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

**Student Exploration:** **Sight vs. Sound Reactions**

**Vocabulary:** histogram, mean, normal distribution, range, standard deviation, stimulus

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

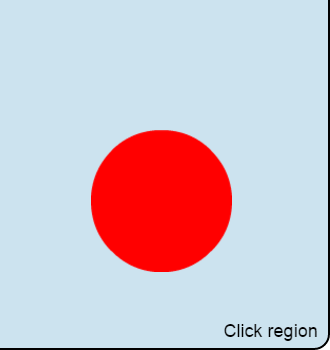
Most professional baseball pitchers can throw a fastball over 145 km/h (90 mph). This gives the batter less than half a second to read the pitch, decide whether to swing, and then try to hit the ball. No wonder hitting a baseball is considered one of the hardest things to do in sports!

1. What are some things in your life you must react to quickly? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. In general, do you think you have quick, slow, or average reactions? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Explain. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Gizmo Warm-up**

A **stimulus** is something that can cause you to react. A stimulus can be something you see (visual stimulus), something you hear (auditory stimulus), something you touch (tactile stimulus), or something you smell (olfactory stimulus). In the *Sight vs. Sound Reactions* Gizmo, you will compare your reactions to visual and auditory stimuli.

To start, check that the **Test** is **Sight**. Click the **Start** button. When you see a red circle, immediately click your mouse. Take the test until the results appear.

1. The **Time from each event** is the time (in seconds) between when the symbol appears and when you clicked the mouse. This is your reaction time.

What was your best reaction time? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. The **mean** (*μ*) of a data set is a measure of the average value in the set.

What is the mean of your data set? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. In many cases, the results of a test follow a **normal distribution**, or a bell-shaped curve.

Select the GRAPH tab. Is this graph shaped like a bell? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| --- | --- | --- |
| **Activity A:**  **Interpreting data** | Get the Gizmo ready:   * Click **Clear data**. * Check that the **Test** is **Sight**, the symbol is a **Circle**, and the color is **Red**. | 43SE2 |

**Question: How can you describe a data set?**

1. Gather data: Click **Start** and run a test with the Gizmo. Record your results below.

|  |  |
| --- | --- |
| **Reaction times (seconds)** | |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

1. Calculate: To calculate the mean of a data set, add the values and then divide by the number of values in the set.
   * 1. What is the sum of the reaction times in the table above? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. How many values are in the data set? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     3. What is the mean of this data set? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

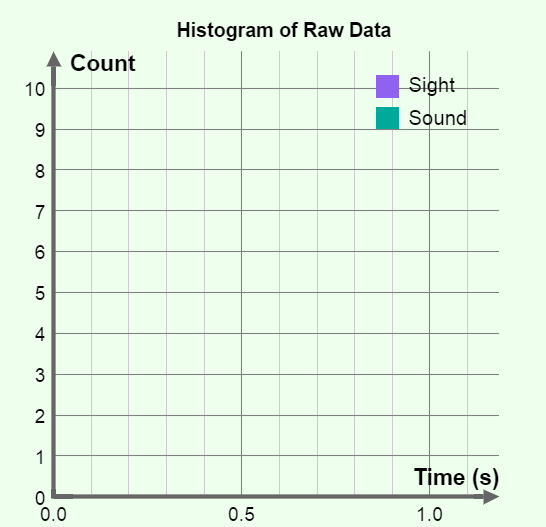
1. Calculate: The **range** of a data set is equal to the difference between the highest and lowest values in the set. To find the range, subtract the lowest value from the highest value.
   * 1. What is the highest value in your data set? \_\_\_\_\_\_\_\_\_\_\_\_ Lowest? \_\_\_\_\_\_\_\_\_\_\_\_
     2. What is the range of this data set? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Calculate: The **standard deviation** (*σ*) of a data set describes how closely the values in the set are bunched together. The standard deviation is listed on the SIMULATION pane.
   * 1. What is the standard deviation of this data set? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. Add and subtract the standard deviation (*σ*) from the mean (*μ*).

*μ* + *σ* = \_\_\_\_\_\_\_\_\_\_\_\_ *μ* – *σ* = \_\_\_\_\_\_\_\_\_\_\_\_

* + 1. How many values in the set are within one standard deviation of the mean? \_\_\_\_\_\_\_

**(Activity A continued on next page)**

**Activity A (continued from previous page)**

1. Interpret: Look at the GRAPH tab. This graph is called a **histogram**. It shows how many values in the data set fall into each time category. Sketch the histogram of your data set in the diagram at right.

What is the shape of this histogram? \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Analyze: If a data set has a normal distribution, then approximately 68% of the values in the set should be within one standard deviation of the mean (*μ* ± *σ*).
   * 1. What percentage of the values in your data set is within one standard deviation of the mean? \_\_\_\_\_\_\_\_\_\_\_\_
     2. Based on this fact and the shape of the histogram above, do you think your data set has a normal distribution? Explain. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Experiment: On the GRAPH tab, click **Clear data**. This time, try to vary your response times randomly as you take the test. Click **Start** and take the test.
   * 1. What is the mean of this new set of values? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. What is the range of this set? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     3. What is the standard deviation of this set? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Analyze: How does the standard deviation relate to the consistency and range of a data set?

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| **Activity B:**  **Visual and auditory stimuli** | Get the Gizmo ready:   * Click **Clear data**. | 43SE3 |

**Introduction:** We perceive stimuli through nerve cells in our eyes, ears, nose, tongue, and skin. When a nerve cell is stimulated, it sends an electrical signal to the brain. After the signal is processed by the brain, other signals are sent to our muscles as we react to the stimulus.

**Question: Do we react more quickly to visual or auditory stimuli?**

1. Form hypothesis: Do you think you will react more quickly to sights or sounds? Explain why.

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1. Gather data: Select the TABLE tab. Use the Gizmo to run five trials of the **Sight** test and five trials of the **Sound** test. Click **Same exam** to start another trial, and **New exam** to switch to a different type of test. Use the same visual symbol and the same sound for each trial.

In the tables below, record the mean reaction time and standard deviation (*σ*) for each trial.

In addition, record the maximum value and minimum value from each test. You will have to record these from the SIMULATION pane at the end of each test.

**Sight tests**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Trial** | **Mean** | ***σ*** | **Max.** | **Min.** |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |

**Sound tests**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Trial** | **Mean** | ***σ*** | **Max.** | **Min.** |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |

1. Analyze: What patterns do you notice in your data? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(Activity B continued on next page)**

**Activity B (continued from previous page)**

1. Interpret: Select the GRAPH tab to see a histogram of your data. Use the zoom controls (the “+” and “–” symbols to the right of the graph) to adjust the graph so the data is clearly visible.

What does this histogram show? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Summarize: Based on the results of your experiments, do you react more quickly to visual or auditory stimuli? Explain. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Think and discuss: The auditory nerve connects your ears to your brain. It measures about 2.5 cm long. The optic nerve connecting your eyes to your brain measures about 5.5 cm long. How does this information relate to the results of your experiment?

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1. Apply: Based on what you’ve learned, describe a safety device that could be used to warn drivers or pilots of an impending collision.

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