# Bay Area Scientists in Schools Presentation Plan

**Lesson Name:** Feel Dead Brains
**Presenter(s):** UC Berkeley Cognitive Science Student Association; Updated by Sabrina Erlhoff
**Grade Level** 5th
**Standards Connection(s)** Multicellular organisms have specialized structures.

**Teachers: Detailed standards information can be found at the end of this lesson plan. Also, please see the accompanying coloring/fact sheet to share with your students after the lesson: http://www.crscience.org/pdf/FeelDeadBrains_TakeHome.pdf*

## Teaser

In this lesson we will learn about the brain and what it does for us, including thinking, moving, using our 5 senses, and remembering. We will learn about the parts of our life that we need to keep healthy to ensure that our brains function properly and well. We'll learn about different ways that we study the brain and then be able to see and hold brains that have been preserved.

## Objective:

Students will recognize that the brain is a very complex organ that has many specialized functions that occur in the various regions within the brain. They will have the opportunity to examine real specimens, learn the names of some of the larger regions, and learn about how to keep our brains healthy.

## Vocabulary Words

- **Neuroscience**: the study of the brain, the spinal cord, and nerves.
- **Autonomic Nervous System**: the system in your body that controls things that your body does automatically without conscious thought like breathing or heartbeats.
- **Voluntary Movement**: controlled movements that you do consciously
- **Involuntary Movement**: motions that you do without thinking like reflexes or tics.

Some regions of the Central Nervous System (the brain and spinal cord):

- **Frontal Lobe:** the part of your brain just behind your forehead that helps control things like planning, reasoning, social behavior, and movement.

- **Parietal Lobe:** the part of your brain directly under the top of your skull that helps control things like perception of touch and pain.
- **Occipital Lobe:** the part of your brain on the back of your head that helps process visual information that comes in from the eyes.
- **Temporal Lobe:** the part of your brain on the sides of your head that helps process sound information that comes in from the ears, helps you speak, and helps you make memories.
- **Cerebellum:** the part of your brain just above the nape of your neck that helps control things like movement, posture, and balance.
- **Brainstem:** the part of your brain that connects it to the spinal cord, that helps control autonomic body functions like breathing and heartbeats, as well as reflexes like vomiting, coughing, sneezing, and swallowing.
- **Spinal Cord:** the bundle of nerves protected by the spine that transmits signals from the brain to the rest of the body, and vice versa.

## Materials

- Preserved Brains (Human & Other Animals)
- Trays
- Gloves for handling brains (1-2 per student)
- Coloring/Fact Sheets (1 per student)
- If doing Stroop Tests:
    - Stroop test cards
    - Stopwatch
- Optional:
    - Visual aids like posters, etc. Drawings on the board work too.

## Classroom Set-up

What is needed for the presentation?

- Sink for washing hands and trays when finished
- At the beginning of the presentation: Students should be seated all together for the introduction, with all materials cleared off of their desks to facilitate easy transitions into brain observations.
- During the hands-on portion, the students will be split into smaller groups. This is flexible depending on how many brains you have, or if you want to make the Stroop test into its own station.
    - 2 groups each for handling human brains

- 2 groups each for handling sheep brains

## Classroom Visit

### 1. Introduction 10-15 minutes

**Personal Introduction:**

a. Hi, we are all college students at UC Berkeley (I'm in the 16th grade!!) who are interested in Neuroscience. Does anybody know what neuroscience is? Neuroscience is the study of the system in the body that includes the brain (write neuroscience on the board). Today we're going to talk about the brain, what it does, and why it's important to keep your brain healthy.
b. Before we get started, let's introduce ourselves. We will say our name and something that we think is really cool about the brain (or our personal research interests).

**Topic Introduction:**

****Note: This part of the lesson can last up to 20 minutes if you talk about everything and take a lot of ideas and questions from the students as you go. It is most important that the kids feel like they are participating in a fun, approachable discussion rather than listening to a lecture. Make sure to teach key ideas, but if they are more interested in one aspect of the brain, let the conversation flow there. This is just an outline and general ideas to get you started.*

a. These are all really cool things about the brain! Can anybody tell me some things that the brain does or helps you do?
    i. Write ideas down on the board.
b. Your brain is very important because it does all of these things that you mentioned earlier. It helps you think, remember, move, talk, eat, and almost anything else you can think of! Your brain is working hard every second of the day, every day. When you wake up in the morning, your brain interprets the sound of your alarm, tastes your breakfast, sees the colors of your socks, walks you to school, figures out your math problems, remembers your friends' names, etc. It regulates your heartbeat, breathing, and even moves your eyeballs for you.
c. Since it does all of these things for us, our brains must be very important! That being said, it is important to keep your brain happy and healthy. How do you think we can keep our brain healthy?
    i. Just like you exercise and drink milk to keep your muscles healthy, you need to exercise your brain, eat right, and get enough sleep.

- Sleep: You brain regulates sleep cycles. Also, a well-rested brain works much better than a tired brain. Sleep deprivation can impair judgment and problem solving skills.
- Eating habits: It is important to be getting the right kinds of nutrients to power your brain. Too many French fries can make your brain tired! Also, scientists have seen that your brain overloaded with sugar can have similar activation patterns as a brain on drugs.
- Playtime/safety: Your brain is extremely fragile. Luckily we have a skull and cushions of fluid to keep it safe, but bad accidents can damage your brain permanently. It is extremely important to wear a helmet when riding your bike and playing sports; for the same reason, it is important to wear a seatbelt when riding in a car.
- School: When you use your brain, cells called neurons send messages to each other over pathways. When these neurons send the same messages over and over, these pathways get stronger. Imagine walking on a path. If you walk on that path every day, it will stay clean and defined. If you don't walk on it for a long time, weeds will grow over it and eventually the path will disappear. In the same way, neurons pathways can become weaker. The point: If you practice doing math problems over and over, you will get better at math! As you become older, it is important to keep using your brain to keep the pathways strong. Use it or lose it!

d. Your brain is actually made up of smaller parts that do different things.

i. Draw a picture of brain on the board with 4 lobes.
ii. Your occipital lobe is for vision.
iii. Your temporal lobe is for hearing, speaking, and memory.
iv. Your parietal lobe is for feeling touch and pain.
v. Your frontal lobe is for movement, planning, reasoning, and dealing with social situations.
vi. Your cerebellum is for movement and balance.
vii. Your brainstem is for autonomic functions like breathing, heartrate, and sleep cycles.
viii. And there are many more, smaller structures within these for other things like emotion and taste. There is even a specific place in your brain just for recognizing faces.

e. How do you think neurologists/scientists find out what these different regions of the brain do?

i. We can look at brain damage or people who are missing parts of their brains. People can lose parts of their brain in accidents (like when you don't wear a helmet!) or when they get older some of their brains cells can die. Sometimes the damage is so small that these people are still able to walk around and do normal things but when any of these brain parts is damaged enough, you can expect to

lose the ability to perform that function. For example, if you were to lose the area for recognizing faces, you would not be able to recognize your best friend, a picture of George Washington, or even you mom if you saw them. Scientists can often recognize these behavior changes and figure out what part of the brain has been damaged.

ii. Another way is to look at what part of the brain is being used when you do a certain thing, by using special machines. These machines can see inside your brain when you're completing a task of thinking about something. This is kind of like taking an x-ray of a broken arm, except some machines are so advanced that we can see the brain working in real time.

iii. Another way is to study the anatomy of brains that have been donated to science!

f. Today we are going to be neuroscientists in two of these ways: experimentation and studying the structure of the brain! First comes experimentation.

## 2. Learning Experience (s): 30 Minutes

**a.** Stroop Test Demo (Optional, or as its own station with the human and animal brains)

i. Get 3-4 volunteers from the class (have teacher decide)

ii. We know that there are different regions inside of your brain that do different things. We're going to try and test how quickly those different regions communicate with each other.

iii. *Poster with Stroop test 1:* Read the words written on the poster, out load, in order, without mistakes. If you make a mistake you have to keep trying to say the word until you get it right. No skipping words! You will be timed, finish the whole list as fast as you can.

iv. *Poster with Stroop test 2*: Same thing, except name the color of the ink that the word is written in. Let's do some examples first. (show mini-cards to make sure students understand the experiment)

v. Write their times on the board. Now let's look at the times. Which one was faster? Why do you think this is?

vi. When you looked at the second deck, your brain got two signals from your eyes – the words and the ink color. Reading is very automatic for most people. But, naming a color isn't. To name the color, your mind has to ignore the first reaction – what a word says. But ignoring something can take real mental effort! In fact, when you do something that takes a lot of concentration, your brain can get very tired. This makes it hard to stay focused.

vii. Want to improve? Give yourself a break before trying again. This is good advice if you have to take a hard test at school. It's really helpful if you get a good amount of sleep or to exercise (in the day time) before you have to do something where you have to concentrate.

viii. What are some other ways you can help improve your concentration? Connect this back to the health talk we had earlier. Get sleep, eat right, practice!
ix. Thanks for volunteering!

**b.** Brain Stations
i. Divide the class into 4 groups – two for human brains and two for animal brains. Switch once halfway so that each student sees one human and one sheep brain.
ii. We have real, preserved brains here for you to observe and touch. We have three rules for touching the brains: be respectful, be safe, and be gentle.
1. **Be respectful.** When you are an adult, you can choose to donate your body to science. This allows scientists to study real specimens, with permission. These brains belonged to people who chose, before they died, to donate they bodies to science. We have to be respectful of this. These brains belonged to real people just like you and me. That being said, we need to be doubly respectful of the animal brains. These animals did not elect to have their brains donated, and we need to be thankful for their sacrifice. (Note: sometimes kids ask… sheep brains usually come from slaughterhouses where their bodies are harvested for meat, etc.)
2. **Be safe.** We all have to wear gloves when touching the brains, no questions asked. This protects us from any germs or pathogens that might still be on the brain, and protects the brain from any germs that might be on your hands. These brains were preserved using special chemicals so that we can study them for a long time. They may smell a little funny, but it is safe.
3. **Be gentle**. Although they are preserved, the brains are still very fragile and can be damaged very easily if you are not careful.

**c.** Human brains (some ideas for discussion)
i. Every memory, experience, hobby, love, etc. of this brains owner was contained by this brain. Their entire life!
ii. Find some of the regions that we talked about earlier.
iii. Why is the brain wrinkled like this? Our brains are too big for our heads. If you unfolded the entire cortex, it would be the size of a newspaper or a school desk.
iv. Notice the brainstem and how it exits vertically down towards the spine.
v. Notice the texture and hardness. It seems so easy to damage this brain, but this is much more firm than what is in your head! Your living brain, unpreserved, would feel a lot more like soft tofu, and even leave a fingerprint for a while if you touched it, like a memory foam mattress!

**d.** Animal brains (sheep)
i. What kind of animal do you think this brain belonged to?
1. Sometimes kids guess things like guinea pig or even elephant. Encourage thought about size of body vs size of brain.

ii. Compare them to human brains (if in second rotation). What's similar and what's different? Think about the brainstem direction and bipedalism vs quadupedalism.
iii. Let's find some of the regions! Are some of them smaller or larger?
iv. Sheep brains and dog brains have much bigger olfactory bulbs than humans. Think about what having a bigger smelling region of the brain might mean.
v. Dolphins have really big motor cortex and cerebellum, as well as very developed areas for finding themselves in 3D space. Why do you think this is?
vi. More advanced: Humans are capable of language and other complex things, yet our brains look very similar. What do you think separates us from animals?

## 3. Wrap Up: Sharing Experiences 10-15 Minutes

a. Help clean up. Wash hands, throw away gloves properly. Wash trays.

b. Review. Tell me some things you learned today. Write some topics on the board?
   i. What the brain does
   ii. How we can keep the brain healthy
   iii. How scientists study the brain
   iv. How the brain processes information
   v. Differences between human and animal brains

c. Questions? What was your favorite part? What did you learn? Leave lots of time for this…it's the fun part!

d. Pass out coloring/fact sheet. Explain that they should take it home and show it to their parents or guardians and share something that they learned about the brain today. Thank you!!

**Total 60 Minutes**

## Follow Up: After the Presentation

**1. ELA Activity:**

Suggest students write a letter explaining "How we learned about neuroscience?"

**2. Reading Connections:**

- *The Human Brain Book* by Rita Carter

- *The Great Brain Book: An Inside Look At the Inside of Your* Head by HP Newquist (ISBN 0-439-45895-1). Content includes history, brain structure and functions, neurons, learning and memory, brain imaging, disease, and future treatment and technology.

Excellent photographs throughout. Written in a very readable format with complementary illustrations and sidebars with related information.

**3. Provide the following coloring & fact sheet for students to take home:**
**http://www.crscience.org/pdf/FeelDeadBrains_TakeHome.pdf**

**4. Other:**

- Draw Your Nervous System: www.amnh.org/ology/features/nervoussystem/
- Stroop Test:
  - www.pbs.org/parents/fetch/activities/act/act-trainyourbrain.html
  - http://faculty.washington.edu/chudler/colors3.html
- Test Your Reflexes:
  - http://faculty.washington.edu/chudler/chreflex.html

## Standards Connections:

**California Science Standards:** Multicellular organisms have specialized structures.

**Common Core Standards:**

ELA/Literacy:

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

Mathematics:

MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.
MP.4 Model with mathematics.

**FOSS Connections:**

Grade 4-6 Module: Living Systems

**Next Generation Science Standards (matrix below):**

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.

| Science & Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
|---|---|---|
| Developing and Using Models<br>Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.<br>• Develop a model to describe phenomena. (4-PS4-2)<br>• Use a model to test interactions concerning the functioning of a natural system. (4-LS1-2)<br><br>Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s).<br>• Construct an argument with evidence, data, and/or a model. (4-LS1-1) | LS1.A: Structure and Function<br>• Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)<br><br>LS1.D: Information Processing<br>• Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2) | Cause and Effect<br>• Cause and effect relationships are routinely identified. (4-PS4-2)<br><br>Systems and System Models<br>• A system can be described in terms of its components and their interactions. (4-LS1-1), (LS1-2) |