



UNIVERSITY OF
NEW ENGLAND

Center for Excellence
in the Neurosciences

Neurological Disorders

Grades 9-12

Driving Question: In what ways do neurological impairments affect brain function?

Objectives: Students will be able to...

- Describe how migraines, Alzheimer's disease, and Multiple Sclerosis affect humans.
- Demonstrate how the function of neurons changes due to Multiple Sclerosis.
- Explain the progressive symptoms of Alzheimer's Disease.

Next Generation Science Standards:

- HS-LS1-2 Develop and use a model to illustrate the hierarchal organization of interacting systems that provide specific functions within multicellular organisms.
- HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Materials:

- Cotton thread
- Two pairs of gloves varying in thickness
- Sewing needles

Key Words: CNS, dexterity, myelin, etiology, progressive

Procedure:

Engage: Divide the class into three groups and assign them one of the three neurological disorders. (MS, Migraine, Alzheimer's). Allow the students to communicate and brainstorm words or phrases that come to mind when thinking about their assigned disorder. Next, each group member should come to the board and write one of the words or phrases around the disorder, creating a graphic organizer.

Example:



Examples:

- MS- motor control, neurons, movement, immune system
- Alzheimers- memory, old age, brain, dementia, confusion, forgetfulness
- Migraine- headache, nausea, fatigue, pain, pressure, sensitive to light

Explore:

- Nerve Review
- Multiple Sclerosis discussion
 - Needle and Thread Activity
- Alzheimer's discussion
 - Telephone Activity
- Migraine discussion

Explain:

- Nerve Review
 - Draw a picture of a nerve and briefly talk about how they work and each main part.
 - Axon
 - Dendrite
 - Soma

- Myelin Sheath

- Multiple Sclerosis
 - Definition: An autoimmune disorder that is often a disabling disease that interrupts the flow of information within the brain and between the brain and body. The protective “myelin sheath” of the nerve is eaten away by the immune system.
 - **Needle and Thread Activity:** the needle threading is intended to show loss of dexterity in multiple sclerosis. Ask for three volunteers and have two of them wear gloves. Each volunteer should thread the needle as quickly as possible. (Put the cotton thread through the hole in the needle).
 - Expected Outcome: The volunteer with no gloves represents the person with no motor control problems. The two wearing gloves should take longer to thread the needle and may not be able to pick up the needle. This represents the loss of fine motor control seen in Multiple Sclerosis.
 - **Refer to the elaborate section to learn more about the affects of Multiple Sclerosis.**

- Alzheimers Disease
 - Alzheimers Disease is the most common form of Dementia and affects about 5 million Americans.
 - **Telephone Activity:** Arrange the students in a large circle whisper a message such as “I like neuroscience” and pass along around the circle. Then ask the last student to repeat the message that reached them.
 - To have a better result during this activity, have the faculty member sit with the students and whisper the message slightly differently, send the message around twice, or make the message longer.
 - Expected Outcome: the message should differ from the original. A non-sense message often causes confusion so that students may have to have the message repeated. This is a good illustration of disrupted neurotransmission in Alzheimer’s Disease.

- Migraine
 - Migraine is the most common neurological disorder in the developed world.
 - In groups, discuss the following questions: What causes migraines? What are the symptoms? How is it treated?
 - **Symptoms:** Throbbing headache, sensitivity to light and noise, visual disturbances, nausea, vomiting.
 - Etiology: Unknown, but there are many “triggers” such as insufficient foods, specific foods, emotional triggers, environmental triggers.
 - Treatment: Non-pharmacological-identify and avoid trigger factors, medication, relaxation techniques, and psychotherapy.

Elaborate:

- Multiple Sclerosis: 400,000 people in the US are diagnosed with MS. It is often diagnosed between the ages of 20-50. Affects 3x more females than males.
 - **Symptoms:** may vary from person to person but common symptoms are abnormal fatigue, severe vision problems, loss of balance, loss of dexterity and muscle coordination, slurred speech and memory issues.
 - **Etiology:** Inflammation of the CNS (the cause of the inflammation is unknown). Inflammation breaks down myelin that forms a protective coat around the brain and spinal cord nerve fibers. Lost myelin is replaced by scars of hardened “sclerotic” tissue. Some nerve fibers are lost and this occurs in multiple places in the CNS.
 - **Treatment:** Research is still looking for a cure for MS. Disease modifying drugs such as natalizumab can slow down the course of MS.
- Alzheimer’s Disease: It is the third most costly disease in the US, costing about \$100 Billion per year.
 - **Symptoms:** Early stages show lapse in memory, as the disease progresses there will be confusion, forgetfulness of people’s names, places, or events, mood changes with feelings of sadness or anger and frustration of memory loss. Also anxiety, suspicion or agitation, delusions or hallucinations.
 - **Etiology:** The cause is generally unknown although there are three hypotheses that have been proposed:

- “Cholinergic hypothesis”: Reduced synthesis of **acetylcholine**. Medications to treat the deficiency only treat the disease symptoms and have not halted or reversed progression.
- “Tau hypothesis”: Abnormalities in a naturally occurring protein found in the brain –tau- may initiate this disease.
- “Amyloid hypothesis” Accumulation of a protein β - amyloid within the brain may be toxic to neurons.
- **Treatment:** Research is looking for a cure to Alzheimer’s disease. Drug treatments can temporarily alleviate symptoms or slow progression in some patients.
- Migraine: 1 in 5 Americans will have a migraine this year. Headache disorders lead to more than \$31 Billion in economic costs in the US annually.
 - Two common forms of migraine 1) migraine with aura, 2) migraine without aura.
 - Phases of migraine 1) Prodrome, 2) Aura, 3) Headache, 4) Postdrome

Evaluate:

- Did the CEN Outreach volunteer teach the student objectives?
- Did the CEN Outreach program reach the goals of the teacher?
- Did the CEN Outreach program reach it’s own goals/objectives?

NGSS Description:

- HS-LS1-2 Develop and use a model to illustrate the hierarchal organization of interacting systems that provide specific functions within multicellular organisms.

Students will demonstrate HS-LS1-2 when they learn about the proper function of a neuron and how it creates a neural response to other larger functions of the body.

- HS-LS1-3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Students will demonstrate HS-LS1-3 when they learn about Alzheimer’s Disease and Multiple Sclerosis and how the defective neuron affects the balance of brain function.