Making a Strong Scientific Argument Tutorial (200 minutes)

Overview

The purpose of this tutorial is to introduce students to scientific argumentation through a combination of videos, text, class discussions, and practice problems. Specifically this tutorial introduces students to scientific argumentation as an authentic practice of scientists and engineers and as a method for evaluating proposed solutions.

Specifically, the students will learn what makes for a persuasive argument in science, how to evaluate an argument for strength, what counts for evidence, how science content and facts give strength to an argument, and the components necessary for making their own strong scientific arguments. There are 5 parts to this tutorial. Each part includes an engagement exercise, a practice problem to go over as a class, and a practice problem to be completed individually. This three-step inquiry process is designed to scaffold students as they learn to engage with and use scientific argumentation. Scientific argumentation aids the students in valuing how *we know something in science rather than simply learning science as fact.*

	Student Actions	**Teacher Actions**	**Level and Indicator of Understanding**
Part 1: 20 min - *Intro*	• Watch and discuss 2 videos • Elicit prior knowledge • Introduce "Scientific Argumentation" • Try identifying parts of arguments (C & E card activity)	• Elicit prior knowledge from students about scientific argumentation • Guide student through text to check for understanding of definitions, what scientific argumentation is and isn't, and purpose • Show appropriate videos and facilitate discussion comparing two arguments. Specifically, discussing what constitutes as a scientific argument and what makes for stronger arguments? • Facilitate students recording notes from text in their student pages	**Novice:** Students introduced to Scientific Argumentation and its three components. Able to define vocabulary words. .
Part 2: 30 min - Claims	• Learn about, engage with, evaluate, and compare scientific claims as a class • Use data to evaluate claims about cause and effect. • Individual practice evaluating strength of claim statements	• Facilitate discussion of claim statements from videos • Guide student through text to check for understanding of the characteristics of strong claims • Guide class through example scientific investigation description, data, and proposed claims (chemical reaction) • Explicitly explain the use of the argumentation rubric using this example. Discuss as a class & check for understanding of Rubric use • Guide class through example scientific investigation (properties of matter) description, data, and proposed claims. Assign student page as an individual assignment on evaluating claims • Facilitate students recording notes from text in their student pages. Walk around classroom asking questions for understanding	**Novice:** Develop knowledge of claims. Students begin to identify the characteristics of strong claims

Part 3: 50 min - Evidence	• Learn about, engage with, evaluate and compare evidence statements as a class • Individual practice evaluating strength of evidence statements.	• Facilitate discussion of evidence statements from videos and the characteristics of strong evidence statements • Guide through text to check for understanding of the characteristics of strong evidence statements • Refer back to the chemical reaction investigation and facilitate student use of rubric to analyze evidence statements from it • Discuss rubric as a class and check for understanding of Rubric use • Have students record notes from text in their student pages Scaffold students' use of rubric on their own or in groups. Walk around to groups asking questions for understanding	**Novice:** Develop knowledge of evidence. Students begin to identify the characteristics of strong evidence
Part 4: 50 min – Reasoning	• Learn about, engage with, evaluate, and compare reasoning statements as a class • Individually practice evaluating reasoning statements	• Facilitate discussion of reasoning statements from videos and the characteristics of strong reasoning statements • Guide student through text to check for understanding of the characteristics of strong reasoning statements • Introduce the underline, number, circle graphic method for identifying components of scientific argument (claim, evidence, and reasoning) • Explicitly go through the argumentation rubric using the class example (chemical reaction). Discuss as a class and check for understanding of Rubric use with reasoning • Scaffold students' use of rubric on their own or in groups. Walk around to groups • Have students record notes from text in their student pages Scaffold students' use of rubric on their own or in groups. Walk around to groups asking questions for understanding	**Novice:** Develop knowledge of reasoning. Students begin to identify the characteristics of strong reasoning
Part 5: 50 min - Comparing and evaluating whole arguments	• Evaluate & Compare two arguments on the same topic and analyze which have stronger claim, evidence, and reasoning statements (NGSS AF-P7)	• Guide through text to check for understanding of scientific argument evaluation • Facilitate evaluation and discussion of student Exercise argument using underline, number, circle graphic method and the rubric • Facilitate student use of rubric to analyze a second scientific argument. Walk among students asking probing questions for understanding. • Review why scientific argumentation is important and how it is a part of everyday. It will help increase students critical thinking skills.	**Novice/Emerging:** Students comprehend Scientific argument. They can evaluate the strength of an argument & compare two arguments

Planning

Georgia Performance Standards	***S8CS7****. Students will question scientific claims and arguments effectively* ***S8CS9b.*** *Scientific investigations usually involve collecting* ***evidence, reasoning,*** *devising hypotheses, and formulating explanations to make sense of collected evidence.* ***S8CS9e.****Accurate record keeping,* ***data sharing****, and replication of results are essential for maintaining an investigator's credibility with other scientists and society*
NGSS	***MS-PS3-5*** *Engaging in argument from evidence:* Evaluate & Compare two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts (Practice 7-Appendix F) ***MS-PS3-5 (NOS)*** *Scientific Knowledge is based on Empirical Evidence* ***Ms-ETS1-2.*** *Engaging in argument from evidence:* Evaluate & Compare two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts (Practice 7-Appendix F)
Engineering	Science and Engineering includes the need to persuade others of conclusions or solutions; Argumentation is the process by which evidence and reasoning based conclusions/solutions are reached. A argument has three components: Claim, Evidence, Reasoning.

Key Terms and Concepts	**Essential Questions**	**Assessment and Grading Opportunities**
Scientific Argument, Claim, Evidence, Reasoning, Trend, Data, Reliability	*What is scientific argument and how do scientists & engineers engage in this practice of using argument from evidence?*	Participation/Discussion**: Formative**

Preparation and Materials (continued on Back)

Preparation

Materials	**Student Pages**
1.7 Part 1 Video 1 and 2 Overheads: • B: Evaluating Claims as a Class page • C: Evaluating Claims as an Individual page • E: Evaluating Evidence as a Class page • F: Evaluating Evidence as an Individual page • H: Evaluating Reasoning as a Class page • I: Evaluating Reasoning as an Individual page • K: Evaluating Arguments as a class page (FRONT) • K: Evaluating Arguments as a class page (Back) • L: Evaluating Arguments as a class page (FRONT) • L: Evaluating Arguments as a class page (Back)	**Letter Sized** • A: Scientific Argument Notes page • B: Evaluating Claims as a Class page • **C: Evaluating Claims as an Individual page** • D: Scientific Argument Notes: Claims page • E: Evaluating Evidence as a Class page • **F: Evaluating Evidence as an Individual page** • G: Scientific Argument Notes: Evidence page • H: Evaluating Reasoning as a Class page • **I: Evaluating Reasoning as an Individual page** • **J: Sc**ientific Argument Notes: Reasoning • K: Evaluating Arguments as a class page (FRONT) • K: Evaluating Arguments as a class page (Back) • **L: Evaluating Arguments as a Individual page (FRONT)** • **L: Evaluating Arguments as a Individual page (Back)**
Before Class: Prepare to play Tutorial Videos – Videos 1 & 2 Check to make sure you have letter sized student pages (Remember that the bold student pages should be individual assignments) Prepare overheads for class examples and discussion.	