



## mobile inquiry technology

### Teacher Notes

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### Reaction Time Introduction

There are two kinds of primary goals in this activity. The first is related to developing students' abilities to understand and conduct scientific inquiry. The second is related to key life science concepts regarding regulation and human behavior.

The students will investigate how quickly they respond in relation to a number of variables. In the first investigation they measure the time it takes to grasp a falling ruler between their fingers following visual, auditory, and tactile cues. In the second investigation they use a computer simulation to test how various kinds of music affects their reaction time.

The students will use a spreadsheet and graphing application to record and display data. In addition they use a computer simulation to accurately measure reaction time. In both cases they examine data displayed in a bar graph to make inferences regarding the relationship between external stimuli and reaction time.

Below are some of the inquiry skills emphasized in the activity:

- designing a systematic investigation (identifying and controlling variables)
- using tools and mathematics to gather and interpret evidence
- making explanations and predictions from evidence
- making logical conclusions about cause/effect from data

In addition, in this activity provides an opportunity to investigate how humans respond to changing conditions in the external environment.





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#### Discussion Guide

Begin the class with a challenge. Ask the class to stay very quiet and to close their eyes while you drop keys on the floor. The task is to see how quickly they can respond to the sound of the keys hitting the floor. Ask them to raise their hands when they hear the sound. If there are no questions begin the challenge.

Make the observation that there was considerable variation in when they raised their hands. A number of questions should arise. Was this a fair test? For example a student might question whether they were all the same distance from the sound. Another might raise the issue of whether hand raising is an accurate measure. Other might simply claim to have faster reaction times. Make a class list of the factors that have affected the outcome. If they have not previously been introduced to the term variable, indicate that it is any single factor that might affect the outcome of an investigation. Ask them to sort their variable list into two groups: one in which the variables are independent of each student and the other in which the variables are unique to each student (hearing acuity, reaction time). This is an opportunity to develop the idea that a "fair test" requires isolating the variable being testing. If the students want to test reaction time in response to a stimulus all other variables must be controlled.

Ask the class to discuss what variables might change their reaction time to the keys hitting the floor? The list might include being able to see the keys, getting some other visual clue, a louder sound, etc. Propose that they will conduct a controlled experiment to investigate reaction time in response to a variety of stimuli.

Direct the student to "Thinking About the Question".

Introduce the terms range, median, and mean to the students. For range and median, it may be helpful to place a sample set of data on a number line. Locate the largest and smallest number and demonstrate finding the range by taking the difference between these two values. Explain to the students that the median can be found by locating the exact middle of the data when it is placed in order as shown on the number line. Have the students find the sum of all of the numbers in the data set. Explain they can find the mean by dividing the sum by the number of data points in the set.

As the students work through the investigation and answer questions in the "Analysis" take time to hold class and groups discussions to compare ideas and results. As the investigation proceeds encourage students to ask each other questions about the soundness of the relationships between the evidence they cite and their explanations.

Direct the students to "Investigation I".





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#### Additional Teacher Background

This activity includes a chart indicating reaction time for different positions that students might grasp on the ruler. It is possible to calculate these values because the rate of acceleration of objects on Earth is a known constant. Objects gain speed continuously due to gravitational force. The rate of change is expressed in meters per second per second. Sometimes this is expressed as  $m/s^2$ . The values of time shown in the ruler drop chart are calculated from the formula  $d = \frac{1}{2} at^2$  [d is the distance in meters, a is the acceleration due to gravity ( $9.8 \text{ cm/s}^2$ ), t is time in seconds]. Additional reaction times can be calculated with this formula.

Students may confuse reflexes and reactions. **Reflexes** are subconscious responses to stimuli, guided by the brain or spinal cord. Your eyes, for example, blink when an object flies toward you. The sight of the object activates movement-control areas of the brain. In contrast to reflexes, **reactions** are conscious responses to stimuli. A light turns green, you cross the street. A car comes near you, you move to avoid it. In each case of a reaction, the mind recognizes a stimulus and consciously produces a response.



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### **Reaction Time Suggested Timeline**

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The amount of time you spend on introductory discussions, data collection, and analysis, will determine your overall timeline. The following represents a possible timeline.

- One class period - Introductory Discussion
- One class period - Investigation I: Measuring reaction time with a ruler
- One class period - Investigation II: Measuring reaction time with a simulation
- One class period - Analysis

Additional days can be used for further investigations.



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