COLUMBIA | Zuckerman Institute

BRAIN STEM | Bringing Neuroscience to the Classroom

The Effect of Stroke on the Brain and Body

Supported by: ΙΣΝ SNF ΙΔΡΥΜΑ ΣΤΑΥΡΟΣ ΝΙΑΡΧΟΣ STAVROS NIARCHOS FOUNDATION

The Effect of Stroke on the Brain and Body

Students learn how a stroke can affect the brain and body, how to present a case study and reach a diagnosis.

Suggested duration

- 4 x 45 min class periods

Essential questions

- What do different brain structures do?
- How can they be affected by stroke?
- How do doctors synthesize a diagnosis?

Objectives

All students will...

- Be able to understand different brain structures and regions
- Understand the functions that different brain structures have
- Recall types of stroke and their causes
- Apply knowledge of structures/regions and types of stroke to create a case study of stroke
- Synthesize a diagnosis based on presented clinical and visual evidence

Materials

- Projector
- Whiteboard

Supplementary materials

- Stroke slides
- The Brain Attack worksheet 1
- The Brain Attack worksheet 2
- Stroke index cards
- Stroke activity cards

Based on

The Stavros Niarchos Brain Insight Lecture, “Can Children Save the Lives of Their Parents in the Throes of Stroke?” By Olajide Williams, MD

https://www.youtube.com/watch?v=_O08ZSg0zFQ&t=2470sI

MINI-UNIT OVERVIEW

- **Class 1:** 1) Identify key brain structures, brain regions, and associated functions; 2) Visualize the location of brain structures and regions.
- **Class 2:** Identify the signs and symptoms of strokes and the types of strokes.
- **Class 3:** 1) Apply knowledge of the brain to identifying affected brain areas/structures in a stroke patient, 2) Compose a case study using Google Slides.
- **Class 4:** Present a case study and collaborate to reach a diagnosis.

Background Information

Prior knowledge needed

- Understanding of the parts of the neuron.
- Know the basics of how action potentials work.
- The Hebbian Synapse Theory.
- Class 1 will serve as the prerequisite knowledge for Class 2 (and so forth for the following lessons).

From the Mayo Clinic:

"A stroke occurs when the blood supply to part of your brain is interrupted or reduced, depriving brain tissue of oxygen and nutrients. Within minutes, brain cells begin to die. A stroke is a medical emergency. Prompt treatment is crucial. Early action can minimize brain damage and potential complications. The good news is that strokes can be treated and prevented, and many fewer Americans die of stroke now than in the past."

Instructional Activities

Class 1

1. Do Now/Introduction | 10min

Explain

Tell students, "Previously, we learned about the building blocks of the central nervous system: the neuron. You learned how they fire and how they wire. Today we put this all together: we will be learning about brain. By the end of the period, you will understand the key structures and areas of the brain and their associated functions."

Aim: What makes you "you"?

- Give students the prompt, "What makes you you?"
- Students collaborate to complete a mind map using the prompt.
- Students share the class mind-map. Responses should include, "I think/ thinking/ thought", "feelings", "I am able to do things", "memories", "emotions", etc.
- Students bullet the teacher's stated lesson objectives.

2. Mini-lesson | 5min

Active teaching/ modeling/ "I do"

- Draw a stick figure and while speaking draw the following: a liver, a heart, and a brain in their approximate locations: "The ancients argued that the seat of emotions lay in the liver; in essence does your liver define who you are? Others argued that the heart was the central focus of emotion and feeling, a seat for the soul. Now, scientists are convinced that the brain is the foundation of everything about you. What is the best argument

you can give to debunk the beliefs of the ancients?"

- Demonstrate for the students as you go:
  - Think aloud
  - Provide model and/or rubric for them to follow

Guided practice/ "we do"

- Students brainstorm a response.
- With teacher feedback, the class usually settles on the fact that the heart and liver can be replaced or transplanted, but the brain cannot.

3. Student Work Time | 30min

- Demonstrate how to draw the brain cortex and lobes ("It's like a big lima bean) including the frontal, parietal, occipital, and temporal lobes, motor and sensory cortex, Broca's and Wernicke's areas.
- For each of these areas, provide a quick story: frontal lobe damage = personality change, loss of inhibition, parietal lobe damage = visual neglect and anosognosia, temporal lobe damage = memory problems, and the story behind Paul Broca and Carl Wernicke.
- Then include the brainstem through the thalamus, including the hypothalamus, cerebellum, limbic system and their functions.
- Students copy the brain diagram and associated functions
- Review student work for accuracy.

4. Closing | 5min

- Bring up the case of Phineas Gage, reenacting the events leading up to his injury and diagramming the skull and location of the iron spike. Ask students to predict the effects of this injury on Gage.
- Record the students' predictions and have them write down the predictions.
- Conclude Class 1 by saying "The key point here is that you are applying your knowledge of how the brain works to situations where something bad happens to this vital organ. By knowing the functions of each structure, you can predict the effects of brain injuries
- Students copy the diagram of Gage's skull and the spike, identify the areas that were most likely affected, and predict the effects of the brain trauma.

For differentiation

- Provide printed notes for those with accommodations.

Feedback opportunities

- Directly to students on their diagrams and predictions.

EXTENSION/HOMEWORK

- Students look up the case of Phineas Gage and compare the actual changes he experienced to their predicted changes.

TYPES OF ASSESSMENTS:

Collect student homework and the diagram of Phineas Gage's skull.

Class2

1. Do Now/Introduction | 5min

Aim: How do I know when the brain is under attack?

Explain

Tell students, “Previously, we learned about the different structures and regions of the brain and their functions. It’s amazing how everything about you from your thoughts to your feelings plays out in a symphony of processes. We also learned how delicate these processes are and how major changes can result from brain injuries. Today we put this all together: we will be learning about one type of brain injury: strokes. By the end of the period, you will understand how strokes happen, the types of strokes that exist, and most important: the warning signs and what to do if you see those signs.”

- Facilitate a discussion of Phineas Gage’s accident.
- Call on students to share how their predictions of the effects of Phineas Gage’s injury compared to the actual effects.
- Have students identify the structures that were affected and the consequences
- Students bullet the teacher’s stated lesson objectives.

2. Mini-lesson | 5min

Active teaching/ modeling/ “I do”

Show students this video: "What is a Stroke?"

Guided practice/ “we do”

- Task students with taking notes from the perspective (randomly assigned) of:
  - A doctor
  - A first-responder (EMT)
  - A concerned family member
- Students brainstorm what information would each find the most important? Doctor (causes, treatments), EMT (time window), concerned family member (warning signs, outcomes).
- Students then take notes following that perspective.

3. Student Work Time | 30min

- In groups (doctor, EMT, family member), students share their information, summarizing the following based on their collected information:
  - The causes of stroke
  - The types of stroke
  - How strokes are treated
- Students build a class mind map on the board.
- Students use their mind map to identify the signs of stroke.
- Students build on the mind map, expanding it to include the need to incorporate mass communication (YouTube, Twitter, social media) and an appealing medium of messaging (music, cartooning, catch-phrases) and an easy-to-remember message.
- Facilitate sharing of information between students.
- Tell students, "We will now watch a person who is experiencing a light stroke. She recorded herself as the stroke occurred. What signs do you notice?”

Show students this video of a stroke happening in real time.

- Ask students to adopt the mindset of a public health official. For a condition so deadly, how can you reach a lot of people with an easy-to-remember message?

Feedback opportunities

- Directly to students on their mind maps and proposals.

EXTENSION/HOMEWORK

- Students brainstorm their own means of social outreach.
- Using the mind maps created in class, how would they incorporate the BE FAST model into contemporary media?
- How would they inform the public of when their or a loved one's brain is under attack?

TYPES OF ASSESSMENTS:

Collect student homework.

Class 3

1. Do Now/Introduction | 5min

Aim: How can different brain stuctures be affected by stroke?

Explain

Tell students, "Previously, we learned about the different structures and regions of the brain and their functions. We also learned about one type of brain injury: strokes. We learned how strokes happen, the types of strokes that exist, and most importantly: the warning signs and what to do if you see those signs. However, many people unfortunately do not receive the care they need, resulting in long term disabilities."

- Have students share their proposals from their homework.

2. Mini-lesson | 5min

Do now

- Ask students to recreate a model of the brain.

Guided practice/ "we do"

- Students draw the brain and major structures.

3. Student Work Time | 30min

Use Brain Attack worksheet 1

Use index cards of brain structures and stroke signs and symptoms

Use stroke activity cards

- Tell students, "You will be creating patient case studies of individuals whose strokes went untreated. These patients will have arrived at the hospital and been appraised with a head CT scan. work in groups."
- Give each group an activity card labelled S#. Have them select structures from the index cards that match the stroke signs and symptoms.
- Give each group an activity card labelled A#. Have them select signs and symptoms from the index cards that they would expect to see with a stroke in that region.

Differentiation

- Have advanced students draw a diagram of the affected structure/s in each case.

4. Closing | 10min

- Say to students, “Take a picture of your work and send it to my email. Tonight, I will share with you a class Google slide deck including all your work. Download the file and next to your image, write the signs and symptoms you identified. Be ready to present in the next class.”

Share your own slides with students

- Teacher models a sample presentation including image and signs/ symptoms, clearly identifying the desired format of presentation:
  - Accuracy of signs/ symptoms
  - Thoroughness of the presentation
- Students share their work with the teacher.
- Students use the teacher’s presentation as a model for their own presentations.

For differentiation

- Provide printed notes for those with accommodations.

Feedback opportunities

- Directly to students on their diagrams and signs and symptoms.

EXTENSION/HOMEWORK

- Students upload a picture of their brain image and download the class Google Slides
- They then include an overview of the signs and symptoms exhibited by their patient.

TYPES OF ASSESSMENTS:

Assess the quality of the students’ diagrams and signs and symptoms.

Class 4

1. Do Now/Introduction | 5min

Explain

Tell students, “Up to this point, we’ve learned the major structures of the brain and their functions. We’ve learned about the terrible destructive potential of strokes and the warning signs that a stroke is occurring. Today, you’re going to be the doctor. Patients have reached your hospital with signs and symptoms and a CT scan has been performed. You will identify what you see, and based on these signs and symptoms, you will identify which brain structures have been compromised, the type of stroke that has occurred, and what additional steps should be taken.”

- Give students time to prepare for their presentations.

Have students make a copy of class slides for their group to use.

2. Mini-lesson | 5min

Active teaching/ modeling/ “I do”

- Present another sample “patient” with signs and symptoms and associated brain diagram.

Guided practice/ “we do”

- Students identify the affected structures, the type of stroke, and the appropriate intervention.

3. Student Work Time | 30min

Use Brain Attack worksheet 2

- Facilitate group presentations.
- Students present their patient “cases,” outlining the signs and symptoms and presenting their brain diagram (“the brain scan”). Each student follows along using their own individual group slides file, identifying the structures that have been affected and the type of stroke.
- At the end of each presentation, the class collaborates, deciding which structures were affected, the type of stroke, and the appropriate follow-up interventions. After a class consensus is reached, the presenting group shares its own conclusions.
- Moderate a discussion between the presenter group and the class groups. Have them compare their conclusions (areas affected, type of stroke, intervention). Acknowledge the thinking behind a diagnosis as opposed to a simple “right/wrong answer” approach.
- Groups update their case study file with the final class consensus information.

4. Closing | 10min

Use Stroke slides.

- Share a series of real brain scans of stroke patients.
- Students practice diagnosing the type of stroke.

For differentiation

- Provide printed notes for those with accommodations.

Standards

NEXT GENERATION SCIENCE STANDARDS (NGSS)	Practice 2. Developing and Using Models
	Practice 8. Obtaining, Evaluating, and Communicating Information
CONTENT SPECIFIC CURRICULUM STANDARDS	HS-LS1-2
COMMON CORE STATE STANDARDS	CCSS.ELA-LITERACY.11-12.9
	CCSS.ELA-LITERACY.11-12.7
CAREER DEVELOPMENT AND OCCUPATIONAL STUDIES	CDOS.3a.BASIC.1-Commencement
	CDOS.3a.BASIC.2-Commencement
	CDOS.3.a.BASIC.4-Commencement
	CDOS.3.a.BASIC.4-Commencement
	CDOS.3.b.ARTS/HUMANITIES.2-Commencement

Vocabulary

Amnesia	Memory loss or inability to form new memories.
Anhedonia	Loss of ability to experience pleasure.
Anosognosia	A deficit of self-awareness, in whcih a person isn't aware that they have a disability.
Bradykinesia	Slowness of movement.
Unilateral visual neglect	Condition in which the patient does not attend to one side of visual space. Often caused by a lesion in right parietal cortex.

Sources

The Stavros Niarchos Brain Insight Lecture, “Can Children Save the Lives of Their Parents in the Throes of Stroke?” By Olajide Williams, MD

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