The Nervous System and Mindfulness

Companion Lesson to X-STEM All Access Episode "Exploring Our Minds"

Grade/ Grade Band: 6-12	**Topic:** Neuroscience	

Brief Lesson Description: Dr. Kaye Tye is a neuroscientist who researches social isolation in order to treat and prevent the negative consequences associated with it. In this lesson, students will examine the part of the brain that regulates emotions and memories before designing their own investigations on the limbic system and investigate the relationships between the nervous system and other body systems and the connection between mindfulness and mood.

Performance Expectation(s):
NGSS MS-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells

Specific Learning Outcomes:
1. Describe the relationship between the nervous system and other body systems
2. Design and carry out an investigation

Narrative / Background Information

Prior Student Knowledge:
Students should know and understand how the human body systems are structured and their functions .

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. (MS-LS1-1)	Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS1-8)

Possible Preconceptions/Misconceptions:
Students believe that the human body systems operate in isolation from each other, however the systems work together to keep you alive.

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions: In a think-pair-share: ask students if they have ever faked a smile, why they did it, and did they think the other person knew the smile was a fake one? Students can use personal devices or laptops to complete the **SMILE Test** **(10 mins)**. While completing the test, have students record their responses on a sheet of paper to assess their performance.

Debrief the results by asking how many students correctly identified 10 or more smiles- use the method of hands up if you correctly identified 10 smiles, keep them up if you identified 11 correctly and repeat until the number drops to less than ¼ of students. Then have students discuss how they determined if a smile was genuine or fake?

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions: Students will watch **Exploring Our Minds- Neuroscientist Dr. Kay Tye** video focusing on what Dr. Tye does, how it benefits the world and the questions asked by students, particularly Andres' and Jennifer's questions**.** Students can record notes in their notebooks, on post-its, or use the back channeling tool in Google Classroom, the Stream feature that allows students to chat in real-time.

After the video, students brainstorm a list of questions based on Dr. Tye's work and/or problems that could be solved using her research.

EXPLAIN: Concepts Explained and Vocabulary Defined:

Discuss the structures and functions of the limbic system and the structures within the brain that deal with emotions and memory. Begin with a quick review of the nervous system by asking students, in teams of 4, to create **chain notes**, beginning with one student responding to the question: "what is the purpose of the nervous system", and pass the note to the next student to add their response. This will help the teacher gauge students' prior knowledge and understanding of the nervous system. Have students do a value-added share before discussing the key points below; students may know more than anticipated.

Key Points:

1. Nervous system is responsible for receiving and processing information from the external environment of an organism. Through the nervous system, the organism is enabled to respond to these external factors accordingly.
   The nervous system is composed of the following parts:
   a. Central Nervous System (CNS)- serves as the main processing center for the entire nervous system. It consists of two main components, namely the:
      i. Brain- This is an organ located within the skull that functions as organizer and distributor of information for the body. It has three main parts:
         1. Cerebrum- large, upper part of the brain that controls activity and thought.
         2. Cerebellum- the part under the cerebrum that controls posture, balance, and coordination.
         3. Brain Stem- the part that connects the brain to the spinal cord and controls automatic functions such as breathing, digestion, heart rate, and blood pressure.
      ii. Spinal Cord- This serves as a channel for signals between the brain and the rest of the body, and controls simple musculoskeletal reflexes without input from the brain.
   b. Peripheral Nervous System (PNS)- connects the central nervous system to the organs and limbs. It has two main divisions:
      i. Somatic Nervous System- This system is associated with the voluntary control of body movements
      ii. Autonomic Nervous System- This system is associated with the involuntary control of body movements

Dr. Kay's research on feeling and emotions looks at specific structures in the limbic system. Let's take a closer look at this system within the nervous system:

2. **The Limbic System- a collection of structures involved in processing emotion and memory located within the cerebrum. It consists of the following structures:**
   a. **Hippocampus-** This complex structure plays a major role in learning and memory and contributes to regulation of motivation and emotion
   b. **Amygdala-** This structure is responsible for formation and storage of memories associated with emotional events
   c. **Hypothalamus-** This structure has multiple functions including being responsible for certain metabolic processes in the autonomic nervous system (i.e. body temperature, heart rate, hunger, sleep) and it can regulate many bodily functions by synthesizing hormones
   d. **Thalamus-**This structure is a major hub for information traveling between the spinal cord and cerebrum It relays sensory signals to the cerebral cortex and motor signals to the spinal cord. It is also involved in the regulation of consciousness, sleep, and alertness

Lead a discussion asking students why they think the body uses the same structures to regulate both memory and emotions, how and why other systems (i.e. endocrine, cardiorespiratory, musculoskeletal) are connected to the system that processes emotions and memory, and why and how mental illnesses affects other parts of the body and not just the brain (i.e. anxiety causing stomach pains or heart palpitations).

Vocabulary: limbic system, hippocampus, amygdala, hypothalamus, thalamus

ELABORATE: Applications and Extensions: In 2020, a study from the University of South Australia confirmed that the act of smiling can trick your mind into happiness, simply by how you move your facial muscles. Neuroscientists have also shown that practicing mindfulness affects brain areas related to perception, body awareness, pain tolerance, emotion regulation, introspection, complex thinking, and sense of self. While you are not recreating the study, students are going to create mindfulness activities/brain breaks and test them to see if they can improve how their mood and their body feels.

Resources:
Mindfulness Can Literally Change Your Brain
10 Mindfulness Practices
25 Fun Mindfulness Activities for Children and Teens
Top Mindfulness Activities for Teens in 2022
Brain Breaks to Energize and Recharge

EVALUATE:
Formative Monitoring (Questioning / Discussion): As students are creating the chain notes about the nervous system gather evidence of understanding by looking at their connections between the structures and their functions.

Summative Assessment (Quiz / Project / Report): Students write a Mindfulness Activity Guide which includes instructions for completing the activity and what they found as the benefits.

Elaborate Further / Reflect: Enrichment: Students read and write a book report about a book discussing anxiety. Possbile book titles:

- Something to Say by Lisa Moore Ramee
- Ghost by Jason Reynolds
- the lonely heart of Maybelle Lane by Kate O'Shaughnessy
- Sara and the search for Normal by Wesley King

SOCIAL EMOTIONAL LEARNING ACTIVITY

SELF AWARENESS and RELATIONSHIP SKILLS

In the Exploring Our Minds episode with Dr. Tye (min 49:51), the student Jennifer asks, what does her research tell us about the impact of the social isolation during the recent pandemic on children's brains. While there aren't any long-term, longitudinal studies on the impact of pandemic isolation, Dr. Kay suggested there are ways to stay connected even virtually. We feel connected to others when they know or can relate to something about us. There are a ton of "Getting to Know You" activities that seem related to the beginning of the school year. Try this one, that you can use any time throughout the school year:

Would You Rather…

Choose an option from the emoji list below.
Make your choice and defend it!

Would you rather...
find a 🦄 unicorn or find a 🧞‍♂️ genie?
be a 💃 🕺 dancer or a 🎤🎶 singer?
be a famous 🎨 artist or a famous 📚 author?
eat 🍩 donuts or 🍉 watermelon?
ride a 🛴 scooter or ride a 🚲 bike?

Be sure students have the opportunity to defend their choices. Ask students to complete a Flip Grid for an added twist.

INTERDISCIPLINARY CONNECTIONS/IDEAS

As a part of Language Arts, students written report:
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1)
As a part of Mathematics, student designed investigations:
6.EE.C.9 Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation. (MS-LS1-1), (MS-LS1-2), (MS-LS1-3)

Materials Required for This Lesson/Activity	
Quantity	**Description**
per students	laptops

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