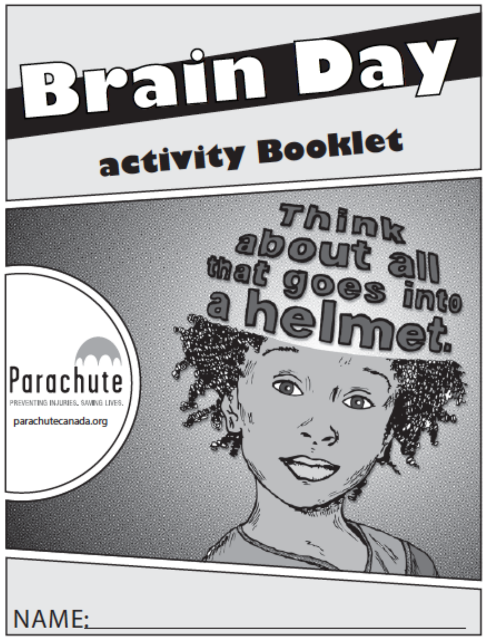
Brain Day Volunteer Instructor Guide



Notes for Brain Day Volunteers

Connect with your classroom to remind students to bring their helmets to Brain Day.

Check your materials list twice before leaving the house!

You do not have to memorize this entire manual. The Appendix is provided for reference to additional activities, or if you require more information on a subject or module.

Keep your sentences and choice of words simple. Please do not read to the students directly from this manual.

Students prefer interaction. Focus on presenting the key points through activities.

Ensure the teacher is present at all times to keep the class under control.

Introduction

(Slides 1-3)*

1. Introduce yourself to the classroom.

2. What is Brain Day? Today we are going to learn about the brain, do some fun activities that will show you how important it is, and learn how to protect ourselves from injuries.

3. Introduce the agenda for the day and lay “ground rules” in the classroom (e.g. raise your hand if you have a question).

4. Any questions before we start? What is the most important part of your body? –YOUR BRAIN

Neurons

(Slides 4-8)*

The human brain is made of 100 billion cells called neurons. Neurons are different from other cells in our body because they have special branches that come out from the centre of the neuron (the cell body or soma). Each neuron passes signals from one neuron to the next. The branches that receive information from other neurons are called the dendrites. The axon comes out of the soma to pass signals to other neurons. No other cell in the body has specialized signaling like neurons. Messages can be sent from the body to the brain, and from the brain to the body.

1) Neuron Anatomy (~8 minutes)

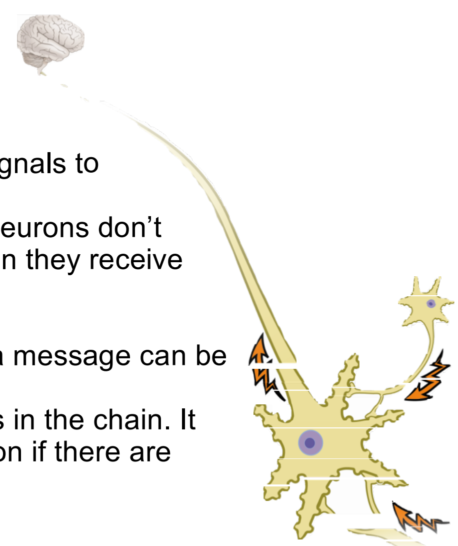
- Brains are made of a billion cells called neurons. The structure of a neuron is below.
- Use the Neuron slide to label the neuron diagram and explain axons and dendrites.

2) Neuron Messaging: (~10 minutes)

This activity demonstrates how neurons are like messengers between the brain and our body. Substitute the note for hand squeezing, or try using different “chain” lengths and/or longer and shorter messages.

(See Slide 8 notes for more detailed guide for activity)

a. Write a joke or word on two pieces of paper.
b. Divide the class into two rows. The class is now two separate chains. Each person is a neuron, sending signals to the Brain (first person) and Leg (last person).
c. Pass the note from the Brain to the Leg. Ensure the neurons don’t look at the note! The Leg reads the note out loud when they receive it.



Ask:

1. Does the number of neurons in a chain affect the speed a message can be sent?
   - Signaling speed is affected by the number of neurons in the chain. It will take longer for a signal to reach its final destination if there are more neurons.

2. What else might affect the speed of a message?
   - The type of message can also affect signal speed. If the message is simple, like a reflex from touching a hot stove, it will be fast. If the message is more complicated, like recognizing a face, it will take longer to process because it requires memories of that person and focusing on their physical features.

Neurons

3) Let's Talk Neurons! (~3 minutes)

- The fastest neurons send signals up to 120 metres per second! Neurons that send temperature signals can move up to two metres per second.
    - Reflexes are sent by the shortest chains in our body. They are usually one or two neurons, or monosynaptic or disynaptic pathways.
- Our skin cells and hair cells grow back. A broken arm or bruise can heal. Damaged neurons cannot repair themselves.

Ask: What things do you do to protect your neurons?

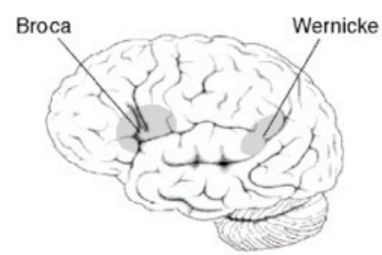
- Wear a helmet, a seatbelt, looking both ways before crossing the street, etc.

Anatomy

(Slide 9-16)*
Ask: Now that we know that the brain is made of billions of neurons, what does it do?
The brain has many different parts, each part of the brain plays an important role in our life:

a. FRONTAL lobe - at the front of the brain. It is the decision making centre responsible for problem solving, making plans, and speaking. Someone with damage to Broca's area of the frontal lobe will not be able to speak normally.

b. PARIETAL lobe - at the top of the brain. It receives touch information from the entire body, allowing the body to move and understand where it is in space.



c. TEMPORAL lobe - at the side of the brain. It deals with memory, hearing, emotion, and language. Damage to the Wernicke's area of the temporal lobe will affect understanding language.

d. OCCIPITAL lobe - at the back of the brain. It takes care of vision. Damage to the occipital lobe can cause blindness, even if there is no damage to the eyes.

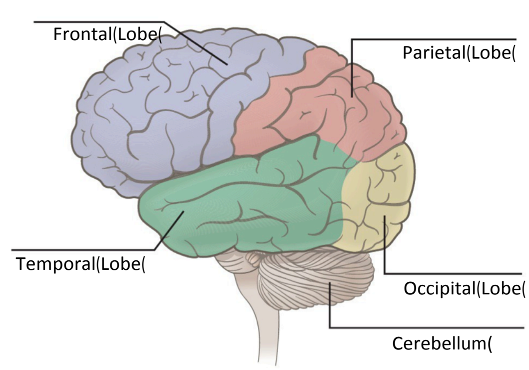
e. The CEREBELLUM is Latin for "little brain". This area is under the occipital lobe. It is responsible for coordinating body movements.

1) Naming the Lobes (~10 minutes)

- Name and describe the lobes using the Brain Anatomy slide.(Slide 12)

Ask: Think about the lobe's functions. What would happen if they were damaged?

→→ Ask a student to help identify lobes on a balloon head. Ensure the students label the lobes in their booklets.



Anatomy

2) Can we live without our lobes? (~5 minutes)

Sample Ask (Instructors, think of some of your own!)

- How would a person with injury to their cerebellum act when they are trying to swing a baseball bat?
  - A person with damage to their cerebellum would not be able to coordinate their movements normally (they will miss the ball, not be able to swing the bat, etc).
- Robert wasn't wearing his helmet when he fell off his bike. After coming home from the hospital his friends noticed that he didn't like playing video games or soccer anymore, and he would laugh at different jokes. What lobe did he damage?
  - Frontal lobe (this lobe is responsible for functions like personality).
- Jane was skateboarding with some friends when she fell. After the accident she only ate food from one side of the plate and walked around with one arm in her jacket. What lobe did she damage?
  - Parietal lobe (it receives information about touch/feeling and allows you to move your body in space).

Smell and Taste

(Introduction to Senses slide 17)*
(Smell – 18-25) *

Smell and taste are grouped together as the chemical senses. Information from these senses can remind us of events we associate with certain tastes and smells.

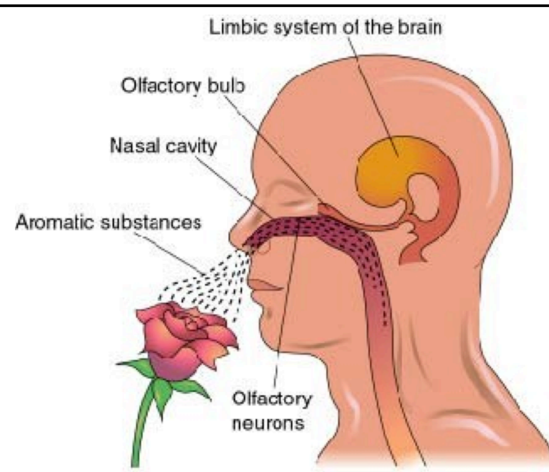
Smell

Chemicals enter our nose and bind to special receptors. The receptors are high inside the nose in an area called the olfactory epithelium. Information about the receptors that have been activated is sent to the olfactory bulb and the brain, allowing us to identify what we are smelling.

1) Introduction and Smell Pathways (~8 minutes)

- Sense of smell is also known as olfaction.
- Ask: What are olfactory receptors? They are the receptors that send signals to your brain so we can recognize what we're smelling.

→ Ensure students have a chance to complete the Smell section of their booklet if supplied.
  a. Odorants
  b. Olfactory epithelium (mucous membrane)
  c. Olfactory bulb/temporal lobe



Smell

2) Olfactory Adaptation (~5 minutes)
   a. Spread the scent around the classroom.
      - Ask: What do you think of the smell? Rate the strength of the smell on the 1 to 10 scale
      - Does the smell remind you of anything? Olfactory bulbs communicate with the parts of the brain that are responsible for our emotions and memory.
      - Can a smell change?

What if we couldn't smell? (~5 minutes)

- Define anosmia. Anosmia is the inability to smell. It can be caused by head injuries and some diseases like Parkinson's disease. People with anosmia can experience depression and loss of appetite. Not having a sense of smell can be dangerous if we need to smell fire (smelling smoke) or when eating food that has gone bad.
- Ask: Why is it dangerous? What would it be like to have it? Have you ever lost your sense of smell?
    - Danger in a fire or gas leak, eating rotten food
    - Loss of smell when sick with a cold or flu
- How can we avoid losing our sense of smell?
- What animals have a good sense of smell? Dogs are an example of an animal with many more olfactory receptors than humans. Insects also have a very good sense of smell. Most birds have a poorly developed sense of smell.

3) Adaptation? (~2 minutes)
   a. Ask: Rate the strength of the smell again. If it hasn't changed, check back after Taste.
      - Have you ever adapted to a smell? e.g. Cooking at home
      - Why is adaptation important and useful? If we smelled everything all the time, we would be overloaded with stimulants.

Adaptation is experienced when a stimulus is present for a long time. After being in a freshly painted room for a while, the smell may not be as strong. However, someone entering the room for the first time will find the smell very strong because they are not adapted.

Taste

Slide 26-34 *

Taste receptors are clustered into taste buds on our tongue, all over our mouth on the roof of our mouth, epiglottis and upper esophagus.

At the top of each taste bud is an opening called a taste pore. This is where the taste bud comes into contact with food molecules to recognize four basic tastes: sweet, salty, sour, and bitter. There is even support for a fifth basic taste: umami (e.g. mushrooms). Signals from taste receptors are sent to the brain to be interpreted.

Taste and smell receptors can be replaced throughout our lives, something that cells in our brains generally cannot do. Since these receptors are found in areas that come in contact with the outside, fingers, hot liquids and assorted foods, it is important that damaged cells can be replaced.

* Refers to Slide Numbers in the Brain Day PowerPoint Presentation document.

Taste

1) Introduction and Taste Pathways (~8 minutes)

- Ask: How are smell and taste related?
- What is a taste bud? A taste bud is a group of taste cells. Look at your neighbours tongue. Taste buds are on each of the little white bumps (papillae).
- Information from your taste buds is only a small part of what we taste when eating.

→→ Ensure students have a chance to complete the Taste section of their booklet if supplied.
   a. Tastants/molecules
   b. Taste buds/papillae
   c. Frontal Lobe (also: insular cortex or amygdala, inner/emotional/memory areas)

Ask: What happens to the taste of your food when you are sick? Smell and taste work together to bring out flavour in our foods. They are our chemical senses.

2) Taste bud mapping (~12 minutes)
   a. Use one or many flavours (salt water, sugar water, juice, vinegar, tonic water, and/or decaffeinted coffee). Distribute cotton swabs and taste cups.
   b. Direct students to dip the cotton swab in the taste cup(s), then rub the stick on different areas of the tongue - the tip, the sides and the back. Remind students to take a new stick each time they dip!
   c. Have students label the tongue map in their booklets to determine the areas of the tongue that can "taste" the best.
   d. Use the tongue map slide to label the regions with more and less taste receptors.

Ask:

- Why can you taste more on certain parts of your tongue? Tastes are more intense where there are more taste receptors.
- Where can you "taste" the most? The tip of the tongue has more receptors than the middle of the tongue. The sides and the back have more receptors than the middle, but fewer than the tip. Therefore, the tip should be the "tastiest" region, followed by the sides, back and finally, the middle of the tongue.
- Have you ever burnt your tongue, or had a sore tongue after eating too much sour candy? The pain comes from damaged taste buds. Injuries like these are not permanent because new taste cell receptors are produced all the time.
- How is this different from other types of nerve cells we've talked about?

Vision

(Slide 36-53)*

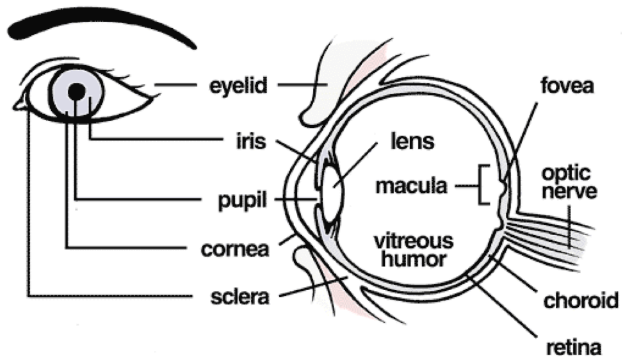
The human eye is ~2.5cm in length and weighs about 7g (less than three pennies!). Muscles control the movement of the eye. The eyelid protects the surface of the eye. Tears clean the eye's surface. The surface of the eye, the cornea, acts like a filter. The iris and pupil adjust to the amount of light going into the eye. The lens focuses the image you are looking at.

When light enters the eye through the lens, it is captured on the retina at the back of the eye. The retina has cells, rods and cones, that sense light. Rods are for night vision and seeing movement. Cones detect colour and detail. This information goes through optic nerves and travels to the brain. The optic nerves exit the eye at the blind spot. The blind spot does not have any rods or cones and cannot see light. The optic nerves cross the midline of the brain, reaching the occipital lobe on the opposite side of the brain.

* Refers to Slide Numbers in the Brain Day PowerPoint Presentation document.

Vision

1) Anatomy of the eye (~8 minutes)
   a. Eyelid
   b. Lens
   c. Pupil
   d. Iris (colour of the eye)
   e. Retina (rods and cones)



The Visual Pathway

1. Light enters the eye through the lens
2. Retina
3. Optic nerve (blind spot)
4. Optic chiasm
5. Occipital lobe (visual cortex)

- Ensure students have a chance to complete the Vision section of their booklet if supplied.
   a. Light
   b. Retina
      - Rods
      - Cones
      - Blind Spot
   c. Occipital Lobe

2) Blind Spot Activity (~5 minutes)
   a. Draw an X and O at each end of the strip of paper.
   b. Hold the strip of paper with your left hand at arm's length. Have the X on the right and the O on the left.
   c. Cover your right eye with your right hand and focus your left eye on the X.
   d. While focusing on the X, move the strip toward you until the O disappears.
   e. When the O disappears, you have found your blind spot.

3) Colour Afterimage Activity (~5 minutes) (Slides 44-49)*
   a. Look at the image for 1 minute. When the image is removed, what do you see?

This is the Opponent Processing Theory of Colour Vision. Every colour has an opposite colour. Afterimages are seen because neurons become adapted to the colour you are staring at. If you look at the image too long, the neuron gets tired and removes the block on the opposite colour when the image is removed.

Ask: Do you know what achromatopsia is? It is colour blindness. Some people are not able to see colour because they are missing a cone type(s), have an abnormality in the cone, or have some abnormality in the colour perception area of the occipital lobe. There are tests to check for colour blindness. How would colour blindness affect you?

4) Please see Appendix for three more Vision Activities (~10 minutes)

* Refers to Slide Numbers in the Brain Day PowerPoint Presentation document.

Hearing

(Slide 54-61)*
An object produces sound when it vibrates in matter. Matter is a solid, such as dirt; a liquid, such as water; or a gas, such as air. Most of the time we hear sounds traveling through the air.

The ear is divided into three parts: outer ear, middle ear, and inner ear. The outer ear (pinna) collects sound waves and sends them through the ear canal to the eardrum (tympanic membrane). The middle ear is air-filled space containing ossicles, the three smallest bones in the human body (malleus, incus, stapes). These bones amplify and transmit sound vibrations across a tiny membrane into the inner ear, a snail shaped, fluid filled structure called the cochlea. Thousands of hair cells can be found deep within the cochlea on the organ of Corti. When the hair cells are excited by vibration, electrical impulses are made in the auditory nerve and sent to the brain to be interpreted as sound.

1) The Auditory Pathway (~7 minutes)
    1. Outer ear (Pinna)
    2. Outer ear (Eardrum)
    3. Middle ear (Name the 3 Ossicles: malleus, incus, stapes)
    4. Inner ear (Cochlea)
    5. Inner ear (Hair Cells)
    6. Auditory nerve
    7. Temporal lobe.

➔ Ensure students have a chance to complete the Hearing section of their booklet
    a. Sound waves
    b. Cochlea
    c. Temporal lobe

Ask
- Why is it important to protect your hearing? Loud noises can cause hearing loss by destroying the hair cells in the inner ear.
- How can you protect your hearing? Avoid loud noises or use ear plugs. Tumors, objects in the ear, or infections that damage the eardrum can cause hearing loss.

2) Sound Localization Activity (~8 minutes)
(Alternative activity suggested on PowerPoint Slides)*
    a. Blindfold a volunteer and sit them in the middle of the room.
    b. Have other volunteers stand in different areas in the room and clap when you signal to them.
    c. With the class quiet, have the seated volunteer cover one ear and point to the direction they hear a clap.
    d. Signal to the other volunteers at random to clap.
    e. Repeat with no ears covered.

Ask: When was the seated volunteer better at locating the sound? Why? The seated volunteer should be more accurate when they can use both ears. Our brains use the volume and time it takes for sounds to reach each ear to determine sound locations.

* Refers to Slide Numbers in the Brain Day PowerPoint Presentation document.

Touch

(Slide 62-69)*

Touch is categorized by the sensory receptors that detect the types of stimuli (see below). Receptors and neurons allow us to interpret sensation. Chemical, thermal or mechanical stimuli is changed to an electrical signal that the brain can understand.

The size of sensory receiving areas, relative to different body parts, is shown by the unusual proportions of the homunculus. A larger area in the brain means a greater sensitivity of that body part, relative to other body parts. Very sensitive areas of the skin, like fingers, have very high densities of receptors and closely packed neurons.

- Pain - tissue damage, physiological, inflammation, neuropathic
- Temperature - heat (30°C to 45+°C) and cold (10°C to -38°C)
- Pressure
- Vibration
- Proprioception - Position in space (Might be more complex for grade level)

1) The Touch Pathway (~5 minutes)
   1. Five touch receptors (see above table)
   2. Spinal Cord
   3. Somatosensory Cortex (Parietal Lobe)

)) Ensure students have a chance to complete the Touch section of their booklet
   a.
      - Pain
      - Pressure
      - Temperature
      - Vibration
      - Proprioception
   b. Skin
   c. Parietal lobe

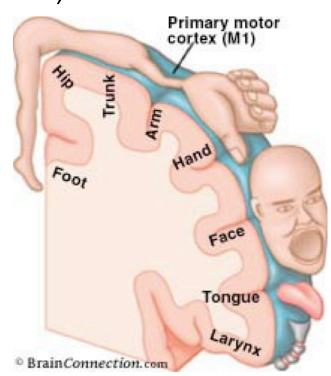
2) Pain “Pinching” Activity (~5 minutes)
   a. Distribute one clothespin to each pair of students.
   b. Have one student clip the pinky finger of another student with a clothespin.
   c. Take the clothespin off the pinky, and clip it onto the elbow.
   d. Ask the students to repeat the above steps with their partners.
   e. Ask the students to vote on whether they found the clothespin more painful on the finger or the elbow.

Distribution of pain receptors is different for different parts of the body, making some body parts more or less sensitive to pain. The clothespin should sting more when it is on the pinky finger than the elbow. The elbow has almost no pain receptors.

* Refers to Slide Numbers in the Brain Day PowerPoint Presentation document.

Touch

3) Two Point Discrimination Demonstration (~5 minutes)
   a. Have a volunteer close their eyes and hold out their hand.
   b. Poke their finger using two cottons swabs (or different materials like paper felt or paper). Remember how far apart the cotton swabs are.
   c. Ask: How many cotton swabs am I using to poke you? (They should say two)
   d. Poke their arm using the two cotton swabs. Make sure the swabs are the same distance apart as above.
   e. Ask: How many swabs did I use to poke you? (They should say one)
   f. Result: it will be easier for the student to tell what the material is with his/her fingers rather than his/her back (more receptors in fingers).



There are more touch receptors at the fingertips than the back or arms, this is called receptor distribution. It should be easier to distinguish the swabs at the fingertips than the arm. Looking at the homunculus, notice that the hands and fingertips are larger than the knees and forearm. The amount of brain for each body part is important to determine how sensitive that body part is to touch. The more brain it has, the more sensitive it is. Use the homunculus slide to show that the fingers, mouth, tongue have a greater representation in the homunculus.

Concussions

(Slides 71-74)*

A *concussion* is a brain injury that any person may experience at some point in his or her life. Any blow to the head, face, neck or body, which causes sudden jarring of the brain inside the skull, may cause a concussion. This section will touch upon what a concussion is, how they are caused, the symptoms and importance of rest in a healthy recovery.

1) **"LETS HAVE A CONCUSSION DISCUSSION!" – (~2 minutes)**
   1) Ask the students: What is a concussion? Have they heard of this word? What do they think it means?
   2) What is the difference between concussion and brain injury? Ask those in class who have ever had a concussion to raise their hand. Ask those who have had a brain injury to do the same.
      - A concussion is a type of brain injury, but most people do not realize this. The number of students raising their hands for concussion may be different from those doing so for brain injury. Emphasize that a concussion is a type of brain injury.
        - **CONCUSSION = A type of BRAIN INJURY!**

* Refers to Slide Numbers in the Brain Day PowerPoint Presentation document.

2) **Video "Concussions 101- Dr. Mike Evans" – (~8 minutes)**

1) If possible show video clip ~ 6 minutes (available online and will be made available on PowerPoint presentation)
    - *This video clip encompasses all of the aspects about concussions that we wish to teach the students. We will use the points in the video and highlight them in subsequent activities.*
      http://www.youtube.com/watch?v=zCCD52Pty4A
2) Reinforce and explain that a very hard hit/blow to the head can cause the brain to jostle back and forth within the skull. A hard blow to the head can injure the brain!
3) Why do doctors say a concussion is an invisible type of brain injury?
    - There are currently no medical tests that can diagnose if someone has had a concussion!

KEY TAKE HOME points to highlight with Discussion:

- ***Concussion is an "invisible injury"***
    a. A concussion can often be an "invisible injury" and is one that any person may experience at some point in his or her life. Not only does a concussion have an impact on the student-athlete, but it can also affect parents, coaches and educators.

- ***You cannot directly see a concussion using medical imaging tests!***
    a. A concussion is a brain injury that **cannot** be seen on routine x-rays, Computed Tomography (CT) scans, or Magnetic Resonance Imaging (MRI). It affects the way a person may think and remember things for a short time, and can cause a variety of symptoms. Any blow to the head, face or neck, or a blow to the body, which causes a sudden jarring of the brain inside the skull, may cause a concussion (e.g., a ball to the head in soccer or being checked into the boards in hockey), and these injuries cannot be detected via medical imaging/tests.

3) **Activity: "Scrambled Brains" (~5 minutes)**
(If time is limited, you could review the symptoms of concussions using the summary table without carrying out the following activity with the class, perhaps do a brainstorm instead.)

1) How does a concussion affect your mind, body, and feelings?
    a. Concussions cause various **signs and symptoms,** which may include the following in the **Concussion Symptoms Summary Table**

PHYSICAL	COGNITIVE (THINKING)	EMOTIONAL
Loss of consciousness (Blanking out for a moment)	General confusion (Being Confused)	"I don't feel like myself"
Headache		
Nausea or vomiting (Throwing up or feeling like throwing up)	Difficulty remembering (Can't remember as well as before)	Sadness
"Pressure in the head"		
Dizziness	Difficulty concentrating (Find it hard to focus/concentrate)	Moody, grumpy (irritable)
Low energy (Tired)		
Sensitivity to light or noise (Lights or noise bother me)	Feeling like "in a fog"	Nervous or anxious

Note: If conducting your presentation in younger grades, using the terminology in brackets may make it easier for the class to follow along.

Activity Preparation

1) Cut strips of paper and on each one write out one of the symptoms from the "Concussion Symptoms Summary Table". On about 5 strips write out some non-concussion specific symptoms, i.e. Broken leg, Broken Arm, Cut on hand, scrapped knee, Sprained Ankle.
2) Put all strips of paper in a bag

(Note: can use strips of paper from Vision Blind spot activity for this section)

Activity Steps

1) Select a student from the class to pick a paper from the bag. Ask them to read out the symptom on the paper they picked.
2) As a class vote (by raising hands for True/False) on whether it is a symptom of concussion.
3) Can write these symptoms on the board as they are selected.
4) Repeat steps 1-3 until all papers are picked and have all symptoms from summary table on the board.

4) **Discussion:**

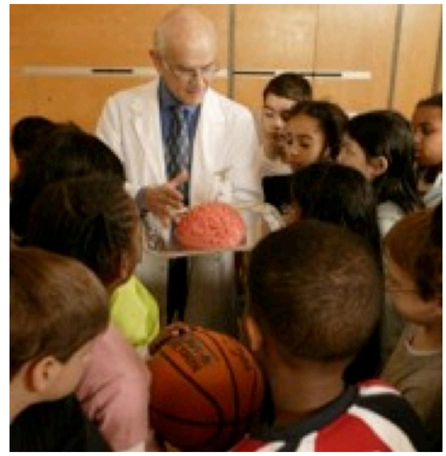
1) Ask the students what they think they should do if they suspect they have a concussion.
   a. **S-T-A-R : S**TOP Playing! (Need to stop playing immediately)
      TELL an adult, (Inform a coach, parent, or caregiver A.S.A.P.)
      Get **A**SSESSED, and (Get checked by a doctor or health provider)
      REST! (REST)

   b. Emphasize that REST means doing nothing that will bring back symptoms including playing video games
   c. Encourage them to discuss concussions with their friends and family.

KEY TAKE HOME points to highlight with Discussion:

- ***What if I suspect I have a concussion?***
  - *"STAR" Stop playing! Tell an Adult, Get Assessed and REST!*
- ***How to get better?? REST!***
  - *Get plenty of sleep at night and lots of rest during the day.*
  - *Avoid activities that are physically or mentally demanding- they can make your symptoms worse!*
  - *Avoid contact sports/activities. Avoid rollercoasters!*
  - *Avoid activities that are physically or mentally demanding- they can make your symptoms worse!*
  - *Avoid playing video games or using the computer for prolonged periods of time, especially early on in the recovery process.*
  - *When your doctor/healthcare practitioner says you are better, Gradually return to your normal activities*
  - *May have to return to school GRADUALLY with the advice of your doctor and teachers.*

Wrap Up



- Re-iterate the importance of the brain and what it would be like to lose any of the senses.
- Do a helmet fitting demonstration using the 2V1 rule at the end of the activity booklet (please refer to Helmet Fitting and FAQ documents below).
- Emphasize that the best way to protect the brain is through injury prevention (e.g. wearing a helmet while cycling, skateboarding, wearing your seatbelt, etc).
- Have the students complete the evaluation, and remind teachers about the online survey.
- Bring out the Jello Brain!

Helmet Fitting

A properly fitted helmet touches the front, back, top, and all sides of your head. The goal is to achieve a fit that is snug, level, and stable to resist violent shakes and hard hits. Incorrect helmet fitting reduces the helmet's ability to protect the head in a crash. Follow the "2V1" approach.

1. Adjust the fitting band or foam pads – "2". Some helmets come with a fitting ring or band. Set the band to its largest setting while you adjust the straps and buckles. Only after the straps have been adjusted and secured should the band be tightened. If tightening the band causes extreme discomfort, and loosening it produces an incorrect fit, you may need to choose another helmet style.

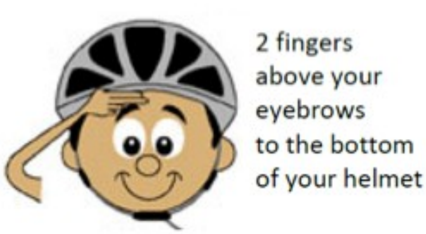
   If the helmet does not have a ring or band, it will come with foam pads. Foam pads can be added or removed on all sides of the helmet. Make sure the pads touch your head evenly, without being too tight. If the helmet does not come with a fitting ring or foam pads, contact the manufacturer and get another helmet.

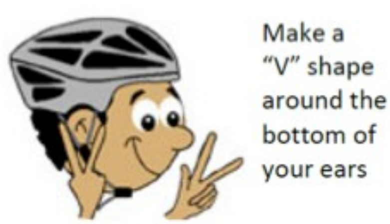
   Once the helmet is snug, ensure the front visor sits about two finger widths above the eyebrows, or just above the frame of your glasses. If you walk into a wall, the helmet should hit before your nose.

2. Adjust the side straps – "V". Fasten the chin buckle and look at the side straps. Adjust the side straps so they form a "V" underneath the earlobes, and sit behind the jaw line.

3. Adjust the chin buckle – "1". The buckle should be tight enough that only one finger fits between the strap and the underside of the chin. Opening your mouth wide should cause your jaw to pull on the chinstrap. Tighten the fitting band (from Step 1).

Please see Which Helmet for Which Activity and 2V1 Helmet Fitting pamphlets for more information. You may request these resources for your Brain Day presentations.





Common questions from students

- How long can I keep my helmet for?

It is recommended that helmets be replaced after 3 to 5 years from the date of purchase, or if it does not fit you any more. Helmets are made of a special material that breaks down over time and will not work as well if they are old. Also, over time your helmet may have been poked or hit by objects that will affect how it works.

- Can I put stickers on my helmet?

Do not modify or remove original parts of your helmet (unless it is meant to be removed, like visors on bicycle helmets or cages on hockey helmets).

Remember, the shiny plastic part (the “shell”) on the helmet is made of a special material. Stickers can react with the plastic causing it to be less effective, and too many stickers can prevent the helmet from sliding across the ground in a collision.

- Can I wear my hockey helmet when I ride my bike?

Most helmets are Single USE. This means the helmet is only certified for one activity. Baseball helmets are an example of a single use helmet.

You can only use your helmet for different activities if it is certified as a Multi-use helmet. The helmet certification sticker will tell you which activities your helmet is certified for. If your helmet is not certified as Multi-use, you cannot use it for different activities.

- If I have a crash, can I reuse my helmet?

This depends on the type of crash you experienced, and the type of helmet you have. Single impact helmets, like a bicycle helmet, means the helmet will protect you against one crash before it has to be replaced. Multiple impact helmets, like hockey or football helmets, can handle many hits before having to be replaced.

However, any helmet that experiences a violent impact should be thrown away, even if the damage is not obvious. Don’t forget that you should replace your helmet after 3 to 5 years.

Appendix

Neurons

The first cellular part of the nervous system is neurons. Neurons process information and signal elements. They send messages to each other through electrical and chemical messengers. Electrical signals send messages from one part of the neuron to the other. Chemical messengers carry information between neurons. Most neurons have branches called dendrites. Dendrites receive information from other neurons. One long cylinder shaped part of the neuron, called the axon, becomes a
series of smaller branches that form connections (or synapses) with other neurons. This allows messages to be sent from axon to dendrites.

There are different types of neurons:

- Sensory neurons (neurons that are sensitive to certain senses, i.e. touch or temperature);
- Motor neurons (neurons that affect muscles); and
- Interneurons (neurons that connect other neurons in the brain).

Anatomy

The nervous system is divided into two parts: the peripheral nervous system (PNS) and the central nervous system (CNS). The CNS is our brain and spinal cord, while the PNS is the spinal and cranial nerves that branch to extend to all parts of our body. These nerves send messages from the CNS.

The brain has many subdivisions:

- Cerebrum (the two massive hemispheres on the top of the brain)
- Cerebellum
- Brainstem (part of the CNS that lies between the cerebrum and the spinal cord).
- The lobes/divisions of the cerebrum are discussed in the neuron section.

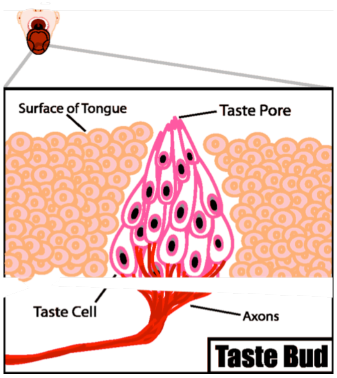
Ask: Why we are capable of language, planning, fine motor movements, personality, etc, but other mammals are not? What distinguishes humans from other animals is our large cerebrum. Our cerebrum, or neocortex, is the most advanced cortex amongst mammals.

Smell

Smell (olfaction) receptors are high inside our nasal cavities in an area called the olfactory epithelium. Molecules dissolve in the nasal mucus and stimulate receptors. The activated receptors send signals to the olfactory bulbs. The bulbs are paired structures in the brain, just above the nasal cavities. To get to the brain, the receptors must send the signal through a special area of the skull called the cribriform plate, which has many tiny holes for cell extensions (axons) to pass through.

Olfactory areas of the brain work closely with structures involved in producing emotions. The limbic system is an example of a related area. There are also links to areas responsible for memory, which is why smells can produce detailed personal memories.

Humans can distinguish about 10,000 different smells. Our olfaction cells each have one type of receptor. When we smell something, the scent molecules will only activate these specific receptors. This allows us to identify the smell. Males and females smell differently, and there seems to be a decline in ability to smell with age. Animals have a very strong sense of smell and use their nose for many more things than humans do. They use smell to find food, mates, and avoid enemies and predators.



Taste

Although you can taste each of the four tastes on all parts of your tongue, some places have more receptors for each type of taste. Sweet is best sensed at the tip of the tongue.

Much of the information about what we eat comes from our sense of smell. The taste of food is actually flavour. Flavour is a combination of 1) input we receive from our taste buds 2) olfactory information from food molecules that make their way up into the nasal cavity 3) sensory information, like texture and temperature, that tells us what food feels like in our mouth. Some nerves can be stimulated by pungent (strong smelling) or spicy food.

Vision

Vision (sight) is one of the most important senses humans use to understand the world. What we "see" is light. Light includes electromagnetic radiation with wavelengths between 380 to 760 nanometres. These are the only visible portion of the electromagnetic spectrum.

3D Perception (~10 minutes)

a. Place a garbage can at one end of the room and crumple a piece of paper.
b. Ask the first volunteer to stand at the other end of the room where they can see the whole the garbage can. Cover one eye.
c. Ask the second volunteer to hold the paper ball with their arms out and stand five steps from the garbage can.
d. With their eye covered, have the first volunteer give instructions to the second volunteer with the goal of dropping the paper ball into the garbage can.
e. If time permits, repeat steps iv-vii without covering any eyes.

Each eye captures its own picture. Images from each eye are sent to the brain. The brain combines the images by matching the similarities and adding in differences. The differences between the two images add up to a big difference in the final picture - the combined image becomes a 3D stereo picture. Stereovision allows us to see where objects are in relation to our bodies with great precision.

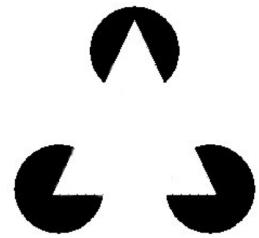
Ask:

- Why did the first volunteer should find it difficult to instruct the second volunteer to throw the paper ball with a covered eye? When one eye is covered, stereovision (3D perception) is lost. Both eyes allow for 3D perception.
- Why is it important to have 3D vision?
- What things do you do that rely on 3D vision? Throwing, catching, or hitting a ball, pouring water into a container, shaking someone's hand, etc.

Colour Afterimage Activity

Red is opposite of green, blue is the opposite of yellow, and white is the opposite of black. Imagine there are three tubes, each have two sets of paint. When using a tube, you can only use ONE of the two colours inside (not both at the same time). Since these colours cannot be found together, they are opposite colours. A colour wheel is useful for explaining this concept.

The Contour Illusion
Q: What does this look like?
A: A triangle on top of three circles



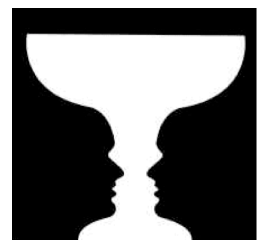
Q: What makes a triangle?
A: 3 lines of equal length at 60 degree angles to each other

Q: Is the triangle really there?
A : No

What we really see are three circles, each missing a chunk. However, they are arranged in a way that looks like the missing parts make a triangle. Our visual system draws invisible lines between the circles. These lines don't really exist, but our brain fills in missing pieces so the picture makes sense.

Many objects we see are covered or blocked by other objects. If the brain is familiar with the object, it will make up the missing part of the object in our mind. This helps us identify what is being blocked so we can decide what to do with it. If the stalk of an apple is visible in a tree, the brain will make an image of the rest of the apple, sending the message that behind the leaves is an apple. If your brain didn't make the missing parts, you would walk away thinking there was only a stalk.

Reversible Figures Illusion:
Q: Focus on the black part, what do you see?
A: Two faces looking at each other



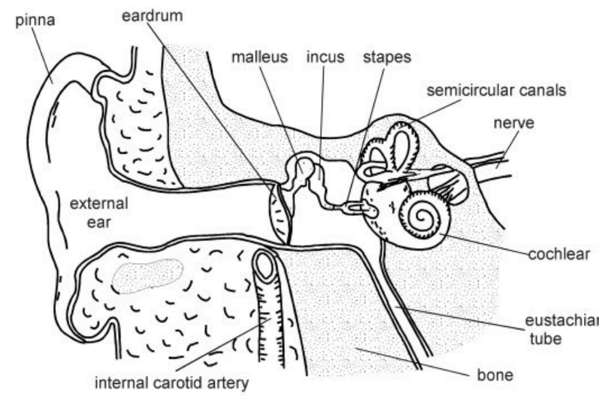
Q: Focus the white part, what do you see?
A: A vase

We see two different images because our brain can only pay attention to one image at a time. Giving our attention to items that interest us allows us to see more detail. For example, if there was a painting on a white wall, looking at the wall for would be uninteresting. It would make more sense to spend time admiring the painting.

When we are looking at a scene we divide the objects into figure and ground. The figure is what we pay attention to. The ground is the background that we know is there but don't really pay attention to. This is important because we cannot focus on everything in a scene at the same time. We have to divide our energy. Our visual system is designed to quickly differentiate between the figure and ground, making us more efficient.

Hearing

When something vibrates in the atmosphere, it moves the air particles around it. In turn, other air particles carry the vibration through the air. Vibrations send waves of pressure changes through the atmosphere. We hear different sounds from different vibrating objects because of differences in the sound wave frequency. A higher frequency means that the air pressure fluctuates back and forth more quickly. We hear this as a high pitch. When there are less fluctuations, the pitch is lower. The level of air pressure in each fluctuation, the amplitude, determines how loud the sound is.



CROSS SECTION OF THE EAR

Sound waves cause the eardrum to vibrate. Humans can hear sound waves with frequencies between 20 and 20,000 Hz. The outer two-thirds of the pinna is lined with cartilage, and contains sebaceous and wax glands. The wax prevents objects from going down the canal.

When sound waves reach the inner ear, they enter the cochlea. The cochlea is a snail-shaped, fluid-filled structure in the inner ear. Inside the cochlea is the organ of Corti. 25,000 tiny nerve endings, also known as hair cells, are located on the basilar membrane of the organ of corti. The cilia (hair) of the hair cells make contact with another membrane called the tectorial membrane.

Touch

The somatosensory system is a part of the nervous system that processes information related to the sense of touch. The part of the brain that receives information about touch is called the somatosensory cortex on the post-central gyrus. Characteristics of the somatosensory cortex, somatotopic organization, can be demonstrated by the homunculus.

Two-point threshold is the minimal distance two stimuli must be separated to be recognized as separate stimuli by the brain. This distance is smallest in areas where there are a lot of touch receptors (e.g. the fingers).

A reflex is a reaction by the body that cannot be consciously controlled. An outside stimulus is detected by the sensory neurons. An electrical impulse is sent to the motor neurons, which send this information to the muscles to cause a contraction.