

Unit 1 - Subjectivity and Objectivity in Science

Students are asked to confront the question of whether or not science is purely objective.

Practices: *Engaging in Argument from Evidence; CCCs: Patterns; Cause and Effect; Influence of Science Engineering and Technology on Society and the Natural World.*

Starting point for instructors

- Do [Unit 0 - Setting the Stage](#) before this, and review norms if needed
- Before jumping into discussions about equity and justice in science, students must question the myth that science is an impersonal affair, divorced from human concerns.

Pre-Lesson Student Exploration / Bell-Ringer

Before coming to class/at the start of class, students need to:

Answer the following questions about the content and culture of physics:

1. What is physics?
2. Do you think physics is subjective (definition: based on or influenced by personal feelings, tastes, or opinions) or objective (definition: not influenced by personal feelings or opinions in considering and representing facts & not dependent on the mind for existence; actual)? Why?
3. Do you think racial diversity in physics is important? Why or why not?

In-class Investigations

What is Science?

- a. *Small-Group Discussions*
Small groups share out individual responses. Groups decide on their best definition.
- b. *Small-Group Share Out*
Each group writes its own definition on the front board.

Is Science Subjective?

- a. *Clicker Question:*
Physics/Chemistry/Biology/Geology is...



- A. completely subjective.
- B. completely objective.
- C. mostly subjective.
- D. mostly objective.

b. *Stand up & Move:*

Ask students to choose a location in the room to stand based on their view of where physics falls on a [spectrum](#) from objective to subjective. The only place they cannot stand is directly in the middle of the classroom. Give students one minute to think about where they will go prior to moving. Here is an example [Classroom Setup](#).

c. *Partner Discussion:*

When students have chosen a location to stand, encourage students to lead a discussion explaining their reasoning for standing on one side of the room to someone nearby. Students can change sides or adjust their position based on the statements of others if they're convinced.

d. *Whole-Class:*

Depending on where students end up, one side of the room can then talk to the other side of the room about their ideas in a whole-class discussion.

- i. Follow up question: Can you see ways in which physics is also subjective?

e. At the end of the class discussion, they write a response to, "What are you thinking about right now and/or how are you feeling regarding our discussion?"

Instructor Note:

The responses here can provide direction for the following discussion.

"I'm asking students just to keep track of their emotions, too, as a way of watching how open to risk/challenge they might be (or might not be)."



How Is Science Subjective?

a. *Jigsaw:*

Use the [Jigsaw Classroom Routine](#) at least three paragraphs from [the Hatton & Plouffe reading](#). See the resources link below if you would like to assign the whole chapter.

b. *Whole-Class*

Share out

c. *Share out*

Oxford Definition of Physics: the branch of **science** concerned with the nature and properties of matter and energy. The subject matter of physics, distinguished from that of chemistry and biology, includes mechanics, heat, light and other radiation, sound, electricity, magnetism, and the structure of atoms. Oxford Definition of [Physics](#) [Chemistry](#) [Biology](#) [Mathematics](#) [Geology](#)
-OR- Have students look up a definition.

d. *Share out*

Oxford Definition of Science: the intellectual and practical **activity** encompassing the



systematic **study** of the structure and behavior of the physical and natural world through **observation and experiment**.

Post-Lesson Homework

Read and Reflect

This assignment is critical to continuing the conversation about the existence of subjectivity in science.

- Read “Science for All Americans” Ch. 1 [Nature of Science](#).
- While you read this Chapter, highlight with one color ideas or descriptions that are primarily objective. With the other color, highlight ideas or concepts that are subjective.
- Pick two sentences from the reading that you found interesting and write two-three sentences/bullets/phrases that explain why you chose those quotes. Be ready to share your ideas in class.

Homework Debrief: Discussion of examples from the reading

Debrief with students their chosen quotes and create a list of examples of subjectivity from the reading. This conversation opens the door to discuss representation in science and the systemic structures that contribute to the culture of each field.

Resources

- [Lesson Plan Resources](#)



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Notes from the Authors

- 1) This lesson plan leads directly into the lesson on [Unit 1 - Why Representation Matters](#). Many of the resources for that lesson also complement the ideas in this lesson.
- 2) We often do this lesson *prior* to the lesson on [Unit 1 - Data Analysis and Underrepresentation](#) so that way students are primed with the idea that subjectivity is a part of physics.
- 3) We position *designated sciences as subjective* explicitly in this discussion to encourage the idea that humans can affect what is studied and how it is studied. We see this position as an opening for students to consider how the disparity in the representation in researchers impacts the community.
- 4) Common student ideas – What is physics?

Physics is typically viewed as a “culture of no culture” (Traweek, 2009). The physicist's quest for objectivity, along with a general focus on a fixed set of laws and formulae, support the treatment of this subject as untouched by people. Students’ ideas about physics align with this sentiment.

Many students take a strong “science is objective” stance and generally keep that view throughout the initial conversation. The debate usually centers on whether science is a *field of study* or the *physical world itself*. A student might say, “Science is objective. It is measurable, quantifiable, and does not depend upon emotions or personal feelings.” Or, “*Science is not ...up to interpretation. I can see how the study of science and practicing science may differ, and how different applied concepts can be interpreted differently, but I view science itself to be the way ‘things’ work, which is based on facts and rules.*”

