executive” vocabulary graphic organizer handout to compare details aloud, so all students can extend their understanding of the word “executive.” Then have students who received the “regulation” vocabulary graphic organizer share their details aloud.

5. Provide a basic understanding of the concept of Executive Function and Self-Regulation (EF/SR)
   A. Watch the EF/SR video overview on the website Center on the Developing Child at Harvard.
      1) Ask students to identify different ways that EF/SR skills benefit preschool age children.
      2) At what ages are there spikes in EF/SR skill gains?
   B. Distribute the article “Executive Function and Self-Regulation” and, using the article and information from the video, ask students to independently work on the handout Executive Function and Self-Regulation Fill-in-the-Blank Notes.

   A. This handout asks students to demonstrate an understanding of the reading and graphics. It’s an individual activity that will require various time commitments from each student. Some may need to finish it as homework.
   B. An option is to complete this Deep Dive exercise as a separate class, particularly if internet access is a challenge for students. There is a printable version of this exercise, but the interactive visual embedded online is more effective in demonstrating the concept.
   C. Display the link and help students find it.
   D. Monitor the students as they spend the remainder of class time using the website to answer questions on the handout.
Student Handout Lesson 8
Vocabulary Graphic Organizer for the word “Executive”

EXECUTIVE

Different forms of the word

Example

Example

Example

Synonym

Synonym

Synonym

Antonym

What does executive action look like?
Student Handout Lesson 8
Vocabulary Graphic Organizer for the word “Regulation”

Different forms of the word

- Synonym
- Synonym
- Synonym
- Antonym
- Antonym

REGULATION

Example

Example

Example

What does regulation look like?
Executive function and self-regulation skills are the mental processes that enable us to plan, focus attention, remember instructions, and juggle multiple tasks successfully. Just as an air traffic control system at a busy airport safely manages the arrivals and departures of many aircraft on multiple runways, the brain needs this skill set to filter distractions, prioritize tasks, set and achieve goals, and control impulses.

When children have opportunities to develop executive function and self-regulation skills, individuals and society experience lifelong benefits. These skills are crucial for learning and development. They also enable positive behavior and allow us to make healthy choices for ourselves and our families.

Executive function and self-regulation skills depend on three types of brain function: working memory, mental flexibility, and self-control. These functions are highly interrelated, and the successful application of executive function skills requires them to operate in coordination with each other.

- Working memory governs our ability to retain and manipulate distinct pieces of information over short periods of time.
- Mental flexibility helps us to sustain or shift attention in response to different demands or to apply different rules in different settings.
- Self-control enables us to set priorities and resist impulsive actions or responses.

Children aren’t born with these skills—they are born with the potential to develop them. If children do not get what they need from their relationships with adults and the conditions in their environments—or (worse) if those influences are sources of toxic stress—their skill development can be seriously delayed or impaired. Adverse environments resulting from neglect, abuse, and/or violence may expose children to toxic stress, which disrupts brain architecture and impairs the development of executive function.

Providing the support that children need to build these skills at home, in early care and education programs, and in other settings they experience regularly is one of society’s most important responsibilities. Growth-promoting environments provide children with “scaffolding” that helps them practice necessary skills before they must perform them alone. Adults can facilitate the development of a child’s executive function skills by establishing routines, modeling social behavior, and creating and maintaining supportive, reliable relationships. It is also important for children to exercise their developing skills through activities that foster creative play and social connection, teach them how to cope with stress, involve vigorous exercise, and over time, provide opportunities for directing their own actions with decreasing adult supervision.

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1. Executive function and self-regulation skills are the mental processes that enable us to
   - P________________
   - F________________ A________________
   - R________________ I________________
   - J________________ M________________ T____________

2. Just as an ____________________________ at a busy airport safely manages
   _________________ and _________________ of many aircraft on multiple runways, the brain needs this
   skill set to
   - F________________ D________________
   - P________________ __________________
   - S___ & A________________ G____________
   - C________________ I________________

3. Explain why you agree or disagree with this statement: “When children have opportunities to develop
   EF&SR skills, the child and society experience life-long benefits.”
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________

4. EF&SR skills depend on three types of brain function:
   - Working ________________
   - Self-________________
   - Mental ________________

   These functions are highly interrelated, and the successful application of executive function skills requires
   them to operate in coordination with each other.
   - ____________________________ helps us to sustain or shift attention in response to different demands or to
     apply different rules in different settings.
   - ____________________________ enables us to set priorities and resist impulsive actions or responses.
   - ____________________________ governs our ability to retain and manipulate distinct pieces of information
     over short periods of time.
5. Children aren’t born with these skills! They are born with the ______________ to _______________ them.

6. What’s an example of “scaffolding” that helps children practice skills before they must perform them independently?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

7. What activities provide opportunities for children to practice developing EF&SR skills?
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Teacher Handout Lesson 8
Executive Function (EF) & Self-Regulation (SR)
Fill-in-the Blank Notes

1. Executive function and self-regulation skills are the mental processes that enable us to
   - Plan
   - Focus Attention
   - Remember Instructions
   - Juggle Multiple Tasks

2. Just as an air traffic controller at a busy airport safely manages arrivals and departures of many aircraft on multiple runways, the brain needs this skill set to
   - Filter Distractions
   - Prioritize Tasks
   - Set & Achieve Goals
   - Control Inhibitions

3. Explain why you agree or disagree with this statement: “When children have opportunities to develop EF&SR skills, the child and society experience life-long benefits.”
   Students should support their opinion with details from the article.

4. EF&SR skills depend on three types of brain function:
   - Working memory
   - Self-control
   - Mental flexibility

   These functions are highly interrelated, and the successful application of executive function skills requires them to operate in coordination with each other.
   - Mental flexibility helps us to sustain or shift attention in response to different demands or to apply different rules in different settings.
   - Self-control enables us to set priorities and resist impulsive actions or responses.
   - Working memory governs our ability to retain and manipulate distinct pieces of information over short periods of time.

5. Children aren’t born with these skills! They are born with the potential to develop them.

6. What’s an example of “scaffolding” that helps children practice skills before they must perform them independently?
   Students should support their opinion with details from the article.

7. What activities provide opportunities for children to practice developing EF&SR skills?
   Students should support their opinion with details from the article.
Using an Internet browser find Center on the Developing Child at Harvard University. On the homepage, along the top menu, open the Science tab and then click on “Deep Dives,” and then “The Science of Adult Capabilities.” Use the website to answer the following questions. You’ll need separate paper to have room to write complete answers.

**Questions on “The Science of Adult Capabilities”**

1. Define the word “capabilities.”

_____________________________________________________________________________________
_____________________________________________________________________________________

2. Key Brain Concept: Self-Regulation and Executive Function

edefinition is one element of Self-Regulation and Executive Function

Example: ____________________________________________________________________________
Example: ____________________________________________________________________________
Example: ____________________________________________________________________________
Example: ____________________________________________________________________________
Example: ____________________________________________________________________________
Example: ____________________________________________________________________________

3. Look at the graphic “Our Core Capabilities in Action.”

- How is the blue side different than the red side?

_____________________________________________________________________________________
_____________________________________________________________________________________

- Why do you think they picked red as the color for the left side?

_____________________________________________________________________________________

- Describe “Automatic Self-Regulation.” In what circumstance might you need this response?

_____________________________________________________________________________________

- Describe “Intentional Self-Regulation.” What does intentional regulation give you the time to do?

_____________________________________________________________________________________

4. List the steps in the cycle of responding to a situation.

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

5. What is a continuum?

6. WE ARE NOT BORN WITH THESE SKILLS! How do these capabilities develop?

- How does a three-year-old use executive function?

- At what age do children show a burst of improvement with these skills?

- What happens within the brain as a child practices these skills?

- At what age is it impossible to learn these skills?

7. What derails a person’s ability to use these core capabilities?

Example: _____________________________________________________________________

Example: _____________________________________________________________________

Example: _____________________________________________________________________

Example: _____________________________________________________________________

8. Look at the graphic on excessive stress.

- How does it affect a young child?

- How does it affect an adult?

The best time to learn these skills is at pre-school age and adolescence. The good news is that these core capabilities can be practiced and improved well into adulthood!
Curriculum Lesson 9: The Teen Brain

TIME
90-100 minutes

OBJECTIVES
At the end of the lesson, students will be able to:
- Understand the unique characteristics of the still-developing teen brain.
- Recognize the relationship between the amygdala and the hippocampus in coding and storing long-term memories.
- Appreciate the benefit of exercising executive function through puzzles.

Because the prefrontal cortex is the last section of the brain to develop, teens tend to rely on another part of the brain, the amygdala, to solve problems and make decisions. Part of the limbic system, the amygdala is located near the edge of the cortex and controls basic emotions, like fear and anger, and instincts, like hunger, sex and self-preservation. The hippocampus, located nearby, plays a role in memory, particularly long-term memory. Their interaction is believed to be what gives power to emotional memories. Knowing that teens’ often moody, irrational, and sometimes dangerous behavior is a developmental stage can help parents of teens, and teens themselves, understand and manage teenage behavior. Teens are less likely to consider consequences or think before they act because their brains work differently from the adult brain. (25 years of age is generally considered the age of brain maturity.)

Much like the infant and toddler brain, the teen brain shows a rapid increase in the connections between brain cells. Teen brains also develop more efficient pathways by pruning unused cells. Myelin, a protective layer that helps nerve cells communicate, develops during this time. It is also worth noting that, according to the Academy of Child and Adolescent Psychology, exposure to drugs and alcohol during the teen years can change or delay these important developments. (Sources noted at end of lesson).

MATERIALS
- Student Handout: Brain Teasers
- Teacher Handout: Brain Teaser Answers
- TED Talk by Dr. Jill Bolte Taylor, “Neuroanatomical Transformation of the Teenage Brain” (16:30 min)
- Student Handout: Fill-in-the-Blank Video Notes
- Teacher Handout: Answer Key to Video Notes
- Student Handout: Where are the Amygdala and Hippocampus?

INSTRUCTIONAL PROCEDURES
Anticipatory (15-20 minutes)

1. Explain that today’s lesson involves being aware of how our brains work. The teenage brain has biological differences from the child’s and the adult’s brain. This opening activity requires mental flexibility, looking at the unfamiliar to produce something familiar. The puzzles involve an executive function that engages many areas of the brain.
2. Distribute Handout: Brain Teasers.
   A. Some students will recognize these brain teaser rebus puzzles. Ask for a student volunteer to explain how the clue describes a common phrase.
   B. Allow 5-10 minutes for students to answer as many of the puzzles as they can.
   C. Offer students the opportunity to share their answers.

Presentation (60-70 minutes)

3. Watch the TED Talk: The author of this TED Talk had a stroke, which changed the way her brain worked and changed the way she looked at the world. She explains some of the biological changes occurring in the teenage brain. Ultimately, she considers the teenage years the most vulnerable period for the brain. What characteristics support that claim?
   A. You may need to pause about 30 seconds into the video to let students adjust to the actual human brain she holds — with spinal cord attached. Point out the hemispheres and the cerebellum at the back.
   B. Continue the video to 8:00 when she begins the section on the biology of adolescence.
   Distribute the handout Amygdala and Hippocampus.
   1) Point out how close they are to each other.
   2) Also note where they are in relation to the brain and the spinal cord.
   3) Ask what information travels along the spinal cord.
   4) Sensory information comes from all over the body into the brain stem.
   5) Responses travel from the brain to the body.
   6) The amygdala and hippocampus are very near the spinal cord.
   C. Next, distribute the handout Fill-in-the-Blank Video Notes.
   D. Allow students some time to write answers. Allow students to discuss answers in pairs or as a group.
      What response do students have to the amygdala’s role in teenagers’ emotional responses to stimuli? Can they think of examples other than test anxiety?
   E. Continue the video to the end, stopping as necessary for students to record details.
   F. Lead a discussion on the video.
      1) What similarities do they recognize between this information and research about infant brain development?
      2) What are the possible connections between environment and social interactions that could influence development?
      3) Do they agree or disagree with Dr. Taylor’s interpretation of society’s emphasis on Left Brain characteristics?
      4) Do they agree or disagree with her assertion that addictions result from this imbalance? How might this knowledge of brain development be applied to the problem of addictions? What changes should be made?
      5) How could this information help them guide their child through the teen years?
      6) How can a person under the age of 25 use this information to stay safe?
   G. Provide time to write answers to questions 26-27 on the handout Fill-in-the-Blank Video Notes.

EXIT CARD
Have students write two details they remember from the video.

EVALUATION PROCEDURES
Questions 26-27 demonstrate understanding of key concepts in the video.
### Student Handout Lesson 9
#### Brain Teasers

Think “outside of the box” to come up with the phrase described in each box.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>history</td>
<td>2.</td>
<td>ARREST YOU’RE</td>
</tr>
<tr>
<td>5.</td>
<td>down</td>
<td>6.</td>
<td>chair</td>
</tr>
<tr>
<td>9.</td>
<td>SK8</td>
<td>10.</td>
<td>STOOD MISS</td>
</tr>
<tr>
<td>13.</td>
<td>LUCK Y</td>
<td>14.</td>
<td>ECNALG</td>
</tr>
<tr>
<td>17.</td>
<td>Funny Words</td>
<td>18.</td>
<td>SHACRYME</td>
</tr>
<tr>
<td>4.</td>
<td>BIG BIG</td>
<td>7.</td>
<td>Milli0n</td>
</tr>
<tr>
<td>8.</td>
<td>ignore</td>
<td>11.</td>
<td>Get IT</td>
</tr>
<tr>
<td>12.</td>
<td>9S2A5F4E8T1Y9</td>
<td>15.</td>
<td>O M.D. B.A. PH.D.</td>
</tr>
<tr>
<td>16.</td>
<td>PROM/ISE</td>
<td>19.</td>
<td>MEAL</td>
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<tr>
<td>20.</td>
<td>ONCE</td>
<td>20:00</td>
<td>am</td>
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</tbody>
</table>
# Teacher Handout Lesson 9

**Brain Teasers Answer Key**

Think “outside of the box” to come up with the phrase described in each box.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>ARREST</td>
<td>Millio1n</td>
<td>BIG BIG ignore ignore</td>
</tr>
<tr>
<td></td>
<td>YOU’RE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. settle down</td>
<td>6. high chair</td>
<td>7. update</td>
<td>8. safety in numbers</td>
</tr>
<tr>
<td></td>
<td>chair</td>
<td>E T A D</td>
<td>9S2A5F4E8T1Y9</td>
</tr>
<tr>
<td></td>
<td>down</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. skating on thin ice</td>
<td>10. misunderstood</td>
<td>11. Forget it!</td>
<td>12. scrambled eggs</td>
</tr>
<tr>
<td></td>
<td>SK8</td>
<td>Get Get IT</td>
<td>EGGS GEGS SGEG GGES</td>
</tr>
<tr>
<td></td>
<td>STOOD MISS</td>
<td>Get Get Get</td>
<td></td>
</tr>
<tr>
<td>13. Lucky break</td>
<td>14. backward glance</td>
<td>15. 3 degrees below 0</td>
<td>16. broken promise</td>
</tr>
<tr>
<td></td>
<td>LUCK Y</td>
<td>O M.D. B.A. PH.D.</td>
<td>PROM/ISE</td>
</tr>
<tr>
<td></td>
<td>ECNALG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. too funny for words</td>
<td>18. cryin’ shame</td>
<td>19. square meal</td>
<td>20. Once upon a time</td>
</tr>
<tr>
<td>Funny Funny Words Words</td>
<td>SHACRYME</td>
<td>M E A L</td>
<td>ONCE 9:00am</td>
</tr>
<tr>
<td>Words Words</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
1. We are Neurocircuitry:
   - Neuro-___________________ is the ability to grow new brain cells.
   - Neuro-___________________ is the cells’ ability to rearrange who they are communicating with.
   - Neuro-___________________ is the interconnected neurons that form circuits; many circuits form neural systems.
   - __________________________ is the ability to observe the neuro-circuitry running in our heads.

2. Humans are capable of changing what we ________________!

3. There are three types of neurocircuitry:
   - ___________ thoughts
   - ___________ emotions
   - Run physiological __________________ to the first two

4. ___________ seconds – that’s how long it takes to go through the three steps.

5. To stay angry longer than ______ seconds you must ___-think, ___-feel and ___-run to keep the anger response going.

**Power and Control**

My circuitry is my circuitry, and NO ONE has the power to trigger my neurocircuitry without my permission.

6. When I give you my power, I become vulnerable to manipulation through:
   - A___________________
   - P_________ P_____________
   - M _______________

7. How might the amygdala overpower the thinking part of the brain?

8. Cerebral Cortex - Outer or Inner? It controls __________________________

9. Limbic System – Outer or Inner? It controls __________________________

10. What question does the limbic system continually ask? __________________________?
11. If sensory input feels familiar, I am ________________________. My amygdala allows messages to pass to the outer, thinking, layer.

12. Biologically we are ______________________ creatures who think — not ______________________ creatures who feel.

13. Amygdala - ___________ stream through it.
   If the information is ___________, then I feel calm, and if I feel calm, the cells by the amygdala, the hippocampus, turn on, and I am capable of ________________________________.

14. How can mindfulness and the 90 second rule overcome test anxiety?
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________

**Neuroanatomical Transformation of the Teenage Brain**

15. We are born with ______________________ as many neurons as we’ll ever use!

16. During the first few years of life, the ones that are stimulated will grow and the ones that aren’t will fade away. What is this called?
   ____________________________________________________________________________________

17. What changes in puberty stir up the amygdala?
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________

18. To top it off, the last to come online is the prefrontal cortex, the part of the brain that helps us
   ____________________________________________________________________________________
   ____________________________________________________________________________________
   ____________________________________________________________________________________

19. AND, teens lose ____________ their minds! Additional pruning makes room for the circuits that are being used to grow.

20. Keep ‘em alive ‘til they’re ____________, when the adult mind is in place.
21. We are feeling creatures who think and live in a left-brain dominant society. Fill in the right side of the chart with values associated with the right side of the brain.

<table>
<thead>
<tr>
<th>Left Brain Values</th>
<th>Right Brain Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>What we think</td>
<td>over</td>
</tr>
<tr>
<td>Me</td>
<td>over</td>
</tr>
<tr>
<td>Personal gain</td>
<td>over</td>
</tr>
<tr>
<td>Profits</td>
<td>over</td>
</tr>
<tr>
<td>Authority</td>
<td>over</td>
</tr>
<tr>
<td>seek differences</td>
<td>not</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>not</td>
</tr>
<tr>
<td>Judgmental</td>
<td>not</td>
</tr>
</tbody>
</table>

22. Valuing the qualities of one side over the other erodes self-value. The brain seeks solace in addictions. Name 3 of the addictions she sees in our society?

__________________________
__________________________
__________________________

23. Create a _______________________________ relationship with your brain — bring balance back to the world.

24. Why does she say the teen years are the most vulnerable? Do you agree? Why or why not? Write a response that includes details from the video.

25. How can this information help you guide your child through the teen?
Nurturing Early Brain Connections

Teacher Handout Lesson 9
Answer Key to Video Notes

The Neuroanatomical Transformation of the Teenage Brain (16 min. 30 sec)
Ted Talk by Dr. Jill Bolte Taylor

1. We are Neurocircuitry.
   Neuro- genesis is the ability to grow new brain cells.
   Neuro- plasticity is the cells’ ability to rearrange who they are communicating with.
   Neuro- circuitry is the interconnected neurons that form for circuits; many circuits form neural systems.
   Mindfulness is the ability to observe the neuro-circuitry running in our heads.

2. Humans are capable of changing what we think!

3. There are three types of neurocircuitry:
   Think thoughts
   Feel emotions
   Run physiological responses to the first two

4. 90 seconds – that’s how long it takes to go through the three steps.

5. To stay angry longer than 90 seconds you must Re-think, Re-feel and Re-run to keep the anger response going.

Power and Control
My circuitry is my circuitry, and NO ONE has the power to trigger my neurocircuitry without my permission.

6. When I give you my power, I become vulnerable to manipulation through
   Advertising
   Peer Pressure
   Marketing

7. How might the amygdala overpower the thinking part of the brain?
   Stimulation travels through sensory neurons to the cerebral cortex which controls cognitive function.

8. Cerebral Cortex – Outer or Inner? It controls outer layer for high thinking.

9. Limbic System – Outer or Inner? It controls inner layer for emotion.

10. What question does the limbic system continually ask? “Am I Safe??”

11. If sensory input feels familiar, I am comfortable and feel safe. My amygdala allows messages to pass to the outer, thinking, layer.

12. Biologically we are feeling creatures who think — not thinking creatures who feel.
13. Amygdala – emotions stream through it.
   If the information is familiar, then I feel calm, and if I feel calm, the cells by the amygdala, the hippocampus, turn on, and I am capable of thinking and remembering.

*Background information for the teacher: The relationship between the Amygdala (responsible for emotions survival instincts and memory) and the hippocampus (highly involved with memory) is everything!*

14. How can mindfulness and the 90 second rule overcome test anxiety?
   Test anxiety is an example of the relationship between the amygdala and the hippocampus. The thinking part of our brain can override the panic response that is test anxiety. I can take new pictures, see I’m safe, and calm the amygdala down so that I can access information for the test. Use mindfulness and the 90 second rule to consciously choose to run OTHER circuits.

**Neuroanatomical Transformation of the Teenage Brain**

15. We are born with twice as many neurons as we’ll ever use!

16. During the first few years of life, the ones that are stimulated will grow and the ones that aren’t will fade away. What is this called?
   This is called PRUNING.

17. What changes in puberty stir up the amygdala?
   - Major physical growth spurt triggers our amygdala.
   - Hormonal upheaval stirs up our amygdala.
   - Pruning back 50% of our synaptic connections (literally losing half our minds) stirs up the amygdala.
   - Testosterone receptors grow on our amygdala and make us feel aggressive.

18. To top it off, the last to come online is the prefrontal cortex, the part that helps us
   - Plan ahead
   - Control impulses
   - Understand consequences
   - Appropriateness of behavior

19. AND teens lose 50% of their minds! Additional pruning makes room for the circuits that are being used to grow.

20. Keep ‘em alive ‘til they’re 25, when the adult mind is in place.
   *Adulthood defined as when the long bones stop growing: approximately 25 years.*
21. We are feeling creatures who think, living in a left brain dominant society. Fill in the right side of the chart with values associated with the right side of the brain.

<table>
<thead>
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<td>Personal gain</td>
<td>community</td>
</tr>
<tr>
<td>Profits</td>
<td>people</td>
</tr>
<tr>
<td>Authority</td>
<td>equality</td>
</tr>
<tr>
<td>seek differences</td>
<td>similarities</td>
</tr>
<tr>
<td>Competitiveness</td>
<td>compassion (cooperation)</td>
</tr>
<tr>
<td>Judgmental</td>
<td>forgiving</td>
</tr>
</tbody>
</table>

22. Valuing the qualities of one side over the other erodes self-value. The brain seeks solace in addictions. Name three of the addictions she sees in our society?

   Food, alcohol, pills, tobacco, gaming, drugs, sex, technology

23. Create a conscious relationship with your brain – bring balance back to the balance to the world.

24. Why does she say the teen years are the most vulnerable? Do you agree? Why or why not? Write a response that includes details from the video.

**Answers may vary but should include the concept of pruning which occurs in the teen years.**

25. How can this information help you guide your child through the teen years?

**Answers may vary.**

**Additional Sources**


Student Handout Lesson 9
Where Are the Amygdala and the Hippocampus?

Normally, there are two amygdala per person, with one on each side of the brain. They are considered part of the brain’s limbic system, which is responsible for emotions, survival instincts, and memory. Located near the center of the brain in the medial temporal lobe, it is near the hippocampus, another part of the limbic system. The hippocampus is involved in the storage of long-term memory, which includes all past knowledge and experiences.

The red, almond-shaped structures are the amygdala.

The hippocampi are the “forearms” that seem to hold the amygdala.
THE BRAIN COURSE FINAL PROJECT

In this course you’ve learned how environment and interactions with caregivers influence brain architecture from the moment a baby is born (and even before!) Serve and return interactions with caring adults make all the difference in developing your child’s brain architecture. As a final project, you will research interactions recommended for your child’s age range and explain which parts of the brain are developed through the interactions within each activity.

The US Department of Health and Human Services has an online site that includes developmental milestone charts and age appropriate activities for children ages two months to five years. It is called “Learn the Signs. Act Early”. You can access it at: https://www.cdc.gov/ncbddd/actearly/pdf/checklists/all_checklists.pdf. The charts are organized around the following four categories of development: Social/Emotional, Language/Communication, Cognitive and Movement/Physical Development.

You will use these charts for this project.

1. Select at LEAST one NEW to your child activity from each of the four categories. Set aside a time and place to deliberately complete each activity. Don’t try to do all of them in one afternoon.
2. After EACH activity, journal what you and your child did and how your child reacted. Take pictures of your child, the process and the outcome.
3. Create a poster or a series of small posters that includes the following:
   - Label the category of development at the top of the poster – Social/Emotional, for example
   - Describe the activity with an explanation of how it involves serve and return – May be typed and printed or hand-written
   - Include at least one picture per category – Minimum of 4 pictures
   - Make a visual connection to the area in the brain strengthened by each activity – Include a picture of the brain with the sections colored or highlighted – Name the section(s) of the brain and their functions – Include a picture of the part(s) of the brain that this activity strengthens
4. Be prepared to talk about your poster with the class.