



UNIVERSITY OF
NEW ENGLAND

Center for Excellence
in the Neurosciences

Traumatic Brain Injury

Grades 9-12

Driving Question: What are symptoms of a traumatic brain injury and in what ways can we prevent injuries to the brain?

Objectives: Students will be able to...

- Describe the role that cerebrospinal fluid has on brain anatomy and safety.
- Compare and contrast helmet use during high impact sports and activities.
- Describe cranial nerves and how they are affected by a concussion.

Next Generation Science Standards:

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

Materials:

- Egg
- Cranial nerve exam tools

Procedure:

Engage: Ask the students the following questions and allow them to brainstorm with a partner:

- How is your brain suspended in the head?
 - **A liquid substance called cerebrospinal fluid suspends your brain within the skull.**
- What is a *traumatic brain injury*?

- **A TBI is caused by a blow or hit to the head that disrupts normal brain function. Brain injuries can range from mild to traumatic, traumatic being more damaging.**

Explore:

- Egg Demonstration (Cerebrospinal Fluid)
- Traumatic Brain Injury (TBI) discussion
- Post-Traumatic Brain Injury Cranial Nerve Exam Demonstration

Explain:

- *Cerebrospinal Fluid*
 - Compare and contrast cerebrospinal fluid (CSF) to an egg. How are they related? If the yolk is the brain, what role does the egg white have on the yolk?
 - CSF allows the brain to move around in the skull, in other words, it provides cushioning for the brain. It can also nourish and remove toxins. Thinking about what CSF does for the brain, why would it be important?
- *Traumatic Brain Injury*
 - Discuss the phrase *traumatic brain injury* and compare to minor brain injury.
 - A TBI is more severe and could cause permanent damage.
 - Brain injury is more common than you think. Name a very common brain injury (**concussion**).
 - How do you know when someone has had a concussion? In other words, what are the symptoms?
 - Symptoms include:
 - Dizziness
 - Nausea
 - Fatigue
 - Confusion
 - Stumbling/ loss of balance
 - Pupil dilation changes
 - Changes in hearing
 - Changes in smell
 - Changes in tactile (touching) sensation

- What activities do you do everyday that require a helmet? How can you be safer during certain activities to prevent brain injury?
- *Cranial Nerve Exams*
 - Cranial nerves are one way to tell the brain what is going on in the body. There are twelve pairs of cranial nerves in the brain. The senses (eyes, ears, etc.) are connected to cranial nerves. There are many tests that a healthcare provider can do in order to test the cranial nerves if he/she thinks a person has experienced a concussion.
 - **Touch:** Using a toothpick and cotton swab, place one or the other against a student's cheek. Ask whether the feeling was soft or hard and explain that someone with a TBI may not be able to tell the difference.
 - **Hearing:** Using a tuning fork, vibrate and place against a student's ear while moving it back and forth. Explain that the sound may not be audible after a TBI.
 - **Smell:** Using the vials of smells, allow each student to smell them and after ask them to identify the smells. Explain that someone who had a TBI may not be able to distinguish the smell.
 - **Sight:** Using a pen or flashlight, demonstrate pupil dilation and explain how someone who has had a concussion may not have proper pupil dilation.
 - **Discuss the pupillary light reflex:** place a hand in front of the student's face so that it creates a barrier between each eye. Move the light over one eye and watch the other eye dilate. This demonstrates how both pupils respond to the light even though light may only be in one eye.

Elaborate:

- *Cerebrospinal Fluid*
 - Cerebrospinal fluid (CSF) has a major role on the brain. CSF is produced in the brain by structures called the *choroid plexus*.
- *Traumatic brain injury*
 - Many professional athletes experience concussion and research is showing memory loss and other long-term affects as they age. The

average number of concussions that people with these symptoms have had is four.

- For more information, visit <http://www.cdc.gov/concussion/index.html>
- *Cranial Nerve Exams:* After this activity students should better understand what might happen after a brain injury- specifically TBI. The sensory and motor function of the brain can be impaired.

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

Students will demonstrate HS-LS1-3 when they learn about cranial nerve exams.

They learn how the nerves should react and how they will be disrupted with a brain injury.