A close up of a sign

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**PromoScience Science Literacy Week – Teacher Orientation**

iSTAND welcomes you and your class to a 6-video series exploring biodiversity and the senses for PromoScience’s Science Literacy Week 2020! Science Literacy Week is an opportunity for all Canadians to engage with science and consider how it lives within everyday life. To learn more about Science Literacy Week, please visit www.scienceliteracy.ca.

This year’s theme is biodiversity. iSTAND aims to highlight the amazing animals that exist in Canada, while also exploring the nervous system and the neural basis of the senses. Each video will feature one sense, examine how that sense is modified in different animals, and introduce the accompanying class activities found in this document. All videos can be found by visiting the [iSTAND YouTube Channel](https://www.youtube.com/channel/UC7cR79KQ957nZHlGvBXyGcA)’s Science Literacy Playlist. Please note that the videos will be released one at a time during the week of September 21st – 25th.

Teachers will be provided with all the supplies and instructions needed to conduct the in-class activities as well as having access to support from iSTAND team members via email ([istand.stem@ubc.ca](mailto:istand.stem@ubc.ca)). We can also arrange a Zoom call to make the learning more personal. Requests and scheduling through email.

Wishing you an exciting Science Literacy Week!

**PromoScience Science Literacy Week 2020 – Video #1 – Introduction to Biodiversity**

**Introduction to Biodiversity:**

Biodiversity refers to the broad variety of living species that exist on earth. This genetic variation allows for species to be well-adapted to their individual environments, although often in dissimilar ways to other animals in the ecosystem. Variations in different species’ nervous systems impact how animals are able to perceive the environment around them through the senses in order to best support survival. Although all the senses vary in terms of how they are received and detected, they all consist of a stimulus interacting with a receptor, creating an electrical signal which travels to the brain for processing.

**Video Summary:**

This video introduces biodiversity of the gustatatory (taste), olfactory (smell), auditory, visual, touch, balance, and proprioceptive systems in Canadian animals. After explaining the importance of biodiversity for survival, the video describes the central and peripheral nervous system, as well as the stimulus-receptor model, which is built upon in the coming videos.

**Activity:**

In this activity, each student will be a neuron in a pathway. In their right hand will be an empty cup and in their left hand will be a cup with about 10-12 beads that will represent the chemical message (neurotransmitters) that are passed to the next neuron. Neurotransmitters are sent out by the axon terminal (left hand) and received by the dendrites (right hand) of the next neuron along a pathway. Arrange the students in a line, arms length apart. The line can be any shape and if done in the classroom will likely weave between and around desks.

Whoever begins the messaging process will be the ‘sensory receptor.’ This student will dump their beads (left hand) into the empty (right hand) cup of their neighbour. Once this student’s right-hand cup (dendrites) has received the message, the beads in their left-hand cup (axon terminal) will dump their beads (neurotransmitters) into the cup of their neighbour, and so on until the message reaches the end of the pathway. After going around once, try timing the class to see how fast they can pass message around the room.

Items required (assuming a class of 25):

1. 51 cups
2. 250-300 beads

**Additional Information/Links:**

iSTAND YouTube: <https://www.youtube.com/channel/UC7cR79KQ957nZHlGvBXyGcA>

Intro to Biodiversity: <https://www.youtube.com/watch?v=GK_vRtHJZu4>

What is Biodiversity: <https://www.youtube.com/watch?v=b6Ua_zWDH6U>

Bill Nye Biodiversity: <https://www.youtube.com/watch?v=-Sybgof-X2k>

**PromoScience Science Literacy Week 2020 – Video #2 –Taste & Smell**

**Introduction to Taste & Smell:**

The gustatory and olfactory systems are slightly different from the other major senses in that they rely on chemoreceptors (receptors that are activated by chemicals/molecules), which are able to sense certain molecules (acting as stimuli) in order to process sensory information. Gaseous particles of an odorant are inhaled into the nasal cavity, where they can bind directly to olfactory sensory neurons in the skin. In gustation, taste buds are located between papillae and interact with food molecules, before sending sensory information to the brain. Olfaction and gustation vary greatly between animal species depending on their needs for survival.

**Video Summary:**

This video provides an introduction to the smell and taste systems, and how biodiversity of these system in Canadian animals allows for survival in their respective environments. After covering how taste and smell is processed by the brain, the differences in olfaction and taste between species of animals are discussed in reference to survival.

**Activity:**

The human senses of smell and taste work together to allow us to identify and experience the flavour of foods. However, when our nasal pathways are blocked, such as when we are sick, molecules of the food are unable to reach smell receptors in the nose, making food taste more “bland.” Allow students to taste jelly beans while plugging their nose, and note the flavour/taste. Then, eat another jelly bean of the same flavour without plugging their nose, and again note the flavour/taste. Encourage students to discuss with a partner how the taste of the jelly bean differed depending on whether your nose was plugged or not.

Certain taste receptors in humans allow for the identification of different flavours, such as sweet, sour, and bitter. However, not all individuals have the same number of each receptor, which can change how certain foods taste. Distribute grapefruit juice to each student, and allow them to taste it. Without discussing with other students, by a show of hands determine how many students tasted bitter or sweet.

Items required (assuming a class of 25):

1. 50 jelly beans
2. 25 napkins
3. 25 small plastic cups
4. Bottle of grapefruit juice (1L)

**Further Information/Links:**

Crash Course Smell & Taste: <https://www.youtube.com/watch?v=mFm3yA1nslE>

Taste for Kids: <https://www.youtube.com/watch?v=0hwOL91cjwM>

Smell for Kids: <https://www.youtube.com/watch?v=hzOSzX_HXE4>

**PromoScience Science Literacy Week 2020 – Video #3 – Auditory**

**Introduction to Audition:**

The auditory system consists of stimuli (in the form of sound waves) and receptors (in the form of hair cells in the ear), that allow for the processing of sound. Vibrations of the eardrum due to incoming sound waves cause the ossicles (3 bones of the middle ear) to vibrate, which moves the fluid of the inner ear, which transmits the vibrations to the hair cells within the inner ear. This allows for electrical signals to travel to the brain so sound can be processed and interpreted. Depending on the demands of the environment an animal exists in, the auditory system is adapted to optimize survival.

**Video Summary:**

This video provides an introduction to the auditory system, and how biodiversity of this system in Canadian animals allows for survival in their respective environments. After discussing how sound waves are able to be transferred to the brain, the differences in hearing techniques of different species of animals are explored.

**Activity:**

When sounds waves travel a long distance through the air, they become more and more spread out, and the sound can become inaudible or uninterpretable. However, if a conductive material is used to transfer the sound waves in the form of vibration, sound can travel much further.

Punch a small hole in the bottom of the plastic cup, and thread one end of the string through. Then, attach the paperclip to ensure the string doesn’t fall out of the end of the cup. Once this is completed on both cups, move until the string is tight, and then allow students to pass messages to each other by talking quietly into the cup. Try talking quietly to a partner with and without the cup telephone, and discuss any differences in the ease of hearing. Place 2 or 3 cotton balls in each cup and note how the sound is muffled.

Items required (assuming class of 25):

1. 25 paper cups
2. 75 cotton balls
3. Cotton string (75m – allow for at least 2m string/pair of students)
4. 25 paperclips

**Further Information/Links:**

Crash Course Auditory: <https://www.youtube.com/watch?v=Ie2j7GpC4JU>

How the Ears Work: <https://www.youtube.com/watch?v=RiVx5Lih_44>

Animated Auditory Lesson: <https://www.youtube.com/watch?v=HMXoHKwWmU8>

**PromoScience Science Literacy Week 2020 – Video #4 – Vision**

**Introduction to Vision:**

The visual system consists of stimuli (in the form of light) and receptors (rods and cones of the retina), that allow the perception of visual information. Light passes through the cornea and the pupil to the lens, where it is refracted to the retina in the back of the eye. The retina consists of rods and cones, which allow for the perception of both grayscale and coloured information, respectively. This information is then passed via the optic nerve to the occipital lobe of the brain, where it is interpreted. Depending on the environmental demands of the animal in question, the visual system is adapted differently to support survival.

**Video Summary:**

This video explores the visual system, and how biodiversity of this system in Canadian animals allows for survival in their respective environments. After briefly explaining how light stimuli travels to and is processed in the brain, the video examines differences in the visual system setup of different classes of animals (prey and predators), as well as individual species. Sensory information received by the occipital lobe is also discussed, however, we highly suggest watching the Backyard Brains video:

Backyard Brains Occipital Lobe EEG: https://backyardbrains.com/experiments/EEG

This video offers a visual of brain activity in the occipital lobe when eyes are open compared to when eyes are closed.

**Activity:**

Refraction of light into the eye allows for animals to properly interpret visual signals. We can mimic this process using a glass of water. The glass acts as a convex lens, similar to what is found in a microscope. This allows the light passed through it to be directed to single focal point. Depending on whether the arrows are closer to the glass or further from the glass than the focal point, the image may appear reversed.

Have students fill a clear cup with water, and draw 2 arrows (facing opposite directions) stacked on top of one another on a piece of paper. With one eye closed, place the paper behind the cup and observe the arrow through the side of the cup. Note the direction that the arrows are pointing, then try altering the distance from the arrows to the cup of water. Discuss differences in the direction that the arrows are pointing.

Items required (assuming a class of 25):

1. 25 clear cups
2. 25 sheets of paper
3. Writing utensils for all students

**Further Information/Links:**

How Your Eyes Work: <https://www.youtube.com/watch?v=i3_n3Ibfn1c>

Specifics of the Retina: <https://www.youtube.com/watch?v=fZDAwXh54is>

Crash Course – Vision: <https://www.youtube.com/watch?v=o0DYP-u1rNM>

**PromoScience Science Literacy Week 2020 – Video #5 – Touch**

**Introduction to Touch:**

The sense of touch consists of stimuli (in the form of objects) and receptors (mechanoreceptors in the skin), that allow the perception of information about what the body is in contact with. Different mechanoreceptors in the skin are able to sense differences in touch, pressure and vibration. However, mechanoreceptors are not distributed equally throughout the body, and places with greater density of them (i.e. the lips, fingertips) have greater acuity, whereas those with less density (i.e. back of the arm, lower back) have lesser acuity. Depending on the demands the environment of the species, the sense of touch is adapted differently to support survival.

**Video Summary:**

This video provides an introduction to the sense of touch, and how biodiversity of this system in Canadian animals allows for survival in their respective environments. After explaining how different mechanoreceptors are able to sense touch, the sensory homunculi (3D internal body map) of humans are described, before comparing how the sense of touch differs across species.

**Activity:**

The density of our mechanoreceptors determines our ability to discriminate between different touch points. In areas with greater density, such as our fingers, we are better able to distinguish whether a touch was made with one or two points, whereas in areas with less density, such as our arm, it is more difficult to identify this.

Following physical distance rules, and school protocol consider students working in pairs. Have one student close their eyes, while the experimenter gradually moves two toothpicks closer together until they are unable to identify two individual points on the leg or the palm of the hand. Measure the distance between the toothpicks when they were not detected as separate. Compare between the leg and hand with the class.

Items required (assuming a class of 25):

1. 50 toothpicks (2 per student)

**Further Information/Links:**

Sense of Touch for Kids: <https://www.youtube.com/watch?v=mWeTqNdSQlE>

Intro to Sense of Touch: <https://www.youtube.com/watch?v=dLTf97di1_I>

The 5 Senses - Sense of Touch for Kids: <https://www.youtube.com/watch?v=qaZ2uytgPec>

Crash Course – Homunculus: <https://www.youtube.com/watch?v=fxZWtc0mYpQ>

**PromoScience Science Literacy Week 2020 – Video #6 – Proprioception & Balance**

**Introduction to Proprioception & Balance:**

Proprioception refers to the unconscious ability to properly perceive body position and movement in space at any given time. This is accomplished via feedback from the visual and vestibular systems, as well as receptors within the joint. Proper proprioceptive abilities are key for maintaining balance, which can be highly important for the survival of certain species of animals (eg. cats). However, proprioceptors are able to be manipulated by certain tasks, such as tendon vibration and muscle contraction. When physicians tap a patient’s knee and the patient’s leg kicks, it is part of the proprioceptive pathway that is being assessed.

**Video Summary:**

This video provides an introduction to proprioception and balance, and how biodiversity of this system in Canadian animals allows for survival in their respective environments. After the concepts of proprioception and balance are introduced, the video explains how different species have varying levels of acuity in this sense, before demonstrating that it is possible to deceive your proprioceptors with simple tasks.

**Activity:**

Balance is impacted by both the visual system and the inner ear, which work in tandem to allow us to remain standing. However, when visual stimuli are removed, especially in a more unbalanced standing position, maintaining standing becomes much more challenging.

Allow students to spread out and stand up, and analyze how much body sway occurs in four positions: eyes open on two feet, eyes closed on two feet, eyes open on one foot, and eyes closed on one foot. Discuss differences that exist in how long students can remain in each position. With appropriate cleaning protocol consider the door frame experiment demonstrated in the video.

Items required (assuming a class of 25): None.

**Further Information/Links:**

Khan Academy - Proprioception: <https://www.youtube.com/watch?v=yKfpBGicqNQ>

Proprioception Intro: <https://www.youtube.com/watch?v=PMm7G0il5oc>

Importance of Proprioception: <https://www.youtube.com/watch?v=236y7EZgH_A>

Thank you for joining iSTAND for Science Literacy Week 2020! Please don’t hesitate in reaching out to us with questions or feedback.

[istand.stem@ubc.ca](mailto:istand.stem@ubc.ca)