Making Neuroscience Fun

A Brain Awareness Program for All Ages

Brain Health: It's SPECtacular

Science Behind the Story (SBS)
The World As We Know It (A Cognitive Health Story)
(4th Grade – 9-10 yrs)

All animals get information about the world around them and they use this information to modify their behaviors in a way that allows them to survive.

- The world as we know it is dependent on our sensory receptors.

  Animals have sensory systems which allow them get information about the world – both inside and outside of the body. Gustation and olfaction make up our chemical senses (Breedlove, 2020). We then have vision, which allows us to see (Breedlove, 2020). Our inner ear senses allow us to hear sounds and get information from our vestibular system regarding balance and the position of our head on our body (Breedlove, 2020). Somatosensation allows us to detect painful stimuli, stretch, vibration, temperature, and proprioception – which is a muscle sense (Breedlove, 2020).

  The sensory system starts with sensory receptors, which allow signals from outside the nervous system to be translated into information that the nervous system can detect, mainly electrochemical signals (Julius, 2012). This process is known as sensory transduction (Breedlove, 2020). Animals are limited to the types of energy signals (electromagnetic, chemical, mechanical, thermal and electrical) that they can detect based on the types of sensory receptors that make up their sensory systems (Breedlove, 2020). This is why some animals, like dogs, can detect sound waves and hear sounds that humans cannot detect.

- Humans are the only animals that are able to enhance their sensory systems to detect stimuli that they would not normally be able to detect. That gives humans a definite advantage as to what they can learn about the world.

  Humans are able to learn about how sensory systems in the brain work and because of that, humans are able to fix or enhance the sensory systems (Jung, 2018). This is what allows people who cannot see properly to use glasses to change how the electromagnetic energy that activates our sensory receptors in our eyes, rods and cones, so we can see better. This is also how we can hear the electromagnetic signals in the air that are transmitting music. Humans were able to capture these signals, which our sensory receptors in our ears – hair cells – cannot detect, by building radios.

- How our brains perceive the information that is obtained from our sensory systems depends on a number of factors. We need to understand that not only is the world around us constantly changing, but that our perception of the world also changes. What we know about the world allows us to choose behaviors that will allow us to not only survive – but, to thrive.

  Information from our sensory receptors are then transmitter to various parts of the brain, depending on the sensory system, and are ultimately transmitted up to the cerebral cortex (Poulet, 2019). It is when the sensory information reaches the level of the cortex that we can then perceive the sensory information (Poulet, 2019). Due to the fact that the sensory information is passed by neurons and that the information can be modified by these neural circuits (Magee, 2020), what you "think" you see, hear, feel, taste, touch

may be different from the actual sensory stimuli. Our perception of the world is based on the sensory information that our cerebral cortex receives, but it can also be modified by our expectation, experience, motivation and alertness (Gordon, 2019; de Lange, 2018).

- Expectation – do we expect to encounter a stimulus
- Experience – is the stimulus something we are familiar with
- Motivation – is this a stimulus that is important to us
- Alertness – are we paying attention

The world we live in is constantly changing and so is our perception of the world around us. Both of these changes can affect how our behaviors change so that we can survive in the world. Being able to understand these concepts will not only help with our Cognitive Health, but with other aspects of our SPEC health as well. Understanding that others may perceive stimuli differently from ourselves and that this may be dependent on not only the anatomy of their sensory systems, but also their expectation, experience, motivation and alertness will also help our Social and Emotional health.

National Standards:

Next Generation Science Standards

- Crosscutting Concepts
  - **Structure & Function:** The way an object is shaped or structured determines many of its properties and functions.
    - Different materials have different substructures; which can sometimes be observed.
    - Substructures have shapes and parts that serve functions.
  - **Stability & Change:** For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
    - Change is measured in terms of differences over time and may occur at different rates.
    - Some systems appear stable, but over long periods of time will eventually change.
  - **Cause & Effect:** Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
    - Cause and effect relationships are routinely identified, tested, and use to explain change.
    - Events that occur together with regularity might or might not be a cause & effect relationship.
- Related Grade Level Content
  - **Waves:**
    - 4-PS4-1., Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
  - **Structure, Function, and Information Processing**
    - 4-PS4-2., Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.
    - 4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
    - 4-LS1-2: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways between wave peaks). (4-PS4-1)
- Disciplinary Core Ideas
  - **PS4.B: Electromagnetic Radiation**
    - An object can be seen when light reflected from its surface enters the eyes. (4-PS4-2)
  - **PS4.C: Information Technologies and Instrumentation**
    - Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa. (4-PS4-3)

ASCA (American School Counselors Association):

Personal/Social Development

- **Standard A:** Students will acquire the knowledge, attitudes and interpersonal skills to help them understand and respect self and others.
    - PS:A1 Acquire Self-knowledge
        - PS:A1.4 Understand change is a part of growth
    - PS:A2 Acquire Interpersonal Skills
        - PS:A2.2 Respect alternative points of view
        - PS:A2.3 Recognize, accept, respect and appreciate individual differences

National Health Education Standards (Shape America) & CDC (Centers for Disease Control and Prevention)

- **Standard 1:** Students will comprehend concepts related to health promotion and disease prevention to enhance health.
    - 1.5.1: Describe the relationship between healthy behaviors and personal health. **(CDC)**
    - 1.5.2: Identify examples of emotional, intellectual, physical, and social health. **(CDC)**

References:

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