

Balance

Target Audience

College, High School

Time Estimate

45–60 min

Prepare for the Lesson

Materials

Materials for each group of students

- ☐ Chromebook™, computer, or mobile device
- ☐ Vernier Graphical Analysis® app
- ☐ Go Direct® Force Plate

Safety Information

1. Ask students whether they are experiencing balance problems or any issues with their feet or legs before allowing them to act as the subject during data collection.
2. Make sure the testing area is free of furniture or objects that could harm students if they lose their balance during data collection. You may also choose to appoint a spotter to each subject, especially when they are balancing with their eyes closed.

Data-Collection and Analysis Tips

1. Some students have extremely poor balance. Reassure them that this is part of biological variability.
2. To ease the set-up process, students are directed to download a preconfigured file, “Balance-Template,” from www.vernier.com/til/19319. This file is set up to
 - Turn on the two sensor channels needed for the lesson, X-axis Balance and Y-axis Balance, and turn off all other channels
 - Display a graph of Y-axis Balance vs. X-axis Balance.
 - Collect data for 30 seconds.
3. For information about how to connect to your Go Direct Force Plate, see vernier.com/start/go-direct

Sample Data

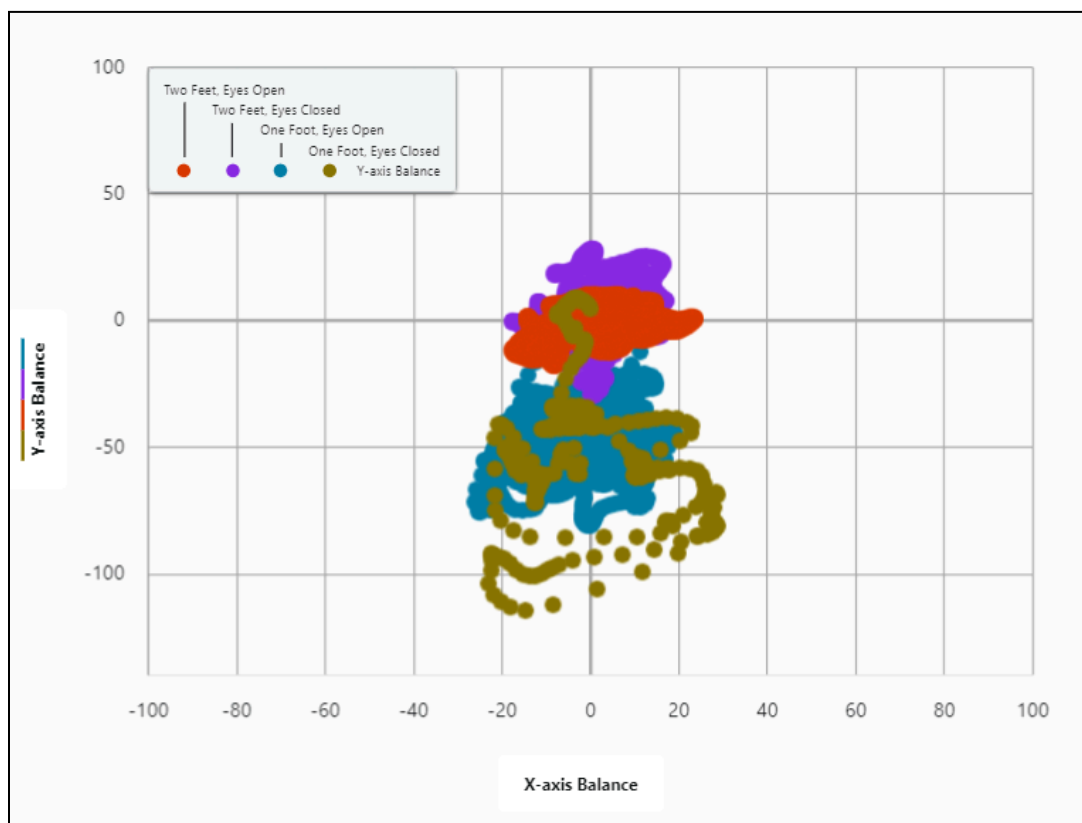


Figure 1 Sample data for balancing on two feet (eyes open, eyes closed) and one foot (eyes open, eyes closed)

Table 1: Balance on Both Feet	
	Standard deviation
Eyes open	5.49
Eyes closed	11.78

Table 2: Balance on One Foot	
	Standard deviation
Left foot, eyes open	11.77
Left foot, eyes closed	32.16

3D Elements in the Lesson

Science and Engineering Practices	<ul style="list-style-type: none"> • Analyzing and Interpreting Data. DATA-H1 Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
Disciplinary Core Ideas	<ul style="list-style-type: none"> • LS1.A Structure & Function. LS1.A-H3 Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
Crosscutting Concepts	<ul style="list-style-type: none"> • Cause & Effect. CE-H1 Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Codes for the elements come from *The NSTA ATLAS of the Three Dimensions* (Willard, 2020) and the elements are described in *A Framework for K–12 Science Education* (NRC, 2012).

Performance Expectation(s) from NGSS

This lesson builds towards

[HS-LS1-2](#) Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

[Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.

TEKS

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Connecting to Students' Cultures and Backgrounds

Student Culture Focus

Connect instruction to students' homes, neighborhoods, communities, and cultures as appropriate, and provide multiple opportunities for students to support their learning with questions and ideas from their own funds of knowledge. As an example, before starting the procedure, facilitate a discussion to draw out students' personal experience with balance. The following prompt could be shared with students:

Think about times when you've had to balance in a challenging situation. Have you ever stood on one foot for an extended period, walked across a narrow beam, or tried to maintain balance after spinning around? What strategies did you use to stay steady? How do you think different parts of your body help you maintain balance?

Consider activities like walking, running, or standing on a bus when it starts moving. How do your eyes, muscles, and inner ear work together to help you stay balanced? What happens when one of these inputs is removed or altered? Write down your ideas and predictions before beginning the experiment.

Varied Classroom Discourse Strategies

Help all students make productive contributions to classroom discourse by providing for individual thinking time and small group sharing before whole group discussion.

Multiple Ways to Learn

Provide multiple access points and modalities for students to learn. For instance, students can construct understanding through use of the SEPs using various modalities, including reading both text and diagrams; writing, drawing, and gesturing to develop models; and speaking and listening through argumentation and evidence-based discourse. Provide support for all students to make thinking visible in ways that are less dependent on English language proficiency.

SOURCE

This lesson is a modified version of experiment 05 "Balance," from [Human Physiology: Experiments Volume 1](#) (order code: HSB-HP).