

THINKING AND ACTING LIKE A SCIENTIST

TEACHER'S GUIDE

How Will You React?

How does the distraction of _____ affect reaction time?

GRADE 4

Life Sciences





How Will You React?

Grade Level/ Content	4/Life Science
Lesson Summary	In this lesson students will discover how animals capture, make sense of, and respond to information from the environment.
Estimated Time	2, 45-minute class periods
Materials	30cm ruler, various materials depending on the distraction variables the students test (access to music, headphones, visual distractions such as TV or video, etc.), Reaction Time Conversion Table , Investigation Plan , journal
Secondary Resources	Reaction Time Video Informational Processing Diagram
NGSS Connection	4-LS1-2 Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
Learning Objectives	<ul style="list-style-type: none">• Students will describe the relationship between the brain, sensory receptors, perception, and reaction.• Students will provide an explanation that describes how distractions affect reaction time.• Students will develop a model showing how the brain processes information and how distractions affect that process.
Cross-Curricular Project Connections	Timer Needed, Don't Drive Distracted!

How does the distraction of _____ affect reaction time?

The brain is the most amazing organ. It is a highly complicated and creative information-processing system. Information processing starts with sensory receptors, organs having nerve endings (skin, eyes, ears, nose and mouth), that respond to stimuli (touch, light, sound, heat, etc.). Impulses are then sent along sensory neurons to the brain. The brain processes and stores this information (memory) and decides how it will react to a stimulus. In this investigation, students will identify their reaction time by dropping a ruler and catching it as quickly as they can. They will use the sensory receptors in their eye to send signals to their brain to catch the ruler. Then, students will need to determine how a particular distraction affects this informational processing cycle.

Investigation is based on the Van Andel Education Institute (VAEI) Instructional Model for Inquiry-Based Science.

In all investigations:



Students don't know the "answer" they are supposed to get.



Students play a driving role in determining the process for learning.



Teachers and students construct meaning together by journaling.



Students are working as hard as the teacher.

Part 1

INVESTIGATION SETUP

Students will need the following materials:

- 30cm ruler
- various materials depending on the distraction variables the students test (access to music, headphones, visual distractions (like TV or video, etc.)
- [Investigation Plan](#)
- [Reaction Time Conversion Table](#)
- Journal

Part 2

INVESTIGATION FACILITATION



Personal Knowledge

Students capture what they already know about how the brain processes information and reaction time.

- View the [Reaction Time Video](#) together to stimulate curiosity.
- Have students identify what they already know about how the brain processes information and reaction time, including what they just learned from the video. Encourage students to ask questions as well.
- Create a class list of prior knowledge and questions students have.

CURIOSITY

Nurture student curiosity about how their brains work. Ask students: *How does your brain make sense of information? Can you identify times when you have been distracted? How have distractions affected your brain's ability to make sense of information?*

COLLABORATION

Have students participate in a *Round Robin* group brainstorming exercise. Each student is given an index card and personally reflects on what they know and questions they have about the brain and reaction time. After the initial independent brainstorm, the group compiles a combined list from the individual cards and during this time is allowed to record additional ideas. Each group then shares their compiled list.



Secondary Knowledge

Students use resources to define terms important to the investigation.

- Have students find definitions and examples (or provide them) for the following terms:
 - Sense receptor: an organ having nerve endings (skin, eye, ear, nose, mouth)
 - Perception: a) becoming aware of something via the senses, b) the representation of what is perceived (a concept or idea)
 - Memory: something that is remembered
 - Respond: to have a reaction
 - Reaction time: the time it takes to have a reaction
- Have them write down what they come up with.

Continued

- Complete a class brainstorm: What are the examples of distractions that could affect your reaction time? Evaluate each example and refine as needed to ensure that it is a distraction that can be tested (listening to music, texting, chewing gum, talking to a classmate, eating, etc.).
- Have students pair up and choose the distraction they would like to investigate from the list.



Question

Introduce the investigation question.

How does the distraction of _____ affect reaction time?

COLLABORATION

Students work together to choose and test a distraction that was identified in the class list.



Prediction

Students communicate an expected outcome, based on prior knowledge.

- Ask students to make a prediction about the investigation question by writing it down using the following prompt: if _____ then _____ because _____.
- Have students share their predictions with the class. Make sure they include their reasoning (because) and how this connects to their prior knowledge.

RISK-TAKING

The sharing of predictions makes student thinking visible. This is important because it not only reveals possible misconceptions that students may hold, but gives you the opportunity to make sure predictions are directly linked to personal knowledge. Do not address misconceptions at this time. Conduct the investigation and return to misconceptions later when students complete their explanation.



Investigation Plan

Students perform trials to determine how distractions affect reaction time.

- Review materials as a whole class.
- Give each student their materials. Discuss the [Investigation Plan](#). Demonstrate how to calculate reaction time under normal conditions and reaction time while being distracted.
- Make sure all students are confident in determining their reaction time (Step 1). Before moving on to Step 2 of the plan, have students post their reaction times for discussion and evaluation. Any reaction times that appear out of normal for the group should be explored. Refine student use of the investigation plan as needed.
- Have students describe the distraction they will be testing in their journal.
- Students continue to follow the investigation plan and record both quantitative and qualitative data.

INVESTIGATION PLAN
HOW WILL YOU REACT?

Step 1: Become Confident in the Procedure

1. Obtain a 30cm ruler.
2. One person holds the ruler near the 30cm mark and lets it hang vertically.
3. The other person places their thumb and index finger on either side of the 0cm mark ready to catch it when it falls—fingers should be about 3cm apart (width of the ruler).
4. Without warning the person holding the ruler lets go and their partner tries to catch the ruler as soon as possible. (Hint: to prevent guessing, vary the time before letting go of the ruler.)
5. The level (in cm) just above the partner's first finger where the ruler is caught is recorded on a piece of scrap paper.
6. Continue practicing until both partners feel confident in their ability to measure their reaction time using this procedure.

Step 2: Determine Normal Reaction Time

1. Complete 10 trials using the procedure above to determine your normal reaction time. Record your reaction in cm for each trial.

Step 3: Determine Your Reaction Time While Being Distracted

1. Complete 10 trials using the procedure above to determine your reaction time while being distracted. Record your reaction in cm for each trial.
2. Describe the distraction being tested in your journal.

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Investigation Plan

Continued

STUDENT CHOICE

Although the **Investigation Plan** indicates 10 trials, you can decide as a class how many trials would be needed to generate sufficient data. Discuss the idea of a fair test. Have students think critically about the investigation plan. Help them understand that a good investigation plan must include a test that is repeatable, generates quality data, and minimizes error. The more critically students think about their investigation plan, the more confident they can be in their results. Use the **Fair Test** checklist to help students think critically about the investigation plan.



Observation

Students record their findings on a data table.

- Ask students to create a data table to record their quantitative and qualitative observations.

Trial	Step 1: Reaction Time	Qualitative Data	Step 2: Reaction Time	Qualitative Data
1	15		24	
2	13		22	
3	9	Start started moving but hand early	25	
4	17		17	
5	14		26	
6	11		28	The song changed at this time. Woooooing. If we should have started the other song over again?

Example of Data Table

Part 3

INVESTIGATION ANALYSIS AND DEVELOPMENT OF CLAIM



Data Analysis

Students make sense of their data by organizing it and representing it visually.

Have students analyze their data. They may wish to use the **Data Analysis** prompt as a guide.

- Have students **evaluate** their data for trustworthiness. Ask students to highlight any data they wonder about.
- Then, have them analyze their data to find patterns and trends. Have students **organize** their data by converting their reaction time in centimeters to reaction time in milliseconds using the **Reaction Time Conversion Table**. Have students use math where appropriate (*averaging the reaction time for Step 1 and Step 2, etc.*). Then, have students **represent** their data visually (*chart, graph, plot, image, etc.*) to show patterns or trends.
- Have students **interpret** what the identified patterns or trends mean.
- Ensure they have enough data that it can be used as evidence to support a claim.



Secondary Knowledge

Students use secondary sources to understand how the brain processes information and how distractions affect that process.

Share what you know (or find a video or article) about how the brain processes information and the effect of distractions on processing time. Use the [Informational Processing Diagram](#) as a possible resource. Students should understand that sensory organs (like the eye) send signals to the brain in response to a stimulus (vision of falling ruler). The brain has to process (perception) and store this information (memory) before it can respond by sending a signal to the fingers to catch the ruler. Distractions add more information for the brain to process and cause the reaction time to be greater. Students use this secondary knowledge in the reasoning portion of their explanation.



Explanation

Students write a claim and provide evidence and reasoning to support it.

- Have students use what they've discovered from their analyzed data to write an explanation that answers their investigation question. Students may wish to use the [Explanation](#) prompt as a guide. Have them write their explanation in their Lab Journal.
- Have students develop a **Claim** to answer the question: How does the distraction of _____ affect reaction time?
- Then, have them add **Evidence** (the analyzed data) to support their claim.
- Finally, have them add **Reasoning** to their claim. Reasoning should include the information obtained from this investigation as well as science principles they have learned.

Claim

I claim that the distraction of loud music affected my reaction time by making it slower.

Evidence

My evidence is that my distracted reaction time was 49ms slower than my normal reaction time (normal 168ms; distracted 207ms).

Reasoning

Investigation: I think that my investigation was a fair test. I followed the investigation plan exactly and carefully did each of the 10 trials the same way.

Science: I learned from our class discussions that the brain has to process information before it can respond. The more information that the brain has to process, the longer it should take. Because I asked my brain to both process loud music and try to decide when to catch the falling ruler, it took longer for me to react. That makes sense to me.

- Once the explanation is written, have students discuss their results using a [Present and Defend](#).

DISCOURSE

Have students conduct a [Present and Defend](#) to develop presentation skills as well as audience participation. Research teams present a summary of their investigation to the class. The class analyzes the information presented and asks clarifying questions, challenges and/or supports the arguments made, and even presents alternative explanations as appropriate. Research teams defend their explanation with evidence and reasoning.



Evaluation

Students reflect on the investigation.

- Ask students how confident they are in their results.
- Ask students what surprised them.
- Ask students what questions they have as a result of this investigation.

Part 4

INVESTIGATION ASSESSMENT AND EXTENSION



Application

Students demonstrate understanding of how distractions affect reaction time by developing a model describing how the brain processes information.

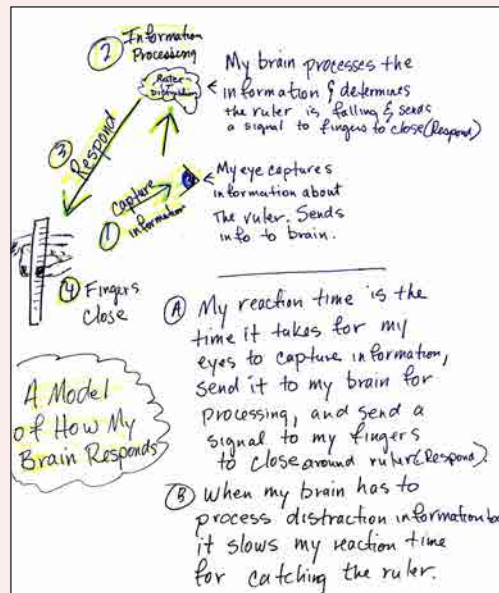
- Have students work with their partners to develop a model (drawing) that shows how they captured, made sense of, and responded to the ruler being dropped. They will also show how being distracted affected their reaction time.
- Have students use the [Informational Processing Diagram](#) to create their own model.

CRITICAL THINKING

Having students apply their learning to use, interpret, and create a simple explanatory model for sensory response will engage them in higher level thinking and processing. Discuss what critical thinking is, and elicit from students how they are/were being “critical thinkers” throughout this investigation.

Assessment

- Students can accurately describe the relationship between the brain, sensory receptors, perception, and reaction.
- Students will provide an explanation (**claim, evidence, and reasoning**) to clarify the cause-and-effect relationship between distractions and reaction time.
- Students will develop a model showing how the brain processes information and how distractions affect that process.



Example of Reaction Model

Take This Lesson Across the Curriculum

Timer Needed

Your PE teacher needs an official timer for the end of the year field day event. In order to make sure you are ready for this challenge, you will need to learn more about reaction time.

Reading/Language Arts	Math	Science	Social Studies
<p>Stating Your Case</p> <p>Write a letter to your PE teacher convincing her to choose you to be the official timer. Include reasons that are supported by facts.</p> <p>CCSS.ELA-LITERACY.W.4.1</p>	<p>Conversion Challenge</p> <p>Using a conversion table, calculate your reaction time to milliseconds. Determine when your reaction time was best.</p> <p>CCSS.MATH.CONTENT.4.MD.A.1</p>	<p>How Will You React?</p> <p>Complete this lesson to learn how your brain processes information and how distractions affect your reaction time.</p> <p>NGSS: 4-LS1-2</p>	<p>Vote for Me!</p> <p>You will participate in a school election where you will need to convince your classmates why you are the best choice for the official timer.</p> <p>NCSS: D2.Civ.7.3-5</p>

Don't Drive Distracted!

You have been asked by your principal to present at the upcoming school assembly on why someone should never drive distracted.

Reading/Language Arts	Math	Science	Social Studies
<p>Doing Your Part</p> <p>Watch the video on Kids and Distracted Driving.</p> <p>Discuss ways you can help your parents on the road.</p> <p>CCSS.ELA-LITERACY.SL.4.1</p>	<p>Know When to Fold Them</p> <p>You need to distribute a brochure about distracted driving to every student at the assembly. It takes 2 ½ seconds to fold each brochure. There will be 50 students at the assembly. How long will it take you to fold all the brochures?</p> <p>CCSS.MATH.CONTENT.4.NF.B.4</p>	<p>How Will You React?</p> <p>Complete this lesson to learn how your brain processes information and how distractions affect your reaction time.</p> <p>NGSS: 4-LS1-2</p>	<p>The Deets on Distracted Driving</p> <p>Create a brochure to hand out during the assembly that highlights the types of distractions drivers face and why driving distracted is dangerous. The brochure will also include tips kids can follow to help keep drivers safe on the roads.</p> <p>NCSS: D2.Civ.10.3-5.</p>

For additional lessons or to customize this lesson, go to www.nexgeninquiry.org.



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INVESTIGATION PLAN

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