EACH BRAIN MATTERS
THE CENTER FOR NEUROSCIENCES FOUNDATION

UNIT
The 5 Senses
Elementary 3-5

TIMEFRAME
15-20 minutes

MATERIALS

Cotton balls, essential oils or objects with noticable smells (cinnamon, orange, banana, cedar or pine, lemon, vanilla, . . .etc), film canisters or other small, matching containers for the scents

Smelly Memories

Synopsis

This lesson demonstrates that scents can trigger memories, sometimes rich with visual information and emotions. This demonstration and a description of neural pathways of odor processing will provide participants first-hand experience on why we think odors trigger memories in this way.

Learning Outcomes

At the end of this activity students will be able to explain why neuroscientists think odors can trigger strong, multisensory memories. They will be able to describe the basics of the pathway odor information takes into emotion and memory processing regions of the brain and offer an explanation for why odor information is different from visual or tactile information.

Background for Teachers

Smells (**odors**) enter our nose and the signals generated there are sent to a region of our brain called the **olfactory bulb**. The olfactory bulb processes odors to help us distinguish them and then makes direct connections to two brain areas known to be crucial for emotional responses and memory, the **amygdala** (emotions) and the **hippocampus** (memory). Visual and tactile (touch) information take a longer, more convoluted path to these regions; the more direct connection to the amygdala and the hippocampus is unique to the olfactory system. Because visual and tactile information are also stored as memories in the hippocampus, neuroscientists think that odors activating these areas can activate the entire experience associated with the odor, bringing up visual and even tactile memories!

The hottest new research in odor-evoked memory has started to focus on the anterior olfactory nucleus (AON), a part of the forebrain that is thought to combine odor information with "what" and "where" information. The AON connects nearly every region that processes odor information, so it may be a central regulatory center for odor processing and perception. The AON is also on of the first places neurodegeneration occurs in patients later diagnosed with Alzheimer's. Since odor information can be so important at triggering memories, the loss of the sense of smell can have deeper consequences that just the inability to detect odors. However, since odors can trigger strong positive emotions, neuroscientists psychiatrists are also considering therapeutic uses of odors.

TEACHING TIPS

You can use different objects rather than cotton balls and essential oils such as orange peels, garlic, rose flowers, ect. try to gather a good number of different smells.

ARIZONA LEARNING STANDARDS

3.L2U1.6
5.L4U3.12

Activity Instructions

In this activity students will first be asked to describe odors and share any memories they evoke, afterward they will be asked to match odors. Therefore, you will need two sets of odors (the “identify” set and the “match” set). Place one cotton ball in each container. Put one drop of essential oil on each cotton ball, making sure you have an “identify” container and a “match” container for each odor. Be sure not to mix odors; using different gloves for handling different essential oils is a good ideaNumber or letter the containers such that each one has a unique number or letter; this will be used in the second part of the activity when students try to match containers. Whatever method you chose for labeling containers, create an answer key to provide students at the end.

- Have each student smell each odor and write down what it makes them think of. Tell them they can write down anything they want, anything the odor triggers.
- Ask them to then write down what they think the smell is. Students may just write a sentence about each odor and their identification guess. Ask students to do this first activity without talking to one another. Emphasize that there are not correct answers because this is an activity about sensory experience, and that is a very person-specific process. The scent of oranges can be identified by many people, but the memories or meaning of that scent will vary greatly from person to person. After the first part of the activity discuss what students think. Did anyone get an odor that triggered a strong memory? Ask them to share. Do students think they can identify all the odors (just ask their confidence level, do not ask them for specific identifications)?
- Next, ask students to match odors. After students have had a chance to write down their thoughts on each odor, ask them to find the match. Again, ask that they do this without talking to their other group members. After they have all finished, provide them the answers for the identity of each odor and its matching container.

Extensions & Discussion

Ask children if they did they do a better job matching known or novel (new) odors? Did their existing memory of an odor affect their ability to identify it or find its match? What strong memories did people have with the odors? Were the memories similar or different? (ex: the smell of oranges may remind people of summer or soccer games)
If you are doing this with family, were there certain smells that evoked similar memories?

*As a technical note, smells that consist of multiple molecules are often referred to as odors, whereas a single molecule is usually referred to as an odorant. This is not crucial for this activity, but knowing it may help instructors not be confused when reading about olfactory processing!

Key Terms & Concepts

Odor: A distinctive smell consisting of
Olfactory bulb: Structure located in the forebrain of vertebrates that receives neural input about odors detected by cells in the nasal cavity
Amygdala: Structure located in the temporal lobe, just anterior to (in front of) the hippocampus which is responsible for emotions, survival instincts, and memory.
Hippocampus: Structure located within the brain's temporal lobe and forms an important part of the limbic system, the region that regulates emotions and is associated mainly with memory

Resources

Smells like nostalgia: Why do scents bring back memories? Meghan Holohan, NBC News. https://www.nbcnews.com/healthmain/smells-nostalgia-why-do-scents-bring-back-memories-895521
Scientists discover new connection between smell and memory. Science Daily. https://www.sciencedaily.com/releases/2018/07/180723155726.htm