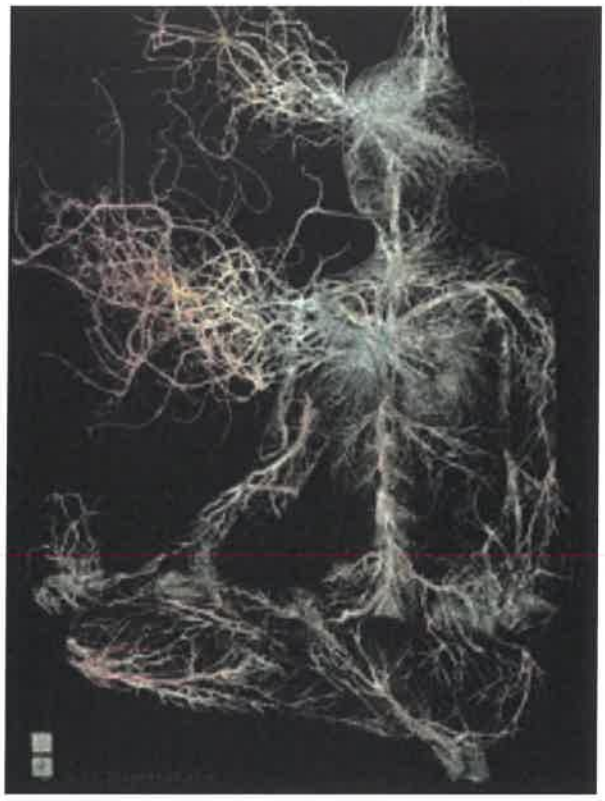


Nurturing Neurons Through Neuroscience

Created by: Amanda Quilliams

Designed for students in grades 4-6

7/31/18

II· Differentiation for Gifted Learners

Part A: Rationale

Human brains are designed to make connections and is a connection machine· The human brain is vastly complex with billions of neurons and quadrillions of connections between and among neurons when forming neural networks· Neuroscience is a specialized area of scientific study often not explored by elementary age children due to the complexity of the nervous system· Most often, students only begin to skim the surface in studying the basic body systems in their general elementary classrooms·

The purpose of this unit is to help students develop and cultivate knowledge of the neurological system in connection with other bodily systems as opposed to viewing the nervous system in isolation· Understanding nervous system's relationship and constant connection to other bodily systems is critical to understand a fully functioning body but also creates the framework for students to view connections in a broader context· Connections are the threads woven in the fabric of what it means to be human·

Neuroscience, like many scientific fields is an interdisciplinary science which is connected to and overlap with other disciplines such as chemistry, philosophy, medicine, psychology, computer technology, engineering, mathematics, and linguistics· From the ancient Egyptians and their belief that the center of intelligence was in the heart to the ancient Greeks who were the first to really study the brain, neuroscience did not take

off in development until the early 19th century· This field of study is relatively "new" in comparison to other sciences· Many advancements and discoveries in recent decades within the field have improved the human condition and developed a deeper understanding of why we do the things we do as humans·

Within this new and important field, breakthroughs and progress impact every area of human life from how we think and behave to how we move and communicate· Guiding students to becoming acquainted in this field not only lays the foundation for future interest in an innovative field at an earlier age but also develops students understand that connections cannot be avoided in human life and that when we as humans better understand the biological role of connection and embrace them, our lives can become richer·

II· Introduction-Differentiation for Gifted Learners

Part B: Dimensions and Features of Differentiation

Dimensions of Differentiation:

Content: Content differentiation relates to the curriculum students access and how they access it· Content differentiation is based on student readiness· Even within a group of gifted learner's various readiness levels will exist· Throughout this *Nurturing Neurons Through Neuroscience* unit, student will learn and grapple with highly engaging content which they likely haven't been presented with before in a regular education classroom·

Process: While creating this neuroscience unit, differentiation of process has been considered in how it relates to sequencing and ways in which students learn· The lesson sequence begins with first introducing students to the connection and relationship between the eye and the brain and the following lesson builds on the first day's lesson expanding to explore the interconnectedness and interdependence of all the body system with the nervous system· Eventually students will be using authentic tools such as manipulatives and models, technology, literature in constructing a deeper understanding of neuroscience and how its connections to the world and themselves·

Product: Products allow students to demonstrate what they know and have learned in each lesson· When students are provided with multiple product choices, they can choose what best suits their particular gifts and talents· Student choice allows them to have ownership in their learning· Within the *Nurturing Neurons Through Neuroscience* unit, students are able to construct neuron models, write poems, create flip books using technology or drawing skills, and create more technical products like a medical record with proposed diagnosis of a neurological condition using research and learning from the entire unit·

Learning Environment: Learning is structured for the lessons in flexible grouping areas where students have the ability to choose where and with whom they sit· Instruction begins in a more formal seating fashion at desks while sitting in chairs and moves to be highly mobile, comfortable, relaxed, with accommodations for each student's learning profile learning profile or learning style· While working independently or within a small group of students can choose where they are most comfortable while working on their learning products·

Features of Differentiation:

Complexity: Nurturing Neurons Through Neuroscience is incredibly complex· The lessons within the unit consistently challenge students to look for relationships whether it is relationships between and among the body systems or within the structure of the brain itself· This unit encourages students to make connections to other concepts like how connections have impacted systems within the larger body of scientific knowledge and how a pseudoscience like phrenology has contributed to the larger scientific field

of modern neuroscience· These ideas and connections are explored in the context of this created this created interdisciplinary unit while consistently utilizing multiple higher level thinking skills and questioning techniques to guide students in their broader understanding of how connections impact systems·

Challenge: Students are challenged through thoughtful selection of materials and readings, more sophisticated resources and content, cross-disciplinary applications, and reasoning·

Depth: The lessons designed to be used within this unit of study are differentiated to develop increasing depth to which students can explore the topic of neuroscience· The reading in the lessons are sophisticated and use advanced vocabulary and technical scientific topics· The content also provides students with depth in understanding related to features and characteristics/details of body system and are required to find evidence to support their ideas· The study of the concept is presented through multiple avenues and in multiple applications· Students will use the details component of Kaplan's Depth and Complexity Icons to develop vocabulary, defining features and characteristics of neuroscience and related concepts·

Creativity: *Nurturing Neurons Through Neuroscience* unit lends itself to many open ended creative product opportunities with choice· The flip book product in the first lesson is open ended in that students can choose to use technology or their own drawing skills to create a flip book (optical illusion of motion) demonstrating their learning from the lesson as it relates to eye function and its interdependence of the nervous, circulatory, and muscular systems· Within an additional unit lesson, students are presented with models of poems for two voices· After students research the function and relationship of their chosen body

system and the nervous system, they will create a poem for two voices demonstrating their understanding of the interdependence of these two systems· These poems for two voices of the body systems lend themselves to be performance pieces and emphasize oral and written communication· Student performance tasks of creating a medical record to diagnosis a neurological condition provides a real world audience for student learning·

Acceleration: *Nurturing Neurons Through Neuroscience* by design is an accelerated unit which moves students more rapidly through a curriculum sequence about neuroscience and is clustered by higher order thinking skills·

II· Introduction-Differentiation for Gifted Learners

Part C: Population

Nurturing Neurons Through Neuroscience is a curriculum unit designed for gifted learners in grades 4-6· Students within this grade span are beginning to move to the Formal Operational Stage of learning according to Piaget· During this stage of learning, students are developing theoretical, hypothetical and counterfactual thinking· Students are moving from more concrete thinking into abstract logic and reasoning where concepts learned in one context can be applied to another· This unit utilizes these developmental changes in students and provides many opportunities to practice the skills in this new stage of development·

This unit is designed for all gifted learners within the 9-12 year age span and has no limitations for students based on gender, race, or socioeconomic status·

Religious beliefs of the population should be considered when delivering instruction as the main subject area is scientific in nature and deals with brain function and some evolutionary concepts·

Social and cultural constructs should also be considered as gender bias, sexism, racism, and eugenics will be explored in lesson three as it relates to previously held beliefs within the study of phrenology· The lasting impacts of these previously held beliefs in modern times in relation to neurology will also be investigated during this unit·

III· Goals and Outcomes

Content Goals and Outcomes Goal 1: To develop vocabulary, defining features and characteristics of optical illusions, body systems and their relationships to the nervous system, phrenology and its impact on modern day neuroscience, and how stress impacts the systems of the body· Students will be able to:

A· Construct an understanding of how optical illusions take advantage of how our eyes and brain process visual information to trick us using blind spot, peripheral vison, and mental filtering·

B· Analyze and sequence how humans have used motion and optical illusions over time·

C· Demonstrate the importance of persistence of vison in developing visual perception·

D· Draw conclusions regarding the functions of neurons and how they connect to form neural networks·

E· Analyze how the human brain is in constant connection with and facilitates communication between/among the nervous system with other bodily systems·

F· Construct an understanding of the interdependence of body systems·

G· Compare and contrast the similarities and difference of the connection of each bodily system and the nervous system in addition to examining and identifying how the other body systems require connection with the brain and nervous system to become a fully functioning body·

H· Draw conclusions regarding how the brain functions in stressful circumstances and hormones that impacts and the response to differentiate between distress and eustress·

I· Analyze the long term impacts of sustained cortisol exposure and epigenetic changes·

J· Create and practice mindfulness strategies to aid in neuroplasticity in effort to lessen the impacts of long term stress·

K· Evaluate the differences between the pseudoscience of phrenology and determine its contribution to the larger body of scientific knowledge related to modern neuroscience·

Process Goals and Outcomes Goal 2: Develop reasoning and critical thinking skills with cross-curricular application to science and social studies· Students will be able to:

A· Utilize observation and critical thinking skills to create individual and personal meaning·

B· Define a problem, given ill-structured, complex, or technical information·

C· Use technological and print resources to discover the interdependence of the body systems·

D· Have freedom of choice when researching specific body systems·

E· Demonstrate/provide evidence of reasoning during group interactions to develop deeper understanding of the concept of connections·

F· Make inferences based on evidence·

Concept Goals and Outcomes Goal 3: To understand the concept of connections· Students will be able to:

A· Use appropriate language as related to connections to identify important elements in effort to determine how they impact systems·

B· Analyze the connections of various system components with and among each other and with input into the system·

C· Predict the impact of various kinds of input on connections·

D· Transfer knowledge about connections with broad applications of how they impact systems including body systems, brain systems, and larger bodies of knowledge·

IV· Assessment-Formative

Coat of Arms-Pre Assessment-As an ice breaker activity, students will record and share two important facts about themselves and include two pieces of knowledge they already had about the brain and learning they hoped to gain from the class and record the information in a coat of arms· This was a quick way to get to know students and their prior knowledge in addition to what the hoped to learn·

Questioning-Using higher order thinking skills and quality questions guides students to deeper and more meaningful opportunities to demonstrate their understanding and expand learning·

Think-Pair-Share-A type of formative assessment where the teacher asks the class a question and each student is given time to answer their question in writing· Students then share their responses with each other· This assessment is learner centered· During lesson 2, the teacher asks students to respond to the following questions in writing: Tell me something you discovered today through your investigations that caused you to think and why it made you think· Tell me something you discovered today that surprised you and why it surprised you· Tell me something you discovered today that you want to share with someone else and why you want to share this knowledge· Students will then share their responses with a partner· Students will discover the essential understanding, "Connections impact systems·" by making generalizations about the relationship of CONNECTIONS between and among the body's systems and the nervous system·

Group Discussion- *Classroom discussions create the opportunities for students to demonstrate their learning and understanding of lesson goals and concepts· These discussions will occur during direct instruction but also during the Taba, Socratic Seminar, Questioning, and Visual Thinking Strategy lesson models· Students will also engage in discussions while creating some of their products·*

Flip Book- *Students are to create an animation flip book (optical illusion of motion) utilizing their new knowledge to demonstrate how eye function is dependent on the nervous, circulatory, muscular systems and will also answer the essential understanding in How do connections impact systems? within the creation of their flip book·*

Poem for Two Voices- *Students will be provided a poem for two voices template and a copy* ***A Joyful Noise: Poems for Two Voices*** *where they will be required to assimilate the information they just learned about the nervous system and an additional body system into a poem for two voices which creates a dialogue between the nervous system and another system within the body· The poem must contain true and accurate research and convey a deep understanding of interdependence of the nervous system with the additional body system of their choice in addition to how the chosen systems are impacted because of their connections· The poem must also demonstrate an understanding of the essential question "Connections Impact Systems·" Once poems have been written and edited, they will be performed and recorded for presentation to parents and classmates in a coffeehouse type setting·*

Teacher Observation-*Observations help provide teachers with what students know and do not know· Teachers can use the information they already know about students, their prior knowledge and acquisition and mastery of learning goals· Teachers can make these observations while students work in groups, pairs or independently· Teachers can make modifications to instruction accordingly·*

Exit Tickets-*These cards are written responses from each student turned in before the end of activity/lesson· The response is required before a student can exit class· Each day I used the same essential question, "How do connections impact systems?" to which students will respond· By asking the same essential question daily, I am able to easily assess how student knowledge is growing from day to day·*

Hand Signals-*Teacher asks students to display a designated hand signal to visually represent their understanding of a concept, lesson component, or process·*

Brain Dumps-*A brief pause during the lesson where students can stop and reflect on the information presented in the lesson· This brief pause allows students the opportunity to make connections to prior learning and to ask clarifying questions·*

Guiding prompts:

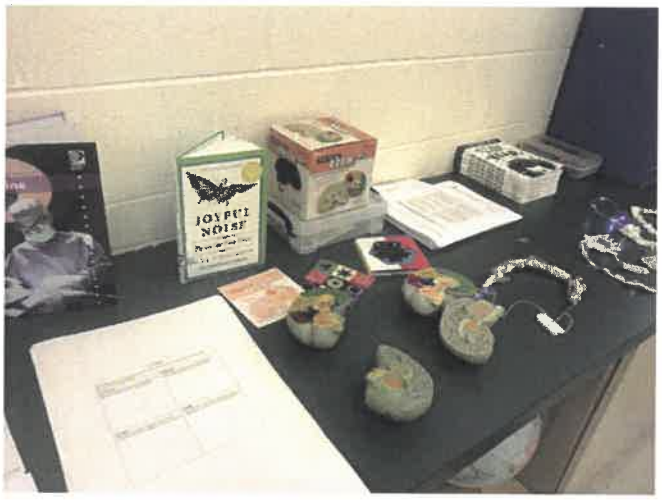
- *"An interesting part was..."*
- *"One new thing I learned was..."*
- *"I felt..."*
- *"This reminds me of or relates to..."*

Concept Maps-*A type of graphic organizer that encourage students to organize and synthesize information presented in the lesson and recognize the relationships between ideas·*

Assessment-Summative

Performance Tasks*-Assessments that determine a student's enduring understanding in an open-ended, complex, authentic, and creative manor often with a real-world application· Performance tasks require students to address an identified audience through a specific purpose· Students were presented with the assigned performance task the first day of the Nurturing Neurons Through Neuroscience class so the task, criteria and standards were known in advance and students could consistently look for the content and concepts they would need to synthesize the information for this summative product· When designing the performance task, I focused on the acronym* ***GRASPS****: goal, role, audience, product or performance, and standards· Students will create a medical record based on a patient's presenting neurological problems· They will create proposed diagnosis of a neurological condition using research and learning from the entire unit to present to their cooperating medical residency team·*

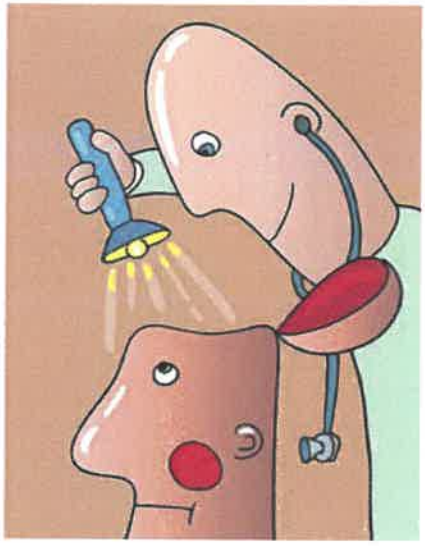
Nurturing Neurons Through Neuroscience -A·Quilliams



Performance Task

You are a doctor after four years of medical school· You are now working to complete four years of residency with a focus in neurology, practice in medicine related to the brain and conditions of the nervous system· As part of your residency, you have joined a neurology team at well-known and respected medical hospital which specializes in your field of study· You are working with the neurology team daily to learn as much as you can about how to treat brain

related conditions· You have only seen patients with the lead doctors on the team· Today, the lead physician asks you to meet with a patient while she observes and take the lead on diagnosis· You will meet with the patient, perform an exam, make recommendations about additional tests and possible causes and treatments for the condition the patient presents· Once you have thoroughly assessed the patient and formally written a medical record, you will present your findings to the team for discussion and approval· Use all the experience, knowledge, and resources you have to help your patient! Please use the format provided to write your medical record·



Findings

Upon meeting Mrs· Lacy, you begin discussing with her what has brought her in to see you today·

Mrs· Lacy, a 39-year-old African-American teacher, describes an initial onset of her chief complaint beginning six weeks ago (May 25, 2018) after sitting down at her computer to do school work· She indicates that after about 30 minutes she developed blurred vision, which she describes as making the computer "look fuzzy and words appeared to run together·" When she looked up from her computer at school, she could also not make out the wording of her posters on the wall in her classroom or the numbers on the clock· At the same time, she described a "strange" sensation in her right eye· Being concerned she would not be able to drive home, she called her husband to come pick her up and thought she was just tired and over worked· After she got home, she struggled to watch TV due to her vison problems and decided to go on to bed to get some rest· When she awoke the following day, which happened to be a Saturday, Mrs· Lacy was unable to open her right eye and lifted the eyelid with her fingers· When she did, she had double vision and objects were appearing side by side· The double vision was most prominent when she looked to the left, but was also present when she looked straight ahead up, down, and to the right, and went away when she closed either of her eyes· Mrs· Lacy reported that the pain in her eyes increased when she moved her eyes and was more intense when looking to the left· That night she was seen at the ER and was referred to University Medical Hospital Department of Neurology·

Mrs· Lacy, describes that she has had intermittent severe headaches (bifrontal, at the front on both sides) which get worse with straining such as coughing· The headaches are not related to her position and do not seem to have an

intensity depending on the time of day· She rates the pain she experiences with the headaches as 7-8 on a 1-10 scale with 10 being the worst pain· She has also experienced nausea without vomiting, sees flashes of light, has significant mood changes, has occasional numbness on her right side and sometimes has trouble getting her right leg to "work" properly· Her recent headaches differ from her previous migraines she has experienced 4-6 times a year since she was a teenager· When reviewing her past medical records, she experienced a head injury 6 years ago during a club soccer game, has had her gallbladder removed when she was 22· She lives with her husband and twin girls in a neighborhood close by· She has no medical history of high blood pressure and hypertension and is fit and athletic in presentation·

Mrs· Lacy's parents and sibling are all living and her mother experiences migraines as well, which also began in puberty· Her maternal grandfather died of a heart attack at 70 and her paternal grandmother died at 80 of a stroke·

When looking at her vital signs, her blood pressure is 128/78 and pules Is 85 with a temperature of 98·7· Upon physical neurological examination Mrs· Lacy experiences intermittent problems with coordination and balance, particularly on the right side, hearing and speech appears normal· She has extreme light sensitivity and continued blurred vision and more significant headaches that Mrs· Lacy describes as "different than her usual migraines·" Ms· Lacy is in a significant amount of pain related to her headaches·

Mrs· Lacy seeks alternative medicine to manage her migraines with acupuncture but prefers not to take a lot of medication if at all possible·

Medical Record

School of Medicine-University Hospital

The purpose of the write-up is:

- *To record your patient's story in a concise and well-organized manner·*
- *To demonstrate your diagnosis and suggested course of action to other medical providers on your team·*
- *To demonstrate your knowledge and problem solving skills·*

Please include the following components:

- ***Patient's name***
- ***Age***
- ***Gender***
- ***Ethnicity***
- ***Vital Signs***
- ***Social History***
- ***Past Medical History****-follow symptoms chronologically backwards to identify any medical history related to the patient's current conditions·*
- ***Chief Complaint and History of Present Illness (HPI)****-pay attention to detail (setting of the complaint, intermittent/constant, progressive/stable/improving, duration, aggravating or alleviating features, or associated symptoms·*
- ***Family History***
- ***Physical Examination/Neurological Examination***
- ***Assessment Plan****-Include concerns/hypothesize reasons for current medical illness and possibilities you are attempting to rule out· Make lab and additional testing/assessment follow-ups·*

Performance Task Rubric

	Above Mastery	Mastery	Approaching Mastery	Novice	
Soring Criteria	4	3	2	1	Weight
Research	Uses 4 or more credible sources to find accurate and relevant information to apply to the task and includes source citations· Research is thorough and goes beyond what was presented in class·	Uses 3 credible sources to find accurate and relevant information to apply to the task and includes source citations· Research is adequate but does not go much beyond what was presented in class·	Uses 2 or less credible sources to find accurate and relevant information to apply to the task and includes source citations· Research is lacking and does not demonstrate what was presented in class·	Does not use credible sources and/or in class learning to find accurate, relevant information and/or does not include source citations· Little or no research is apparent·	20
Medical Record	Medical record includes all required components and demonstrates in depth and thoughtful diagnosis with strong supporting evidence for proposed diagnosis· Assessment plan contains clear proposed plan for future medical recommendations and follow-up testing·	Medical record includes most required components and some in depth and thoughtful supporting evidence for proposed diagnosis· Assessment plan contains basic plan for future medical recommendations and follow-up testing·	Medical record includes limited required components and limited thoughtful supporting evidence for proposed diagnosis· Assessment plan is not well developed and lacks future medical recommendations and suggestions for follow-up testing·	Medical record does not include required components and/or supporting evidence for proposed diagnosis· Assessment plan is not included in medical record·	50
Presentation	The presentation demonstrates a scientific understanding of the patient's presenting ailments and creates a viable diagnosis based on relevant scientific knowledge· The presentation is effective in conveying ideas to the audience	The presentation demonstrates some scientific understanding of the patient's presenting ailments and creates a basic diagnosis based on some scientific knowledge· The presentation is effective in conveying ideas to the audience·	The presentation demonstrates lack of scientific understanding of the patient's presenting ailments and a basic diagnosis is not based on scientific knowledge· The presentation lacks clarity when attempting to convey ideas to the audience·	The presentations is not based in scientific understanding and/or doesn't provide a diagnosis based on scientific knowledge· The presentation does not adequately convey ideas to the audience·	30
				Total	100

Nurturing Neurons Through Neuroscience -A·Quilliams

Lesson 1-Optical Illusions: Connections Between the Eye and Brain

Visual Thinking Strategies Instructional Model

TEACHER NAME			Lesson #
Amanda Quilliams			1
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Visual Thinking Strategies	Science	4-6	
CONCEPTUAL LENS	**LESSON TOPIC**		
Connections	Optical Illusions		

LEARNING OBJECTIVES *(from State/Local Curriculum)*

ELA-LITERACY·SL·5·1

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly·

5·L·1·2 Science Compare the major systems of the human body (digestive, respiratory, circulatory, muscular, skeletal, and cardiovascular) in terms of their functions necessary for life·

5·L·1·2 Science Students know that there are many systems in the human body· Some of these systems are:

- Circulatory System (heart, blood, vessels)
- Respiratory System (nose, trachea, lungs)
- Skeletal System (bones)
- Muscular System (muscles)

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Visual Thinking Strategies Instructional Model

• Digestive System (mouth, esophagus, stomach, intestines) • Nervous System (brain, spinal cord, nerves) Students know that each system performs a special life process function and that the systems work together to maintain health and fitness **5·V·1-VISUAL ARTS** Use the language of visual arts to communicate effectively **4·V·2** Apply creative and critical thinking skills to artistic expression· **4·CX·2-VISUAL ARTS CONTEXTUAL RELIVANCY** Understand the interdisciplinary connections and life applications of the visual arts·

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	**THE ESSENTIAL QUESTION** *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Connections impact systems·	How do connections impact systems?

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CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	PROCESS SKILLS (What will students be able to do as a result of this lesson?)
Tricks of optical illusion use: • **Blind Spot**- where your nerves and blood vessels connect to your eye, so you don't have cells there to process what you're seeing· Brains are unable to process anything in this spot because it cannot be seen· • **Peripheral Vision**-Brain often fills in what is in the peripheral vision when one's eyes are focused on a central point, often leaving details out· • **Mental Filtering**- Using memory, Brain assumes and filters stimuli so as not to become overwhelmed with visual stimuli· The eye is part of the nervous system	• Students will be able to analyze and interpret· • Students will be able to infer and draw conclusions • Students will be able to demonstrate understanding· • Students will be able to sequence·

but relies on the muscular and circulatory system to function· The eye uses the optic nerve as a major connection to the brain· The location of the visual cortex is in the occipital lobe of the brain· Humans have used illusions over centuries and millennia· Persistence of vision develops visual perception·	
GUIDING QUESTIONS ***What questions will be asked to support instruction?*** ***Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding***	

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Visual Thinking Strategies Instructional Model

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
• What are optics? • Compare optics' relationship to optical illusions· • What is the etymology for the word optics? • What is perception and how does perception differ for each individual and why? • What connections in your body are involved with optics? • What systems in your body are involved with	**Questions for Connect:** • How do blind spots, peripheral vison and mental filtering support optical illusions? • Why is it more important for the brain to process information rapidly than to be accurate? • What are some examples of optical illusions which focus more on color, pattern, light (form, color, depth and motion or a combination of all·	• How do optical illusions trick the brain? • What connections do blind spots, peripheral vision, and mental filtering work to facilitate optical illusions? How do these connections impact systems? • What connections happen in the brain when visualizing blind spots, peripheral vison, and mental filtering? • The eye

optics? • How is perception related to a connections or system in your body? • How is perception related to optical illusion?	Which create more of an impact for you why? **Questions for Explore:** • Upon first glance, what do you see? • What do you notice as you begin to look a bit deeper and analyze the picture more thoroughly? • What do you notice about the setting of the art? • What are the people doing and how are the riders on top different from the riders beneath?	communicates directly with the brain· What other body systems are required to have a fully functioning eye? • How does each identified system connect to support eye function? • How do connections impact systems? **Questions for the Elaborate Section:** • How have people used optical illusions of motion over time from cavemen

	• How does the artist utilize optical illusions to trick your brain in this piece of art? • What message is the artist attempting to convey through using tricks of the eye? • What are some other professional fields in which optical illusions are utilized? • What else do you see?	to LED screens of today? • What connections exist between optical illusions and motion pictures? • What is persistence of vision? How does it connect to motion perception? • How is persistence of vision interpreted in the brain, specifically the visual cortex? • How do connections impact systems?

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Visual Thinking Strategies Instructional Model

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
Students will use the details component of Kaplan's Depth and Complexity Icons to develop vocabulary, defining features and characteristics of optical illusions, body systems, a brain structure·	Students use observation and critical thinking to create individual and personal meaning by using the Virtual Thinking Skills model·		

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PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Have artistic optical illusion video playing as students enter the room· After the brief video has played, ask pre-lesson questions·

- *The next step of the lesson will begin with an explanation video about optical illusions* https://www·youtube·com/watch?time_continue=20&v=ONPH_udOOek · *Students will be provided with a graphic organizer to help synthesize information from the video and how the brain is tricked with optical illusions focusing on ways the brain draws conclusions using memory, expectations and learning:*
- ***Blind Spot***- *where your nerves and blood vessels connect to your eye, so you don't have cells there to process what you're seeing· Brains are unable to process anything in this spot because it cannot be seen· (Draw a diagram)*
- ***Peripheral Vision***-*Brain often fills in what is in the peripheral vision when one's eyes are focused on a central point, often leaving details out·*
- ***Mental Filtering:*** *Using memory, Brain assumes and filters stimuli so as not*

to become overwhelmed with visual stimuli·
Debrief with students using the graphic organizer· Make conjectures about how these adaptations are helpful to humans· Why is it more important for the brain to process information rapidly than to be accurate?

Identify and describe examples of optical illusions which focus more on color, pattern, light (form, depth, color, motion) or a combination· Which create more of an impact for you why?

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

The teacher reveals, Rob Gonsalves' cave image "As Above So Below" (Canadian artist who creates art through well-planned optical illusions) on the SmartBoard· The teacher gathers students around the picture and asks them to observe the painting without speaking· The teacher allows three minutes for students to observe the painting in silence· After an appropriate time period has passed for students to observe in silence, during lesson questions can be asked·

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What do you see?

What do you see that makes you say that?

What else do you see?

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Students are divided into groups and are provided with cards which have the post-lesson questions· Students are asked to read, discuss and record their responses to the questions on the cards·

- How have people used optical illusions of motion over time from cavemen to LED screens of today?
- What connections exist between optical illusions and motion pictures?
- What is persistence of vision? How does it connect to motion perception?
- How is persistence of vision interpreted in the brain, specifically the visual cortex?
- How do connections impact systems?

After 10 minutes, the teacher asks groups to share their responses, question by question· Discussion is facilitated by the teacher as he/ she asks probing questions: Why do you say that? What else do you see that lead you to that decision? Say a little bit more about...

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Visual Thinking Strategies Instructional Model

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Elaborate and extend learned material by watching the TedED Talk on The optical illusion of motion-
https://www·youtube·com/watch?time_continue=9&v=V8A4qudmsX0

How have people used optical illusions of motion over time from cavemen to LED screens of today?

What is persistence of vision? (Perceiving apparent motion in successive images)·

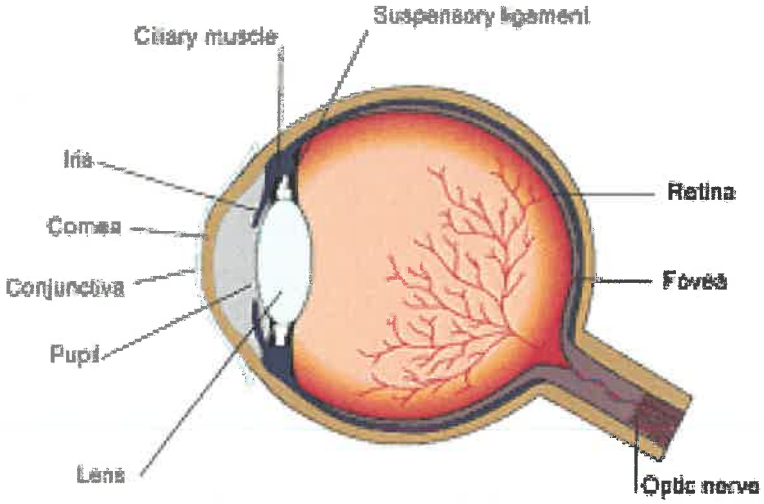
How is persistence of vision interpreted in the brain, specifically the visual cortex? Through form, color, depth, motion which are transmitted to different areas of the visual cortex through different pathways from the retina· It is the continuous interaction of various computations in the visual cortex puting those elements together into a perception·

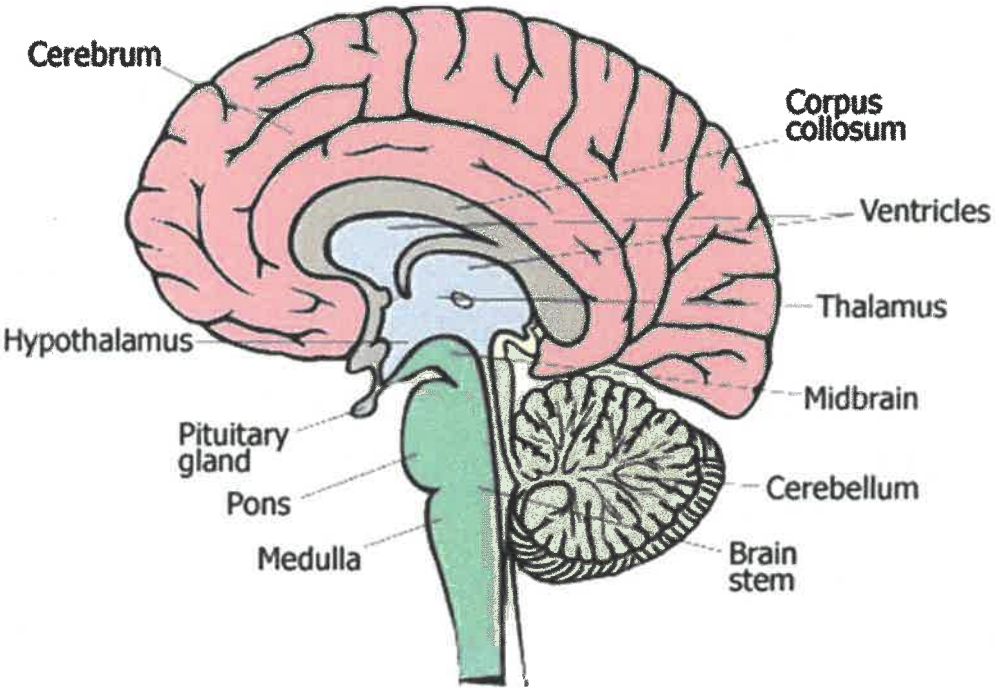
Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

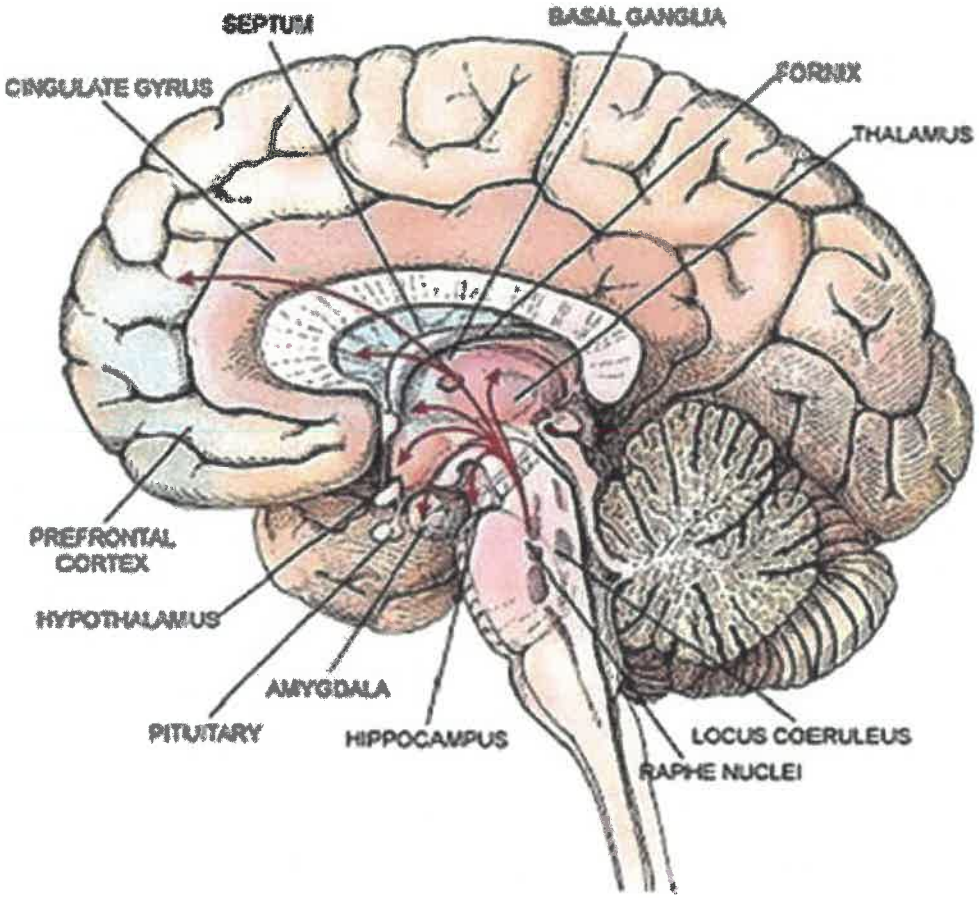
Students will be provided with appropriate materials such as card stock and colored pencils along with additional links where they are able to research the

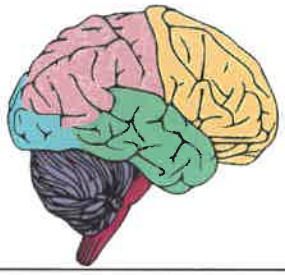
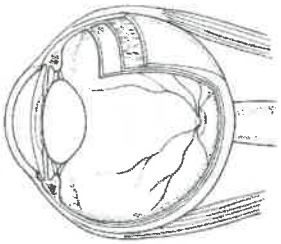
ideas further connected to their learning within the lesson·

Students are to create an animation flip book utilizing their new knowledge about the connections and systems involved in optical illusion of motion to demonstrate how eye function is dependent on the nervous, circulatory, muscular systems.


Ciliary muscle
Suspensory ligament
Iris
Cornea
Conjunctiva
Pupil
Lens
Retina
Fovea
Optic nerve


Cerebrum
Corpus collosum
Ventricles
Thalamus
Hypothalamus
Midbrain
Pituitary gland
Pons
Cerebellum
Medulla
Brain stem

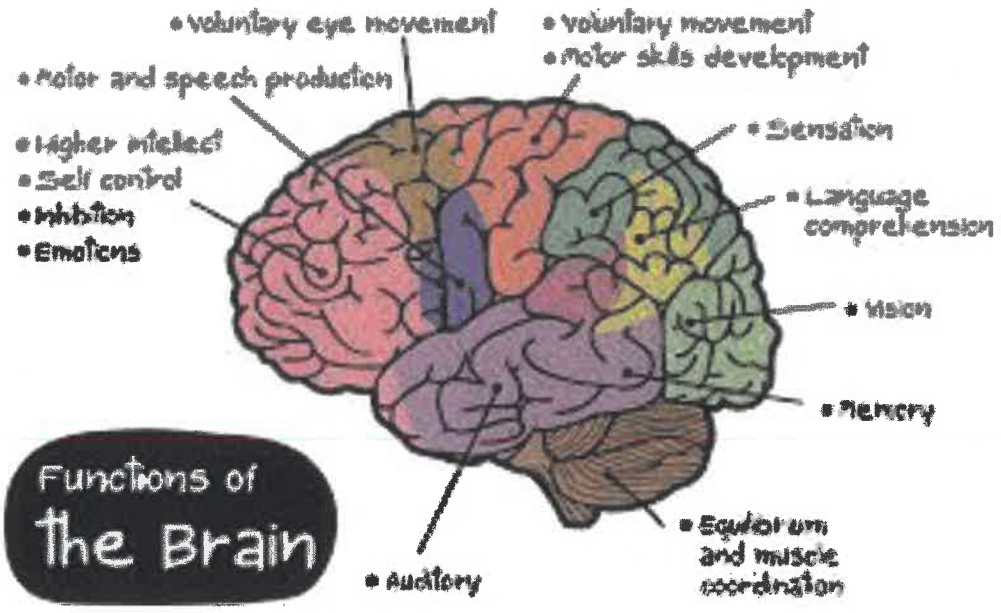

SEPTUM
BASAL GANGLIA
CINGULATE GYRUS
FORNIX
THALAMUS
PREFRONTAL CORTEX
HYPOTHALAMUS
AMYGDALA
PITUITARY
HIPPOCAMPUS
LOCUS COERULEUS
RAPHE NUCLEI

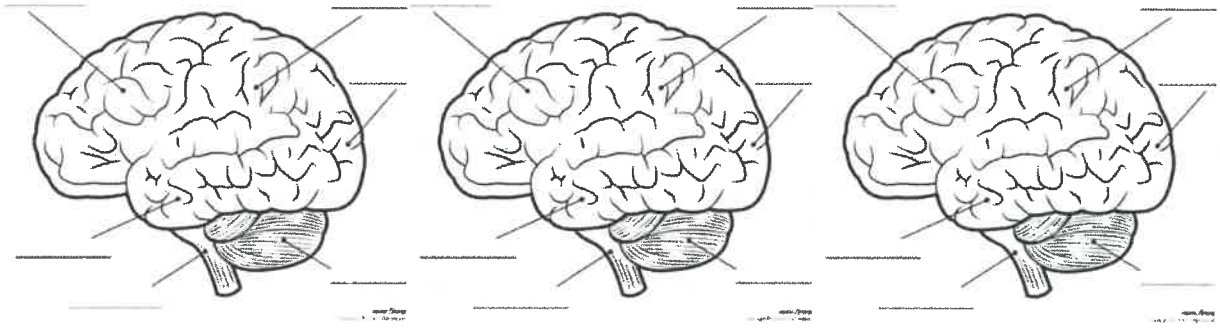
About the Brain	About the Eye
	

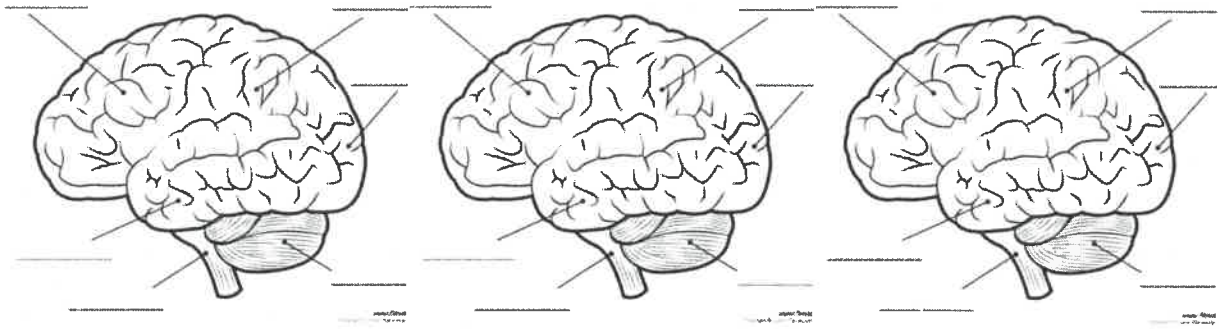
Ted Talks/4Cs

After viewing the TED ED video, please complete the following graphic organizer.

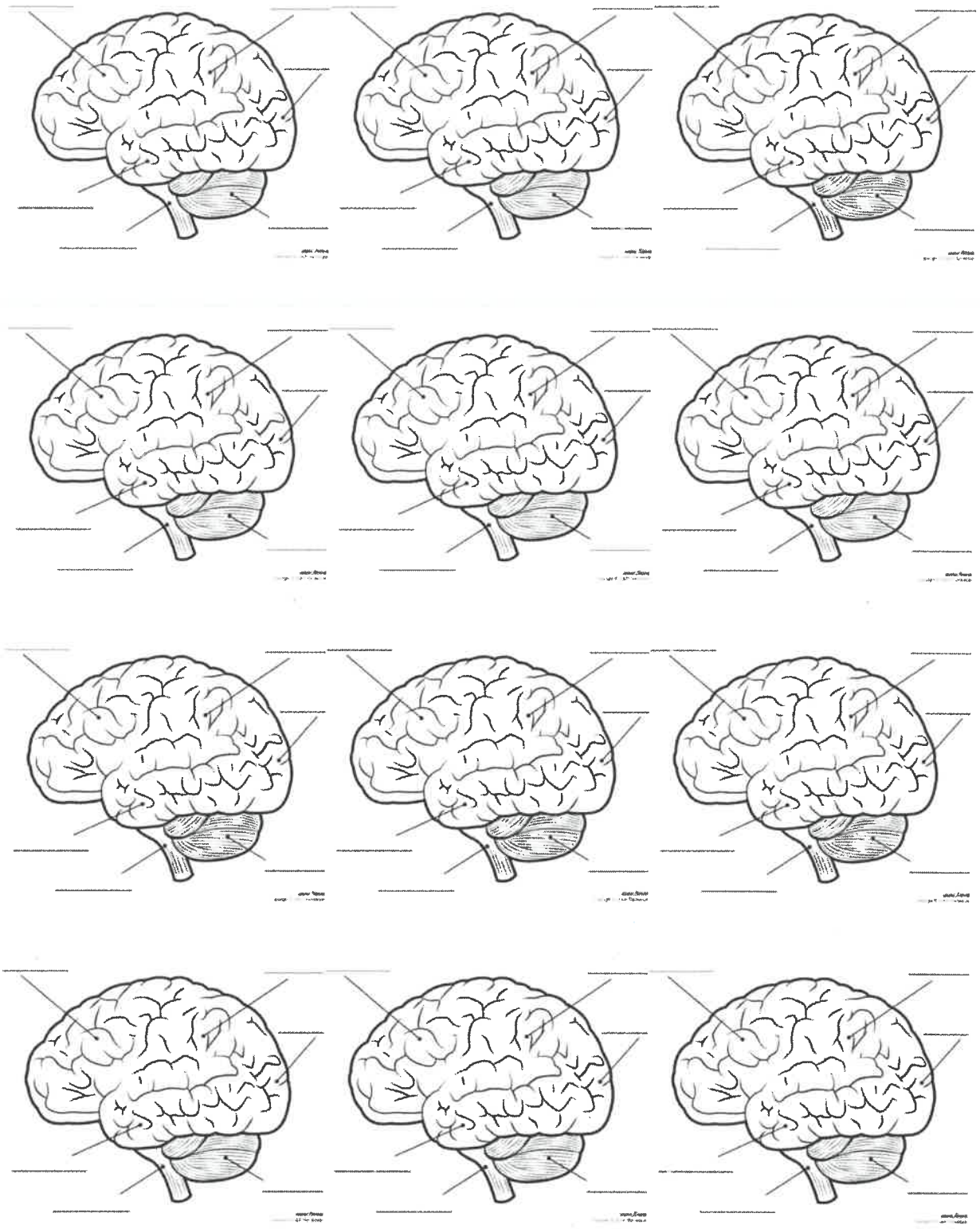
Connections What connections do you draw between the TED talk, your own life, and/or other learning?	**Challenges** What ideas, positions, or assumptions do you want to challenge or argue within this talk?
Concepts What key concepts or ideas do you think are important and worth holding on to from the talk?	**Changes** What changed in attitudes, thinking, or action are suggested by the talk, either for you or others?


• voluntary eye movement
• voluntary movement
• motor skills development
• motor and speech production
• Higher intellect
• Self control
• Inhibition
• Emotions
• Sensation
• Language comprehension
• vision
• memory
Functions of the Brain
• Auditory
• Equilibrium and muscle coordination





Nurturing Neurons Through Neuroscience -A·Quilliams



Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 2-Brain: Mission Control
Questioning Instructional Model

TEACHER NAME			Lesson #
Amanda Quilliams			2
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Questioning	Science/English Language Arts	4^{th}-6^{th}	
CONCEPTUAL LENS		**LESSON TOPIC**	
Connections		Body Systems	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

5·L·1·2 Compare the major systems of the human body (digestive, respiratory, circulatory, muscular, skeletal, and cardiovascular) in terms of their functions necessary for life

CCSS·ELA-LITERACY·RL·5·10
By the end of the year, read and comprehend literature, including stories, dramas, and poetry, at the high end of the grades 4-5 text complexity band independently and proficiently·

CCSS·ELA-LITERACY·RI·5·3
Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text·

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 2-Brain: Mission Control
Questioning Instructional Model

CCSS·ELA-LITERACY·RI·5·9
Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably·

CCSS·ELA-LITERACY·RI·5·10
By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4-5 text complexity band independently and proficiently·

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	THE ESSENTIAL QUESTION *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Connections impact systems·	*How do connections impact systems?*
CONTENT KNOWLEDGE *(What factual information will students learn in this lesson?)*	**PROCESS SKILLS** *(What will students be able to do as a result of this lesson?)*
Students will know... • The human brain itself is a connection machine and "boss," "master communicator," or "mission control" of the body·	**Students will be able to···** • Students will be able to draw conclusions· • Students will analyze and synthesize information as it relates to their research·

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Lesson 2-Brain: Mission Control
Questioning Instructional Model

• The purpose of neural connections· • When connections are used regularly in the brain, the brain becomes stronger and more complex· (It's important to understand that the following systems and their connections to the brain will be explored in groups, as in each group will explore a body system and how the brain/nervous system impact how it functions· Groups will present their findings to the whole group in a jigsaw type of learning where everyone benefits from the group learning)· • Within the skeletal system, the skull protects the brain and the vertebrae protect the spinal cord from injury·	• Students will compare and contrast to determine similarities and differences· • Students will examine and identify· • Students will construct an understanding·

• The brain connects with cardiovascular system when the endothelial cells create and maintain the blood-brain barrier· Blood pressure is reported to the brain using baroreceptors· Heart rate and blood pressure would be uncontrolled without regulation from the brain· • The brain connects to the muscular system through receptors in the muscles which give information about body position· • The endocrine system and the brain are most closely connected because hormones impact neural processing· The hypothalamus gives guidance to the pituitary gland and other endocrine glands·	

• Infection becomes week when the lymphatic system teams up with the brain· Breathing is regulated within the respiratory system when the brain controls breathing speed· • The brain works with the digestive system to control eating and drinking along with controlling the muscles for input and output within the tract·	

GUIDING QUESTIONS
What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
• What is a system? • What are important body systems? • How would you describe the basic function of each body system? • What would be important details in	• What are the features of the nervous system? • What distinguishes the nervous system from other bodily systems? • How does the brain interact with the assigned bodily system?	• How would other systems in the body be able to function without the functioning brain? Why or why not? • How are interdependence and

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 2-Brain: Mission Control
Questioning Instructional Model

determining the communication of the nervous system with other systems in the body? • Why are connections important for a fully functioning body system? • How would you rank the body systems according to importance within the body? • What is a neuron and why are they important?	• What are the associated organs of the bodily system being compared to the nervous system? • What are special vocabulary words associated with the systems being compared? • What role do neurons play in communication among/between systems in the body? • Why are connections important for a fully functioning body system/brain system?	connections between and among the body systems required for a fully functioning body? • What is an instance when the nervous system might not be fully functioning but yet the other systems in the body could function? • How would the limited functioning of the brain impact other systems of the body? • How does the brain connect to other bodily systems? • How do connections impact systems?

Nurturing Neurons Through Neuroscience -A·Quilliams

Lesson 2-Brain: Mission Control

Questioning Instructional Model

DIFFERENTIATION *(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.*			
Content	**Process**	**Product**	**Learning Environment**
The readings in the lesson are sophisticated and use advanced vocabulary and technical/scientific topics· Content also provides students depth in understanding related features and characteristic/details of each body system and are required to find evidence to support their ideas·	Students engage in in-depth critical thinking as they analyze the concept of CONNECTIONS within/among the systems of the body through the Questioning model·		

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Lesson 2-Brain: Mission Control
Questioning Instructional Model

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect - *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Students will view one brief video before their exploration phase to introduce how the brain connects through the rest of the body systems to connect prior knowledge before the lesson begins· This video uses song/music to engage students and establishes the language of the discipline·

(2 min·)

https://www·youtube·com/watch?v=Qw8E9WnZTQk

Ask before lesson questions:

- What is a system?
- What are important body systems?
- Describe the basic function of each body system?
- What would be important details in determining the communication of the nervous system with other systems in the body?
- Why are connections important for a fully functioning body system?
- How would you rank the body systems according to importance within the body?

- *What is a neuron and why are they important?*

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Students will be grouped and assigned one body system based on their previously indicated preference· The body systems include: Skeletal, Muscular, Cardiovascular, Respiratory Lymphatic, Endocrine, Respiratory, and Digestive Systems· Using a variety of materials, (print and digital) students will examine how the brain interacts and connects with their assigned system and record their research in a Google Doc graphic organizer identifying the system they are studying, its function and the connections it makes to and how it impacts other systems, associated organs, and the interaction with the nervous system, identifying and explaining any special vocabulary associated with their research· Student groups will also be required to come up with a way the class can remember how the two systems they studied interact· This can include a body motion, a song or other brief creative representation· As a group, students should answer the during lesson questions they have as it relates to investigating the nervous system and their other chosen body system· The teacher circulates during this exploration to facilitate groups·

- *What are the features of the nervous system? Other researched system?*

- What distinguishes the nervous system/chosen system from other bodily systems?
- How does the brain interact with the assigned bodily system?
- What are the associated organs of the bodily system being compared to the nervous system?
- What are special vocabulary words associated with the systems being compared?
- What role do neurons play in communication among/between systems in the body?
- Why are connections important for a fully functioning body system/brain system?

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

The teacher will ask each group to share their researched information in a think-pair-share with other students becoming the experts of the nervous system and their assigned body system· As a group, students will also share their created way for their classmates to remember the importance of their body systems and the nervous system and we will "perform" them with the presenters· Other students will be able to ask questions during this time· In addition, the teacher will refer back to the during lesson questions to clarify ideas and facilitate student's ability to draw conclusions· When all groups have finished the teacher asks the Post Lesson Questions:

- How would other systems in the body be able to function without the functioning brain?
- How are interdependence and connections between and among the body systems required for a fully functioning body?
- Describe a personal instance when the nervous system might not be fully functioning but yet the other systems in the body could function?
- How would the limited functioning of the brain impact other systems of the body?
- How does the brain connect to other bodily systems?
- How do connections impact systems?

Students volunteer answers and feedback from multiple students is discussed.

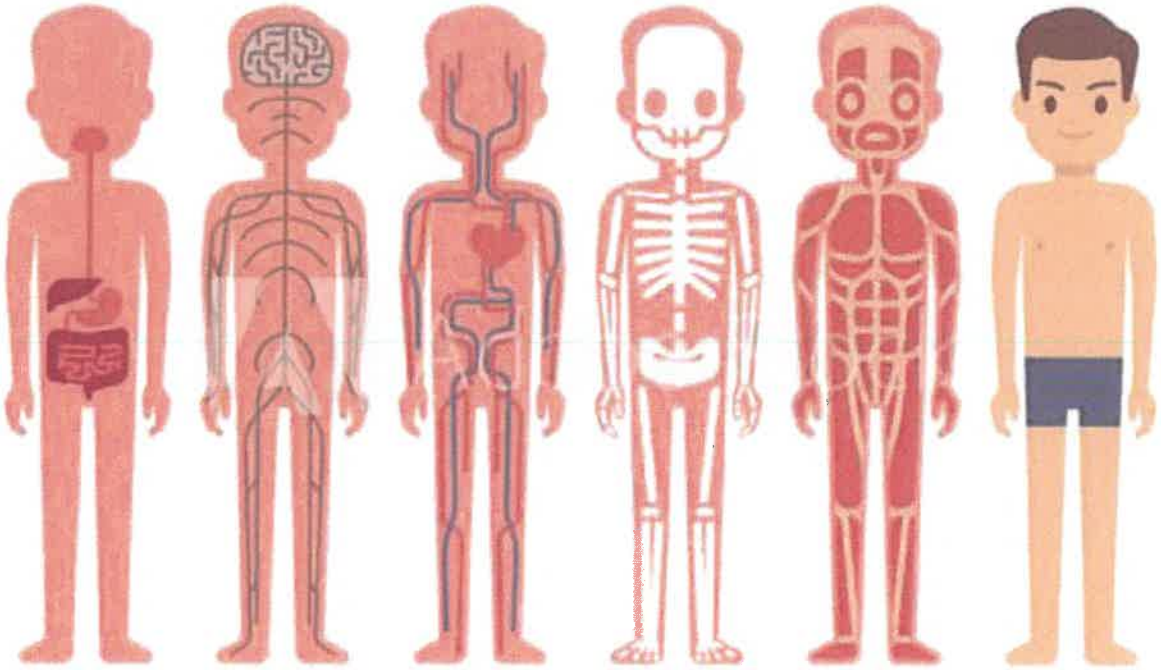
Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

During this time, the teacher asks for questions from the students about what they learned during the lesson· The teacher then requests: Tell me something you discovered today through your investigations that caused you to think and why it made you think· Tell me something you discovered today that surprised you and why it surprised you· Tell me something you discovered today that you want to share with someone else and why you want to share this knowledge·
Time will vary depending on discussion)· Students will discover the essential understanding, "Connections impact systems·" by making generalizations about

the relationship of CONNECTIONS between and among the body's systems and the nervous system·

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

Students will be provided a poem for two voices template and a copy ***A Joyful Noise: Poems for Two Voices*** *where they will be required to assimilate the information they just learned about the nervous system and an additional body system into a poem for two voices which creates a dialogue between the nervous system and another system within the body· The poem must contain true and accurate research and convey a deep understanding of function of the nervous system and the additional body system of their choice in addition to how the chosen systems are impacted because of their connections· The poem must also demonstrate an understanding of the essential question "Connections Impact Systems·" Once poems have been written and edited, they will be performed and recorded for presentation to parents and classmates in a coffeehouse type setting·*



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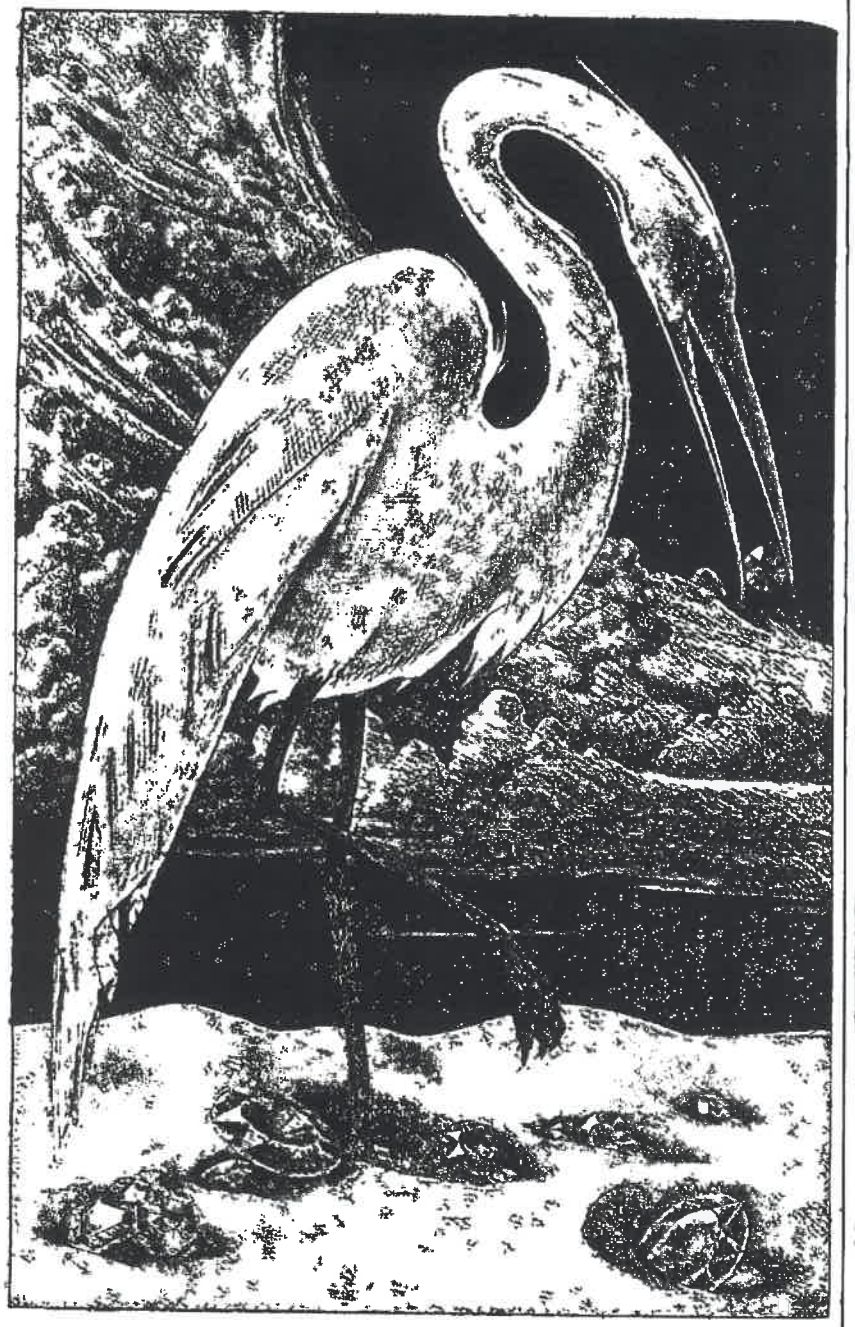


The Common Egret

common

Common!

As if to be so white that
snow

clouds

that milk

rates as ordinary.

They call us
common
egrets.

The injustice!

snow
is filled with envy
clouds
consumed with spite
that milk
should seem molasses

Gold
should be so slandered
diamonds
scorned as worthless
rubies
spurned

egrets

common.

Gold

diamonds

rubies

if common
egrets
are but
common.

The Phoenix

I am Phoenix

Phoenix
everlasting!
I am Phoenix!

Immortal
eternal.
I live in
Arabia

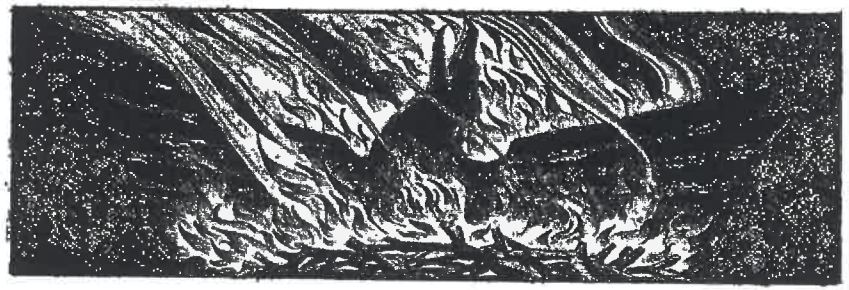
eagle
My feathers are
scarlet,
purple,

I am Phoenix
the fire-bird!
Phoenix

I am Phoenix!
Immortal
eternal
undying.

Arabia
I'm as large as an
eagle

scarlet,



golden.

one

there have never been more.
I am my own
daughter
granddaughter
great-granddaughter
I was

will be
my gravedigger.

I gather up twigs of
sweet-smelling spices
and build a nest
on the top of a palm.

Then I wait for noon—

fire
I flap my wings

purple.
There is but
one
Phoenix—

I am my own
mother
grandmother
great-grandmother.
I was
my own midwife,
will be

For each time I discover
I'm becoming old

sweet-smelling spices

I climb inside.

and when the sun's hot as
fire

burst
into flames

which I fan
with my wings
and fan

and I

Eight days pass.
The ashes cool.

in the morning,

just as the sun

I rise
from the ashes
and fly upward—

new

till the twigs beneath me
burst

which I fan
with my wings
and fan
and fan
till the fire

are no more.

Eight days pass.

Then, on the ninth day

at dawn,

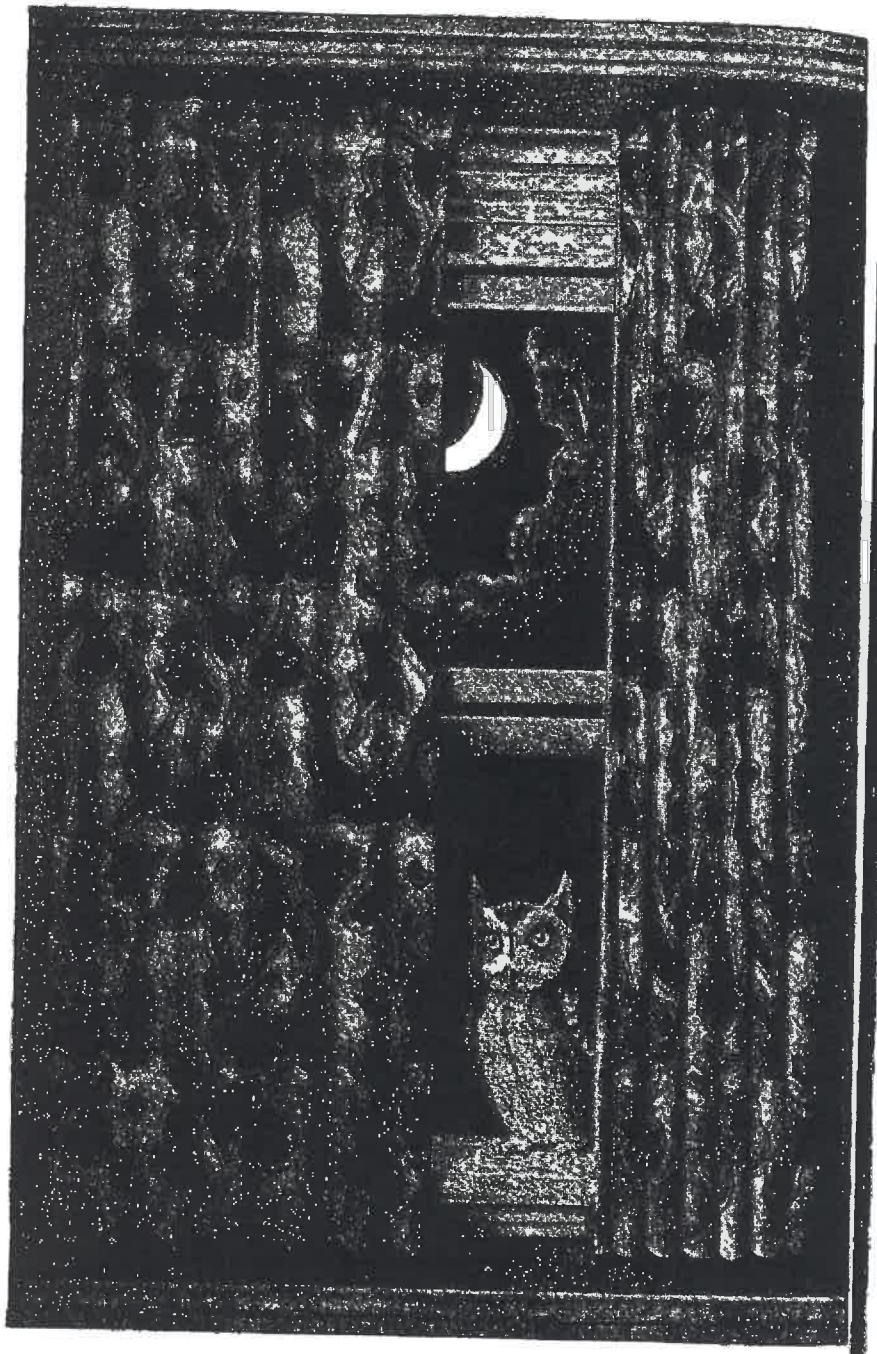
rises in the east
I rise

a
new
Phoenix,

my own
mother
grandmother
great-grandmother
and on
and on
until the end of time.

daughter
granddaughter
great-granddaughter

and on
until the end of time.



Owls

Sky's dark,

Larks sleeping
Black night

Bright noon
for owls.

(siskins sleeping)

(phoebes dreaming)
Screech owls

Sun's down,

Loons sleeping

Black night
for them,
Bright noon

Barn owls

Barred owls

Screech owls

are

lis-
ten-
ing

are
lis-
ten-
ing

are
lis-
ten-
ing

Spotted owls

(sleeping cranes)

Saw-whet owls

(dreaming quail)

Elf owls

Elf owls
are
call-
ing
out

are
call-
ing
out

are
call-
ing

Great gray owls
are
calling
out
into the night.

Great gray owls

calling

into the night.

whin-
ing

whir-
ring

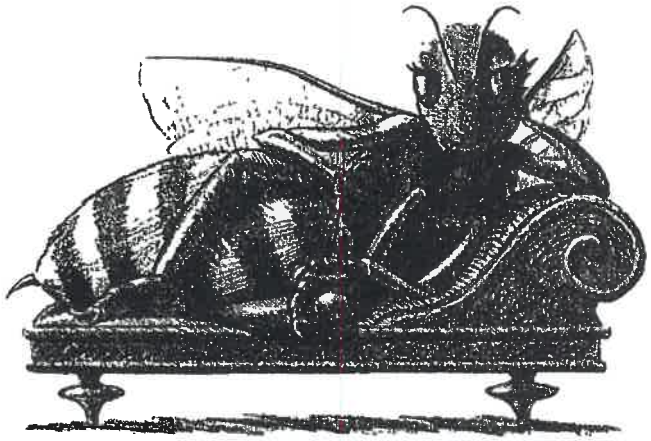
pulsing
chanting from the treetops
sending
forth their
booming
boisterous
joyful noise!

ci-
cadas
whirring

ci-
cadas
pulsing

chanting from the treetops

sending
forth their
booming
joyful noise!



Honeybees

Being a bee

is a pain.

I'm a worker
I'll gladly explain.

I'm up at dawn, guarding
the hive's narrow entrance

Being a bee
is a joy.

I'm a queen

I'll gladly explain.
Upon rising, I'm fed
by my royal attendants,

I'm bathed

then I take out
the hive's morning trash

then I'm groomed.

then I put in an hour
making wax,
without two minutes' time
to sit still and relax.

The rest of my day
is quite simply set forth:

Then I might collect nectar
from the field
three miles north

I lay eggs,

or perhaps I'm on
larva detail

by the hundred.

feeding the grubs
in their cells,
wishing that *I* were still
helpless and pale.

I'm loved and I'm lauded,
I'm outranked by none.

Then I pack combs with
pollen—not my idea of fun.

When I've done
enough laying

Then, weary, I strive

I retire

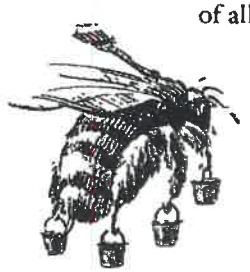
to patch up any cracks
in the hive.

for the rest of the day.

Then I build some new cells,
slaving away at
enlarging this Hell,
dreading the sight
of another sunrise,
wondering why we don't
all unionize.

Truly, a bee's is the
worst
of all lives.

Truly, a bee's is the
best
of all lives.



Poem for Two Voices

(1)	Spoken Together	(2)

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 3-Phrenology: Debunking Pseudoscience
Socratic Seminar Lesson Model

TEACHER NAME			Lesson #
Amanda Quilliams			3
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Socratic Seminar	Science-Biology	4-6	
CONCEPTUAL LENS	**LESSON TOPIC**		
Connections	Phrenology: Debunking Pseudoscience		

LEARNING OBJECTIVES *(from State/Local Curriculum)*

Science-5·L·1·2 Compare the major systems of the human body (digestive, respiratory, circulatory, muscular, skeletal, and cardiovascular) in terms of their functions necessary for life·

CCSS·ELA-LITERACY·RL·5·10
By the end of the year, read and comprehend literature, including stories, dramas, and poetry, at the high end of the grades 4-5 text complexity band independently and proficiently·

CCSS·ELA-LITERACY·RI·5·3
Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text·

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 3-Phrenology: Debunking Pseudoscience
Socratic Seminar Lesson Model

CCSS·ELA-LITERACY·RI·5·9

Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably·

CCSS·ELA-LITERACY·RI·5·10

By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4-5 text complexity band independently and proficiently·

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	**THE ESSENTIAL QUESTION** *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Connections impact systems·	How do connections impact systems?
CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	**PROCESS SKILLS** (What will students be able to do as a result of this lesson?)
Students will know... • Phrenology is the study of the skull to determine mental abilities and character traits·	***Students will be able to...*** • Students will hypothesize and draw conclusions· • Students will analyze and

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 3-Phrenology: Debunking Pseudoscience
Socratic Seminar Lesson Model

• Phrenology is considered a pseudoscience· • Phrenology was developed by a Franz Joseph Gall, a doctor in the 19th century· • Five principles of the basis of phrenology include: • The brain is the organ of the mind· • Mental powers can be analyzed into a definite number independent of faculties· • These faculties are innate and each one has a different area of on the brain surface· • The size of each region of each faculty and its location determines the character of the	generalize· • Students will differentiate· • Students will evaluate and produce· • Students will connect and infer· • Students will create and develop·

person and measure of its power· • There's a relationship between the surface of the skull and the shape of the brain surface beneath· • Although phrenology spread across Europe it was most popular in the United States· • After reaching the United States, L·N· Fowler continued the movement which led to head reading and racial/sexist concerns· • Phrenology was debunked· • Phrenology had some ideas and concepts of modern day neurology correct· • Localistic and distributed models of the brain proposed by	

Victorian scientists were used to describe speech and memory regions in the brain· Phrenology was developed in the midst of this debate· • Modern technology has allowed neuroscientists to fully investigate phrenology's principles by imaging the brain digitally which is no comparison to the Victorian approach of determining brain function by feeling the scalp·	

GUIDING QUESTIONS

What questions will be asked to support instruction?
Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding

Pre-Lesson Questions:	During Lesson Questions:	Post Lesson Questions:
• What is phrenology? • How was phrenology developed? • Why might the 19th	***Opening Question*** for the seminar-This question serves to get the discussion started·	***Reflection Questions for Post Seminar:*** • How did your thinking grow or

century have been the perfect time period for phrenology to develop? • What is pseudoscience? • How does pseudoscience connect to science? • Why was it so difficult to debunk phrenology in the 19th century? • What social systems were in place during this time period that caused phrenology to flourish and spread?	• How do connections impact systems? • What connections exist between pseudoscience of phrenology impacted neuroscience? **Sustaining Questions-** These questions represent the questions the teacher/facilitator would ask if the discussion lulled in flow· • What factors/discoveries lead to the challenging of phrenology as a	change as a result of participating in the seminar? • What questions or confusion did you have going into the seminar? • How was your thinking clarified? • What actions did you observe others doing that you felt were effective? • What were effective ways that were used that kept the conversation going? • Why do we no longer practice phrenology?

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 3-Phrenology: Debunking Pseudoscience
Socratic Seminar Lesson Model

• Why didn't Gall's popular method of measuring the skull to determine a person's strong and weak mental faculties hold up to scrutiny? • Are the areas of the brain responsible for carrying out the production and comprehension of speech the same of different? How do we know? • What are two models of how the brain functions·	practice? • How did phrenology serve to support existing social systems of the period? • What principles of phrenology were considered "dark?" How are these ideas connected to a larger social system of the time? • How does modern technology help put phrenology to the test?	• How has our knowledge and understanding of science and the brain challenged existing beliefs about phrenology? • How is biology intertwined with emotions and thoughts? • Would neuroscientists have thought critically about the connections of biology and thoughts/emotions without the impact of phrenology?

What are the approaches scientists used to draw their conclusions? What connections do these two approaches share? • How did localistic and distributed models proposed by Victorian scientists to describe speech and memory regions in the brain?		• What myths that fed phrenology have been debunked by new scientific discoveries? • How do connections impact systems?
DIFFERENTIATION *(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.*		

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 3-Phrenology: Debunking Pseudoscience
Socratic Seminar Lesson Model

Content	Process	Product	Learning Environment
Students will use the details component of Kaplan's Depth and Complexity Icons to develop vocabulary, defining features and characteristics of phrenology and neuroscience·	Students engage in in-depth critical thinking as they must analyze the how a pseudoscience (phrenology) impacts the scientific body of knowledge of neuroscience·		

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 3-Phrenology: Debunking Pseudoscience
Socratic Seminar Lesson Model

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect- *This phase focuses on piquing students' interest and helping them access prior knowledge· This is the introduction to the lesson that motivates or hooks the students·*

What Is Phrenology? To build background about the practice of phrenology students will watch the following video:

Victorian Pseudoscience: Brain Personality Maps-
https://www·youtube·com/watch?v=iBv1wKinQXw

- *What is phrenology?*
- *How was phrenology developed?*
- *Why might the 19th century have been the perfect time period for phrenology to develop?*
- *What is pseudoscience?*
- *Why was it so difficult to debunk phrenology in the 19th century?*
- *How did subjective validation help phrenology take hold within the public?*
- *How did phrenology influence classism?*
- *How did craniometry support racism?*

- *Why is functional specialization an important concept?*

TED-ED-How Stress Affects the Brain- *https://ed·ted·com/lessons/the-great-brain-debate-ted-altschuler*

- *Why didn't Gall's popular method of measuring the skull to determine a person's strong and weak mental faculties hold up to scrutiny?*
- *How are the areas of the brain responsible for carrying out the production and comprehension of speech the same of different?*
- *What are two models of how the brain functions· What are the approaches scientists used to draw their conclusions based on these models?*
- *Describe localistic and distributed models proposed by Victorian scientists to describe speech and memory regions in the brain·*

Explore *- In this phase, the students have experiences with the concepts and ideas of the lesson· Students are encouraged to work together without direct instruction from the teacher· The teacher acts as a facilitator· Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas·*

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 3-Phrenology: Debunking Pseudoscience
Socratic Seminar Lesson Model

(Before this lesson, students will gain an understanding of Socratic Seminars and their function in addition to the expectations of the participants· They will watch a video seeing Socratic Seminars being modeled in a classroom· Collectively we will practice how to write open ended questions as well)·

Students will be provided with a consumable text https://theconversation·com/neuroscientists-put-the-dubious-theory-of-phrenology-through-rigorous-testing-for-the-first-time-88291 to read independently· As students read the text independently, they are instructed to annotate the text using the structure of a close reading· Students should circle any unknown words, identify any interesting parts in their reading· While students are reading, they will construct four open-ended questions they can ask during the seminar· Each question will be written on a sticky tab and be placed at a corresponding location within the text· As students read and craft their questions, the teacher will circulate to support students during this process·

Explain - Students communicate what they have learned so far and figure out what it means· This phase also provides an opportunity for teachers to directly

introduce a concept, process, or skill to guide students toward a deeper understanding·

Before beginning the Socratic Seminar, the teacher will use anchor charts to remind students of behavioral expectations for participating in the seminar in addition to how the seminar will function· The teacher will then divide the students into two circles (fish bowl), an inner circle and an outer circle· Students in the inner circle will begin the dialogue by responding to the opening question· Students will use the open ended questions they have written to keep the seminar going· As questions are posed, the inner circle will respond to posed questions while students in the outer circle listen to the dialogue and take notes about the discussion· After a rich discussion has occurred, the participants in the inner and outer circles switch places· In doing so, the participants in the outer circle become observers and the participants in the inner circle become involved in the discussion· Students moving to the inner circle can then comment on anything that they heard while they were observing which connects to the text or video·

The teacher/facilitator may ask the following questions to encourage and support the discussion if it were to lull· If the questions aren't used during the

discussion, the teacher may use them at the end of the Socratic Seminar·

Elaborate —Allow students to use their new knowledge and continue to explore its implications· At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways·

Students will debrief by using the following reflection questions:

- What went well during the seminar?
- What could you do differently next time to be a more effective participant?
- How did your thinking grow or change as a result of participating in the seminar?
- What questions or confusion did you have going into the seminar?
- How was your thinking clarified?
- What actions did you observe others doing that you felt were effective?
- What were effective ways that were used that kept the conversation going?

After reflecting using the questions above to guide students? The teacher poses

the Post-Lesson Questions:

- Why do we no longer practice phrenology?
- How has our knowledge and understanding of science and the brain challenged existing beliefs about phrenology?
- How is biology intertwined with emotions and thoughts?
- Would neuroscientists have thought critically about the connections of biology and thoughts/emotions without the impact of phrenology?
- What myths that fed phrenology have been debunked by new scientific discoveries?

Evaluate: This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies·

The teacher/facilitator asks students to respond to the essential question on an index card which will be submitted to the teacher as a ticket out the door· The response will serve as a formative assessment·

- How do connections impact systems?

Ted Talks/4Cs

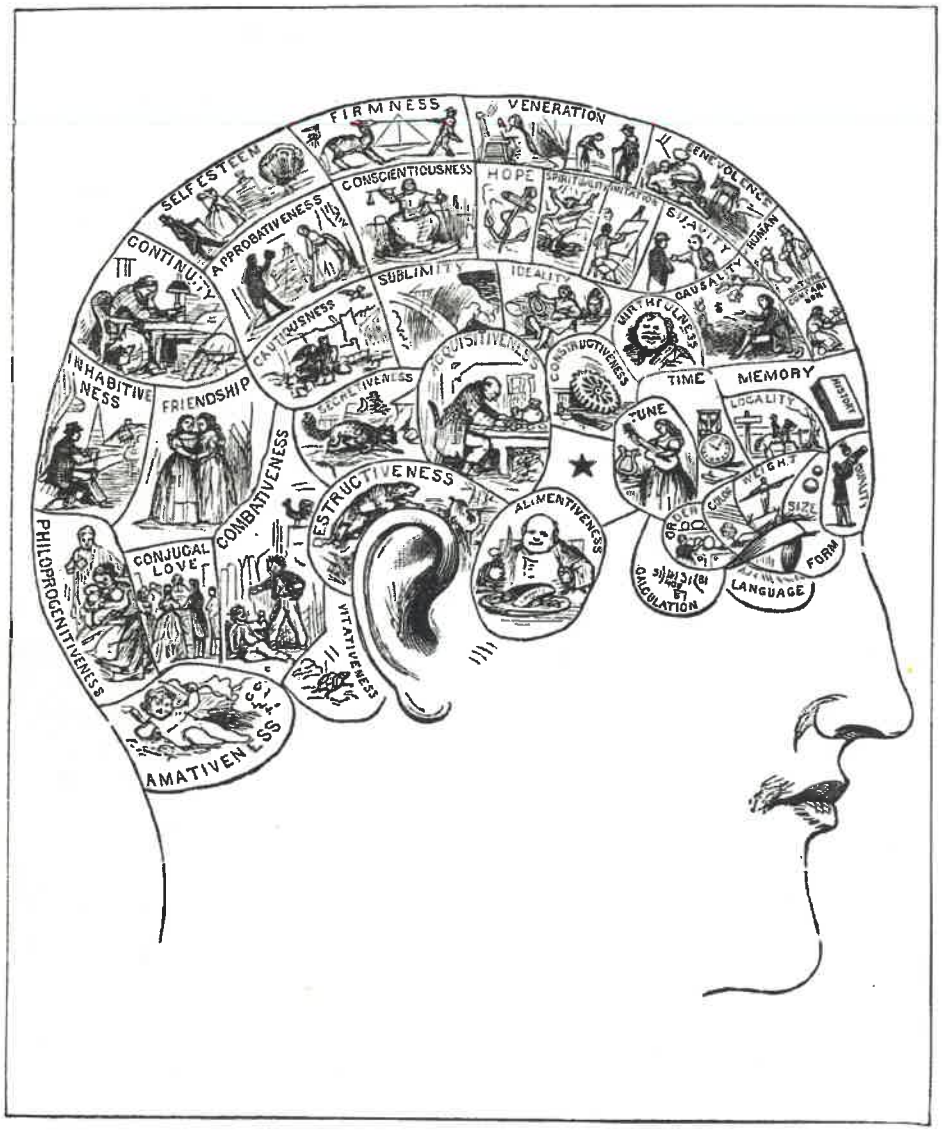
After viewing the TED ED video, please complete the following graphic organizer.

Connections What connections do you draw between the TED talk, your own life, and/or other learning?	**Challenges** What ideas, positions, or assumptions do you want to challenge or argue within this talk?
Concepts What key concepts or ideas do you think are important and worth holding on to from the talk?	**Changes** What changed in attitudes, thinking, or action are suggested by the talk, either for you or others?

THE CONVERSATION
Academic rigor, journalistic flair

Neuroscientists put the dubious theory of 'phrenology' through rigorous testing for the first time

January 22, 2018 9.10am EST



Phrenological Chart of the Faculties.

An 1883 phrenology chart. wikipedia

Author

Harriet Dempsey-Jones
Postdoctoral Researcher in Cognitive Neurosciences, University of Oxford

Nobody *really* believes that the shape of our heads are a window into our personalities anymore. This idea, known as "phrenology", was developed by the German physician Franz Joseph Gall in 1796 and was hugely popular in the 19th century. Today it is often remembered for its dark history – being misused in its later days to back racist and sexist stereoptypes, and its links with Nazi "eugenics".

But despite the fact that it has fallen into disrepute, phrenology as a science has never really been subjected to rigorous, neuroscientific testing. That is, until now.

Researchers at the University of Oxford have hacked their own brain scanning software to explore – for the first time – whether there truly is any correspondence between the bumps and contours of your head and aspects of your personality. The results have recently been published in an open science archive, but have also been submitted to the journal Cortex.

But why did phrenologists think that bumps on your head might be so informative? Their enigmatic claims were based around a few general principles. Phrenologists believed the brain was comprised of separate "organs" responsible for different aspects of the mind, such as for self-esteem, cautiousness and benevolence.

They also thought of the brain like a muscle – the more you used a particular organ the more it would grow in size (hypertrophy), and less used faculties would shrink. The skull would then mould to accommodate these peaks and troughs in the brain's surface – providing an indirect reflection of the brain, and thus, the dominant features of an person's character.

Despite its initial popularity, phrenology started losing support from scientists in the 20th century due to methodological criticisms and failure to replicate various findings. Gall was restricted in the cases he used to define the location of bump-trait correspondences – often he studied just a few people, such as his family and friends. Other times, he relied on dubious and somewhat offensive stereotypes. His method was also questionable: probing subjects' heads with his fingertips until he began to "detect patterns".

Caricature showing Franz Joseph Gall measuring the head of a bald lady. E.F. Lambert/Wellcome collection, CC BY-SA

While there was some renewed interest in the theory in the 20th century due to the rise of disciplines like evolution, criminology and anthropology, it soon was almost completely abandoned.

Large sample

This year, however, in the spirit of scientific fun, my colleagues decided to put this old theory to the test. They did so by repurposing various pieces of sophisticated software, originally designed for MRI brain analysis. Where normally these tools carefully discard all bits of skull, allowing analysis of the brain alone, they engineered them to do the reverse: relegating all of the brain to the trash, instead keeping the bony bits for analysis.

From this surface structure, they could create a detailed map of the contours – bumps – of individual skulls. By taking advantage of the largest freely available brain imaging database in the UK, the scientists acquired a massive sample of data from almost 6,000 people. Alongside brain data, this database also contains a wealth of information from demographic and lifestyle questionnaires, as well as language and cognitive tests from its participants.

The scientists picked 23 measures from this data that best corresponded with the 27 personality factors from phrenology. Some map very closely, such as phrenology's "eventuality" (aptness to

receive an education) and the modern version: "age completed full time education". Similarly, "tune" (sense for sounds, musical talent) in phrenology matched with "musical profession".

Before they started linking these personality traits with skull features, they looked at overlapping traits (so if you have one trait you also tend to have another) and found some rather amusing associations. For instance, they found a very strong positive association between the trait "amativeness" (the arousal of feelings of sexual desire) and "words". To break this down, it turns out that the more sexual partners a person has had, the higher their verbal fluency in a word naming task.

The verdict

What they didn't find, however, were any "statistically significant or meaningful effects" when it came to the skull. That means they were unable to find *any* correlation between the contours of the skull and the 23 personality traits, selected to mirror those championed by phrenology.

What's more, undermining a deeper fundamental premise, they demonstrated there was no correspondence between the curvature of the brain and the contours of the skull. That is, there is no way lumpy bits of brain are pushing the skull out to create surface bumps – the skull does not mirror the brain surface.

Research based on MRI images usually exclude the skull. Wikimedia Commons., CC BY-SA

This is obviously unsurprising, given the shaky "science" upon which phrenology was based. That said, it was among one of the earlier disciplines to recognise that different parts of the brain have different functions. Sadly, the phrenologists didn't quite nail what the actual functions were: focusing largely on the brain as the seat of the mind (governing attitudes, predispositions etc) rather than the more fundamental functions we know it to control today: motor, language, cognition, perception and so forth. However, for better or worse, phrenology is largely considered as a scientific game-changer – with the roots of many modern scientific, but also psuedoscientific disciplines, following in its wake.

All in all, it appears – as the researchers themselves state – that the "digital" technology of the time (feeling the scalp with "digits" aka fingers) was no match for the digital MRI technology of the current day. An infamous historical discipline finally investigated, and a topnotch science pun: pretty successful day at the office for the Oxford team.

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 4: Stress and Brain
Taba Lesson Model

TEACHER NAME			Lesson #
Amanda Quilliams			4
MODEL	**CONTENT AREA**	**GRADE LEVEL**	
Taba Concept Development	Science-Biology	4-6	
CONCEPTUAL LENS		**LESSON TOPIC**	
Connections		Brain Function	

LEARNING OBJECTIVES *(from State/Local Curriculum)*

5·L·1·2 Compare the major systems of the human body (digestive, respiratory, circulatory, muscular, skeletal, and cardiovascular) in terms of their functions necessary for life·

CCSS·ELA-LITERACY·RL·5·10
By the end of the year, read and comprehend literature, including stories, dramas, and poetry, at the high end of the grades 4-5 text complexity band independently and proficiently·

CCSS·ELA-LITERACY·RI·5·3
Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text·

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Lesson 4: Stress and Brain
Taba Lesson Model

CCSS·ELA-LITERACY·RI·5·9

Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably·

CCSS·ELA-LITERACY·RI·5·10

By the end of the year, read and comprehend informational texts, including history/social studies, science, and technical texts, at the high end of the grades 4-5 text complexity band independently and proficiently·

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Taba Lesson Model

THE ESSENTIAL UNDERSTANDING *(What is the overarching idea students will understand as a result of this lesson?*	**THE ESSENTIAL QUESTION** *(What question will be asked to lead students to "uncover" the Essential Understanding)*
Connections impact systems·	*How do connections impact systems?*
CONTENT KNOWLEDGE (What factual information will students learn in this lesson?)	**PROCESS SKILLS** (What will students be able to do as a result of this lesson?)
Students will know... • *The human brain is in constant connection with other bodily systems and the effects of stress on the other body systems·* • *The human brain itself forms connections even under stressful circumstances·*	**Students will be able to...** • *Students will hypothesize and draw conclusions·* • *Students will analyze and generalize·* • *Students will differentiate·* • *Students will evaluate and produce·* • *Students will connect and infer·*

• Hormones and neurotransmitters are released by the brain into the body during a stress response· • Stress responses in the learning environment impede learning because deep learning does not occur when senses are over stimulated· • Differences of eustress and distress and pros/cons of both· • Eustress is a positive type of stress that prepares the body for perceived challenges· Eustress is a natural physical response which improves blood flow to the muscles and speeds up the heart· Eustress is beneficial in the short term and encourages emotional	• Students will create and develop·

balance and peace and lessen the likelihood of many mental and physical ailments· • Distress is negative stress and damage from the conflict between the outside environment and the body leading to physical and emotional pressure· Long term distress can lead to headaches, hypertension, irritability, heart palpitations and many other relationship and health problems· • Epigenetic changes change DNA and occur with long term exposure to stress· • Once cortisol reaches the hippocampus dendritic spines disintegrate rapidly, affecting	

memory· • Purpose of cortisol release and impacts of sustained cortisol exposure in specific parts of the brain· Cortisol is produced from cholesterol in the adrenal glands· It is released in response to eustress and distress· It is involved in the "fight-or-flight" response and temporary increase in energy production· It creates a biochemical hormone imbalance but if stress is long term and a cortisol response is activated the whole body can be impacted with blood sugar changes, weight gain, immune system suppression, gastrointestinal problems, cardiovascular disease, insomnia, chronic fatigue syndrome, thyroid	

disorders, dementia, and depression· • Chronic stress changes neural networks and brain size· • Neuroplasticity strategies when practiced can lessen the impacts of long term stress·	

GUIDING QUESTIONS *What questions will be asked to support instruction?* *Include both "lesson plan level" questions as well as questions designed to guide students to the essential understanding*		
Pre-Lesson Questions:	**During Lesson Questions:**	**Post Lesson Questions:**

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 4: Stress and Brain
Taba Lesson Model

• What is stress? • What obvious changes in your body are you aware of when you feel stressed? • What is the difference between eustress and distress? • When is stress useful/harmful? • What body systems communicate during the fight-or-flight response? • How are the changes in your body when you feel stressed evidence	• When and where in the brain is cortisol released? • Trace the release of cortisol in the brain· What happens after it is released and what long term affects does cortisol have on the brain and other body systems? • What emotional/physical challenges does exposure to chronic stress cause? • What are epigenetic changes and how do	• What are positive/negative impacts of epigenetic changes? How can we control epigenetic changes? • What are ways we can improve our neural plasticity? • Why do hyper connected circuits and hardened wires in the brain result in excess myelin? • How does chronic stress change neural network connections and brain size? • What are neuroplasticity

that your body is a system?	they impact physical and emotional connections? • How are connections in the body impacted as a result of chronic stress?	strategies and how should they be practiced to create positive change within systems? • How does stress change brain function? • How do connections impact systems?

DIFFERENTIATION

(Describe how the planned learning experience has been modified to meet the needs of gifted learners. Note: Modifications may be in one or more of the areas below. Only provide details for the area(s) that have been differentiated for this lesson.

Content	Process	Product	Learning Environment
Students will use	Students engage in		

the details component of Kaplan's Depth and Complexity Icons to develop vocabulary, defining features and characteristics of specific areas of the brain and how stress impacts and interrupts the connectivity of the systems·	in-depth critical thinking as they must analyze the concept of STRESS through grouping and regrouping· i·e·, the Taba model		

Nurturing Neurons Through Neuroscience -A·Quilliams
Lesson 4: Stress and Brain
Taba Lesson Model

PLANNED LEARNING EXPERIENCES
(What will the teacher input? What will the students be asked to do? For clarity, please provide detailed instructions)

Engage and Connect- *This phase focuses on piquing students' interest and helping them access prior knowledge. This is the introduction to the lesson that motivates or hooks the students.*

Students will begin by watching the introductory TED ED video related to stress and the brain· Students will begin to define effects of stress on the brain while making connections to the areas of the brain which play a role in stress responses, including the release of hormones· Together, students will create a concept map identifying the neurobiological effects and long-term effects of over exposure to stress helping students make connections of how connections impact systems· The concept map will include: Useful Stress/Impacts of Chronic Stress, Importance of Hypothalamus Pituitary Axis and Cortisol, Amygdala, Hippocampus, Epigenetic Changes, Neuroplasticity Strategies to Deal with Stress·
(6 min· minutes)

TED-ED-How Stress Affects the Brain-
https://www·youtube·com/watch?v=WuyPuH9ojCE

Explore - *In this phase, the students have experiences with the concepts and ideas of the lesson. Students are encouraged to work together without direct instruction from the teacher. The teacher acts as a facilitator. Students observe, question, and investigate the concepts to develop fundamental awareness of the nature of the materials and ideas.*

Students will read three articles, after students read the three articles they will be asked to work together to generate a list of ideas and concepts in their

reading related to concept of STRESS· The teacher will compile a list (with a goal of 20 different ideas and concepts) as students generate their ideas related to the concept and their reading·

"Cortisol: Why the Stress Hormone is Public Enemy No·1"
https://www·psychologytoday·com/us/blog/the-athletes-way/201301/cortisol-why-the-stress-hormone-is-public-enemy-no-1
"Chronic Stress Can Damage Brain Structure and Connectivity"-
https://www·psychologytoday·com/us/blog/the-athletes-way/201402/chronic-stress-can-damage-brain-structure-and-connectivity
"How Stress Affects the Brain During Learning
http://www·edudemic·com/stress-affects-brain-learning/

Explain - *Students communicate what they have learned so far and figure out what it means. This phase also provides an opportunity for teachers to directly introduce a concept, process, or skill to guide students toward a deeper understanding.*

Grouping and Labeling

1· Students will be divided into groups of 3-4 and will be provided with two different color sticky notes· Each group of students will work collaboratively to group, highlight or list words and/or phrases which are related to stress as it connects to systems· The teacher

will monitor the progress of each group serving as a facilitator but allowing each group of students to draw their own conclusions· The items from the comprehensive list will be recorded on the same color sticky notes· Students will be given the following criteria:

- Using the additional colored sticky notes, students should create categories in which the items from the comprehensive list should be placed·
- The items from the comprehensive list that were generated together as a whole group should be grouped together with at least three different items in each group·
- Each item from the comprehensive list may only be used once·

2· Once students have completed sorting ideas from the comprehensive list and labeling each grouping, the teacher will ask each group to share how they chose to organize their items and describe their reasoning for each grouping and label· Students will be asked to identify similarities between and among groups related to their organization and labeling of ideas related to STRESS in the two readings provided· (Time will vary depending of discussion)·

Elaborate —*Allow students to use their new knowledge and continue to explore its implications. At this stage students expand on the concepts they have learned, make connections to other related concepts, and apply their understandings to the world around them in new ways*

Regrouping and Renaming

1· After students share their groupings they will be challenged to formulate new groups for their items using new category names· Students will be given the following criteria for regrouping:

- Items from the collaborative list must can be used again·
- Each group must contain at least for items from the list·
- Categories for all items must be different from categories used or discussed in the previous round of labeling but the concept of STRESS must be the basis of these categories· There should be at least three categories· (Time will vary depending on discussion)·

3· Students will again share how they chose to reorganize their items and describe their reasoning for each grouping and label· Students will be asked to identify similarities between and among groups

related to their organization and labeling of ideas related to STRESS in the two readings provided· Students will be asked to explain how their categories were different from the original sort· (Time will vary depending of discussion)· Students will discover the essential understanding, "Connections impact systems" by making generalizations about the relationship of STRESS and how it connects to the body systems and brain·

Evaluate: *This phase assesses both learning and teaching and can use a wide variety of informal and formal assessment strategies.*

I will lead students through a guided relaxation/imagery simulation to model mindfulness/meditation as a strategy for lessening the long term impacts of stress on the brain and body·
https://www·greenchildmagazine·com/guided-relaxation/
http://www·innerhealthstudio·com/visualization-scripts·html

Students will take their newly learned information about how stress influences brain function/dysfunction thereby having connections impact systems to answer a ticket out the door question and describe how stress changes connections and impacts systems·

Christopher Bergland
The Athlete's Way

Chronic Stress Can Damage Brain Structure and Connectivity

Chronic stress and high levels of cortisol create long-lasting brain changes.

Posted Feb 12, 2014

Neuroscientists have discovered how chronic stress and cortisol can damage the brain. A new study reconfirms the importance of maintaining healthy brain structure and connectivity by reducing chronic stress.

Neuroscientists at the University of California, Berkeley, have found that chronic stress triggers long-term changes in brain structure and function. Their findings might explain why young people who are exposed to chronic stress early in life are prone to mental problems such as anxiety and mood disorders later in life, as well as learning difficulties.

It has long been established that stress-related illnesses, such as post-traumatic stress disorder (PTSD) trigger changes in brain structure, including differences in the volume of gray matter versus white matter, as well as the size and connectivity of the amygdala. However, researchers are just beginning to understand exactly how chronic stress creates long-lasting changes in brain structure, which affect how the brain functions.

In a series of revolutionary experiments, Daniela Kaufer, UC Berkeley associate professor of integrative biology, and her colleagues discovered that chronic stress and elevated levels of cortisol can generate more overproduction of myelin-producing cells and fewer neurons than normal. Kaufer et al. published their findings in the February 11, 2014, issue of the journal Molecular Psychiatry.

Chronic Stress Changes Neural Networks

The "gray matter" of the brain is densely packed with nerve cell bodies and is responsible for the brain's higher functions, such as thinking, computing, and decision-making. But gray matter is only half of the brain matter inside our heads — the other half of brain volume is called white matter.

White matter is comprised of axons, which form a network of fibers that interconnect neurons and create a communications network between brain regions. White matter gets its name from the white, fatty myelin sheath that surrounds the axons and speeds the flow of electrical signals between the neurons and brain regions.

"We studied only one part of the brain, the hippocampus, but our findings could provide insight into how white matter is changing in conditions such as schizophrenia, autism, depression, suicide, ADHD, and PTSD," Kaufer said. The hippocampus regulates memory and emotions, plays a role in various emotional disorders, and has been known to shrink under extended periods of acute stress.

The researchers found that hardening wires may be at the heart of the hyper-connected circuits associated with prolonged stress. This results in an excess of myelin — and too much white matter — in some areas of the brain. Ideally, the brain likes to trim the fat of excess wiring through neural pruning in order to maintain efficiency and streamlined communication within the brain.

Cortisol Can Trigger Stem Cells to Malfunction

Chronic stress has the ability to flip a switch in stem cells that turns them into a type of cell that inhibits connections to the prefrontal cortex, which would improve learning and memory, but lays down durable scaffolding linked to anxiety, depression, and post-traumatic stress disorder.

Kaufer's lab focused on neural stem cells in the hippocampuses of the brains of adult rats under acute or chronic stress. These stem cells were previously thought to mature only into neurons or a type of glial cell called an **astrocyte**.

However, the researchers found that chronic stress made stem cells in the hippocampus mature into another type of glial cell called an **oligodendrocyte**, which produces the myelin that sheaths nerve cells.

This finding suggests a key role for oligodendrocytes in long-term, and perhaps permanent, changes in the brain that could set the stage for later mental problems. Chronic stress decreases the number of stem cells that mature into neurons, which might provide an explanation for how it also affects learning and memory, according to the researchers.

"Usually the brain doesn't make much oligodendrocytes in adulthood from those neural stem cells," according to Kaufer. In fact, a recent study suggested these cells were incapable of producing oligodendrocytes, which are somewhat like a vine spreading out and wrapping around axons, both insulating and supporting them.

Rats who have high levels of cortisol and chronic stress had fewer neurons overall, but a big increase in oligodendrocytes. By blocking the equivalent of cortisol receptors, the researchers discovered that the process was tied to the stress hormone. "This was absolutely not what we were expecting to find," Kaufer said. "But those are always the best discoveries."

Although this sheath is vital to human brains — myelin formation can be good or bad, depending on time or place, according to Kaufer. This excessive sheathing may have evolved to bolster the connection between the amygdala and hippocampus, which would improve fight-or-flight responses during extended periods of threat or attack. Unfortunately, in a modern world, chronic stress can hijack the fight-or-flight system and backfire in a daily life when you are not in physical danger.

Although this study doesn't focus on the benefits of reducing cortisol, other research suggests that making lifestyle choices that reduce stress and lower cortisol can improve brain structure and connectivity.

For five simple ways to lower cortisol without drugs, check out my Psychology Today blog, "Cortisol: Why "The Stress Hormone" Is Public Enemy No. 1."

Daniela Kaufer is now conducting experiments to determine how stress in infancy affects the brain's white matter, and whether chronic early-life stress decreases resilience later in life. She also is looking at the effects of therapies ranging from exercise to antidepressant drugs, which reduce the impact of stress and stress hormones.

Kaufer concludes that moderate or "good stress" — such as studying hard for an exam or training to compete in the Olympic Games — can build stronger circuitry and a more resilient brain. But acute, prolonged chronic stress wreaks havoc. "You're creating a brain that's either resilient or very vulnerable to mental disease, based on the patterning of white matter you get early in life," said Kaufer.

That said, the structure of your brain is constantly undergoing changes through plasticity. Mindset, behavior, and chronic stress are never fixed. The power of neuroplasticity makes it possible to change your brain structure and function throughout your lifespan. You can consciously make daily choices of mindset and behavior that will improve the structure and connectivity of your brain.

In 2012, Alex Schlegel from Dartmouth College published a study showing that the adult brain can change for the better. "This work is contributing to a new understanding that the brain stays this plastic organ throughout your life, capable of change," Schlegel says.

"This flies in the face of all these traditional views that all structural development happens in infancy, early in childhood," Schlegel says. "Now that we actually do have tools to watch a brain change, we are discovering that in many cases the brain can be just as malleable as an adult as it is when you are a child or an adolescent."

About the Author

Christopher Bergland is a world-class endurance athlete, coach, author, and political activist.

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Cortisol: Why the "Stress Hormone" Is Public Enemy No. 1

5 simple ways to lower your cortisol levels without drugs

Posted Jan 22, 2013

Source: The Digital Artist/Pixabay

The stress hormone, cortisol, is public health enemy number one. Scientists have known for years that elevated cortisol levels: interfere with learning and memory, lower immune function and bone density, increase weight gain, blood pressure, cholesterol, heart disease... The list goes on and on.

Chronic stress and elevated cortisol levels also increase risk for depression, mental illness, and lower life expectancy. This week, two separate studies were published in Science linking elevated cortisol levels as a potential trigger for mental illness and decreased resilience — especially in adolescence.

Cortisol is released in response to fear or stress by the adrenal glands as part of the fight-or-flight mechanism. The fight-or-flight mechanism is part of the general adaptation syndrome defined in 1936 by Canadian biochemist Hans Selye of McGill University in Montreal. He published his revolutionary findings in a simple seventy-four-line article in Nature, in which he defined two types of "stress": eustress (good stress) and distress (bad stress).

Both eustress and distress release cortisol as part of the general adaptation syndrome. Once the alarm to release cortisol has sounded, your body becomes mobilized and ready for action — but there has to be a physical release of fight or flight. Otherwise, cortisol levels build up in the blood, which wreaks havoc on your mind and body.

Eustress creates a "seize-the-day" heightened state of arousal, which is invigorating and often linked with a tangible goal. Cortisol levels return to normal upon completion of the task. Distress, or free-floating anxiety, doesn't provide an outlet for the cortisol and causes the fight-or-flight mechanism to backfire. Ironically, our own biology — which was designed to insure our survival as hunters and gatherers — is sabotaging our bodies and minds in a sedentary digital age. What can we do to defuse this time-bomb?

Luckily, you can make 5 simple lifestyle choices that will reduce stress and anxiety and lower your cortisol levels:

1. Regular Physical Activity: Kickboxing, sparring, or a punching bag are terrific ways to recreate the "fight" response by letting out aggression (without hurting anyone), thus reducing cortisol.

Fear increases cortisol. Regular physical activity will decrease fear by increasing your self-confidence, resilience, and fortitude — which will reduce cortisol. Yoga will have a similar effect, with the added benefits of mindfulness training.

If your schedule is too hectic to squeeze in a continuous session of aerobic activity, you can reap the same benefits by breaking daily activity into smaller doses. An easy way to guarantee regular activity is to build inadvertent activity into your daily routine. Try things such as riding a bike to work, walking to the store, taking the stairs instead of the escalator... These all add up to a cumulative tally of reduced cortisol at the end of the day.

2. Mindfulness and Loving-Kindness Meditation (LKM): Any type of meditation will reduce anxiety and lower cortisol levels. Simply taking a few deep breaths engages the Vagus nerve which triggers a signal within your nervous system to slow heart rate, lower blood pressure, and decrease cortisol. The next time you feel yourself in a stressful situation that activates your "fight-or-flight" response, take 10 deep breaths, and feel your entire body relax and decompress.

Setting aside 10 to 15 minutes to practice mindfulness or meditation will fortify a sense of calm throughout your nervous system, mind, and brain. There are many different types of meditation. "Meditating" doesn't have to be a sacred or new-agey, "woo-woo" experience. People often ask me specifically what kind of meditation I do and how to practice "Loving-Kindness Meditation" (LKM). I am not an expert on this, but have developed a technique that works for me. I suggest that you do more research, visit a meditation center if you can, and fine-tune a daily meditation practice that fits your schedule and personality. Below is my daily meditation routine:

Example of Mindfulness and Loving-Kindness Meditation (LKM) method.

I like to practice two types of meditation in one 15-minute session. Personally, I like to use a timer and an "Om" or "Aum" track I have on my iTunes. Some purists might call this "sacrilege," but it works for me, and it might work for you....

To begin, I jot down the names of people I know who are struggling or suffering on a notecard. Next, I set my iPhone to a 15-minute countdown that ends in a harp sound. Then, I sit upright in a chair with my legs crossed at the ankles, set the timer, start the Om/Aum track, and sit with my palms open and facing upwards on my knees.

shoulders, and feel myself drift into a trance-like state.

After a few minutes, I move into the Loving-Kindness Meditation (LKM) phase, which has three steps for me. First, I go through the checklist of specific people I know who are struggling, suffering (or frustrating me), and send them love, light, strength, and compassion. Secondly, I move to universal thoughts of loving-kindness for strangers I may have read about in the news or larger populations that are suffering. Thirdly, as part of the LKM phase, I focus on self-compassion and forgive myself for my "trespasses" and ask for atonement.

After I've completed the LKM cycle, I return back to a single-focused meditation, emptying my mind and focusing on my breathing until the alarm goes off. When I hear the harp sound, there is always a Pavlovian-conditioned response of an "ahhh" feeling, accompanied by a big exhale, as I open my eyes and face the real world again.

Remember, you can meditate anytime and any place. There don't have to be strict boundaries to when and how you do it. Mindfulness and meditation is a powerful de-stressor and cortisol reducer that is *always* in your toolbox and at your fingertips. You can squeeze in a few minutes of meditation on the subway, in a waiting room, on a coffee break... I hope this advice is helpful to you.

3. Social Connectivity: Two studies published this week in the journal Science illustrate that social aggression and isolation lead to increased levels of cortisol in mice, which trigger a cascade of potential mental health problems — especially in adolescence.

Researchers at Johns Hopkins established that elevated levels of cortisol in adolescence change the expression of numerous genes linked to mental illness in some people. They found that these changes in young adulthood — which is a critical time for brain development — could cause severe mental illness in those predisposed for it. These findings, reported in the January 2013 journal Science, could have wide-reaching implications in both the prevention and treatment of schizophrenia, severe depression, and other mental illnesses.

Akira Sawa, M.D., Ph.D., a professor of psychiatry and behavioral sciences at the Johns Hopkins University School of Medicine, and his team set out to simulate the social isolation associated with the difficult years of adolescence in human teens. They found that isolating mice known to have a genetic predisposition for mental illness during their adolescence triggered "abnormal behaviors" that continued even when they were returned to the group. They found that the effects of adolescent isolation lasted into the equivalent of mouse adulthood.

"We have discovered a mechanism for how environmental factors, such as stress hormones, can affect the brain's physiology and bring about mental illness," says Sawa, the study leader. "We've shown in mice that stress in adolescence can affect the expression of a gene that codes for a key neurotransmitter related to mental function and psychiatric illness. While many genes are believed to be involved in the development of mental illness, my gut feeling is environmental factors are critically important to the process."

To shed light on how and why some mice got better, Sawa and his team studied the link between cortisol and the release of dopamine. Sawa says the new study suggests that we need to think about better preventative care for teenagers who have mental illness in their families, including efforts to protect them from social

In another study, published on January 18, 2013 in the journal Science, researchers from France revealed that mice who were subjected to aggression by specific mice bred to be "bullies" released cortisol, which triggered a response that led to social aversion to all other mice. The exact cascade of neurobiological changes was complex, but also involved dopamine. The researchers found that if they blocked the cortisol receptors, the bullied mice became more resilient and no longer avoided their fellow creatures.

Close-knit human bonds — whether it be family, friendship, or a romantic partner — are vital for your physical and mental health at any age. Recent studies have shown that the Vagus nerve also responds to human connectivity and physical touch to relax your parasympathetic nervous system.

The "tend-and-befriend" response is the exact opposite to "fight-or-flight." The "tend-and-befriend" response increases oxytocin and reduces cortisol. Make an effort to spend real face-to-face time with loved ones whenever you can, but phone calls and even Facebook can reduce cortisol if they foster a feeling of genuine connectivity.

4. Laughter and Levity: Having fun and laughing reduces cortisol levels. Dr. William Fry is an American psychiatrist who has been studying the benefits of laughter for the past 30 years and has found links to laughter and lowered levels of stress hormones. Many studies have shown the benefits of having a sense of humor, laughter, and levity. Try to find ways in your daily life to laugh and joke as much as possible, and you'll lower cortisol levels.

5. Music: Listening to music that you love, and fits whatever mood you're in, has been shown to lower cortisol levels. I recently wrote about the wide range of benefits that come from listening to music in a Psychology Today blog titled "***The Neuroscience of Music, Mindset, and Motivation***." We all know the power of music to improve mood and reduce stress. Add reducing your cortisol levels as another reason to keep the music playing as a soundtrack of health and happiness in your life.

Conclusion

President Obama's second inaugural speech brought up many calls to action that can be framed through the lens of "Cortisol as Public Health Enemy Number One." The ripple effect of a fearful, isolated, and stressed-out society increases cortisol levels across the board for Americans of all ages. This creates a public health crisis and a huge drain on our economy.

If each of us works alone, and together, to reduce cortisol levels, we will all benefit. As citizens, if we live like we are "***All for one, and one for all,***" we can reduce the amount of stress hormone in our society and individual lives.

Feeling socially connected, safe, and self-reliant reduces cortisol. I hope the 5 tips presented above will help you make lifestyle choices that reduce your levels of stress hormone.

Lastly, in light of the Sandy Hook tragedy last month, we are all looking for components to a multi-pronged approach that will stop the violence and bloodshed. In my opinion, one specific way for us to do this is to create public health policies and funding aimed specifically at reducing cortisol levels in American youth.

In Obama's inauguration speech, he declared, "Our journey is not complete until all of our children, from the streets of Detroit, to the hills of Appalachia, to the quiet lanes of Newtown, know that they are cared for, and cherished, and always safe from harm." Beyond talk of gun violence legislation, if our legislators and business leaders strive to create policies and fund initiatives that create social connectivity among at-risk teens and reduce bullying, they will be reducing cortisol levels in our young people. This will make them mentally and physically healthier, more resilient, and less likely to be violent.

How Stress Affects the Brain During Learning

By Leah Levy on October 13, 2014 *@LeahAnneLevy*

A fight or flight reaction may be useful in some situations, but it is highly detrimental in the classroom. Whether anxiety stems from test taking or from an unstable home environment, the brains of students experiencing high levels of stress look different than those who are not — and those brains behave differently, too. In this article, we'll take a look at the neural and hormonal responses that underpin a student's stress response, and make a few suggestions for continuing to teach through the challenges it presents.

What Happens to the Brain During a Stress Response

The body and the brain respond to stress with a complex cascade of hormones and neurotransmitters. When a child's senses perceive danger, their hypothalamic-pituitary-adrenal (HPA) system releases steroid hormones (glucocorticoids). This includes the primary stress hormone, cortisol, which has a direct effect on the heart, lungs, circulation, metabolism, immune system and skin. The HPA also stimulates the release of catecholamine neurotransmitters like dopamine, norepinephrine and epinephrine (adrenaline), which activates the amygdala, which in turn triggers a fearful response. The brain then releases neuropeptide S, which increases alertness and feelings of anxiety.

How Stress Inhibits a Brain's Ability to Learn

Together, the HPA system will keep a child's stimulated and ready to run. But while this may be good for truly life or death situations, this stress response makes learning difficult, as the stimulated senses are not those associated with deep learning. Think about it this way: would you be able to memorize the times tables when you were being chased by a bear? Of course not. But while this may be obvious, the reasons why this is the case is more complex than you might expect.

The Hippocampus and Memory Storage

In the short term, acute stress prevents memory storage. According to a 2008 study by University of California Irvine researchers, when cortisol reaches the hippocampus, the brain's primary structure for consolidating information from short term into long term memory, the structure's dendritic spines disintegrate rapidly. That's important, because dendritic spines are the protrusions that branch off of neurons. Learning and memory storage happens effectively when neurons are repeatedly activated across their synapses — a process that effectively tells the brain that a stimulus, behavior or habit is important to retain. When dendritic spines degrade, the brain's ability to identify and store important information is significantly inhibited.

The Prefrontal Cortex and Executive Function

Fortunately, dendritic spines can grow back (though in the long term, their loss may actually shrink the hippocampus). However, as the team at This American Life explored in their comprehensive 2012 episode, Back to School, when a child experiences prolonged stress, their brain repeats the same responses again and again, thus strengthening the neural pathways that control the stress

and fear responses. In essence, the brain is learning to stay stressed or to escalate to a stress response quickly. This is like any type of learning; for example, a brain that is repeatedly taught to add 2 plus 2 will go from a convoluted to a more streamlined and finally an instant thought process.

And it's not just that this heightened stress reaction is a problem in itself; it's that it short circuits other neural pathways in the prefrontal cortex. Specifically, executive functions like self-control, impulse control, memory, and reasoning — skills that are essential to successful learning. Some studies indicate that cortisol even has the ability to flip a switch in stem cells so that they actively will inhibit the forming of new connections in the prefrontal cortex, while hardening pathways that run between the amygdala and the hippocampus.

Identifying At-Risk Youth

Both acute and chronic stress are bad for students of any age, but the effects are particularly dangerous in early development. As the This American Life episode explores in-depth, students that live below the poverty line, are the victims of neglect or abuse, or have a parent with a history of mental illness or substance abuse are far more likely to struggle with attention and self-control. Of course, nothing is certain, and it is possible for, say, an impoverished student with present parents to thrive. But each one of these factors does indicate a significant risk and the need for early interventions.

What Educators Can Do

Teach Grit

According to economist and Nobel Laureate James Heckman, who was interviewed for the This American Life episode, cognitive skills are set around age 10. However:

"Social skills, personality traits, the ability to stay on task– these can be taught. And these can be taught at later ages. And there's a malleability there that actually offers a new perspective on social policy– how social policy might redirect itself towards those more malleable soft skills."

If you're tapped into education circles, this should remind you of two trendy buzzwords du jour: resilience and grit. Indeed, rewiring the brain, just like persevering through skill mastery, requires determination, continual effort and pushing through perceived failures. As we discussed recently in our article on this subject, educators can teach this skill by creating lesson plans on grit and exploring the concept explicitly. However, for the most at-risk youth, individual coaching outside of the classroom will prove most effective, both in terms of teaching grit directly and for teaching subject specific concepts.

Reduce Anxiety in the Classroom

There are numerous actions teachers can take to reduce anxiety in the classroom. These include:

1. Designating a safe place for at-risk children. Outside of mentoring, tutoring, and coaching, children should have a designated safe adult in the classroom, whether that's the classroom teacher, the school psychologist or the school nurse. This person should be a calming and empathetic presence, equipped with coping strategies individualized to the given student.
2. Encourage self-awareness. In addition to discussing grit, it can also be useful to develop a lesson plan that explores the physical symptoms of stress and anxiety so that students can recognize the signs in themselves and fellow students and offer a helping hand.
3. Teach time management. Students will have less stress in their lives when they feel organized and like they are on top of their assignments. This is especially important if you also opt to provide flexible due dates in, say, the form of packets that can be completed as students go. Combined, these two strategies will keep students motivated and on top of their work without feeling anxiety about due dates.
4. Give As for effort. Or if not an A, then at least make sure you're adding extra points in for a nice, determined effort, even when the ultimate answer is wrong. This will encourage students to take risks and persevere, rather than feeling like they'll only "win" if they're perfect.
5. Teach mindfulness and meditation. Today's schooling system puts a heavy emphasis on outcome-based learning, but just as important is staying in touch with one's emotions.

Setting aside time to, for example, have students meditate before starting an exam, will not only help reduce anxiety in the present, but will also teach coping strategies for the long term.

6. Provide exemptions for especially anxiety-inducing activities. To a shy student, answering a question on the board or reading in front of their classmates may be an insurmountable task. It may be an unnecessary one too, as long as they are still participating socially with other students in some way and progressing at grade level in a one-on-one setting.

How Do You Reduce Anxiety in the Classroom?

If we ever want to close the achievement gap, understanding the effects of stress on the brain is of the utmost importance. Let us know your best anxiety reducing strategies in the comments below or on Twitter through @edudemic!

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5 COMMENTS

Tris25
October 18, 2014 at 5:19 pm

Great article but you are leaving out the genetic predisposition inherent in students with ADHD/ADD and LD–lower dopamine and serotonin levels to begin with. Also, these students develop "stress responses" inside the classroom itself. It would be wonderful if you could explore how teachers could help prevent these stress responses from being created in the early years. Many teachers ridicule kids who don't hear directions clearly or miss assignments due to attention/difficulty processing. Many kids with LD live in fear that they will miss something, do something wrong — this stress compounds their learning comprehension in school and makes their problems worse. By the time these kids reach high school, they are at high risk for developing insomnia, depression/anxiety disorders, addictions that ease their anxieties, self-harming and rebelious behavior. It is important for teachers to be knowledgble about learning disabilities so that they do not contribute to wiring these stress responses in a child's brain.

Leah Levy
October 20, 2014 at 7:22 pm

Great point! Having worked closely with LD-students one-on-one for years, I've seen what you describe all too often. Learning disabilities are a big and important topic, and one we hope to cover soon. Thanks for your comment!

Kashya
October 25, 2014 at 9:38 am

ADHD is a concern (I have it) but they're are also kids who have other learning challenges, including stressful or traumatic home lives and these kids often get lumped into the ADHD label because the symptoms are so similar.

This calming color relaxation script allows you to relax with visualization by imagining each color of the rainbow. A rainbow consists of red, orange, yellow, green, blue, and violet... and this relaxation script will describe each color to allow you to relax by mediating on the colors.

Visualization can be particularly effective to relax because it allows you to focus your mind on an imagined image. This focus is key to meditation and relaxation in general.

Begin reading the calming color relaxation script here:

To begin, make yourself comfortable. Adjust your clothing as needed and assume a comfortable position.

First, before the calming color relaxation begins, notice how your body feels in this moment.

Passively pay attention to the state of your body right now. Do not try to change anything, simply notice how your body and mind feel.

Feel your body begin to relax slightly, as your shoulders drop a little lower.... your jaw loosens so your teeth are not touching.... and your eyelids start to feel heavy.

Take a deep breath in.... hold it.... and slowly breathe out....

Now just notice your breathing. Your body knows how much air you need. Notice with interest how your breath goes in and out. Feel the pause after you inhale and before you exhale.... and the pause before drawing another breath.

Allow your body to relax and your mind to focus on the calming color relaxation.

Allow the relaxation to occur naturally.... allow and observe....

Imagine red of all shades....

You might picture red objects, a red landscape, or just a solid color.....

Imagine all of the different tones of red.... roses.... bricks.... apples....sunset....

Enjoy the color red.

Now allow the color you are imagining to change to orange. Picture the color orange.... infinite shades of orange.... flowers.... pumpkins .... carrots....

Fill the entire visual field of your mind's eye with the color orange.

Enjoy the color orange.

Visualize the color yellow. See in your imagination all the various shades of yellow. Allow yellow to fill your vision.... lemons.... flowers..... fall leaves...

Imagine the endless tones of the color yellow. Imagine yourself surrounded with the calming color yellow..... Immerse yourself....

Enjoy the color yellow.

Let the color you are imagining become green. Fill your imagination with the color green. Endless shades and tones of green.... plants.... leaves.... grass....

Imagine being surrounded by beautiful green..... all shades from the lightest to the darkest, bright green.... subdued green...

Enjoy green.

Now see in your mind the color blue. Surround yourself with beautiful blue.... Unending shades of blue..... water....sky....

Imagine blue filling your vision.....

Enjoy the color blue.

Allow the color in your imagination to become violet..... Focus on the multitude of purples around you.... flowers....eggplant....sunrise....

Immerse yourself in the color violet....

Enjoy violet.

Now allow your attention to return to your breathing..... notice how calm and regular your breathing is now.....

Meditate on the calming color relaxation once more....

Imagine the colors again, one at a time.... starting with red....

Orange....

Yellow....

Green.....

Blue.....

Violet.....

Enjoy the feeling of relaxation you are experiencing.....

Now it is time to return your attention to your regular activities.....

Become more alert with each breath you take....

More aware of your surroundings....

Stretch your muscles.... and open your eyes. Fully alert and calm.

Check out the **Relaxation Downloads** page for free audio downloads

Return from Calming Color Relaxation to **Relaxation Scripts**

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Back to Inner Health Studio Home

New! Comments

Have your say about what you just read! Leave me a comment in the box below.

Guided Relaxation: You Are Loved

Last updated on December 26, 2017 By Mellisa Dormoy — Leave a Comment

This nighttime meditation takes your child on a journey to feel all the love inside of him and to recognize how very much he is loved.

Use this script right before bed, while your child is relaxing. Speak the words gently, and use expression in your voice. Relax yourself a bit before reading to create the perfect atmosphere of calm and serenity.

These peaceful guided relaxation scripts are written by Mellisa Dormoy of ShambalaKids. Her guided relaxation audios help children and teens relieve stress and anxiety, improve self-esteem, feel fantastic in mind, body and spirit and develop a positive mental attitude at school and at home.

Free Guided Relaxation "You Are Loved"

Take in a deep breath, and when you let it out, feel everything around you getting calmer and quieter. Take in another long breath, release it slowly, and feel even calmer still.

As you continue to breathe deeply and calmly, notice that the only thing you want to pay attention to is my soothing voice.

Now imagine in front of you, a movie screen. On the screen, you see images from your own life.

You see every time when you did something kind for someone. You also see every time someone did something nice for you.

As you watch the movie, you see how happy you've made other people, and you see all the happy times that you've had as well.

As you continue to watch this movie, you see a time when you helped somebody who needed you. You see how happy it made them.

Just this thought makes you feel warm and fuzzy inside. Now switch to a time when someone helped you. Think how good you felt to know that someone was there for you.

Feel all those wonderful good feelings come rushing back to your heart! Watch these beautiful moments of your life. Remember how happy you were and how wonderful you felt!

All these happy feelings – all those times you felt warm and fuzzy – were because of a very special feeling: ***love!***

These things you see in front of you happened because you loved and showed that love to someone else, and because they love you.

Love is about taking care of other people, doing nice things, expressing your gratitude and showing kindness and patience. Inside of us, we are all really that – simply LOVE!

That's really who we are! When we can express this part of ourselves every day, as much as possible… our hearts are filled up with joy and such satisfaction that sometimes we feel we might burst from pure happiness!

And that happy love feeling means that you're a part of a community of people, a very important part of a very loving universe!

I want you to remember all this love you have inside of you and how easily you can express your love with simply acts of kindness towards yourself and others. You are truly wonderful. You are pure love!

Notice how the love feels like a soft, fuzzy blanket wrapped all around you. It makes you feel warm and peaceful and happy.

Now take in a nice deep breath and exhale slowly. Continue to feel all the wonderful feelings of love and gentleness as you snuggle in for sleep tonight.

Sweet dreams!

About | Latest Posts

Mellisa Dormoy

Founder of ShambalaKids, Mellisa Dormoy is on a mission to teach self esteem, stress management and goal attainment to children everywhere. She's the author of Guided

Free Guided Relaxation "Shine Your Light"

Notice your body relax instantly and easily. Allow your body to sink down in your bed further and further, as your muscles become soft and limp. It feels so comfortable.

Your body just seems to relax more and more with each and every word you hear.

Imagine now a small sparkle somewhere deep inside your heart. This small sparkle begins to glow brighter now, and you feel it reaching up and expanding out.

The glow becomes brighter and brighter filling up your chest. You feel the warmth spreading out touching your tummy, your shoulders…. getting bigger and bigger…. getting brighter and brighter, glowing all the way down to your toes.

Now feel your whole body glowing like a radiant star shining out. This wonderful light is your light – your shining light – your personal brilliance. It is all the love in your heart. It is the sum of your possibilities – and your possibilities are endless.

Shine your light wherever you go. Sharing your light makes others happy, and it makes you happy as well. It's a wonderful feeling to share your light, and by doing so, you become a good example to them.

When you shine your light brightly, it lets others know that it is okay for them to shine their light brightly too. When we all do this, it makes the world a more beautiful, peaceful place.

Sharing your light can be as simple as sharing your smile, or doing a kind deed. Hold a happy thought about someone, or send a happy wish to someone who is feeling sad. It can mean helping someone who is younger than you, or not as strong as you.

All of this is shining your light, and you will discover a wonderful warm, fuzzy feeling inside your heart when you do this.

This wonderful feeling comes from doing what you were created to do – feeling and spreading love

Now, allow that bright light inside to become like a gentle shower of fireworks.

See how beautiful and amazing you are?

You light up the sky!

As the fireworks sizzle and flare down, imagine your brilliant light touching the heart of every person you know and will meet. They feel happier just because they know you. How wonderful and blessed life is!

Now take in a deep breath and bring back all the good feelings you have right now with you as you slowly stretch your body. Open your eyes when you're ready. You've done an amazing job!

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Mellisa Dormoy

Founder of ShambalaKids, Mellisa Dormoy is on a mission to teach self esteem, stress management and goal attainment to children everywhere. She's the author of Guided Imagery Work with Kids, for teachers and professionals and Imagine That!, a guided imagery storybook for children.

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Other-Models

Cross Section of Brain Model-Learning Resources

Cross Section of Eye Model-Learning Resources

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