

Traumatic Brain Injury Curriculum



Every effort has been made to trace the ownership of copyrighted material and to make full acknowledgement of its use. If errors or omissions have occurred, they will be corrected in subsequent editions, provided that notification is submitted in writing to the publisher.



© 2021, Realityworks, Inc. All rights reserved.

2709 Mondovi Road
Eau Claire, WI 54701 USA

800.830.1416

+1.715.830.2040

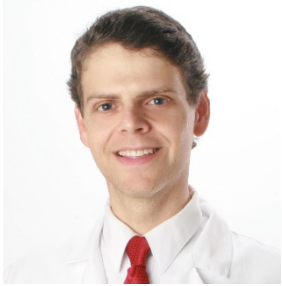
www.realityworks.com

(1061460-01)

Table of Contents

About the Author.....	4
Curriculum Structure.....	5
Lesson Structure.....	5
Lesson One – Introduction to Traumatic Brain Injury.....	6
FOCUS: Defining TBI.....	7
LEARN: Categorizing and Describing the Anatomy and Structural Injury in TBI.....	12
REVIEW: TBI Overview.....	14
Sources.....	17
Lesson Two – Concussion Signs and Symptoms.....	18
FOCUS: Concussion Signs and Symptoms.....	19
LEARN: Concussion Simulation Experience and Beyond Concussion.....	21
REVIEW: Concussion Signs and Symptoms Quiz.....	27
Sources.....	31
Lesson Three – TBI Treatment and Prevention.....	32
FOCUS: Concussion Treatment.....	33
LEARN: Treatments to Address Specific Symptoms and More Severe TBI, and TBI Prevention.....	36
REVIEW: TBI Treatment & Prevention Quiz.....	40
Sources.....	45
Lesson Four – TBI Scenarios.....	46
FOCUS: Introduction Case Scenario.....	47
LEARN: Further Case Scenarios.....	48
REVIEW: TBI Case Scenarios Quiz.....	65
Sources.....	68
Pre- and Post-Summative Assessment.....	69

About the Author



Ari Magill, M.D. earned a B.S. in Zoology from the University of Texas in Austin, TX, and graduated with an M.D. from UT Southwestern Medical School in Dallas, TX. Dr. Magill completed his neurology residency at the University of Arizona in Tucson, AZ, and completed a movement disorders neurology fellowship at the University of Colorado Anschutz Medical Center in Aurora, CO. He formerly practiced as a staff neurohospitalist at Northwest Medical Center in Tucson, AZ. Currently, Dr. Magill conducts independent VA disability exams on veterans who sustained traumatic brain injury (TBI) and serves as a clinical research investigator for the IMA Group at their Alea Clinical Research facility.

Dr. Magill enjoys medical writing and participating in medical education and has a special interest in cognitive, behavioral, and memory disorders and functional medicine health coaching. He is passionate about advancing dementia and TBI treatment through clinical research and aggressive lifestyle change aided by judicious use of supplements. Dr. Magill is an avid bicycle rider, a film enthusiast, and enjoys playing basketball in his free time.

The Concussion Education Kit and accompanying curricula will include the combination of a wearable simulation experience and other hands-on opportunities. It will help participants walk in the shoes of a person experiencing a concussion as well as understanding what happens in the brain during a concussion injury. Participants will receive a thorough introduction to Traumatic Brain Injury and the impact of concussions on the body.

Curriculum Structure

The Traumatic Brain Injury curriculum is composed of the following lessons. Approximate lesson times are included.

Lesson	Title	Approximate Time
One	Introduction to Traumatic Brain Injury	60 minutes
Two	Concussion Signs and Symptoms	90-130 minutes
Three	TBI Treatment and Prevention	80-100 minutes
Four	TBI Scenarios	90-105 minutes
	Total	5 ½-6 ½ hours

Lesson Structure

Each lesson begins with a Lesson Overview, Lesson Objectives, and a Lesson at a Glance table which lists the lesson activities, materials required, suggested preparation steps, and approximate class time.

Lesson Sections

The actual lesson follows the overview, which will contain some of the sections described below.

FOCUS

Every lesson begins with a FOCUS activity intended to capture participants' attention. This may be in the form of a small or large class discussion, a game, a review of previous lesson information, or a demonstration. During this activity, participants are introduced to the topic of the lesson.

LEARN

The LEARN activity in each lesson varies in its presentation mode. It may be a slide presentation, group activity, or demonstration.

REVIEW

The majority of lessons end with a REVIEW activity intended to briefly review the lesson's key messages or main points.

Lesson One – Introduction to Traumatic Brain Injury

Lesson Overview

This lesson will help participants learn what a traumatic brain injury is and common causes. Participants will be able to categorize Traumatic Brain Injuries (TBIs), the impact and damage that occurs, and how this relates to common sports injuries.

Lesson Objectives

After completing this lesson, participants will be able to:

- Be able to give a definition for TBI.
- Be able to list the two most common causes for TBI.
- Be able to categorize TBI by severity.
- Be able to describe focal brain injuries due to TBI.
- Be able to describe terms used to describe generalized brain tissue damage.
- Be able to describe chronic traumatic encephalopathy (CTE).

Lesson at a Glance

Activity	Materials	Preparation	Approximate class time
FOCUS	• <i>Introduction to Traumatic Brain Injury</i> slide presentation • Internet access • <i>Introduction to Traumatic Brain Injury Notes Page</i> • <i>Introduction to Traumatic Brain Injury Notes Page – Answer Key</i>	1. Prepare <i>Introduction to Traumatic Brain Injury</i> slide presentation for viewing. 2. Print/photocopy the <i>Introduction to Traumatic Brain Injury Notes Page</i> (one per participant).	15 minutes
LEARN	• <i>Introduction to Traumatic Brain Injury</i> slide presentation • Paper and rubber bands for every participant • <i>Anatomy of the Brain During a Concussion</i> poster (post for reference) • <i>Introduction to Traumatic Brain Injury Notes Page</i> • <i>Introduction to Traumatic Brain Injury Notes Page – Answer Key</i>	1. Prepare paper and rubber bands for each participant. 2. Post poster on the wall for reference during the lesson.	15 minutes
REVIEW	• <i>TBI Review Quiz</i> • <i>TBI Review Quiz – Answer Key</i>	1. Print/photocopy <i>TBI Review Quiz</i> (one per participant).	15-20 minutes

Lesson One – Introduction to Traumatic Brain Injury

FOCUS: Defining TBI

15 minutes

Purpose:

Participants will learn the definition of TBI and the mechanisms of closed head injuries. They will also learn the latest epidemiology data on TBI. This activity will help participants appreciate the depth and scope of the disorder regarding healthcare resources and human capital.

Materials:

- *Introduction to Traumatic Brain Injury* slide presentation
- Internet access
- *Introduction to Traumatic Brain Injury Notes Page*
- *Introduction to Traumatic Brain Injury Notes Page – Answer Key*

Facilitation Steps:

1. Share the following information with participants as you show the slide presentation.

Defining TBI

Slide 2: TBI is any traumatic insult from external mechanical forces that results in an alteration of brain function. Such forces could include both closed and penetrating head injuries. Penetrating head injuries caused by a foreign body penetrating the skull will not be discussed further.

Slide 3: Closed head injuries can occur from a direct impact, strike, or blow to the head and from rapid acceleration and deceleration of the skull, causing the brain to collide with the interior of the skull.

The latest epidemiologic data concerning TBI in the US can be found from the Centers for Disease Control and Prevention Website.

Slide 4: Of the total number of emergency department (ED) visits, hospital admissions, and deaths in the U.S. in 2014, 2.87 million were for TBI. Children (defined as age 17 and younger) were

affected in 837,000 of these cases (close to 30 percent)

Nearly 56,000 deaths occurred in 2014, 2,529 of which were children (close to 4.5%). The latest data from 2019 documented nearly 61,000 TBI-related deaths.

Around 288,000 hospital admissions in the U.S. in 2014 were TBI-related, of which 23,000 were children (close to 8%). TBI-related hospitalizations decreased to about 224,000 in 2017.

Slide 5: Primary causes of TBI-related ED visits based on 2014 CDC data (2013 data is depicted in the slide)

Almost half of all TBI-related ED visits in the U.S. were due to falls, which disproportionately affect children and the elderly.

The second most common cause of TBI-related ED visits were due to being hit by or against an object, which accounted for more than 1 in 4 TBI-related ED visits in children (17 percent of all age groups). Motor vehicle collisions were third.

Slide 6: High School Sports-Related Concussion

According to a 2017 CDC report, 15% of high school students reported one or more concussions, and 6% reported two or more.

9% of high school students endorsed one concussion, 3% endorsed 2, 1% endorsed 3, and 2% endorsed four or more concussions associated with sports or other physical activities.

2. Ask the class which sports carry the highest risk of concussion and TBI. Allow participants 3 minutes to do an internet search.
3. Have participant share their findings with the rest of the class. With a show of hands, determine how many members of the class participate in sports.

Name: _____ Class: _____

Introduction to Traumatic Brain Injury

Notes Page

Define Traumatic Brain Injury:

What may cause a closed head injury?

What are the primary causes of TBI-related emergency room visits?

True or False Concussion is a form of mild TBI.

What are the three forces that can deform brain tissue?

TBI Injuries

Injury	Notes
Skull Fractures	
Contusions	
Intercranial Hemorrhages	

What are two terms used to describe generalized brain tissue damage?

Brain Region	What does this area of the brain do?	How would damage to this area of the brain impact someone?
Brain Stem		
Temporal Lobes		
Frontal Lobes		

What is CTE?

Introduction to Traumatic Brain Injury

Notes Page – Answer Key

Define Traumatic Brain Injury:

TBI is any traumatic insult from external mechanical forces that results in an alteration of brain function.

What may cause a closed head injury?

Closed head injuries can occur from a direct impact, strike, or blow to the head and from rapid acceleration and deceleration of the skull, causing the brain to collide with the interior of the skull.

What are the primary causes of TBI-related emergency room visits?

Falls and being hit

True or False Concussion is a form of mild TBI.

What are the three forces that can deform brain tissue?

Compression, elongation or tensile stress and shear stress

TBI Injuries – Answers will vary

Injury	Notes
Skull Fractures	Skull fractures include fractures of the cranial vault (skull cap), called vault fractures, and the base of the skull called basal skull fractures. - Vault fractures typically arise from an immediately adjacent impact, while basal skull fractures usually arise from transmitted forces. They are often linear (in the form of a line) and can travel into the sinuses, the hollow cavities of the skull where mucus flows. These fractures can also be stellate or star-shaped. - Basal skull fractures are sometimes associated with damage to adjacent structures, including cranial nerves, and can cause spinal fluids leaks from the ear or nose. c. Closed vs. open: Closed fractures do not allow communication between the intracranial and external environments; open fractures do.
Contusions	- Coup: Brain tissue bruising directly at the site of head impact. - Contrecoup: Brain tissue bruising on the opposite of side of head impact from the sloshing movement of the brain within the cranial vault slamming into the interior skull. - Coup-Contrecoup: Bruising that occurs at both ends of the brain; classically associated with whiplash from rapid acceleration and deceleration.
Intercranial Hemorrhages	Bleeding from tissues interior to the skull - Epidural hematoma: - Subdural hematoma: - Subarachnoid hematoma - Intracerebral hemorrhage - Intraventricular hemorrhage (IVH)

What are two terms used to describe generalized brain tissue damage?

Concussion and diffuse axonal injury

Brain Region	What does this area of the brain do?	How would damage to this area of the brain impact someone?
Brain Stem	The medulla and pons, important for breathing and other basic functions necessary for life, and the midbrain, which is important in coordinating eye movements and motor, visual, and auditory processing.	Answers will vary
Temporal Lobes	Important for hearing and language processing.	Answers will vary
Frontal Lobes	Critical for decision making, organizational skills, emotional regulation, and inhibition of impulsive behaviors.	Answers will vary

What is CTE?

Unique progressive neurodegenerative disease that occurs as a consequence of repeated head trauma in genetically at-risk individuals.

Lesson One – Introduction to Traumatic Brain Injury

LEARN: Categorizing and Describing the Anatomy and Structural Injury in TBI

15minutes

Purpose:

Participants will learn about how to group TBIs based on severity. They will discover how brain tissue and surrounding structures, such as the skull, get damaged by external forces. Next, participants will learn about brain hemorrhages that can result from a head injury. Participants will also learn about areas of the brain that are the most vulnerable to damage from TBI. Finally, they will be introduced to a condition known as chronic traumatic encephalopathy (CTE).

Materials:

- *Introduction to Traumatic Brain Injury* slide presentation
- Paper and rubber bands for every participant
- Poster of the Anatomy of the Brain During a Concussion (post for reference)
- *Introduction to Traumatic Brain Injury Notes Page*
- *Introduction to Traumatic Brain Injury Notes Page – Answer Key*

Facilitation Steps:

1. Continue to share information about TBI.

Slide 7: TBI can be categorized as mild, moderate, and severe. According to the Head Injury Interdisciplinary Special Interest Group of the American Congress of Rehabilitation Medicine, one way to determine severity is using the Glasgow Coma Scale (GCS). Concussion is a form of mild TBI.

The GCS score is based on the assessment of three components: eye opening, motor response, and verbal response. A maximum of four points can be given for eye opening, six points for motor responsiveness, and five points for a verbal response, for a maximum total of 15 points.

- Mild TBI is characterized by A GCS score from 13-15 with no abnormalities on a CT scan of the head and a hospital visit less than 48 hours.

- Moderate TBI correlates with a GCS score of 9-12.
- Severe TBI is associated with a GCS score less than 9 (3-8).

Slide 8: As a result of trauma, brain tissue can deform from three distinct forces:

- Compression, where tissue is squeezed together
- Elongation or tensile stress, where tissue is stretched or pulled apart
- Shear stress, where tissue is warped by one tissue plane sliding over another

2. Exercise:

- Have participants crumple a piece of paper. This represents compression.
- Have participants stretch a rubber band. This represents elongation.
- Have participants tear a piece of paper. This represents shear stress.

In the immediate aftermath of TBI, tissue damage can be both focal and generalized. Examples of focal tissue damage include examples on the following slides.

Slide 9: Skull fractures include fractures of the cranial vault (skull cap), called vault fractures, and the base of the skull, called basal skull fractures

- Vault fractures typically arise from an immediately adjacent impact, while basal skull fractures usually arise from transmitted forces. They are often linear (in the form of a line) and can travel into the sinuses, the hollow cavities of the skull where mucus flows. These fractures can also be stellate or star-shaped.
- Basal skull fractures are sometimes associated with damage to adjacent structures, including cranial nerves, and can cause spinal fluids leaks from the ear or nose.
- Closed vs. open: Closed fractures do not allow communication between the intracranial and external environments; open fractures do.

Slide 10: Contusions

- Coup: Brain tissue bruising directly at the site of head impact.
- Contrecoup: Brain tissue bruising on the opposite of side of head impact from the sloshing movement of the brain within the cranial vault slamming into the interior skull.
- Coup-Contrecoup: Bruising that occurs at both ends of the brain; classically associated with whiplash from rapid acceleration and deceleration.

Slide 11: Intracranial hemorrhages – bleeding from tissues interior to the skull

- Extradural hemorrhage:
 - Bleeding that occurs between the skull and the thickest, outermost layer of the meninges, called the dura mater
 - Most often caused by damage to the middle meningeal artery, the largest artery that supplies blood to the lining of the brain, or meninges
- Subdural hemorrhage:
 - Bleeding that occurs between the brain and the dura mater
 - Frequently due to tearing of bridging veins that cross the subdural space
- Subarachnoid hemorrhage:
 - Bleeding that occurs between the brain and the arachnoid mater, an inner layer of the meninges
 - A feared complication is cerebral artery spasm that can lead to strokes
- Intracerebral hemorrhage:
 - Bleeding that occurs within the substance of the brain, which compresses surrounding brain tissue
- Intraventricular hemorrhage (IVH):
 - Bleeding that occurs within the open cavities called ventricles within the brain that cerebrospinal fluid (CSF) flows through
 - By blocking the flow of CSF, IVH can cause increased intracranial pressure (elevated pressure inside the skull) and obstructive hydrocephalus, where the ventricles expand and compress surrounding brain tissue

Slide 12: Two terms are used to describe generalized brain tissue damage

- Concussion: a type of mild diffuse axonal (axons are the “cable wires” coming off each individual

nerve cell, or neuron) injury affecting deep structures of the brain leading to loss of consciousness (LOC) or alteration of consciousness (AOC).

- Diffuse axonal injury: generalized, widespread insult to white matter in the brain, which is made up of the fatty cable wiring of the brain that allows large groups of brain cells, or nuclei, to communicate with other areas of the brain.

Slide 13: TBI can affect any area of the brain.

However, certain areas are especially vulnerable to traumatic insult. These include the brain stem, frontal lobes, and temporal lobes due to their proximity to bony projections within the interior skull.

Brainstem:

- Consists of the base of the brain that connects directly with the spinal cord
- There are three components: the medulla and pons, important for breathing and other basic functions necessary for life, and the midbrain, which is important in coordinating eye movements and motor, visual, and auditory processing

Temporal lobes:

- Important for hearing and language processing
- The deep (mesial) temporal lobes contain the hippocampus, a nucleus of brain cells central for the encoding of new, conscious memories

Frontal lobes:

- Almost universally damaged in TBI due to its large size and anterior location
- Critical for decision making, organizational skills, emotional regulation, and inhibition of impulsive behaviors

Slide 14: Chronic Traumatic Encephalopathy (CTE)

- Now identified as a unique progressive neurodegenerative disease that occurs as a consequence of repeated head trauma in genetically at-risk individuals.
- Often manifests decades after the head injury events, characterized by abnormalities in behavior, cognition, and movement.
- Parkinsonian features are present (symptoms that resemble Parkinson’s disease), including rigid posture and slow, low amplitude movements.
- Results in dementia.

Lesson One – Introduction to Traumatic Brain Injury

REVIEW: TBI Overview

20 minutes

Purpose:

Participants will review the key information learned in the introduction to traumatic brain injury. This assessment will help instructors see knowledge gained over the lesson.

Materials:

- *TBI Review Quiz*
- *TBI Review Quiz – Answer Key*

Facilitation Steps:

1. Give each participant the *TBI Review Quiz*.
Give them 10 minutes to complete the quiz.
2. Have participants self-check and peer check the quiz answers as you share from the answer key.

Name: _____ Class: _____

TBI Review Quiz

Directions: Fill in the blank with the correct answer in the space provided below.

1. TBI results from an external mechanical force that results in an _____ of brain function.
2. Rapid acceleration and deceleration cause the brain to _____ with the interior of the skull.
3. Name the two most common causes of TBI-related Emergency Department Visits.

4. True or False Mild TBI results in visible trauma to the brain on CT Head imaging.
5. What GCS range characterizes:
Mild TBI _____
Moderate TBI _____
Severe TBI _____
6. What three forces deform brain tissue? _____, _____, and _____

7. Provide three examples of focal head trauma: _____ fractures, _____, and _____ hemorrhages
8. Name three types of contusions that can result from TBI. _____, _____, and _____

9. What type of intracranial hemorrhage directly blocks the flow of cerebrospinal fluid (CSF)?

10. Name the three areas of the brain that are particularly vulnerable to traumatic insult.
_____, _____, and _____

11. Chronic traumatic encephalopathy (CTE) can result from _____ head injuries in genetically vulnerable individuals.
12. How soon after head injuries does CTE manifest? _____

TBI Review Quiz – Answer Key

1. TBI results from an external mechanical force that results in an **alteration** of brain function.
2. Rapid acceleration and deceleration cause the brain to **collide** with the interior of the skull.
3. Name the two most common causes of TBI-related Emergency Department visits. **Falls and being hit by or against an object**
4. True or **False** Mild TBI results in visible trauma to the brain on CT Head imaging.
5. What GCS range characterizes:
Mild TBI **13-15**
Moderate TBI **9-12**
Severe TBI **3-8**
6. What three forces deform brain tissue? **Compression, elongation, and shear stress**
7. Provide three examples of focal head trauma: **skull** fractures, **contusions**, and **intracranial** hemorrhages
8. Name three types of contusions that can result from TBI. **Coup, contrecoup, and coup-contrecoup**
9. What type of intracranial hemorrhage directly blocks the flow of cerebrospinal fluid (CSF)? **Intraventricular**
10. Name the three areas of the brain that are particularly vulnerable to traumatic insult. **Brainstem, frontal lobes, and temporal lobes**
11. Chronic traumatic encephalopathy (CTE) can result from **multiple** head injuries in genetically vulnerable individuals.
12. How soon after head injuries does CTE manifest? **decades**

Sources

1. American Speech-Language-Hearing Association. (n.d.). *Traumatic Brain Injury in Adults*. American Speech-Language-Hearing Association (ASHA). Retrieved April 13, 2021, from <https://www.asha.org/practice-portal/clinical-topics/traumatic-brain-injury-in-adults/>
2. Brain Injury Association of America. (2021, March 19). *Understanding the Injury*. <https://www.biausa.org/brain-injury/about-brain-injury/basics/understanding-the-injury>
3. Centers for Disease Control and Prevention. (2019). *Surveillance Report of Traumatic Brain Injury-related Emergency Department Visits, Hospitalizations, and Deaths—United States, 2014*. Centers for Disease Control and Prevention (CDC). https://www.cdc.gov/traumaticbraininjury/pdf/TBI-Surveillance-Report-FINAL_508.pdf
4. Centers for Disease Control and Prevention. (2021). *Surveillance Report of Traumatic Brain Injury-related Hospitalizations and Deaths by Age Group, Sex, and Mechanism of Injury—United States, 2016 and 2017*. Centers for Disease Control and Prevention (CDC). <https://www.cdc.gov/traumaticbraininjury/pdf/TBI-surveillance-report-2016-2017-508.pdf>
5. Centers for Disease Control and Prevention. (2019, March 11). *TBI: Get the Facts*. Centers for Disease Control and Prevention (CDC). https://www.cdc.gov/traumaticbraininjury/get_the_facts.html
6. Centre for Neuro Skills. (n.d.). *Brain Injury Overview*. Centre for Neuro Skills (CNS). Retrieved April 13, 2021, from <https://www.neuroskills.com/brain-injury/brain-injury-overview/>
7. Dawodu, S. T. (2021, March 19). *Traumatic Brain Injury (TBI) - Definition, Epidemiology, Pathophysiology*. Medscape. <https://emedicine.medscape.com/article/326510-overview>
8. Gavett, B. E., Stern, R. A., & McKee, A. C. (2011, January 1). *Chronic Traumatic Encephalopathy: A Potential Late Effect of Sport-Related Concussive and Subconcussive Head Trauma*. Clinics in Sports Medicine. [https://www.sportsmed.theclinics.com/article/S0278-5919\(10\)00086-4/fulltext](https://www.sportsmed.theclinics.com/article/S0278-5919(10)00086-4/fulltext)
9. Knapp & Roberts. (2019, October 25). *Brain Injury Statistics*. <https://www.knappandroberts.com/brain-injury-statistics/>
10. Nizamutdinov, D., & Shapiro, L. (2017). Overview of Traumatic Brain Injury: An Immunological Context. *Brain Sciences*, 7(12), 11. <https://doi.org/10.3390/brainsci7010011>
11. Physiopedia. (n.d.). *Overview of Traumatic Brain Injury*. Retrieved April 13, 2021, from https://www.physio-pedia.com/Overview_of_Traumatic_Brain_Injury
12. Woodard, T. J., & Allen, S. N. (2017, Jan 1). *An Overview of the Management of Concussion*. Medscape. https://www.medscape.com/viewarticle/877675_4

Lesson Two – Concussion Signs and Symptoms

Lesson Overview

Concussion has potentially debilitating signs and symptoms, including sleep disturbance, headache, changes in vision and hearing, confusion, short-term memory deficits, and irritability. Participants will learn to recognize symptoms and signs of concussion.

Lesson Objectives

After completing this lesson, participants will be able to:

- Identify, physical, sensory, cognitive, and behavioral symptoms and signs of concussion.
- Identify physical, cognitive, and behavioral signs and symptoms of more severe TBI.
- Describe Second Impact Syndrome.
- Describe Post-Concussion Syndrome.

Lesson at a Glance

Activity	Materials	Preparation	Approximate class time
FOCUS	• <i>Concussion Signs and Symptoms</i> slide presentation • <i>Concussion Signs and Symptoms Chart</i> • Signs and Symptoms of Traumatic Brain Injury poster	1. Prepare to show <i>Concussion Signs and Symptoms</i> slide presentation. 2. Print/photocopy <i>Concussion Signs and Symptoms Chart</i> (one per participant). 3. Hang poster for reference. 4. Internet access ready for videos.	10–20 minutes
LEARN	• Concussion Education Kit • <i>Concussion Signs and Symptoms</i> slide presentation • Signs and Symptoms of Traumatic Brain Injury poster • <i>Concussion Experience Checklist</i> • <i>Interview Questions and Answers</i> worksheet • <i>On the Grasshopper and Cricket</i> worksheet • <i>Basic Math Quiz</i>	1. Print/photocopy <i>Concussion Experience Checklist</i> (one per participant). 2. Set up each simulation station. 3. Check to ensure the Concussion Education Kit materials are ready to use.	60-90 minutes
REVIEW	• <i>Concussion Signs and Symptoms Quiz</i> • <i>Concussion Signs and Symptoms Quiz – Answer Key</i>	1. Print/photocopy the <i>Concussion Signs and Symptoms Quiz</i> (one per participant).	20 minutes

Lesson Two – Concussion Signs and Symptoms

FOCUS: Concussion Signs and Symptoms

10-20 minutes

Purpose:

Concussion has potentially debilitating signs and symptoms, including sleep disturbance, headache, changes in vision and hearing, confusion, short-term memory deficits, and irritability. Participants will learn to recognize symptoms and signs of concussion.

Materials:

- *Concussion Signs and Symptoms* slide presentation
- *Concussion Signs and Symptoms Chart*
- Signs and Symptoms of Traumatic Brain Injury poster

Facilitation Steps:

1. Begin by introducing concussion signs and symptoms. Give each participant the *Concussion Signs and Symptoms Chart* to complete as they listen. Display the poster as an additional reference source for the lesson.

Slide 2: Symptoms of Concussion can vary depending on which area of the brain was damaged, which will be more pronounced in cases of more severe injury where focal damage has occurred from a brain contusion or hemorrhage. However, there is a general constellation of symptoms that can be grouped as physical, sensory, cognitive, and behavioral.

Slide 3: Physical signs and symptoms:

- Brief loss of consciousness from seconds to a few minutes
- Headache, plus or minus nausea, plus or minus vomiting
- Fatigue/ drowsiness and sleep disturbances (such as insomnia, worsened sleep quality, or excessive sleep)
- Dizziness/vertigo, incoordination, impaired balance

Slide 4: Sensory signs and symptoms:

- Vision: transient blurred vision, seeing “stars,” inability to maintain focus for an extended

amount of time, or sensitivity to light (aka photophobia)

- Hearing: ear ringing (aka tinnitus) and sensitivity to sound (aka phonophobia or hyperacusis)
- Taste or smell: partial loss or alteration of taste or smell

Slide 5: Cognitive signs and symptoms:

- Feeling dazed, confused, or disoriented immediately following the injury
- Trouble with short-term memory (such as misplacing items, forgetting new information or parts of conversations, and names) or loss of memory for events surrounding the head injury (aka post-traumatic amnesia)
- Trouble maintaining focus, concentration, and attention
- Mild trouble processing language (either comprehension or expression verbally or in writing) such as occasional trouble coming up with names
- Difficulty planning and organizing (executive function)
- Losing track of time or why you went somewhere
- Slowed processing speed

Slide 6: Behavioral signs and symptoms:

- Irritability
 - Poor ability to handle stress
 - Anxiety, depression, and rapid mood fluctuations
 - Impulsive behavior (compromised ability to inhibit inappropriate reactions or urges)
2. If time permits, share a short video about concussion signs and symptoms. Here are a few suggested links but there are many others.

<https://www.youtube.com/watch?v=SKPHF6ZOarM>

<https://www.youtube.com/watch?v=wMlpP2dqfW0>

https://www.youtube.com/watch?v=0Gi2Uz_yF9w

Name: _____ Class: _____

Concussion Signs and Symptoms Chart

Complete the chart below from lecture information, slides, posters and/or Internet sources.

	Signs (Visible to others)	Symptoms (Felt by Affected Individual)
Physical		
Sensory		
Cognitive		
Behavioral		

Lesson Two – Concussion Signs and Symptoms

LEARN: Concussion Simulation Experience and Beyond Concussion

60-90 minutes

Purpose:

More severe head trauma or serial repeated concussions that occur without adequate time to heal and recover lead to more serious and prolonged deficits. Participants will learn about more serious potential consequences of moderate to severe TBI. They will also learn to recognize second impact syndrome, post-concussion syndrome, and risk factors for development of these syndromes.

Materials:

- Concussion Education Kit
- *Concussion Signs and Symptoms* slide presentation
- Signs and Symptoms of Traumatic Brain Injury poster
- *Concussion Experience Checklist*
- *Interview Questions and Answers* worksheet
- *On the Grasshopper and Cricket* poem worksheet
- *Basic Math Quiz* worksheet

Facilitation Steps:

1. Concussion Simulation Experience: Set up stations around the room.
 - Station 1: Interview a classmate. Provide copies of the interview worksheet enough for each student to complete.
 - Station 2: Poetry Time. Provide copies of the poem worksheet, *On the Grasshopper and Cricket* with questions for participants to answer.
 - Station 3: Math Time. Provide copies of the *Basic Math Quiz* for participants to complete.
 - Station 4: Writing Time. Write a sentence on the board. Provide paper at the station for participants to write on.
 - Station 5: Screen Time. Provide a tablet at the station or have participants use their

cell phone to read something. Provide a specific question if desired for participants to research.

- Station 6: Play Catch! Provide a small ball or paper that can be used.
 - Station 7: Walk the line. Use tape to create a 10-foot line on the floor. Or set the station up in an area where there is an existing line on the floor to use.
 - Station 8: Provide a chair.
 - Station 9: Provide an area with enough space to do pushups or jumping jacks.
 - Station 10: Provide a chair.
2. Pair up participants and give each pair the concussion glasses and headphones with MP3 player.
 3. Give each participant the Concussion Experience Checklist handout to complete.
 4. Assign each pair of participants to begin at a specific station or with a specific task. Both participants should have the opportunity to wear the concussion simulation glasses and headphones and complete all of the tasks on the list. Participants should rotate to each station upon both of them completing the task.
 5. Continue slide presentation

Slide 7: Moderate to severe TBI can result in more extreme findings.

Slide 8: Physical symptoms and signs

- Loss of consciousness (LOC) for more than a few minutes, even hours or days (coma)
- Profoundly impaired coordination or balance
- Slurring of speech (dysarthria)
- Impaired ability to swallow food or water (dysphagia)
- Persistent double vision (diplopia)

Slide 9: A so-called thunderclap headache (worst headache of one's life), which may suggest

subarachnoid hemorrhage, or a progressively worsening headache, especially when lying down, which may suggest swelling of the brain.

Slide 10: Inappropriate dilation or constriction of one or both pupils

- Results in differently-sized pupils (called anisocoria)
- Can be caused by increased ICP, which moves brain tissue outside of their usual location (a process called herniation)
 - Herniated brain tissue presses on nerve (CN) III, which controls certain eye movements and the pupillary response to light

Slide 11: Drainage of clear fluid or blood from the nose or ears.

- Clear fluid might be cerebrospinal fluid, the fluid that bathes the brain and spinal cord
- Blood suggests a skull fracture

Slide 12: Presence of swelling or bruising behind the ears or around the eyes, known as racoon eyes or Battle's sign, which suggest a fracture of the base of the skull (aka basilar skull fracture).

Slide 13: Focal weakness or numbness from injury to the motor or sensory cortices or their pathways from the brain to the spinal cord (e.g. hemiparesis, weakness on one side of the body).

Slide 14: Central sleep apnea, a disordered breathing pattern during sleep. It occurs when the brain's area that controls your breathing does not function correctly during sleep. It can result from brainstem damage. Obstructive sleep apnea is caused by blockages in the upper airway that restrict oxygen to the body.

Slide 15: Convulsions or seizures, which can occur in the immediate aftermath of TBI or later (early and late post-traumatic seizures). They can occur in mild TBI but more frequently in more severe TBI.

Slide 16: Cognitive and Behavioral symptoms

- Profound speech deficits, including aphasia (inability to comprehend or express language) and dysarthria (slurring of speech) and inability to name objects (anomia)
- Difficulty recognizing faces
- Inability to copy a simple drawing

- Profound confusion, not knowing where you are or even who you are
- Profound behavior changes that appear suddenly, including complete lack of inhibition such as uncontrolled aggression, out-of-control spending, or reckless sexual promiscuity

Slide 17: Head Injury Red Flags – symptoms and signs where immediate medical attention is recommended

Slide 18: Second Impact Syndrome

- Used to describe a rare phenomenon of sudden severe brain swelling that occurs when an individual sustains a second concussion without fully recovering from an initial concussion
 - There is some controversy as to whether the phenomenon truly exists because it is so rare and poorly characterized
 - Is frequently associated with death or severe permanent disability
- Risk factors include:
 - Younger age: including children, teenagers, and young adults
 - Male gender: may be due to genetics or simply greater likelihood of participation in contact sports
 - Persistent symptoms of prior concussion: this is an important consideration regarding return to play; symptoms of prior concussion should be completely resolved
 - Participation in high-risk contact sports: American football, boxing, rugby, karate

Slides 19: Post-Concussion Syndrome

- Phenomenon of persistent symptoms beyond the expected recovery period of weeks to months
- Symptoms are those typical for concussion/mild TBI, such as headache, dizziness, altered sleep, and impaired focus and concentration
- Risk factors include:
 - Increasing age
 - Psychiatric co-morbidities, such as depression, anxiety, and PTSD
 - Psychosocial stressors and poor coping skills
 - Female gender

Name: _____

Class: _____

Concussion Experience Checklist

Instructions: Do each task while wearing the Concussion Simulator. Record your observations.

Task	Rate the difficulty to complete each 1(easy) – 5 (hard)					What did you observe about your body as you completed the task?
	1	2	3	4	5	
Station 1: Interview a classmate. Ask 5 questions and write down answers to the questions. Use the worksheet provided to record your interview.						
Station 2: Poetry Time. Read a poem and answer questions in the space provided.						
Station 3: Math Time. Complete some basic math problems in the space provided.						
Station 4: Writing Time. Copy a sentence off the board and sign your name at the bottom.						
Station 5: Screen Time. Try to read information off a computer screen, tablet or cell phone.						
Station 6: Play Catch! Play catch with a classmate. Use a small ball if available, or a crumpled piece of paper. Start close together and move further apart.						
Station 7: Walk the line. Walk a line on the floor without falling off.						
Station 8: Power nap. Close your eyes for one minute as if sleeping.						
Station 9: Workout. Do 5-10 pushups or 10 jumping jacks. Choose a different physical activity if you cannot do either of these.						
Station 10: Stand up, sit down. Sit in a chair. Whenever ready, stand up and down 5 times as fast as possible. You have to stand up fully and sit down with your butt touching the chair. Now do it with your eyes shut.						

How did this inform you about the problems someone who has suffered a TBI is going through?

Name: _____ Class: _____

Interview Questions and Answers

1.

2.

3.

4.

5.

Name: _____ Class: _____

On the Grasshopper and Cricket

BY JOHN KEATS

The Poetry of earth is never dead:

When all the birds are faint with the hot sun,
And hide in cooling trees, a voice will run
From hedge to hedge about the new-mown mead;
That is the Grasshopper's—he takes the lead
In summer luxury,—he has never done
With his delights; for when tired out with fun
He rests at ease beneath some pleasant weed.

The poetry of earth is ceasing never:

On a lone winter evening, when the frost
Has wrought a silence, from the stove there shrills
The Cricket's song, in warmth increasing ever,
And seems to one in drowsiness half lost,
The Grasshopper's among some grassy hills.

1. What is main theme of the poem?
2. Where do birds take rest in hot summer day?
3. Where do grasshoppers take rest when he tired?
4. In which season do crickets sing?

Name: _____ Class: _____

Basic Math Quiz

$35 + 42 =$

$88 \div 22 =$

$23 \times 66 =$

$9 \times 72 =$

$427 - 322 =$

$88 - 43 =$

$16 + 31 =$

$324 \div 9 =$

From Jackson's house to Mia's house is 2.5 miles. On Friday, Jackson rode his bike to and from Mia's house five times. How many miles did he ride his bike?

Lesson Two – Concussion Signs and Symptoms

REVIEW: Concussion Signs and Symptoms Quiz

20 minutes

Purpose:

Participants will review the key information learned about Concussion signs and symptoms. This assessment will help instructors see knowledge gained over the lesson.

Materials:

- *Concussion Signs and Symptoms Quiz*
- *Concussion Signs and Symptoms Quiz – Answer Key*

Facilitation Steps:

1. Give each participant the *Concussion Signs and Symptoms Review Quiz*. Give them 10 minutes to complete the quiz.
2. Have participants self-check and peer check the quiz answers as you share from the answer key.

Name: _____ Class: _____

Concussion Signs and Symptoms Quiz

1. Which of the following is not a physical sign or symptom of concussion?
 - a. Fatigue/ drowsiness with sleep disturbances
 - b. Enhanced alertness
 - c. Headache
 - d. Dizziness/vertigo
2. Which of the following is not a sensory sign or symptom of concussion?
 - a. Transient blurred vision
 - b. Sensitivity to light
 - c. Ear ringing
 - d. Improved night vision
3. Which of the following is not a cognitive sign or symptom of concussion?
 - a. Feeling dazed, confused, or disoriented immediately following the injury
 - b. Trouble with short-term memory
 - c. Hearing voices that tell you to harm yourself
 - d. Slowed processing speed
4. Which of the following is not a behavioral sign or symptom of concussion?
 - a. Uncontrollable hunger
 - b. Irritability
 - c. Rapid mood fluctuations
 - d. Impulsive behavior
5. Which of the following is not a physical sign or symptom of moderate to severe TBI?
 - a. Raccoon eyes
 - b. Clear fluid coming from the nose or ears
 - c. Mild headache
 - d. Coma

6. Which of the following is false regarding the rare phenomenon of sudden severe brain swelling that occurs when an individual sustains a second concussion without fully recovering from an initial concussion?
 - a. It is called second-impact syndrome
 - b. Older age increases the risk
 - c. It most frequently affects male gender athletes
 - d. It is frequently associated with death or severe permanent disability
7. Regarding post-concussion syndrome, which of the following is false?
 - a. Symptoms are atypical for concussion
 - b. Female gender increases the risk
 - c. Poor coping skills and psychosocial stressors increase the risk
 - d. Psychiatric comorbidities, such as depression, anxiety, and PTSD, increase the risk

TBI Signs and Symptoms Quiz – Answer Key

1. Which of the following is not a physical sign or symptom of concussion?
 - a. Fatigue/ drowsiness with sleep disturbances
 - b. Enhanced alertness**
 - c. Headache
 - d. Dizziness/vertigo
2. Which of the following is not a sensory sign or symptom of concussion?
 - a. Transient blurred vision
 - b. Sensitivity to light
 - c. Ear ringing
 - d. Improved night vision**
3. Which of the following is not a cognitive sign or symptom of concussion?
 - a. Feeling dazed, confused, or disoriented immediately following the injury
 - b. Trouble with short-term memory
 - c. Hearing voices that tell you to harm yourself**
 - d. Slowed processing speed
4. Which of the following is not a behavioral sign or symptom of concussion?
 - a. Uncontrollable hunger**
 - b. Irritability
 - c. Rapid mood fluctuations
 - d. Impulsive behavior
5. Which of the following is not a physical sign or symptom of moderate to severe TBI?
 - a. Raccoon eyes
 - b. Clear fluid coming from the nose or ears
 - c. Mild headache**
 - d. Coma
6. Which of the following is false regarding the rare phenomenon of sudden severe brain swelling that occurs when an individual sustains a second concussion without fully recovering from an initial concussion?
 - a. It is called second-impact syndrome
 - b. Older age increases the risk**
 - c. It most frequently affects male gender athletes
 - d. It is frequently associated with death or severe permanent disability
7. Regarding post-concussion syndrome, which of the following is false?
 - a. Symptoms are atypical for concussion**
 - b. Female gender increases the risk
 - c. Poor coping skills and psychosocial stressors increase the risk
 - d. Psychiatric comorbidities, such as depression, anxiety, and PTSD, increase the risk

Sources

1. American Speech-Language-Hearing Association. (n.d.). *Traumatic Brain Injury in Adults*. American Speech-Language-Hearing Association (ASHA). Retrieved April 19, 2021, from <https://www.asha.org/practice-portal/clinical-topics/traumatic-brain-injury-in-adults/>
2. BrainLine. (2017, December 1). *Symptoms of Traumatic Brain Injury (TBI)*. <https://www.brainline.org/article/symptoms-traumatic-brain-injury-tbi>
3. Centers for Disease Control and Prevention. (2019, March 11). *Symptoms of Traumatic Brain Injury (TBI)*. Centers for Disease Control and Prevention (CDC). <https://www.cdc.gov/traumaticbraininjury/symptoms.html>
4. Centre for Neuro Skills. (n.d.). *Brain Injury Overview*. Centre for Neuro Skills (CNS). Retrieved April 19, 2021, from <https://www.neuroskills.com/brain-injury/brain-injury-overview/>
5. CogSMART program of the VA San Diego Healthcare System. (n.d.). *Traumatic Brain Injury: A Guide For Patients*. U.S. Department of Veterans Affairs. <https://www.mentalhealth.va.gov/docs/tbi.pdf>
6. Evans, R. W., & Schachter, S. C. (2020, December 21). *Posttraumatic seizures and epilepsy*. UpToDate. <https://www.uptodate.com/contents/posttraumatic-seizures-and-epilepsy>
7. John Hopkins Medicine. (n.d.). *Traumatic Brain Injury*. Retrieved April 19, 2021, from <https://www.hopkinsmedicine.org/health/conditions-and-diseases/traumatic-brain-injury>
8. Mayfield Clinic. (2018, July). *Traumatic Brain Injury*. Mayfield Brain and Spine. <https://mayfieldclinic.com/pe-tbi.htm>
9. Mayo Clinic. (2020, October 6). *Persistent post-concussive symptoms (Post-concussion syndrome) - Symptoms and causes*. <https://www.mayoclinic.org/diseases-conditions/post-concussion-syndrome/symptoms-causes/syc-20353352#:~:text=Persistent%20post%2Dconcussive%20symptoms%2C%20also,problems%20with%20concentration%20and%20memory>
10. Mayo Clinic. (2021, February 4). *Traumatic brain injury - Symptoms and causes*. <https://www.mayoclinic.org/diseases-conditions/traumatic-brain-injury/symptoms-causes/syc-20378557>
11. National Institute of Child Health and Human Development. (2020, November 24). *What are common symptoms of traumatic brain injury (TBI)?* National Institute of Child Health and Human Development (NICHD). <https://www.nichd.nih.gov/health/topics/tbi/conditioninfo/symptoms>
12. Physiopedia. (n.d.). *Overview of Traumatic Brain Injury*. Retrieved April 19, 2021, from https://www.physio-pedia.com/Overview_of_Traumatic_Brain_Injury
13. Physiopedia. (n.d.). *Second Impact Syndrome*. Retrieved May 11, 2021, from https://www.physio-pedia.com/Second_Impact_Syndrome

Lesson Three – TBI Treatment and Prevention

Lesson Overview

Participants will learn about general principles in treating concussion. They will also be given information on specific strategies to promote and enhance recovery following a concussion. Prevention is key as well. Participants will learn a variety of strategies to use to prevent the occurrence of concussions.

Lesson Objectives

After completing this lesson, participants will be able to:

- Be able to describe the fundamental component of mild TBI/ concussion treatment.
- Be able to describe general strategies to promote healing in the setting of concussion.
- Be able to describe specific treatments for particular concussion symptoms.
- Be able to name some emergency treatments and ways of monitoring patients in cases of moderate and severe TBI.
- List some preventative strategies to protect against TBI.

Lesson at a Glance

Activity	Materials	Preparation	Approximate class time
FOCUS	• <i>TBI Treatment and Prevention</i> slide presentation • <i>Health Improvement Group Discussion</i> form • Poster on Signs/Symptoms of Traumatic Brain Injury/Prevention	1. Print/photocopy <i>Health Improvement Group Discussion</i> form (one per group). 2. Prepare <i>TBI Treatment and Prevention</i> slide presentation for viewing. 3. Hang poster for reference.	20 minutes
LEARN	• <i>TBI Treatment and Prevention</i> slide presentation • Internet Access • Signs and Symptoms of Traumatic Brain Injury poster • <i>Headache and Sleep Partner Discussion</i> form • Large blank paper for posters	1. Print/photocopy <i>Headache and Sleep Partner Discussion</i> form (one per pair). 2. Prepare <i>TBI Treatment and Prevention</i> slide presentation for viewing.	40-60 minutes
REVIEW	• <i>TBI Treatment and Prevention Quiz</i> • <i>TBI Treatment and Prevention Quiz – Answer Key</i>	1. Print/photocopy the <i>TBI Treatment and Prevention Quiz</i> (one per participant).	20 minutes

Lesson Three – TBI Treatment and Prevention

FOCUS: Concussion Treatment

20 minutes

Purpose:

Participants will learn about general principles in treating concussions. They will also be given information on specific strategies to promote and enhance recovery following a concussion.

Materials:

- *TBI Treatment and Prevention* slide presentation
- *Health Improvement Group Discussion* form
- Signs and Symptoms of Traumatic Brain Injury poster

Facilitation Steps:

1. Share the *TBI Treatment and Prevention* slide presentation with participants on TBI treatment and prevention strategies.

Slide 2: Most sports-related head injuries are relatively mild and fall into the category of mild TBI, or concussion. Rest, both mental and physical, is a fundamental component of mild TBI/ concussion treatment.

Slide 3:

- Taking off from school and work for the first couple days following head injury is recommended.
- A gradual return to full-time work or school is optimal, starting out with part-time hours and increasing weekly if possible.
- Limit screen time, including television and video games.
- A good strategy for school-age patients is to space out extended study and reading time with frequent breaks.
- Avoid strenuous physical activity, particularly high-impact exercises that involve sudden, repeated head movements, such as jogging or running, since that can exacerbate the injury.

Slide 4:

- There is growing evidence that low-impact cardio without repeated movements, such

as use of a stationary bike or elliptical machine, promotes concussion recovery.

- Exercise promotes blood flow and leads to neurogenesis, creation of new brain cells, and angiogenesis, growth of new blood vessels.
- It should be performed as tolerated daily to avoid aggravation of symptoms, such as dizziness or headaches, up to 30 minutes.
- To maximize recovery, there is evidence for following up low-impact cardio with a short interval of cognitive challenge that does not involve screen time, such as reading from paper sources, having an intellectually stimulating conversation with a friend, or playing a word game up to 30 minutes as tolerated.

Slide 5:

- Stress reduction practices can also be immensely helpful in concussion recovery
- Concussion can cause dysfunction of the autonomic nervous system that regulates response to stress, leading to over-predominance of the sympathetic branch of the autonomic nervous system that promotes a fight or flight response.
- Helpful techniques include meditation and mindfulness, yoga, relaxing music, prayer, and gratitude practices.

Slide 6:

- Making sure to eat three meals per day (or smaller, more frequent meals) to obtain the proper energy and nutrients.
- Meals should emphasize fruits and vegetables while reducing or eliminating processed oils and other foods.
- There is some evidence to suggest supplementation with omega-3 fish oil, turmeric, green tea extract, and resveratrol to promote healing and reduce inflammation.

Exercise:

2. Have the class break into groups of five and give each group the *Health Improvement Group Discussion* form.
3. Have group members discuss stress reduction practices they personally practice and share with the rest of the group.
4. Have group members come up with ways they can improve their diet (which has broad health benefits not just recovery from concussion) and share with the rest of the group.
5. Call the groups back together to have a class discussion on both points.

Health Improvement Group Discussion

Group members: _____

Stress Reduction: Discuss stress reduction practices that you personally practice and make a group list to share.

Diet Improvement: Come up with ways one can improve their diet (which has broad health benefits, not just recovery from concussion). Make a list below.

Lesson Three – TBI Treatment and Prevention

LEARN: Treatments to Address Specific Symptoms and More Severe TBI, and TBI Prevention

40-60 minutes

Purpose:

Participants will learn about treatments to address specific concussion symptoms. They will also learn how more severe TBI is treated in the hospital setting and how different professionals play important roles in post-TBI rehabilitation. Finally, participants will learn TBI Prevention Strategies and a recently approved FDA device, called the Q-collar, used to protect athletes against TBI.

Materials:

- *TBI Treatment and Prevention* slide presentation
- Internet Access
- Signs and Symptoms of Traumatic Brain Injury poster
- *Headache and Sleep Partner Discussion* form
- Large blank paper for posters

Facilitation Steps:

There are treatments to consider for particular TBI symptoms

1. Continue the *TBI Treatment and Prevention* slide presentation.

Slide 7: Sleep-Wake Cycle Disruptions

- Good sleep hygiene is essential: Try to go to bed and get up at the same time every day but set your bedtime for when you are sleepy. Do not stay in bed for more than 20 minutes without falling asleep. Minimize naps. Do not eat a heavy meal at the end of the day. No heavy exercise within a couple of hours of bedtime. Avoid screen time and loud music prior to bedtime. Avoid alcohol, nicotine, and caffeine.
- The supplements melatonin, L-theanine, and L-tryptophan or 5-hydroxytryptophan (5-HTP) may be beneficial. Limited use of Benadryl can

be considered but be aware that it can worsen cognitive function.

- Avoid benzodiazepines, such as Ativan and Xanax, and non-benzodiazepine hypnotic agents, such as Ambien, due to their addictive potential and harmful effects on cognition and mood.

Slide 8: Headaches

- Alternate Tylenol and non-steroidal anti-inflammatories (NSAIDs), such as ibuprofen to avoid kidney and liver toxicity, when treating tension-type headaches.
- For severe migraine-type headaches, talk to your doctor about triptans, such as Imitrex.
- In general, narcotics should be avoided due to their addictive potential and potential for medication overuse headaches.
- Prescription migraine prophylactic medication, such as topiramate or amitriptyline, may be necessary if migraines develop but be aware that both medications can impair cognitive function.
- Dark, quiet relaxing environments are therapeutic.

Slide 9: Disturbances of Mood and Cognition

- Disturbances include mood lability, depression, anxiety, mental fatigue, and impaired memory, focus, and attention.
- Antidepressants, such as selective serotonin reuptake inhibitors (SSRIs) or serotonin and norepinephrine reuptake inhibitors (SNRIs), may be prescribed by one's doctor.
- Medications that promote focus and attention, including prescription stimulants, such as methylphenidate, may be helpful for those experiencing post-traumatic difficulties in these areas.

- Cognitive rehab for more severely affected individuals is helpful.

Slide 10: Post-traumatic Seizures and Epilepsy

- In general, immediate seizures that occur right at the time of head injury and early post-traumatic seizures that occur within one week of injury are felt to represent an acute response to trauma and carry a low risk of recurrence.
- Seizures that occur one week or more following TBI without a trigger are more likely to develop into post-traumatic epilepsy (PTE). In this condition, seizures recur on their own, requiring long-term treatment with anti-epileptic drugs (AEDs).
- Blood is very irritating to brain tissue, which can trigger a seizure.
 - If a head injury results in bleeding within the skull on the brain's surface, the patient may be placed on a prophylactic AED for a specified period of period time while blood remains to prevent seizure occurrence.
 - The AED can be tapered off if the person remains seizure-free and no scar tissue develops.

2. Exercise: Think – Pair - Share

- a. Divide the class into pairs and give each pair the *Headache and Sleep Partner Discussion* handout.
- b. Have the pairs discuss their own strategies for the treatment of headaches.
- c. Have the pairs discuss their own strategies for improving sleep.
- d. Call the class back together and share ideas discussed.

Continue the *TBI Treatment and Prevention* slide presentation.

Slide 11: Coordination and balance problems are helped by physical therapy, vestibular rehabilitation (balance restoration) therapy, and balance training exercises.

Slide 12: Persistent blurred/ double vision (aka diplopia) can be addressed with visual rehab and prism glasses if needed. When moderate or severe TBI occurs, affected individuals must be monitored in an ICU setting.

Slide 13: An intracranial pressure (ICP) monitor may be placed by neurosurgery to evaluate pressure

inside the skull, called intracranial pressure or ICP, which is a way of assessing for brain swelling.

- If ICP pressure is elevated, emergency surgical intervention may be necessary.
- A frequently used ICP monitor is a ventriculostomy tube where a tube is placed into a fluid space (called a ventricle) within the brain.
- Elevated ICP can sometimes be relieved through the removal of fluid through the ventriculostomy tube.

Slide 14: Emergency neurosurgical procedures following more severe TBI

- Craniotomy: removal of a small portion of the skull (which is replaced after the surgery) to remove a blood clot or repair a damaged blood vessel or fractured skull
- Decompressive craniectomy: removal of a large area of skull to relieve brain swelling; once the swelling comes down after 1-3 months, the skull is replaced
- Intubation may be necessary for artificial respiration, such as if the brainstem, which controls breathing, is affected, or prior to surgical intervention
- Neurorehabilitation for long-term deficits

Slide 15: Multiple professionals play key roles in post-TBI rehabilitation

- Occupational therapists focus on improving upper extremity function.
- Physical therapists focus on improving lower extremity function.
- Speech therapists and cognitive therapists work on improving language and cognitive function, respectively.
- The Physical Medicine and Rehabilitation physicians, aka physiatrists, direct and coordinates the rehabilitative process.

Slide 16: An enriching, stimulating environment appears to aid in recovery following TBI. This can be partly explained by its ability to enhance motivation and improve emotional well-being, protecting against depression. It also promotes re-engagement with the outside world and exploration.

Slide 17 and 18: Preventative Strategies include:

- Education
 - What concussion is and its seriousness

- How to limit exposure to head injury through proper technique
- Use of appropriately sized and fitted protective equipment, including use of helmets and other protective headgear approved by the American Society for Testing and Materials (ASTM)
- Strengthening neck muscles can help mitigate head injury by absorbing some of the force of a blow to the head
- Avoiding unnecessary clothing that will obstruct one's vision
- Improving lighting and visibility
- Adhering to rules that promote safety and changing rules that foster injury (such as sliding headfirst into bases while playing baseball)
 - For example, requiring evaluation by a licensed healthcare professional before return to play
 - Monitoring patterns of injury will help in coming up with rules to avoid them.
- Appropriately supervising young children
 - Younger children need to be monitored closely
 - Sports played should be appropriate for a child's age
- Checking the depth of pools to avoid diving in pools less than 12 feet deep
- Avoiding sports when ill or otherwise compromised (e.g., poor sleep or under the influence of alcohol or drugs, even if prescribed)
- Inspecting sports facilities (including fields and playgrounds) and equipment for safety
- Replacing damaged sports equipment and safety gear
- Monitoring for and attempting to mitigate long-term sequelae: post-concussion syndrome and chronic traumatic encephalopathy

Slide 19: A new device, known as the Q-collar, has been authorized by the FDA for marketing beginning in early 2021 for athletes aged 13 years and older to protect the brain against the effects of repeated minor head trauma

- The collar is worn around the neck, and pressure from the device slightly reduces venous outflow, increasing blood volume. This decreases the movement of the brain within the skull resulting from blows or jolts to the head, reducing impact injury to brain tissue.
- It is used in conjunction with helmets and other protective equipment; it does not replace them.
- It requires a prescription.

3. Exercise: TBI Prevention Poster

- a. Ask the class if they can think of other ways to enhance safety when they play sports to decrease their risk of TBI.
- b. Give participants 4 minutes to look up prevention strategies.
- c. Have participants make some notes on prevention strategies they find.
- d. Hand out the poster paper and have each participant come up with a TBI prevention logo and messaging.
- e. Hang posters around the school.

Name: _____ Class: _____

Headache and Sleep Partner Discussion

Discussion members: _____

Headache Treatment: Discuss strategies for the treatment of headaches. Write treatments in the space provided below.

Sleep Improvement: Discuss strategies for improving sleep. Write strategies in the space provided below.

Lesson Three – TBI Treatment and Prevention

REVIEW: TBI Treatment & Prevention Quiz

10 minutes

Purpose:

Participants work in groups to complete a puzzle, testing their knowledge of the male and female reproductive systems.

Materials:

- *TBI Treatment and Prevention Quiz*
- *TBI Treatment and Prevention Quiz – Answer Key*

Facilitation Steps:

1. Give each participant the *TBI Treatment and Prevention Quiz*. Give them 10 minutes to complete the quiz.
2. Have participants self-check and peer check the quiz answers as you share from the answer key.

Name: _____ Class: _____

TBI Treatment and Prevention Quiz

1. What is the fundamental component of mild TBI/ concussion treatment?

2. True or False Ideally, return to work or school should be all or none after TBI.
3. Which of the following strategies are helpful in recovery following a concussion? (Circle all that apply)
 - a. Strenuous high impact exercise
 - b. Low-Impact Cardio
 - c. Lots of screen time
 - d. Session of cognitive challenge no more than 30 minutes following low-impact cardio
 - e. Stress reduction techniques, such as meditation
 - f. Giving yourself a free pass to eat as much junk food as you want
4. Good sleep hygiene is critical in treating sleep-wake cycle disruptions that can result from concussions. Which of the following are components of good sleep hygiene? (Circle all the apply)
 - a. Getting up and going to bed at the same time every day
 - b. Staying in bed for as long as it takes until you fall asleep
 - c. Eating a heavy meal right before bedtime
 - d. Taking full advantage of chemical aids such as caffeine to stay alert during the day and alcohol to help fall asleep at night
 - e. Trying to sleep as much as you can and for as long as possible during the day
 - f. Avoiding screen time and loud music before bedtime
5. Why is alternating Tylenol and NSAIDs, such as ibuprofen, important in treating tension-type headaches?
 - a. Because it is common sense
 - b. To avoid becoming resistant to their pain-relieving effects
 - c. To make sure different pharmaceutical companies get adequately compensated
 - d. To avoid liver and kidney toxicity
6. True or False Cognitive rehab may be helpful for individuals more severely affected by concussions.
7. True or False Someone who has a seizure immediately following a head injury always has epilepsy and will need to be on AEDs for the rest of their life.

8. Which of the following might be necessary in cases of moderate to severe head trauma?
 - a. Intubation for artificial respiration
 - b. Placement of intracranial pressure (ICP) monitor
 - c. Surgical intervention, such as a craniotomy to remove a large build-up of blood or a hemicraniectomy to relieve pressure from brain swelling
 - d. All of the above might be necessary depending on the location, nature, and extent of brain injury
9. What type of therapist focuses on improving upper extremity (arm and hand) function?
 - a. Physical therapist
 - b. Speech therapist
 - c. Occupational therapist
 - d. Physiatrist
10. Which of the following are NOT helpful preventative strategies against TBI? (Circle all that apply)
 - a. Educating athletes about the risk of TBI and proper techniques of play
 - b. Making sure athletes wear the same size helmet no matter what their head size is
 - c. Playing in the dark and dimly lit environments
 - d. Closely supervising younger children
 - e. Using old, damaged equipment, including safety equipment, to save money
 - f. Adhering to rules that promote safety
11. True or False The new Q-collar device replaces the use of helmets and other protective equipment.

TBI Treatment and Prevention Quiz – Answer Key

1. What is the fundamental component of mild TBI/ concussion treatment? **rest, both mental and physical**
2. True or **False** Ideally, return to work or school should be all or none after TBI.
3. Which of the following strategies are helpful in recovery following a concussion? (Circle all that apply)
 - a. Strenuous high impact exercise
 - b. Low-Impact Cardio**
 - c. Lots of screen time
 - d. Session of cognitive challenge no more than 30 minutes following low-impact cardio**
 - e. Stress reduction techniques, such as meditation**
 - f. Giving yourself a free pass to eat as much junk food as you want
4. Good sleep hygiene is critical in treating sleep-wake cycle disruptions that can result from concussions. Which of the following are components of good sleep hygiene? (Circle all that apply)
 - a. Getting up and going to bed at the same time every day**
 - b. Staying in bed for as long as it takes until you fall asleep
 - c. Eating a heavy meal right before bedtime
 - d. Taking full advantage of chemical aids such as caffeine to stay alert during the day and alcohol to help fall asleep at night
 - e. Trying to sleep as much as you can and for as long as possible during the day
 - f. Avoiding screen time and loud music before bedtime**
5. Why is alternating Tylenol and NSAIDs, such as ibuprofen, important in treating tension-type headaches?
 - a. Because it is common sense
 - b. To avoid becoming resistant to their pain-relieving effects
 - c. To make sure different pharmaceutical companies get adequately compensated
 - d. To avoid liver and kidney toxicity**
6. **True** or False Cognitive rehab may be helpful for individuals more severely affected by concussions.
7. True or **False** Someone who has a seizure immediately following a head injury always has epilepsy and will need to be on AEDs for the rest of their life.

8. Which of the following might be necessary in cases of moderate to severe head trauma?
- a. Intubation for artificial respiration
 - b. Placement of intracranial pressure (ICP) monitor
 - c. Surgical intervention, such as a craniotomy to remove a large build-up of blood or a hemicraniectomy to relieve pressure from brain swelling
 - d. All of the above might be necessary depending on the location, nature, and extent of brain injury**
9. What type of therapist focuses on improving upper extremity (arm and hand) function?
- a. Physical therapist
 - b. Speech therapist
 - c. Occupational therapist**
 - d. Physiatrist
10. Which of the following are NOT helpful preventative strategies against TBI? (Circle all that apply)
- a. Educating athletes about the risk of TBI and proper techniques of play
 - b. Making sure athletes wear the same size helmet no matter what their head size is**
 - c. Playing in the dark and dimly lit environments**
 - d. Closely supervising younger children
 - e. Using old, damaged equipment, including safety equipment, to save money**
 - f. Adhering to rules that promote safety
11. True or **False** The new Q-collar device replaces the use of helmets and other protective equipment.

Sources

1. Allen, M. (2019, March 29). *How to Treat a Concussion*. Cognitive FX. <https://www.cognitivefxusa.com/blog/how-to-treat-a-concussion>
2. American Association of Neurological Surgeons. (2020, February 3). *Traumatic Brain Injury – Causes, Symptoms and Treatments*. American Association of Neurological Surgeons (AANS). <https://www.aans.org/Patients/Neurosurgical-Conditions-and-Treatments/Traumatic-Brain-Injury>
3. Centers for Disease Control and Prevention. (2019, February 12). *Recovery from Concussion*. Centers for Disease Control and Prevention (CDC). https://www.cdc.gov/headsup/basics/concussion_recovery.html
4. Cleveland Clinic. (2020, June 2). *Concussion: Causes, Symptoms, Diagnosis, Treatments, Prevention*. <https://my.clevelandclinic.org/health/diseases/15038-concussion>
5. Galgano, M., Toshkezi, G., Qiu, X., Russell, T., Chin, L., & Zhao, L. (2017, June 30). *Traumatic Brain Injury: Current Treatment Strategies and Future Endeavors*. SAGE Journals. <https://journals.sagepub.com/doi/full/10.1177/0963689717714102>
6. Ko, D. Y. (2017, December 6). Posttraumatic Epilepsy. Medscape. <https://emedicine.medscape.com/article/1184178-overview>
7. Mayfield Clinic. (2018, July). *Traumatic Brain Injury*. Mayfield Brain & Spine. <https://mayfieldclinic.com/pe-tbi.htm>
8. Mayo Clinic. (2020, February 22). *Concussion - Diagnosis and treatment*. <https://www.mayoclinic.org/diseases-conditions/concussion/diagnosis-treatment/drc-20355600>
9. Mayo Clinic. (2021, February 4). *Traumatic brain injury - Diagnosis and treatment*. Mayo Clinic. <https://www.mayoclinic.org/diseases-conditions/traumatic-brain-injury/diagnosis-treatment/drc-20378561>
10. National Institutes of Health. (2020, November 24). *What are the treatments for traumatic brain injury (TBI)?* National Institutes of Health (NIH). <https://www.nichd.nih.gov/health/topics/tbi/conditioninfo/treatment>
11. U.S. Food & Drug Administration. (2021, March 31). *Traumatic Brain Injury: What to Know About Symptoms, Diagnosis, and Treatment*. U.S. Food and Drug Administration (FDA). <https://www.fda.gov/consumers/consumer-updates/traumatic-brain-injury-what-know-about-symptoms-diagnosis-and-treatment>
12. U.S. Food and Drug Administration. (2021, February 26). *FDA Authorizes Marketing of Novel Device to Help Protect Athletes' Brains During Head Impacts*. U.S. Food and Drug Administration (FDA). <https://www.fda.gov/news-events/press-announcements/fda-authorizes-marketing-novel-device-help-protect-athletes-brains-during-head-impacts>
13. Woodard, T. J., & Allen, S. N. (2017, January 1). *An Overview of the Management of Concussion*. Medscape. https://www.medscape.com/viewarticle/877675_4

Lesson Four – TBI Scenarios

Lesson Overview

Participants will be introduced to a series of scenarios involving concussions including CTE. They will learn to recognize TBI based on mechanism of injury, subsequent constellation of symptoms and signs, and overall course of injury and subsequent recovery. Participants will apply knowledge gained from previous lessons to recognize complications and syndromes, specifically second impact syndrome and post-concussion syndrome.

Lesson Objectives

After completing this lesson, participants will be able to:

- Recognize an example of uncomplicated concussion both with and without skull fracture.
- Recognize epilepsy as a consequence of multiple TBIs and brain bleeds as a risk factor for the development of post-traumatic seizures.
- Recognize a case of second impact syndrome.
- Recognize a case of chronic traumatic encephalopathy (CTE).
- Recognize a case of post-concussion syndrome.

Lesson at a Glance

Activity	Materials	Preparation	Approximate class time
FOCUS	• <i>TBI Scenarios</i> slide presentation • Anatomy of a Brain During Concussion poster • Brain and Cerebral Arteries Model	1. Prepare the <i>TBI Scenarios</i> slide presentation for viewing 2. Have the brain model available for use 3. Hang the poster for reference	10-15 minutes
LEARN	• <i>TBI Scenarios</i> slide presentation and/or • <i>TBI Scenarios Packet</i> • Internet access	1. Print/photocopy <i>TBI Scenarios Packet</i> (one per participant or group) 2. Prepare <i>TBI Scenarios</i> slide presentation for viewing	60 minutes
REVIEW	• <i>TBI Case Scenarios Quiz</i> • <i>TBI Case Scenarios Quiz – Answer Key</i>	1. Print/photocopy <i>TBI Case Scenarios Quiz</i> (one per participant)	20 minutes

Lesson Four – TBI Scenarios

FOCUS: Introduction Case Scenario

10-15 minutes

Purpose:

Participants will be introduced to a scenario involving concussion. They will learn to recognize TBI based on the mechanism of injury, a subsequent constellation of symptoms and signs, and overall course of injury and subsequent recovery.

Materials:

- *TBI Scenarios* slide presentation
- Anatomy of a Brain During Concussion poster
- Brain and Cerebral Arteries Model

Facilitation Steps:

1. Introduce Case Scenario 1

Slides 2-3

Patty is a 14-year-old female who was kicked in the head in the final round of a karate match. She was wearing head protection and was not knocked down from the blow. However, later she was noticed to be acting a bit dazed and confused. Patty was unable to recall what happened during the match and complained of having a headache. Her symptoms improved after being given fluids.

Two days later, Patty was evaluated by her pediatrician. She complained of a moderate headache for the past two days that was improving. An Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) test was conducted, which showed that her overall score had worsened, along with persistent symptoms including headache and confusion.

For the next two weeks, Patty had greater difficulty staying on task and completing her homework assignments. Her school was very techno-savvy, and most of her assignments were administered through a tablet device. Patty

was given school accommodations to return to full-time classwork gradually and was excused from any strenuous physical activity.

By the fourth week following her head injury, symptoms had stopped, and Patty was performing well in school. She had been cleared for non-contact sports with plans to return to contact sports soon.

2. Exercise: Group Debrief

Ask the class the following questions:

- What did Patty do to protect herself from head injury?
Answer: wearing her helmet and possibly using good karate defensive technique
- If Patty had not been given school accommodations, how would this have affected her recovery?
- Is there anything else Patty could or should have done to protect herself?
- Ask the class if any of them have suffered head injuries or witnessed others who had one. Allow those who raised their hand to recount their stories.

3. Anatomy Review: Review the parts of the brain with participants by using the poster and the brain model as references. Pass the brain model around or ask for volunteers to put it back together again.

4. Explain to participants that they are going to be working through a series of case studies in this lesson. Knowing the vulnerable areas of the brain will help them understand the impact of the head injuries in the various case scenarios.

Lesson Four – TBI Scenarios

LEARN: Further Case Scenarios

60 minutes

Purpose:

Participants will gain greater mastery and application of information they learned about TBI by going through seven other case scenarios. Many of the scenarios involve complications beyond a straightforward concussion and subsequent recovery. Participants will apply knowledge gained from previous lessons to recognize complications and syndromes, specifically second impact syndrome and post-concussion syndrome. One of the case scenarios is an example of chronic traumatic encephalopathy (CTE).

Materials:

- *TBI Scenarios* slide presentation and/or
- *TBI Scenarios Packet* (one per individual, pair, or small group)
- Internet access

Facilitation Steps:

1. Decide how you'd like participants to work through the seven scenarios in the scenarios packet. Participants can complete these individually, or you can use pairs or small groups as well.
2. Give each participant and/or group the TBI Scenarios Packet.
3. Allow time to work through each one.
4. Another alternative is to work through these as a whole class discussion. If you choose this method, show each of the scenarios using the *TBI Scenarios* slide presentation. As you share each scenario with the class, you can ask the discussion questions in the packet orally.

TBI Scenario Packet

Case 1

Patty is a 14-year-old female who was kicked in the head in the final round of a karate match. She was wearing head protection and was not knocked down from the blow. However, later she was noticed to be acting a bit dazed and confused. Patty was unable to recall what happened during the match and complained of having a headache. Her symptoms improved after being given fluids.

Two days later, Patty was evaluated by her pediatrician. She complained of a moderate headache for the past two days that was improving. An Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) test was conducted, which showed that her overall score had worsened, along with persistent symptoms including headache and confusion.

For the next two weeks, Patty had greater difficulty staying on task and completing her homework assignments. Her school was very techno-savvy, and most of her assignments were administered through a tablet device. Patty was given school accommodations to return to full-time classwork gradually and was excused from any strenuous physical activity.

By the fourth week following her head injury, symptoms had stopped, and Patty was performing well in school. She had been cleared for non-contact sports with plans to return to contact sports soon.

Case 1 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Case 2

Dustin is a 16-year-old male with a history of numerous headaches sustained during football games. He mentioned feeling “out of it” at the start of a high school football game. During the game, he sustained several blows to the body from collisions with other players and was tackled once, resulting in his head hitting the ground. At halftime, Dustin had difficulty remembering routine stretching exercises.

Other complaints included concentration difficulties, dizziness, nausea, and disorientation. During sideline assessment, half an hour after his last contact, Dustin lost consciousness and went on to develop a three-and-a-half-minute generalized tonic-clonic seizure and then right hemiparesis (weakness in one-half of the body) in the immediate aftermath of the seizure (called the post-ictal period). [Note this phenomenon of partial body weakness following a seizure is known as Todd’s paralysis and does not mean a stroke occurred].

Dustin spontaneously regained consciousness and was transported via ambulance to the hospital. A CT Head was performed, which was negative for any acute pathology, such as detectable brain swelling, hemorrhage, or skull fracture. After being monitored overnight, he was sent home with a concussion diagnosis and instructions to follow up in the clinic.

Two days later, Dustin came in for a physical exam and complained of the following symptoms: mild to moderate headaches, dizziness, nausea, fatigue, transient blurred vision, noise sensitivity, light sensitivity, trouble concentrating, irritability, forgetfulness, drowsiness, insomnia, and sleeping more than usual. He admitted to having had several prior head injuries that had never been medically evaluated. His physical exam was notable for neck stiffness and tenderness in the muscles of the neck and right posterior head (occiput). The following diagnoses were made: cervical neck sprain, concussion with LOC, and post-concussive seizure.

Dustin was placed on a plan to gradually return to academic coursework, a low-impact home exercise program, a rigorous sleep hygiene schedule, and restriction from contact sports. At a two-week follow-up, symptoms had improved. However, ten weeks later, symptoms persisted, and Dustin experienced another witnessed generalized tonic-clonic seizure.

At that point, he had an MRI Brain and an electroencephalogram (EEG), which detects the electrical activity on the surface of the brain to look for evidence of irritability that would suggest an increased risk of seizures. The MRI was unremarkable. The EEG showed left greater than right temporal slowing and left temporal, sharp waves.

Dustin initially declined treatment with anti-epileptic drugs (AEDs). After two more seizures in the following five months, he finally agreed to treatment and was placed on lamotrigine, which was slowly titrated up to a therapeutic dosage.

A sports medicine physician, neurologist, neuropsychologist (psychologist who treats patients with neurologic conditions), cognitive-behavioral therapist, physical therapist, athletic trainer, and neuro-ophthalmologist (an eye doctor who focuses on vision problems due to neurologic problems) continued to follow his progress. Symptoms have slowly ameliorated, and Dustin has had only one breakthrough seizure in one year since starting AED treatment.

Case 2 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Case 3

Hank, a 17-year-old high school football player, sustained two unreported head injuries during a football game and had continued to play despite headaches and nausea. On the way to the sideline, he took off his helmet and looked disoriented. Hank then collapsed onto his knees and vomited. Upon questioning, he was fully oriented but complained of intense head pain, nausea, and vertigo. EMS was called, and paramedics came onto the field to transport him via stretcher to an ambulance.

When a C-collar was being placed, Hank became briefly unresponsive, and there was some concern for seizure. Later, while he was being driven to the hospital, he did experience a visible tonic-clonic seizure lasting several minutes with urinary incontinence. Hank was lucid and fully oriented upon arrival to the Emergency Room but continued to experience severe headaches, nausea, and vomiting. The treating physician administered an IV solution to reduce intracranial pressure, called mannitol. A neurologic exam was normal. An urgent Brain MRI revealed a 1.3 cm acute subdural hematoma (SDH) located at the border zone between the frontal and temporal lobes.

Hank was administered the AED Dilantin for seizure prophylaxis since he had a prior seizure, and head bleeds overlying the surface of the brain are known to induce seizures. He was carefully monitored overnight with serial exams and repeated CT Heads, and neurosurgery was alerted in case emergent neurosurgical intervention became necessary.

At 24 hours, Hank's CT Head showed that the size of his SDH had significantly decreased without any further bleeding, and there was no evidence that cerebral spinal fluid (CSF) flow through the open spaces of the brain (cerebral ventricles) was blocked. Furthermore, there was no compression of brain tissue (mass effect). He was discharged home with instruction for his parents to closely monitor him. Hank was written a note excusing him from schoolwork or sports participation until follow-up examination by a physician, and a repeat CT Head was performed.

At his one-week follow-up, both an EEG and a CT Head were performed. His CT Head demonstrated complete resolution of the SDH. However, an EEG demonstrated some left temporal sharp waves (indicating an increased risk of seizures), so Hank was placed on another AED called levetiracetam, which is better tolerated for six months. He was placed on driving restriction until he accrued three months in a row without seizures. Head and neck pain persisted, for which he was given an NSAID injection called ketorolac and prescribed high dose ibuprofen, as well as a low dose muscle relaxer.

At one month, Hank was doing well; symptoms were improving, and he remained seizure-free. Gradual return to full-time daily activity was permitted except for restriction from physical education class, which would remain in place until Hank was completely asymptomatic and cleared by a physician. Contact sports were prohibited for one year, and preventative measures would be necessary to participate in baseball if cleared by a physician to do so. At six months, Hank's neurologist will determine whether continuing levetiracetam will be necessary or whether it can be stopped after repeating an EEG and finding out whether any further seizures occurred.

Case 3 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Case 4

Tim is an 18-year-old male playing centerfield. During warm-up practice before a game, he was walking through the batting circle and accidentally got hit with a baseball bat by another player on the right side of his head. Loss of consciousness did not occur, but Tim was stunned and disoriented and had trouble focusing for a short time. His only other symptom was a headache. Other symptoms, such as dizziness, visual changes, nausea, vomiting, numbness, weakness, or seizures, were absent.

Tim was transported to the closest hospital for ER evaluation. His GCS came back at 15. Confusion had resolved, and no memory loss surrounding the event was found. No neurologic deficit was detected on physical examination. A scalp laceration and hematoma in the parietal area was noted. CT Head showed a nondisplaced skull fracture (the contour of the skull was maintained without any opening to the outside environment) in the right parietal area with a small underlying brain contusion (bruise).

Tim got admitted to the hospital for observation overnight. He did well overnight without any new complaints or neurologic abnormalities seen on the exam. A repeat CT head showed stable findings. Tim was discharged with instructions to avoid active participation in baseball until being evaluated by a neurosurgeon.

Two weeks later, when seen at the neurosurgery clinic, Tim reported being symptom-free. His headache had resolved. No neurologic abnormalities were detected on the exam, and he was cleared to resume regular daily activities, including baseball. The neurosurgeon did recommend staying away from heavy lifting, bending, turning, and twisting over the next several months, but no physical therapy or protective headgear was needed. Tim later followed up at the sports medicine clinic and remained asymptomatic.

Case 4 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Case 5

Jimmy is a 17-year-old football player. Of note, three weeks before, he was diagnosed with a concussion but had fully recovered and was medically cleared to return to play a week later. This afternoon, Jimmy was tackled during a game after intercepting the ball and running 80 yards, and his head hit the ground. He did not lose consciousness, although the force of the impact broke his chinstrap and ear pads. Within a couple of minutes, Jimmy was evaluated by the team's physician assistant and the athletic trainer. During the exam, Jimmy felt nauseous and vomited several times. He also complained of having a headache and feeling dizzy. Neurologic examination revealed no abnormalities. Given the complaints of headache and nausea, Jimmy was taken to the local hospital's emergency department. Since no LOC had occurred and the neurologic exam was unremarkable, the ER physician made a diagnosis of "forehead contusion" and discharged the athlete on ibuprofen for headache without performing a CT Head.

Two days later, Jimmy was re-examined by the physician assistant overseen by the supervising physician. Some residual headaches persisted, but dizziness, nausea, and vomiting had stopped soon after the injury. Again, a neurologic exam was normal. An Automated Neuropsychological Assessment Metrics (ANAM) computerized test was performed that revealed deficits in reaction time, problem-solving, and short-term memory when compared to age-matched individuals. A CT Head was performed that did not show any brain swelling or bleeding. Jimmy was diagnosed with resolving mild TBI/ concussion. His vomiting was felt to have been induced by physical exertion after racing 80 yards. Jimmy was instructed to avoid high-impact exercise and all contact sports until completely asymptomatic, both at rest and with exertion. The risk of second impact syndrome if a return to play is premature was discussed. Follow-up ANAM testing was scheduled, but Jimmy skipped the appointment. Reportedly, he felt back to baseline health after three weeks post-concussion and was doing well at school.

Case 5 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Case 6

Liam is a 15-year-old football player. In the first quarter, he fell backward while tackling another player and hit the back of his head on the surface of the playing field. The play was stopped according to league rules, and Liam left before the end of the quarter and waited out the first half of the game. He did not tell anyone about the headache he was having. Liam insisted on returning to play after halftime despite the athletic trainer's suggestion otherwise.

In the fourth quarter, his father noticed that Liam collided with other players on several occasions. After the game, Liam's father went to check on him and found him sitting, unable to rise. He was grabbing his head and rocking back and forth in pain. Liam's father and another parent carried him off the field. EMS first responders transported him via helicopter to the nearest comprehensive medical center.

A CT Head showed severe, diffuse brain swelling. Emergency bilateral hemicraniectomy (the removal of sides of the skull) was performed to relieve the elevated intracranial pressure that would cause rapid death from the swollen brain compressing the brain stem, which controls breathing and other basic functions necessary for life.

After the surgery, Liam suffered several small strokes. He remained on the artificial ventilator for seven days and spent three months in the ICU in a coma. Upon awakening, Liam spent four weeks in a nursing home and two months in a children's hospital for rehabilitation. It took nine months to speak his first word and 13 months to move an arm or leg. Liam remained on a feeding tube for 20 months. Even with aggressive rehab, it took three years until he could stand upright with assistance.

Case 6 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Case 7

Bobby was a 43-year-old male with a storied 20-year career playing for the National Football League (NFL), where he served as a linebacker and suffered numerous concussions. In the past couple of years, Bobby underwent a series of sudden behavioral changes and cognitive deterioration. Most recently, he developed resting tremors in his hands and a slowing of his movements (parkinsonism). Sadly, Bobby committed suicide, and an autopsy was performed confirming the diagnosis of chronic traumatic encephalopathy (CTE).

Case 7 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Case 8

Susan was a 20-year-old college freshman hockey player previously treated for depression and anxiety. During a hockey game, she collided with another player on ice resulting in a coup-contrecoup head injury. Initially, Susan experienced dizziness, nausea, headache, and some transient blurring of her vision. She was excused from school and stayed at home, lying down for most of the day in a dark room. Susan had multiple doctor follow-ups for both concussion symptoms and exacerbation of her depression and anxiety. Her neurologic exam was within normal limits.

Because Susan's concussion symptoms did not seem to be resolving, and her headaches were, in fact, getting worse over time, her physician ordered an MRI Brain Scan, which came back unremarkable. Susan attempted to go back to her studies after one week and multiple times thereafter, but the stress of schoolwork gave her intolerable dizziness and headaches. She also complained of feeling fatigued for hours after studying or physical activity.

At six months, symptoms had only minimally improved after trying multiple therapies to treat headache, nausea, and dizziness. Susan admitted to having three prior concussions over the past year. Resolution of symptoms from her prior concussions took progressively longer durations of time (one week up to three weeks).

Case 8 Debrief Answers

1. Was the affected athlete wearing protective equipment? Yes No
2. Was the athlete following recommended guidelines regarding return to play when the head injury occurred? Yes No
3. What symptoms does the affected athlete have?
4. How do these symptoms inform you about the severity of the head injury?
5. What measures were taken to promote recovery?
6. Were special treatments necessary. If so, what were they?
7. How quickly did the athlete return to baseline function or what deficits were they left with?

Lesson Four – TBI Scenarios

REVIEW: TBI Case Scenarios Quiz

20 minutes

Participants will review the key information learned in the TBI case scenarios. This assessment will help instructors see knowledge gained over the lesson.

Materials:

- *TBI Case Scenarios Quiz*
- *TBI Case Scenarios Quiz – Answer Key*

Facilitation Steps:

1. Give each participant the *TBI Case Scenario Quiz*. Give them 10 minutes to complete the quiz.
2. Have participant self-check and peer check the quiz answers as you share from the answer key.

Name: _____ Class: _____

TBI Case Scenarios Quiz

1. Which case scenario # provides an example of post-concussion syndrome? _____
2. True or False Epilepsy (a syndrome of recurrent non-provoked seizures) can occur in the context of multiple concussions.
3. True or False Brain bleeds (particularly when they involve the surface of the brain) decrease the risk of developing seizures.
4. True or False Anti-epileptic drugs (AEDs) are sometimes prescribed prophylactically (preventatively) in the context of brain bleeds affecting the surface of the brain.
5. True or False Every skull fracture means serious brain injury has occurred.
6. What three case scenarios represent concussion with uncomplicated recovery?

7. Which case scenario is an example of second impact syndrome? _____
8. In the second impact syndrome case scenario, which of the following risk factors for acquiring the syndrome do not pertain to the subject?
 - a. Young age
 - b. Not wearing a helmet
 - c. Returning to play before fully recovering from a head injury
 - d. Male gender
9. True or False NFL players are not at higher risk of developing chronic traumatic encephalopathy (CTE) than non-athletes.
10. In the post-concussion syndrome case scenario, which of the following risk factors for acquiring the syndrome pertain to the subject (find all that apply)?
 - a. Female gender
 - b. Psychiatric comorbidities
 - c. Older age
 - d. Psychosocial stressors

TBI Case Scenarios Quiz – Answer Key

1. Which case scenario # provides an example of post-concussion syndrome? **Case 8**
2. **True** or False Epilepsy (a syndrome of recurrent non-provoked seizures) can occur in the context of multiple concussions.
3. True or **False** Brain bleeds (particularly when they involve the surface of the brain) decrease the risk of developing seizures.
4. **True** or False Anti-epileptic drugs (AEDs) are sometimes prescribed prophylactically (preventatively) in the context of brain bleeds affecting the surface of the brain.
5. True or **False** Every skull fracture means serious brain injury has occurred.
6. What three case scenarios represent concussion with uncomplicated recovery? **Case 1, Case 4, and Case 5**
7. Which case scenario is an example of second impact syndrome? **Case 6**
8. In the second impact syndrome case scenario, which of the following risk factors for acquiring the syndrome do not pertain to the subject?
 - a. Young age
 - b. Not wearing a helmet**
 - c. Returning to play before fully recovering from a head injury
 - d. Male gender
9. True or **False** NFL players are not at higher risk of developing chronic traumatic encephalopathy (CTE) than non-athletes.
10. In the post-concussion syndrome case scenario, which of the following risk factors for acquiring the syndrome pertain to the subject (Circle all that apply)?
 - a. Female gender**
 - b. Psychiatric comorbidities**
 - c. Older age
 - d. Psychosocial stressors**

Sources

1. Azad, T. D., Li, A., Pendharkar, A. V., Veeravagu, A., & Grant, G. A. (2016). Junior Seau: An Illustrative Case of Chronic Traumatic Encephalopathy and Update on Chronic Sports-Related Head Injury. *World Neurosurgery*, 86, 515.e11-515.e16. <https://doi.org/10.1016/j.wneu.2015.10.032>
2. Centers for Disease Control and Prevention. (n.d.). *Traumatic Brain Injury in Sports: A Father's Story*. Centers for Disease Control and Prevention (CDC). https://www.cdc.gov/headsup/pdfs/stories/a_fathers_story-a.pdf
3. Dirks, R. P., & Valovich McLeod, T. C. (2008). Sport-Related Mild Traumatic Brain Injury. *Clinician Reviews*, 18(9), 18–24. <https://www.mdedge.com/clinicianreviews/article/86213/pediatrics/sport-related-mild-traumatic-brain-injury>
4. Hellwinkel, J. E., Anderson, F. L., Trofa, D. P., Deitrich, M. P., Dansby, J. D., Noble, J. M., & Bottiglieri, T. S. (2020). Post-Traumatic Epilepsy after Sports-Related Concussion: A Case Report. *Neurotrauma Reports*, 1(1), 42–45. <https://doi.org/10.1089/neur.2020.0013>
5. Liu, R. W., Smith, S. E., Tanner, P. C., Belzberg, A. J., & McFarland, E. G. (2009). Skull Fracture and Brain Contusion in a Baseball Player: A Case Report. *Athletic Therapy Today*, 14(1), 35–38. <https://doi.org/10.1123/att.14.1.35>
6. Logan, S. M., Bell, G. W., & Leonard, J. C. (2001). Acute Subdural Hematoma in a High School Football Player After 2 Unreported Episodes of Head Trauma: A Case Report. *Journal of Athletic Training*, 36(4), 433–436. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC155441/>
7. Physiopedia. (n.d.). *Case Study - Rehabilitation of Post Concussion Syndrome*. https://www.physio-pedia.com/Case_Study_-_Rehabilitation_of_Post_Concussion_Syndrome
8. Rudnick, C. (2016, May 4). *Case Study: High School Sports Concussions*. The Medical Algorithms Company (Medal). <https://blog.medicalalgorithms.com/high-school-sports-concussions/>

Name: _____ Class: _____

Pre- and Post-Summative Assessment

1. TBI results from an external mechanical force that results in an _____ of brain function.
2. Name the two most common causes of TBI-related Emergency Department Visits. _____

3. True or False Mild TBI results in visible trauma to the brain on CT Head imaging.
4. True or False Epilepsy (a syndrome of recurrent non-provoked seizures) can occur in the context of multiple concussions.
5. True or False Brain bleeds (particularly when they involve the surface of the brain) decrease the risk of developing seizures.
6. Name three types of contusions that can result from TBI. _____, _____, and _____

7. True or False NFL players are not at higher risk of developing chronic traumatic encephalopathy (CTE) than non-athletes.
8. True or False Anti-epileptic drugs (AEDs) are sometimes prescribed prophylactically (preventatively) in the context of brain bleeds affecting the surface of the brain.
9. Name the three areas of the brain that are particularly vulnerable to traumatic insult. _____, _____, and _____

10. True or False Every skull fracture means serious brain injury has occurred.
11. Which of the following strategies are helpful in recovery following a concussion? (Circle all that apply)
 - a. Strenuous high impact exercise
 - b. Low-Impact Cardio
 - c. Lots of screen time
 - d. Session of cognitive challenge no more than 30 minutes following low-impact cardio
 - e. Stress reduction techniques, such as meditation
 - f. Giving yourself a free pass to eat as much junk food as you want
12. Which of the following is not a cognitive sign or symptom of concussion?
 - a. Feeling dazed, confused, or disoriented immediately following the injury
 - b. Trouble with short-term memory
 - c. Hearing voices that tell you to harm yourself
 - d. Slowed processing speed

13. Which of the following is not a behavioral sign or symptom of concussion?
- a. Uncontrollable hunger
 - b. Irritability
 - c. Rapid mood fluctuations
 - d. Impulsive behavior
14. What type of therapist focuses on improving upper extremity (arm and hand) function?
- a. Physical therapist
 - b. Speech therapist
 - c. Occupational therapist
 - d. Psychiatrist
15. Which of the following are NOT helpful preventative strategies against TBI? (Circle all that apply)
- a. Educating athletes about the risk of TBI and proper techniques of play
 - b. Making sure athletes wear the same size helmet no matter what their head size is
 - c. Playing in dark and dimly lit environments
 - d. Closely supervising younger children
 - e. Using old, damaged equipment, including safety equipment, to save money
 - f. Adhering to rules that promote safety
16. Which of the following is not a physical sign or symptom of moderate to severe TBI?
- a. Raccoon eyes
 - b. Clear fluid coming from the nose or ears
 - c. Mild headache
 - d. Coma
17. Good sleep hygiene is critical in treating sleep-wake cycle disruptions that can result from concussions. Which of the following are components of good sleep hygiene? (Circle all that apply)
- a. Getting up and going to bed at the same time every day
 - b. Staying in bed for as long as it takes until you fall asleep
 - c. Eating a heavy meal right before bedtime
 - d. Taking full advantage of chemical aids such as caffeine to stay alert during the day and
 - e. alcohol to help fall asleep at night
 - f. Trying to sleep as much as you can and for as long as possible during the day
 - g. Avoiding screen time and loud music before bedtime

18. Which of the following is false regarding the rare phenomenon of sudden severe brain swelling that occurs when an individual sustains a second concussion without fully recovering from an initial concussion?
- a. It is called second-impact syndrome
 - b. Older age increases the risk
 - c. It most frequently affects male gender athletes
 - d. It is frequently associated with death or severe permanent disability
19. Regarding post-concussion syndrome, which of the following is false?
- a. Symptoms are atypical for concussion
 - b. Female gender increases the risk
 - c. Poor coping skills and psychosocial stressors increase the risk
 - d. Psychiatric comorbidities, such as depression, anxiety, and PTSD, increase the risk
20. True or False Ideally, return to work or school should be all or none after TBI.

Pre- and Post-Summative Assessment – Answer Key

1. TBI results from an external mechanical force that results in an **alteration** of brain function.
2. Name the two most common causes of TBI-related Emergency Department Visits. **Falls and being hit by or against an object.**
3. True or **False** Mild TBI results in visible trauma to the brain on CT Head imaging.
4. **True** or False Epilepsy (a syndrome of recurrent non-provoked seizures) can occur in the context of multiple concussions.
5. True or **False** Brain bleeds (particularly when they involve the surface of the brain) decrease the risk of developing seizures.
6. Name three types of contusions that can result from TBI. **Coup, contrecoup and coup-contrecoup**
7. True or **False** NFL players are not at higher risk of developing chronic traumatic encephalopathy (CTE) than non-athletes.
8. **True** or False Anti-epileptic drugs (AEDs) are sometimes prescribed prophylactically (preventatively) in the context of brain bleeds affecting the surface of the brain.
9. Name the three areas of the brain that are particularly vulnerable to traumatic insult. **Brainstem, temporal lobes, and frontal lobes**
10. True or **False** Every skull fracture means serious brain injury has occurred.
11. Which of the following strategies are helpful in recovery following a concussion? (Circle all that apply)
 - a. Strenuous high impact exercise
 - b. Low-Impact Cardio**
 - c. Lots of screen time
 - d. Session of cognitive challenge no more than 30 minutes following low-impact cardio**
 - e. Stress reduction techniques, such as meditation**
 - f. Giving yourself a free pass to eat as much junk food as you want
12. Which of the following is not a cognitive sign or symptom of concussion?
 - a. Feeling dazed, confused, or disoriented immediately following the injury
 - b. Trouble with short-term memory
 - c. Hearing voices that tell you to harm yourself**
 - d. Slowed processing speed
13. Which of the following is not a behavioral sign or symptom of concussion?
 - a. Uncontrollable hunger**
 - b. Irritability
 - c. Rapid mood fluctuations
 - d. Impulsive behavior
14. What type of therapist focuses on improving upper extremity (arm and hand) function?
 - a. Physical therapist
 - b. Speech therapist
 - c. Occupational therapist**
 - d. Physiatrist

15. Which of the following are NOT helpful preventative strategies against TBI? (Circle all that apply)
- a. Educating athletes about the risk of TBI and proper techniques of play
 - b. Making sure athletes wear the same size helmet no matter what their head size is**
 - c. Playing in dark and dimly lit environments**
 - d. Closely supervising younger children
 - e. Using old, damaged equipment, including safety equipment, to save money**
 - f. Adhering to rules that promote safety
16. Which of the following is not a physical sign or symptom of moderate to severe TBI?
- a. Raccoon eyes
 - b. Clear fluid coming from the nose or ears
 - c. Mild headache**
 - d. Coma
17. Good sleep hygiene is critical in treating sleep-wake cycle disruptions that can result from concussions. Which of the following are components of good sleep hygiene? (Circle all that apply)
- a. Getting up and going to bed at the same time every day**
 - b. Staying in bed for as long as it takes until you fall asleep
 - c. Eating a heavy meal right before bedtime
 - d. Taking full advantage of chemical aids such as caffeine to stay alert during the day and
 - e. alcohol to help fall asleep at night
 - f. Trying to sleep as much as you can and for as long as possible during the day**
 - g. Avoiding screen time and loud music before bedtime
18. Which of the following is false regarding the rare phenomenon of sudden severe brain swelling that occurs when an individual sustains a second concussion without fully recovering from an initial concussion?
- a. It is called second-impact syndrome
 - b. Older age increases the risk**
 - c. It most frequently affects male gender athletes
 - d. It is frequently associated with death or severe permanent disability
19. Regarding post-concussion syndrome, which of the following is false?
- a. Symptoms are atypical for concussion**
 - b. Female gender increases the risk
 - c. Poor coping skills and psychosocial stressors increase the risk
 - d. Psychiatric comorbidities, such as depression, anxiety, and PTSD, increase the risk
20. True or **False** Ideally, return to work or school should be all or none after TBI.