

What Are You Looking At | Using Eye Tracking to Detect Vertigo and Physiological States

Teacher Instructions

Activity name: What Are You Looking At? Using Eye Tracking to Detect Vertigo and Physiological States

Content domains: biology | physics

Age group: junior high and high school

Classes/specializations: Science

Activity duration: three hours (alternatively, if using only the first unit: an hour and a half):
Four periods.

Study spaces: a computer classroom and an adjacent space.

Activity description

Using a series of experiments, students will learn about eye tracking and how different physiological states (e.g. vertigo) affect eye movements.

The core lesson introduces students to scientific thinking using two experiments:

- 1) Eye tracking and the effects of dizziness on eye movements.
- 2) Heart rate tracking and the effects of strong emotional responses and physical activity on heartrate.

In an optional bonus lesson, students can learn about eye movements and things people's gaze is drawn to. This lesson also introduces the importance of eye movements for normal sensory function, and includes a discussion about the ethical issues around eye-tracking technology.

In this lesson, the students create an experiment independently.

The rationale

Eytan Stibbe will perform an eye-tracking experiment in space. In this experiment, eye tracking is used to monitor his physiological condition or diagnose vertigo. The students will run a similar experiment with a laptop webcam. They will be able to see the connection

The students will also practice scientific thinking and learn how to design an experiment and analyze results correctly.

Activity goals

- 1) Learn about eye tracking, vertigo, the vestibular system, and active sensing (optional).
- 2) Experience the study Eytan will conduct in space.
- 3) Learn about the effects of microgravity on vertigo and spatial orientation.
- 4) Become familiar with scientific thinking and learn to draw conclusions from an experiment.
- 5) Design and run an experiment (optional).
- 6) Discuss the ethical implications of technology (optional).

The main concepts introduced by the activity

Eye-tracking technology

Vertigo

The vestibular system

Microgravity

Active sensing (optional)

Learning methods

Hands-on experiences, exploration and discussions, knowledge gathering, frontal instruction

Equipment requirements

- A laptop with a webcam for every pair of students (for the main and optional lessons).
- The students' active email addresses (for creating user profiles for the eye-tracking software; these are needed for the main and optional lessons).
- Differently shaped and textured objects for the students to touch and feel (for the optional lesson only).

Prepare for the activity

- 1) Before the activity, each student has to create an account on <https://www.realeye.io> by following the instructions in the file named "Create an account".

Note: Accounts are only valid for seven days. Each student needs to have their Realeye.io username and password ready at the start of class.

- 2) Prepare a computer classroom with a laptop and a webcam for each pair of students, and an adjacent space such as a classroom, a hallway, or a yard.
- 3) Download the folder “Experiment files and instructions” to each laptop.
- 4) Please note that the free eye tracking software account has some limitations. To work within those limitations, note the following:
 1. If you plan to run the optional experiment (outlined below), have pairs of students take turns running the experiment on one laptop, with both students using the same account. Each pair can then use the second student’s account to run the optional experiment.
 2. If you are not planning to run the optional experiment, students can work in pairs or individually.

Activity overview

These instructions are a short overview of the steps in this lesson. For the full lesson plans, please refer to the comments under each slide.

Main lesson: slides 1-18

Slide 2: Introduction

The opening slide is intended to spark the students’ curiosity, get their attention, get them engaged in the class, and pool their existing knowledge.

Students will view a short video received from the air force, showing an aircraft accident caused by vertigo.

After watching the video, the students will have a short discussion about how the video is related to the topic of this lesson.

Slides 2-4: Discussion

Class discussion of the video.

Invite students to discuss the phenomenon they observed in the video by following these five steps:

- Describe the result.
- Raise hypotheses.
- Think about what caused the accident (introduce students to the concept of disorientation).

Slides 5-6: “Experiment 1: Spin”

The students will run an eye-tracking experiment at rest and while dizzy. Eye-tracking measurements will be taken using the webcams.

This experiment is similar to the study Eytan Stibbe will run in space.

Slide 7: Analyze the results

Collect the data from the experiment, discuss the results and draw conclusions.

Slides 8-14: Introduce fundamental concepts

Introduce students to vertigo and the vestibular system via a mix of frontal instruction, class discussions, and short activities.

Students need to understand how these concepts relate to the experiment.

Slide 8: The experiment’s relevance for pilots and astronauts who sometimes experience vertigo. Explain the danger of impaired functioning caused by vertigo.

Slides 9-11: What is vertigo?

Slides 12-13: How the vestibular system works (includes short activities)

Slide 14: Explain how the vestibular system relates to the experiment and discuss how Eytan Stibbe’s experiment can help pilots and astronauts.

Slide 15: Experiment 2: “Heart rate during physical and emotional exertion”

In this experiment, the students will measure their heart rate at rest, after physical activity, and after experiencing a strong emotion (anger). The students will learn that physiological metrics can be used as indicators of physiological states.

Slides 16-18: Eytan’s experiments

Students will learn about the experiments Eytan Stibbe will run in space: their objectives, their benefits and future applications on Earth and in space, and how they are related to what they have learned today.

In this experiment, the students will track their eye movements while looking at an image, and learn about the connection between attention and eye movements.

Slide 21

The students will now design their own eye-tracking experiment.

Slide 22

The students will learn about active sensing. To demonstrate the importance of movement for the sensory system, the students will participate in a tactile activity.

Slide 23

The students will have a class discussion on the ethics, upsides, and downsides of using eye-tracking technology.

Slide 24

We will sum up what we have learned in the optional lesson and see how it relates to the first lesson.

Deliverables

Core lesson

Results from two experiments: ("Spin" and "Heart rate during physical and emotional exertion")

Bonus lesson

- 1) Students will design an eye-tracking experiment.
- 2) Students will write a very short report or present their results to the class.

Materials for further reading

- 1) [An article about vertigo](#) by The Davidson Institute of Science Education.
- 2) [An article about alcohol and vertigo](#) by The Davidson Institute of Science Education.
- 3) An article in ALS Magazine (page 17).

This activity was developed by Dr. Dorit Granot and Dr. Noa Pinsker-Zeharia from The Davidson Institute of Science Education.

