Bay Area Scientists in Schools Presentation Plan

Lesson Name Brains – Spiker Box
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Grade Level 5th+ **Standards Connection(s)** Multicellular organisms have specialized structures.

Next Generation Science Standards:

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

Science & Engineering Practices	*Disciplinary Core Ideas*	*Crosscutting Concepts*
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. (**MS-LS1-2**) **Planning and Carrying Out Investigations** Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (**MS-LS1-1**)	**LS1.D: Information Processing** Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (**MS-LS1-8**)	**Cause and Effect** Cause and effect relationships may be used to predict phenomena in natural systems. (**MS-LS1-8**) **Systems and System Models** Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. (**MS-LS1-3**) **Structure and Function** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural and designed structures/systems can be analyzed to determine how they function. (**MS-LS1-2**)

Common Core Standards:

ELA/Literacy:

RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
SL.8.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Mathematics:

MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.

FOSS Connections:
Grade 5 Module: *Living Systems*

Teaser: *Your opportunity to tell teachers and kids what's going to be fun and interesting about your visit!*

Your brain is the command center of your body. It lets you see, hear, touch, jump, sing, breathe, read, poop, think, and so much more. But how does it work?? Here's your chance to:

- See and handle brains from humans and other species
- Learn what neurons do and how they work
- See real live neurons in action

Objective: *As a result of your lesson, what will students learn? What will they be able to do?*

Students will learn about the brain as an organ and its function in the body, as well as basic brain anatomy. In addition, they will understand neurons -- what they are, how they work, and how sensory nerves can carry information about touch to the brain.

Vocabulary/Definitions:

- Neuron
- Axon
- Dendrite
- Synapse
- Action Potential (Spike)

Materials:
What will you bring with you?

- 3 Spiker Boxes
- Demo Brains

What should students have ready (pencils, paper, scissors)?

- Their brains!

Classroom Set-up: *Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed*

- Tables will be grouped to form three stations. All will need outlet access.

Classroom Visit

1. **Personal Introduction:** __5__ Minutes
   Who are you? What do you want to share with students and why? How will you connect this with students' interests and experiences?

- Individual introductions (Names and hobbies)
- We're graduate students and researchers at UC Berkeley.

●What is a grad student/researcher? How do you get to become a graduate student?

2. **Topic Introduction:** ___5__ Minutes

What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge…

Introducing...the brain!

○ Who has brains? What else has a brain? What do brains do? What is a brain's job?

3. **Learning Experience(s):** _30-35__ Minutes

What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring… Describe in order, including instructions to kids.

10 minutes: Presentation of brains

●Similarities and differences across species

○ Compare and contrast

●Basic neuroanatomy

○ Hemispheres

○ Cortical lobes

●Localization of functions - Ryan's dad story

○ Cerebellum

○ Brain stem

○ Sensory and motor cortex

10 minutes: Making it brain

●What they are (special cells)

○ (Ask how many they think they have) You have billions!

○ Draw a picture on the board, label vocab: neuron, axon "sends information", dendrite, synapse, "receives information"

●Relay game to demonstrate how neurons communicate.

○ Students will line up into a semi-circle.

○ One hand should be spread open. This will represent the dendrites - where you will receive the information.

○ The other hand should be ready to poke the next person's hand. This will represent the axon - how you send information to the next neuron.

○ For the first run, students will try to pass the message as quickly as possible. For the second run, a specific pattern of pokes will be sent down the line.

●Transition to electricity: "Why is it important for neurons to be fast? "So how can neurons communicate so quickly?" Maybe use light switches as an analogy for using electricity to communicate quickly

10 minutes: Spiker box presentation/hands on activity

●Neurons use electricity to communicate signals

●We can use electrodes/amplifiers to listen in on these signals and figure out what neurons are doing

●There are neurons in the the bristles of the leg of the cricket that are sensitive to touch

○ Kind of like how you can sense hairs on your arm being touched

○ Normally these neurons send signals to the cricket's brain- even when disconnected they will still try to send these signals

●Activity 1: Listening to neurons

○ We can touch the neurons and listen (and see) to the signals they are sending through their axons.
○ Instruct students to (gently) touch the hairs on the cricket leg with a pencil tip. Point out spikes on the computer/iPhone.
●Activity 2: Stimulating neurons
○ There are also neurons that send signals from your brain to your muscles to tell them to move. So by sending electricity back into the leg, we might be able to stimulate these neurons and get the leg to move.
○ Students should see the cricket leg move to the beat of the music.

4. **Wrap-up: Sharing Experiences** ___5__ Minutes
Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

●Ask if students have any questions.
●What's the coolest thing you saw/learned today?
●What did you learn about how neurons talk to each other?

5. **Connections & Close:** __5__ Minutes
What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

●Relating things back to humans - is it possible to record from human neurons? What would happen if you recorded from nerves in a human leg? What about a human brain? What would happen if you stimulated human nerves/brains??!!? Where do brains keep their memories?

Total 50 – 60 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to perform neuron activities. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students think of and write down other functions of neurons, especially in the human brain.

Follow-up Possibilities

ELA Activity:
Suggest students write a letter explaining "How we learned about neurons"

Reading Connections:
- The Brain: Our Nervous System, by Seymour Simon- "The Brain, written for ages 8 and older, is a solid launching pad for further investigation of the organ that makes us who we are. Kids

will love learning that our brains grow until we are 7 years old, that our spines have 33 vertebrae, and that our skulls are made of 28 bones. Large, full-color photographs and illustrations show the fascinating, if slightly nauseating, areas of the human brain--a positron computed tomography (PCT) photo, for example, shows the dramatically different levels of visual stimulation to the brain when your eyes are open or closed." http://www.amazon.com/The-Brain-Our-Nervous-System/dp/0060877197/ref=sr_1_1?ie=UTF8&qid=1371163367&sr=8-1&keywords=0060877197

- Phineas Gage: A Gruesome but True Story About Brain Science, by John Fleischman - "Phineas Gage was working on the railroad in 1848 when an accident blew a 13-pound iron rod through his head. He survived, and the changes in his personality helped doctors begin to understand the workings of the brain. This is book illustrated with photographs and diagrams." http://www3.cde.ca.gov/reclitlist/displaytitle.aspx?pid=16596

- The Great Brain Book, by HP Newquist- "This NSTA/CBC Outstanding Science Trade Book includes some history of brain research, brain structure and functions, information about neurons, learning and memory, brain imaging, disease, and future treatment and the technology that will support future discoveries." http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=16201

- Brain: Inner Workings of the Gray Matter, by Richard Walker – "The book covers anatomy of the brain, the nervous system, neurotoxins, mapping the brain, memory, personality tests, phobias, brain waves, sensors, communication, electricity and magnetism, optical illusions, and reflexes. The senses are discussed in detail." http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=13136
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Mathematics Activity:

Students can write equations and/or word problems using different numbers of neurons.

Other:

The Spiker Boxes were from http://backyardbrains.com/. Here you can find many other Spiker Box demonstrations and experiments, as well as videos and cool neuroscience facts.

The Animaniacs also understand how cool neuroscience is!
http://www.youtube.com/watch?v=EDdv7YWs_IY

More neuroscience games, lesson plans, and activities at
http://dana.org/resources/brainykids/default.aspx
A great, comprehensive neuroscience-for-kids education website is:
http://www.brainfacts.org/educators/educator-resources/neuroscience-for-kids/

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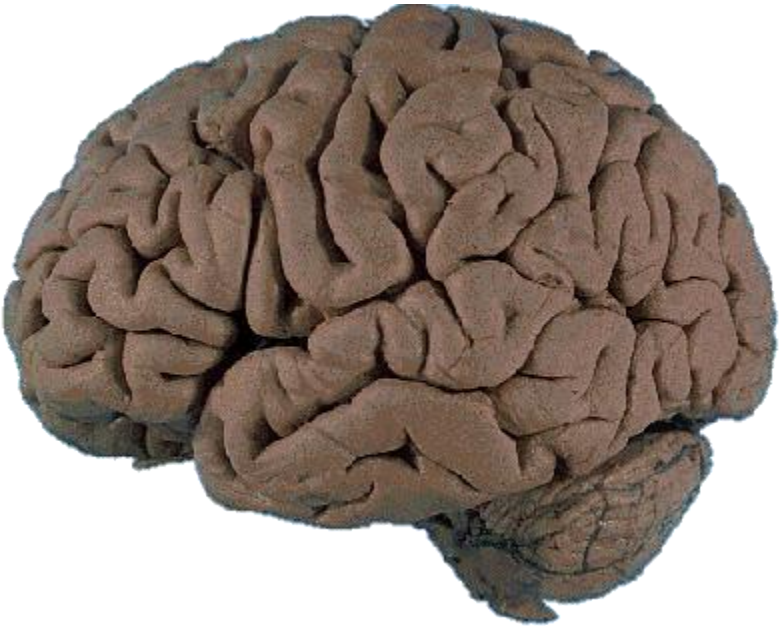

Image of a human brain.

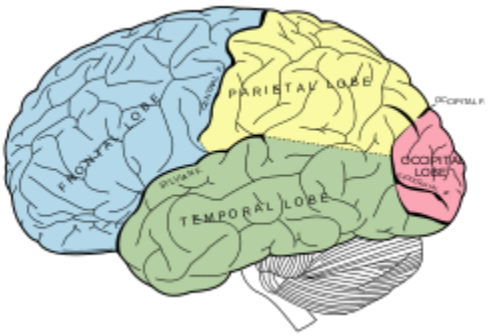

Image of a brain with the cerebral lobes labeled.

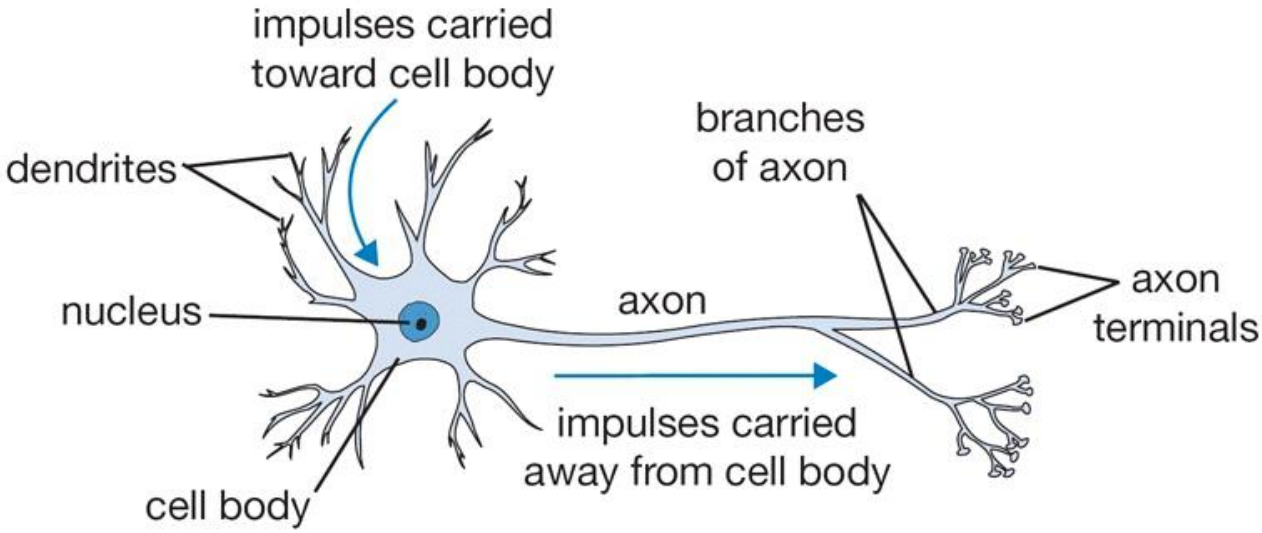

Diagram of a neuron.

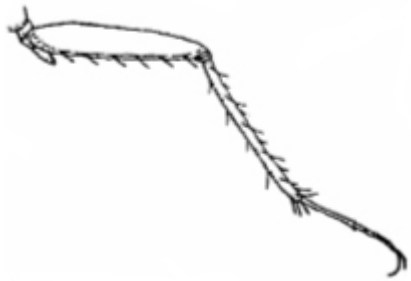

Image of a cricket leg. The spiny “hairs” along the leg help the cricket feel what it is touching. We’re using the Spiker Boxes to listen in on these neurons as we touch the hairs.