

Learning Objectives

Students learn about human reflexes, how our bodies react to stimuli. Some body reactions and movements are controlled automatically, without thinking consciously about the movement or responses. In the associated activity, students explore how reflexes work in the human body by observing an involuntary human reflex and testing their own reaction times using dominant and non-dominant hands.

Vocabulary:

reflex An involuntary body movement in response to something.

stimulus Something that causes a response.

Part I: Reflexes

Question: Have you ever wondered why your leg kicks when a doctor taps your knee with that mallet

Answer: It's a reflex! A reflex is an involuntary body movement in response to something. You don't even have to think about it. Reflexes protect your body from things that might harm it.

Knee Jerk Reflex (aka patellar reflex)

When the doctor uses a mallet to hit your knee at a spot just below your knee cap and your leg kicks out, it's a quick response; it only takes about 50 milliseconds between the tap and the kick!

- The patellar reflex is processed before the brain, by the spinal cord. This means that you react *before your brain notices* the stimulus.

Try it out: Have a partner sit with his/her legs crossed so that his leg can swing freely. Hit his leg just below the knee with the side of your hand.



Q: Ask students if they can think of any reflexes involving their eyes.

Blinking - When something flies towards your eyes, you blink. By blinking, your body prevents dust and other particles in the air or anything else that might be dangerous from entering your eyes and harming them.

Try it out:

Have a student stand behind a see-through barrier like a window or a wire screen. Throw a cotton ball at the person. Did they blink?

Pupillary reflex - What happened last week when you shone a light in your eye? If they didn't get to do it last week, show them how it works by having a partner cover/close their eye for a minute and then open it. (You can also shine a light in your eye and show them).

Q: Can you think of any other reflexes?

Additional reflexes:

Blushing - reddening of the face caused by embarrassment, shame or modesty.

Shivering - shaking of the body in response to early hypothermia in warm-blooded animals

Vestibulo-ocular reflex - movement of the eyes to the right when the head is rotated to the left, and vice versa.

Infants exhibit many reflexes that are not seen in adults: tonic neck reflex, grip reflex, step reflex, crawl reflex, rooting reflex (infant turns head toward anything that strokes the cheek or mouth).

Q: Coughing/Sneezing are reflexes? What do you think their purpose is?

Part II: Reaction time

Reaction time is a measure of the quickness an organism responds to some sort of stimulus. Reflexes and reactions, while seeming similar, are quite different. Reflexes are involuntary, used to protect the body, and are faster than a reaction. [Reflexes are usually a negative feedback loop and act to help return the body to its normal functioning stability, or homeostasis.]

What's the difference between the patellar reflex and something like a soccer goal keeper dealing with an oncoming ball? When the soccer player realizes the ball is coming towards them, there is visual information that has to be processed and they have to make decisions about the correct course of action. The brain then needs to send many signals to various muscles to tell when what to do. This is the work of many neurons as well as numerous systems and circuits in the brain, and what's more, and you can train and enhance your skill through practice. This is how you get better at sports over time.

Tell students they will be testing their visual, auditory and touch reaction times. Have them predict which they think will be the fastest. See worksheet.

Visual Test

1. Student one dangles dominant hand off the edge of a table.
2. Student two holds a 30 centimeter (12-inch) ruler between two fingers at the 30 cm mark, having the 0 mark touching Student one's index finger.
3. Student two tells Student one to grab the ruler as fast as possible, when they SEE it being released. Make sure they don't make any sounds or gestures indicating they're going to release the ruler.
4. Record the centimeter measurement.

- Repeat this three times, for a total of four measurements

Auditory Test

- Student one is blindfolded before dangling dominant hand off the edge of a table.
- Student two holds a 30 centimeter (12-inch) ruler between two fingers at the 30 cm mark, having the 0 mark touching Student one's index finger.
- Student two tells Student one to grab the ruler as fast as possible, when they HEAR the word "release" being said.
- Student two simultaneously says "release" and lets go of the ruler. Record the centimeter measurement.
- Repeat this three times, for a total of four measurements

Tactile Test

- Student one is blindfolded before dangling dominant hand off the edge of a table.
- Student two holds a 30 centimeter (12-inch) ruler between two fingers at the 30 cm mark, having the 0 mark touching Student one's index finger.
- Student two tells Student one to grab the ruler as fast as possible, when they FEEL their non-dominant shoulder being touched.
- Student two simultaneously touches the shoulder and lets go of the ruler. Record the centimeter measurement.
- Repeat this three times, for a total of four measurements

Calculate the average centimeter number for each sensory measurement.
Use this chart to determine reaction time.

Cm Distance	Milliseconds
3.0	80
4.0	90
5.0	100
6.0	110
7.0	120
8.0	130
9.0	130
10.0	140
11.0	150
12.0	160

Cm Distance	Milliseconds
13.0	160
14.0	170
15.0	170
20.0	200
25.5	230
30.5	250
43.0	300
61.0	350
79.0	400

(You can also calculate this with $t = \sqrt{2y/g}$)

Follow up lab questions:

How do your reaction times compare to the average reaction time for humans?

(0.25 seconds for a visual stimulus, 0.17s for an audio stimulus, and 0.15 seconds for a touch stimulus)

Do you see a difference between your dominant hand and your non-dominant hand? Try it out! Compare reaction times among different ages. Who is fastest? The older students or the younger students?

Discussion:

-What's the difference between a reflex and a reaction?

- What happens when you touch a hot pot? Is that a reflex or a reaction? *If your hands come in contact with hot objects (perhaps stove burner, hot plate, hot pan or a hot potato), a reflex causes you to immediately remove your hand before the message, "Hey, this is hot!" even gets to your brain.*

-Challenge question: How could you use these ideas to build a robot that could conduct similar reactions?

Adapted from:

https://www.teachengineering.org/lessons/view/umo_ourbodies_lesson03

<https://backyardbrains.com/experiments/reactiontime>