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|  | **Activity 1-Brain Size** |  |

**Teacher Instructions**

Students are given a picture of the brains of different species. They will analyze the pictures and hypothesize for the differences in size, shape, and function.

**Objective**

After this activity, students should be able to:

* Analyze the structure the brain and hypothesize how the structure of the brain relates to the function of the brain.

**Materials:**

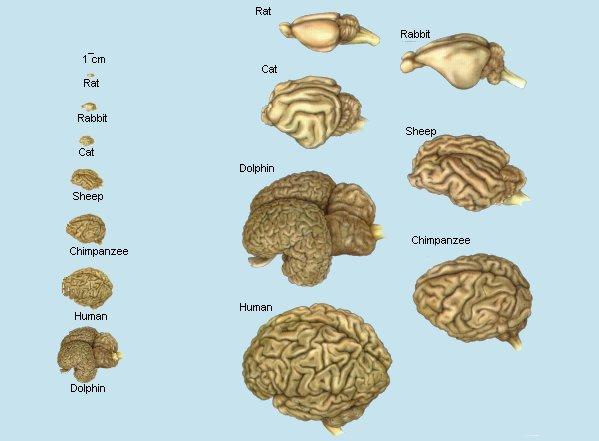
Copy of Student Worksheet

Writing utensil

Brain Picture

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|  | **Activity 1-Brain Size** |  |

Use this image of the brains of several species to answer the questions on your worksheet.



**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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| **Activity 1 – Brain Size** |

Look at the picture of brains of different species. The picture is drawn to scale. Using the picture, answer the following questions.

|  |  |
| --- | --- |
| **Question** | **Answer** |
| 1. Which animal has the smallest brain? Which has the largest? |  |
| 2.Do you think the size of the brain directly relates to the intelligence of the species? Why or why not? |  |
| 3.The higher (more intelligent) species have more folds of tissue on the surface. Does this mean they might have more neurons on the surface (because there is more surface)? |  |
| 4.The porpoise brain is almost as big as the human brain, and it has more folds.  What do you think that this suggests? |  |
| 5.The two small lobes at the left of the brain of the rat, rabbit, cat, and porpoise are "olfactory bulbs," used in processing odors. They are present, but much smaller relative to the rest of the brain, in the other species. What does this suggest about the role of odor in the animal's life style? |  |

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|  | **Activity 2-Conditioned Learning** |  |

**Teacher Instructions**

Students brainstorm about their own experience with conditioned learning. They then choose one experience and design a hypothetical experiment to test whether it is conditioned learning.

These two websites: <https://www.verywellmind.com/classical-conditioning-2794859>

and <https://courses.lumenlearning.com/boundless-psychology/chapter/classical-conditioning/>

contain easy-to-understand descriptions of how classical conditioning works and also have examples. This would be a good introduction for the students before they start the activity.

**Objective**

After this activity, students should be able to:

* Recognize conditioned learning experiences
* Design and experiment in conditioned learning

**Materials:**

Worksheet

**Names: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_**

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| **Activity 2 – Conditioned Learning** |

**Objective:** Design and experiment to test conditioned learning.

Classical conditioning basically involves forming an association between two stimuli resulting in a learned response. It's important to note that classical conditioning involves placing a neutral signal before a naturally occurring reflex. In Pavlov's classic experiment with dogs, the neutral signal was the sound of a tone and the naturally occurring reflex was salivating in response to food. By associating the neutral stimulus with the environmental stimulus (presenting of food), the sound of the tone alone could produce the salivation response. For a detailed description of how this happens, along with some examples, [click here](https://www.verywellmind.com/classical-conditioning-2794859).

1. With your group, see if you can think of an everyday experience or behavior that might have been conditioned. Try to think of one behavior per person. List the behaviors below.
2. Design and experiment that could test whether such behavior is conditioned. You could imagine an animal or person who does not have the behavior and test a conditioning design on him or her to see if the new behavior would be acquired. Outline your experiment below.

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|  | **Activity 3 – Memory Consolidation** |  |

**Teacher Instructions**

Students are divided into groups. Each group is assigned the set of matching terms and descriptions. They are instructed that tomorrow they will have a quiz where they will have to match the terms with the descriptions. At the end of the period, the students are separated into two test groups.

Test Group 1- consolidation group

* When the class period bell rings, do not leave (arrange with teachers for permission if this will make them late to their next class). Close the lesson list of items to be memorized, but continue to think about what was on the list.
* Instruct them to remain silent. They should not look around the room or out the windows. They should not talk to anyone or move from their chair. They should continue to think about the lesson for five minutes.
* Tell them to think about the list and see how much they can remember of the list throughout the day. This could include lunch, P.E., etc. If they have a chance, they should talk to others in their group about the material and help each other remember everything on the list.

Test Group 2 - consolidation disruption group

* As soon as the class period bell rings, they should quickly leave.
* They should immediately talk to as many people as they can about anything other than the lesson.
* They should look outside, around the room, and the halls.
* They should do something else and not think about the lesson until the next day.

During the next class period, everyone should take the test independently, not as a group. Have them report their scores by group. Compare scores.  You could pool scores across student groups, create a bar graph of the distribution of scores for everyone in each condition. That is, graph how many students scored from 0-20%, how many from 20-40%, 40-80%, 80-100%.

Discuss how each group did. Did the behavior of the students at the end of the lesson affect their test score? Ask about how they could apply this information to help them study or learn new material.

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|  | **Activity 3 – Memory Consolidation** |  |

**The Test Material - matching items study sheet**

|  |  |
| --- | --- |
| name for nerve cell | neuron |
| brain diseased with excess electrical activity | epilepsy |
| two causes of stroke | artery breaks or plugs up |
| kind of muscle that curls toes | flexors |
| consciousness occurs in and from the \_\_\_\_ | cerebral cortex |
| man who discovered conditioning | Pavlov |
| word for converting temporary memories to long-lasting ones | consolidation |
| disease causing trembling | Parkinson's disease |
| word for chemicals released by neurons | transmitters or messengers |
| another name for nerve gases | cholinesterase inhibitors |
| name of famous scientist in this lesson | Walter Cannon |
| brain map image of blood supply | PET scan or MRI |
| potassium and \_\_\_ create the electrical charge of nerves | sodium |
| two things neurons do | generate electricity, secrete chemicals |
| a brain area important to memory | hippocampus |

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_**

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|  | **Activity 3 – Memory Consolidation** |  |

Instructions: Match the items on the left with the descriptions on the right. Put the letter of the answer in the blank next to the item.

|  |  |
| --- | --- |
| \_\_\_ 1. name for nerve cell | * 1. Walter Cannon |
| \_\_\_2. brain diseased with excess electrical activity | * 1. Parkinson's disease |
| \_\_\_3. two causes of stroke | * 1. transmitters or messengers |
| \_\_\_4. kind of muscle that curls toes | * 1. hippocampus |
| \_\_\_ 5. consciousness occurs in and from the \_\_\_\_ | * 1. generate electricity, secrete chemicals |
| \_\_\_ 6. man who discovered conditioning | * 1. neuron |
| \_\_\_ 7. word for converting temporary memories to long-lasting ones | * 1. artery breaks or plugs up |
| \_\_\_ 8. disease causing trembling | * 1. consolidation |
| \_\_\_ 9. word for chemicals released by neurons | * 1. epilepsy |
| \_\_\_ 10. another name for nerve gases | * 1. cholinesterase inhibitors |
| \_\_\_ 11. name of famous scientist in this lesson | * 1. sodium |
| \_\_\_ 12. brain map image of blood supply | * 1. PET scan or MRI |
| \_\_\_ 13. potassium and \_\_\_ create the electrical charge of nerves | * 1. Pavlov |
| \_\_\_ 14. two things neurons do | * 1. cerebral cortex |
| \_\_\_ 15. a brain area important to memory | * 1. flexors |

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|  | **Activity 4 – How Does Smell Affect Taste** |  |

**Teacher Instructions**

This activity is adapted from: <https://www.education.com/science-fair/article/does-smell-affect-way-you-perceive-taste/>

The purpose of this activity is to show how smell and taste are related.

**Objective**

Students will:

-Understand how smell and taste are related

-Understand the design of a valid experiment including using multiple trials and using a control

**Materials**

* volunteers, **none of whom are allergic to any of the foods you are giving them.**
* Assortment of fruit
* Knife
* Cutting board
* 3 large plates
* Q-tips
* Essential oil of peppermint
* Clipboard
* Pencil
* Plain crackers
* Water
* Cups

**Procedure:** from:<https://www.education.com/science-fair/article/does-smell-affect-way-you-perceive-taste/>

1. Before you start your experiment, make sure that each of your volunteers is aware that he or she is participating in an experiment related to smell and taste. Ask about any allergies to fruit or peppermint oil. **Allergies are a serious concern. You may need to check students’ medical records for fruit or peppermint allergies before proceeding.**
2. Create a data table that you can fill in quickly as you test each volunteer. Make a copy for each volunteer (see example below).

|  |  |  |  |
| --- | --- | --- | --- |
| **Fruit** | **Peppermint Oil** | **Nose plugged** | **Control** |
| Strawberry |  |  |  |
| Pear |  |  |  |
| Kiwi fruit |  |  |  |
| Tomato |  |  |  |
| Banana |  |  |  |
| Watermelon |  |  |  |
| Apple |  |  |  |

1. Chop the fruit into bit-sized pieces. You need three pieces of each kind of fruit for each volunteer.
2. Stick a toothpick in each piece of fruit.
3. Make sure all different types of fruit are cut into pieces of the same size and that there are no pieces of fruit skin or seeds.
4. Make piles of each type of fruit on each of the three plates.
5. For one plate of fruit, use the cotton swab to dab a drop of peppermint oil on each piece of fruit.
6. Do not let your volunteers see the plates of fruit. Also, they will need to shut their eyes or be blindfolded throughout the experiment.
7. Test each volunteer separately.
8. Start with the fruit with peppermint oil on top. Hand your volunteer a piece of fruit. Give her 3 seconds to identify the fruit. If she identifies the fruit correctly, put a check mark on the data table with her name. If she can’t identify the fruit or if she identifies it incorrectly, mark a 0 on her chart.
9. After testing everybody with peppermint oil covered fruit, give each volunteer some time to rest, drink a glass of water, and eat a couple crackers.
10. Repeat the experiment, this time asking your volunteers to close their eyes and hold their noses as they taste each fruit.
11. Again, give your volunteers a rest before you do the final trial.
12. For the next trial, your volunteers just need to shut their eyes.
13. Repeat the taste test and record the results in each data table.

**Results:**

Your results will vary depending on the fruits you chose, the peppermint oil, and your volunteers. In general, your volunteers will be less able to recognize the taste of the fruit when it was masked by peppermint oil or when holding their noses. Fruits your volunteers eat less often might be harder to recognize.

**Why?**

You removed as much skin and seeds as you could so your volunteers would not get clues about the identity of the fruits through texture, and you had them close their eyes so that you could test smell and taste without including touch or sight. Tomato is a good food to test because they are fruits according to the botanical definition and your volunteers might not expect it. The purpose of the last trial was a control, to see how well your volunteers could identify the fruits without peppermint or plugging their noses.

Your volunteers were likely to have a hard time identifying the fruits when their sense of smell was plugged by their fingers or overwhelmed by the peppermint oil. A lot of what we consider taste is actually smell. Remember that there are only five types of taste receptors, salty, bitter, sweet, sour and umami. Many of the fruits you offered taste sweet, and perhaps a bit sour, but the main way to tell one fruit from another is smell. Your sense of smell can differentiate up to 1000 different scents!