



adapted from "Neuroscience Laboratory and Classroom Activities" created by the National Association of Biology Teachers and the Society for Neuroscience; and "The Senses, Behavior, and Learning" by Dr. Roger Johnson

## Teacher Guide

### Motor Learning and Memory

**Grade Level 4-12**

**Lesson Length  
1 class period**

**Lesson Summary:** Students will measure reaction time during tasks of increasing complexity.

#### Standards Alignment

**Minnesota Science Standards** – Alignment Matrix [www.brainu.org/resources/MNSTDS](http://www.brainu.org/resources/MNSTDS)

**National Science Standards** – Project 2061: Atlas of Science Literacy reference

- a) Behavior/Heredity and experience shape behavior – learning from experience (p.97, Atlas Vol. 1)

*Research on student learning:* "No relevant research available in Benchmarks." (p.97, Atlas Vol. 1)

#### Objectives—Students will

- experience activities that involve reaction time.
- investigate how reaction time can be altered.
- discuss brain regions that mediate reaction time.
- discuss how information is sent from the senses to brain regions involved in this activity.

#### Assessment Options

- Collect and graph data, then discuss results.
- Discuss what is going on in the nervous system when the activity is performed.
- Brainstorm ideas on different ways to investigate reaction time.

#### Materials

- decks of playing cards
- time clocks or stopwatches

#### Procedures

##### Engage

- Ask students what makes a task hard to do.
- Generate ideas with the class about what makes an activity hard to do.
- Ask what might happen in the brain when a task gets harder to do.



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#### Explore

1. Instruct students to work in pairs. Assign the roles of Card sorter and Recorder to each pair. Ask the students to shuffle the cards.

##### Activity 1

The card sorter deals the card into two piles. The recorder starts the time clock or stopwatch as soon as the card sorter begins to put the cards into two piles. The recorder times how long the cards are randomly sorted and records the time.

##### Activity 2

The card sorter sorts the cards into two piles **based on the color** of the suits: one pile for red and another pile for black. Again, the recorder writes down the time it took the card sorter to put the cards into two piles.

##### Activity 3

The card sorter puts the cards into **four random piles**. The recorder writes down the time the card sorter took to finish this task.

##### Activity 4

The card sorter sorts the cards into **four piles based on the suits**: aces, spades, clubs, diamonds. The recorder writes down the time the task was completed.

2. Ask students to create a graph of the data they collected. Discuss with students different ways to graph the data (e.g. create a bar graph of time versus activity). You can also make a graph of the data from the class.

#### Develop Questions

- Ask students if they observe any patterns in their graphs? If they observed a pattern, ask the students what they thought of the pattern.
- Talk about what happens when the task becomes more complex.

#### Explain

Discuss how information is translated.

- Information about the card is received through the eyes and travels to the **visual cortex (occipital lobe)** then to the **association cortex (parietal lobe area)** where the visual information is related to memory of where to place the card.

As the task gets more complex, it takes a longer time for the cerebral cortex to evaluate and decide where to place the card.

- The information (decision on where to place the card) travels to the **motor cortex (frontal lobe)** and from there it is sent down through the **spinal cord** to the muscles that control the arm movement.



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#### Expand and evaluate

- Ask students how one could become more efficient with card sorting. Discuss how repetition can be a strategy to performing a complex task faster.
- If anyone cut the deck of cards into 2 or 4 piles, discuss with the class where this idea may have come from (frontal lobe, cerebral cortex) and if this is a fair way to do the task. What do students think of this solution?
- Students can develop their own experiment to investigate reaction time.

For example: In groups of two, one student holds the tip of the ruler and lets go of it. The second student grasps the ruler. Use the markings to determine how many inches or centimeters the student grasped. Record the inches/centimeters. Try the activity again three times and record the inches/centimeters every time the student grasps the ruler.