Enhancing scientific literacy through attention to argumentation as a disciplinary literacy practice

Whitney McWilliams
University of Northern Iowa

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Abstract
This project is partly driven by Science Writing Heuristic as writing to learn is part of a larger objective to help students develop literacy. While research on the SWH examines its own effectiveness through the lens of literacy, it only looked at its impact on science content knowledge. This project will examine five assessment tasks structured around the practice of argumentation. Data collected will measure use and inclusion of phenomena, three dimensional learning, and alignment to Performance Expectations. The content of the performance expectations center around two standards focused on electromagnetic radiation's effect on matter and technological devices used to communicate information and energy transmission.
Enhancing Scientific Literacy through Attention to Argumentation as a Disciplinary Literacy Practice

Non-Thesis Curriculum Development Project for the
Master of Arts in Science Education University of Northern Iowa

Presented by
Whitney McWilliams
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Date: Dr. Dawn Del Carlo, Advisor

Date: Dr. Ron Rinehart, Outside Reader
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Chapter 1 Introduction

“Student engagement in scientific argumentation is critical if students are to understand the culture in which scientists live, and how to apply science and engineering for the benefit of society “ (National Science Teaching Association, 2014). Science has long been viewed as black and white in supplying answers to questions posed. However, this ideology is outdated. Argumentation stands to be a vital skill within the science community, but also something to be expected of members of society. In order to achieve this, teaching this to our students is the first step (Hogan & Magleinti, 2001; Kuhn, 1991; Zohar & Nemet, 2002).

Historically, argumentation has been used as a tool for teaching content and not as a skill alone. Much of the research focuses on the use of argumentation to help students gain a deeper content knowledge over various disciplines, specifically in science. However, with the adoption of the Next Generation Science Standards (NGSS), educators moved from a content focused lens of teaching science facts to developing skills and practices specific to science as a mechanism for learning science content.

The shift to the new science standards also brought to light the emphasis on scientific literacy as the forefront of science education. For students to be scientifically literate, the focus shifted from memorization of scientific facts to applying scientific content to societal and personal issues to help engage students in relevant work. The NGSS grounded this in the use of phenomena and three-dimensional (3D) learning by integrating facts (disciplinary core ideas or DCIs) with relationships (cross-cutting
concepts or CCCs) by application of skills (science and engineering practices or SEPs).

But the new shift in science teaching and learning came with little to no curriculum. This left many educators scrambling to alter their current curriculum or starting from scratch, including assessments. While this is not a criticism, the question becomes, how do educators provide evidence of alignment of current curriculum and assessments to the standards? The research presented will focus on singular topics such as the impact of NGSS on classrooms, argumentation implementation and strategies and even the development of curriculum on a variety of science disciplines; however, there is little to no research which focuses on the integration of all three collectively.

This project aims to evaluate developed assessments around argumentation and scientific literacy; the NGSS Task Screener will be used to measure the quality, intent, and three-dimensional learning of the assessments related to specifically aligned performance expectations (PEs). The following PEs will be used for this project:

- **HS-PS4-4**: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter
- **HS-PS-4-5**: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy (NGSS Lead States, 2013c).
Chapter 2 Literature Review

Literacy and Literacy Education

While much of science education is centered on content knowledge, emphasis is rarely placed on literacy. However, literacy has value in content knowledge development, especially in science classrooms (Jiménez-Aleixandre, 2002).

A 2006 ACT report concluded that only half of the “roughly half a million test takers” were predicted to have a 75% chance to receive a C or better in an introductory post secondary course with an intense amount of high level reading. The major take away from this report was not a differentiator between race, class, sex or even socioeconomic class but all students’ ability (or inability) to answer multiple-choice questions when reading complex text (ACT, 2006).

The intent of a K-12 education is for all students to progress in reading complexity such that they can be successful in college or their chosen career. While this may be the current standard for students, complexity levels of texts have decreased in the last 50 years when compared to those of colleges and workforce training programs (National Governors Association Center, 2010). Hayes, Wolfer, and Wolfe (1996) showed a decline in reading complexity and oversimplification of text in schoolbooks after World War II. Publishers began the process right after World War I, mostly for younger elementary level readers but by 1945, many school texts geared towards sixth through eighth grade were now written at an astonishing fifth grade level. The justification for changing reading level expectations for students derived from multiple social causes
including competition with the rise of technology, specifically the TV, in hopes to make reading just as attention-getting as this new rival (Hayes, Wolfer, & Wolfe, 1996). Not only were publishers trying to rival the TV for attention, the decrease in reading complexity and word choice was to help show more “success” among students at grade level. This oversimplification was seen in non-academic reading books, across all levels as well (Hayes, Wolfer, & Wolfe, 1996). Reading comprehension does not end with school; many careers and almost all post-secondary educational experiences require an individual to read for understanding. This creates a larger gap in reading skills faced by high school graduates when entering the workforce or even a post-secondary institution (National Governors Association Center, 2010). While it has been shown that reading levels have decreased dramatically since the 1950s, this should not deter teachers from requiring high levels of reading, especially in science classes (Hayes, Wolfer & Wolfe, 1996).

While reading information to gain science understanding is vital, writing is also a key component in literacy. There are three types of writing styles discussed in the Common Core State Standards (CCSS) for Literacy: narrative, informational and argumentative. Narrative styles center on expressing a real or imaginative experience (Britton, 1972). This includes anecdotes, memoirs, and autobiographies, each using descriptive language to help illustrate the author’s characters, locations and motives. In science classes, students use narratives to express their own personal description of experimental procedures. Informational or explanatory writing is used to present
information as accurately as possible. This writing style focuses on the collection of facts and truths of information both previously known and discovered from research. Lastly, argumentation combines informational and narrative as a way to explain personal perspectives with claims and evidence. This project will focus on the style of argumentative writing.

Compared to high school, college writing focuses more on writing with a purpose. More specifically, the emphasis in college is writing with claims and evidence. Williams and McEnerney (1995) discuss that while many students thrive in writing in high school, these same students are the ones who seem to get the most frustrated with college writing requirements. High school and college teachers state that writing does not truly change; what changes is the shift in expectation to argumentation. For many students, writing more than claims can be difficult and argumentation requires supporting evidence with those claims. Argumentation is how one combines the pursuit of knowledge by respectfully presenting as much evidence as possible in support of the claim being made (Williams & McEnerney, 1995). Students refute this with statements such as, “we are all entitled to our opinions, and so we all should have to express them clearly. Here is my opinion. Take it or leave it” (Williams & McEnerney, 1995, p. 2). This represents a contradiction in the nascent epistemologies of students standing in conflict with the expectations of college. The nascent student epistemology leaving high school, students perceive that claims are adequately supported by an expression of opinion while the collegiate expectation is that claims must be backed by evidence with sufficient
justificatory support. College is designed for students to research and gain knowledge but to also use this new information to help make informed decisions.

Not only does an argumentation style inform, it also requires the author to inform using evidence and persuade the targeted audience. The author is not just presenting information, but using it to determine if the evidence provided actually supports a claim. Argumentative writing is critical in science but less than a quarter of the students entering college have argumentative literacy (National Governors Association Center, 2010).

K-5 teachers are responsible for literacy (writing, reading, listening and speaking) in science by integration. However, grade 6-12 English Language Arts (ELA) teachers are responsible for integrating informational text in their subject area while 6-12 science teachers are responsible for teaching literacy as it relates to science content. Using and applying scientific argumentation works directly with literacy and therefore, should not be the sole responsibility of ELA teachers. Argumentation involves a continuous implementation of constructing, comprehending, communicating, critical thinking and critiquing. These processes are also known as the “five Cs” of argumentation (National Research Council, 2014, p. 18). Applying any number of the five Cs is a comprehensive way to integrate literacy as a life skill in school and post-secondary citizenry (National Governors Association Center, 2010).

**Writing to Learn**

As mentioned earlier, writing is also classified as a part of literacy. It is the piece students struggle with most when communicating their ideas (Drew & Thomas, 2018).
But with the help of specific writing to learn (WTL) strategies, writing skills can improve through the process of learning content.

Within any content area, there is a significant connection between student learning and writing. Britton (1972) described that writing and learning are intertwined. Students have their own understanding and perceptions of all experiences; when students write and share these understandings, this is known as expressive writing. Britton describes the need for students to move out of expressive, personal writing and move to transactional, descriptive content writing; this is also known as argumentative writing. This type of writing leads students into learning content by practicing the skill of argumentative writing. The main focus of this project is on argumentative writing, in which assessments on claims, evidence and connections to problems will be evaluated. Much of the writing our students practice does not focus on argumentative or scientific style, yet this is an expectation of students in science. As such, practice writing in this style needs to start early in a student’s education.

Prior research has shown that students can engage with conceptual learning in science by making use of learning strategies like Writing-To-Learning (Burke, Greenbowe, & Hand, 2006). One example includes the Science Writing Heuristic (SWH) (Burke et al., 2006). This project aims to add to this research. The goal is to pursue writing in an argumentative style as opposed to other forms of writing like informational writing or even expressive writing. The justification for this approach comes from decades of science education research showing that there are deep connections that link
the epistemic, social, and conceptual learning in science (Duschl, 2008). First, conceptual learning has been shown to facilitate deeper cognitive processing of important information by the need to provide evidence in support of claims (Osborne, 2016; Ryu & Sandoval, 2012). Second, the epistemic aims of science, as reflected in materials like the NGSS, hold the aspiration that students develop scientific norms for knowledge development (Duschl, 2008; NGSS Lead States, 2013a). One way that science is developed through writing is with the collection and analysis of evidence to support or refute claims. A focus on argumentative writing makes it clear that claims need to be backed up with evidence. Learning science through this approach makes clear the connection between conceptual learning and the epistemic norms of science. Finally, argumentation is a social endeavor. Having students review the writing of others would provide an opportunity to link all three aims in ways that correspond with a more authentic perspective of scientific knowledge formation embraced by science education researchers and the NGSS (Duschl, 2008; NGSS Lead States, 2013a).

Much of science education focuses on the accumulation of factual knowledge, specifically in related disciplines. The perspective taken for this work is that factual knowledge can be obtained through argumentative writing; while also attending to the other important aims of a complete science education, specifically the socially constructed norms of science (Duschl, 2008; NGSS Lead States, 2013a). There is a need to develop assessments that address the connection between argumentative writing and learning. These assessments, using the science-specific WTL strategy of the Science
Writing Heuristic, were examined for alignment to the PEs and three-dimensional learning.

One study conducted by Adams and Pegg (2012) found that teachers implement literacy strategies by having students “rehearse or reorganize information provided by the teacher.” (pg. 153). Content-area teachers tend to use various reading and writing to learn strategies but modify them in order to match their views of literacy within their discipline. Teacher's instructional practices, goals of the strategy and timeframe of implementation are some of the reasons for modification. This leads to the use of stated strategies in content areas such as math and science to simply fit the needs of the class and/or teacher (Adams & Pegg, 2012). Another study found that the literacy strategies suggested to many content-area teachers, specifically mathematics and science, come in one form: Traditional reading, writing and decoding of texts. This approach comes from the single-track message literacy education conveys; literacy is ambiguous and not directly stated, and as such, literacy does not need to be taught in a content-area. This teaching should be done in that field of study, specifically Language Arts or English, to feel less “pressure of an overloaded curriculum” (Siebert & Draper, 2008, p.14).

Historically, reading and writing to learn strategies come from a textbook with associated questions. However, many teachers, supported by the research, do not find this type of pedagogy effective. This approach negates constructivist development of knowledge and assumes all students learn at the same time, at the same level, and in the
same way. Literacy strategies should engage students in current content and student knowledge on a topic (Fisher & Ivey, 2005).

Klein (2000) assessed 70 elementary students in science and found that student writing activities must be strategic and varied in the strategy utilized. Across a multi-year study, elementary students who participated in a collaborative letter writing WTL activity with high school students performed statistically better on a post-test than those who did not participate. The collaborative writing assignments were geared towards argumentative writing with questions, claims and evidence. Consistent writing across the unit also helped this specific WTL strategy to be effective (Chen, Hand, & McDowell, 2012). This means instruction centered on writing must be focused, structured, and continuous throughout a unit or year to be effective.

These same ideas translate to secondary classrooms as well. From 7th grade biological science to 11th grade chemistry, using WTL strategies improved total test scores and performance on conceptual questions with an emphasis on content (Gunnel, Hand, & Prain, 2007). Across this meta-analysis of six studies, a variety of strategies were used: Science Writing Heuristic, Calibrated Peer Review (CPR), and pre-planned writing activities. All strategies focused on the five vital components all writing tasks need: purpose, type, audience, context and method of text production. When discussing this analysis, it is important to note that different strategies were used but each required students to write, revise, and address their scientific understanding to a non-scientific audience. Successful implementation of this strategy was evidenced by “translation of
language from scientific to everyday….more rhetorical elements of text production….and
re-represent key concepts in different wording thereby.” (Gunel et. al 2007, p.634). This
means students were more successful in discussing science content using common,
extday language when the focusing on these specific WTL strategies were
implemented. Being intentional with the type of WTL strategy, specifically for the
science classroom, is vital to scientific writing.

Requiring students to write, whether it is strictly scientific or a more informal
style, leads to deeper concept development. This style of writing is a skill that needs to be
practiced and refined. As the literacy standards associated with this project read below,
multiple pieces need to be fully articulated in student writing:

- RST.9–10.8: Assess the extent to which the reasoning and evidence in a text
  support the author’s claim or a recommendation for solving a scientific or
technical problem

- RST.11–12.1: Cite specific textual evidence to support analysis of science and
  technical texts, attending to important distinctions the author makes to any gaps or
  inconsistencies in the account

- RST.11–12.7: Integrate and evaluate multiple sources of information presented in
  diverse formats and media in order to address a question or solve a problem
• RST.11–12.8: Evaluate the hypotheses, data, analysis and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

• WHST 11-12.8: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively: assess the strengths and limitations of each source in terms of the specific task, purpose and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism, and overreliance on any one source and following a standard format for citation (NGSS Lead States, 2013b).

Much of this is not practiced in the early grades and tends to only happen in secondary education. By this point in their schooling many students have developed incorrect habits, however, there are still some ways to help students’ argumentative writing thrive.

Construction of Student Arguments

One requirement under NGSS is the application of problem solving around societal or personal issues. Jime´nez-Aleixandre (2002) analyzed personal values and attitudes of 38 students and their ability to construct an argument around an environmental issue. The results of this study showed students created claims or warrants similar to an expert but did not consider scientific conceptual knowledge in the formulation of the claims. As such students’ claims were not necessarily influenced by the standard which was set by the teacher. While many felt incapable of doing so,
students still created “expert” arguments when applying knowledge production in a real world context. This gave many the sense of societal importance when participating in an actual scientific argumentation that applied to their life. Students tend to lose interest in science, as they get older (Potvin & Hasni, 2014). By exposing them to everyday issues and asking their views and claims on such topics, this ideology continues to pique their interest in science. Therefore, argumentation is a skill that must be practiced, with purpose, and must become the norm in science classrooms (Jime´nez-Aleixandre, 2002). Allowing personal and societal issues to be the center of focus when requiring students to write arguments gives purpose and value to the skill being taught.

Science is not just centered on the accumulation of facts for knowledge overload; it is a process of receiving, interpreting, analyzing and communicating this new information. Making connections to multiple disciplines and practicing problem solving all support the development of more literate science students (Drew & Thomas, 2018). Students need to be able to express their knowledge in scientific writing. While many students can identify what is “correct” or “incorrect” in other aspects of their education, many struggle to present information on a topic where there is no standard correct answer (Osborne et. al, 2016). One measure of student success in science would be represented by a students’ ability to generate an argument consisting of a claim, scientific evidence, societal evidence and prior held knowledge (Feinstein, 2013; Phillip & Norris, 1999; Roberts & Bybee, 2014).
Progression of Teaching Argumentation

Argumentation is a skill and should be explicitly taught, and not assumed to be known by students (Hogan & Magleinti, 2001; Kuhn, 1991; Zohar & Nemet, 2002). This skill, just like with any other skill, takes practice for students to master. Argumentation is currently taught as a tool for teaching content and not the content itself, which does not lead to developing strong argumentation skills.

Using common vocabulary such as claim, evidence, warrant and rebuttal frequently throughout a student’s science educational path has not yet occurred. Research suggests that proper scaffolding can help students develop competency with argumentation (Osborne et. al, 2016). Scaffolding includes sentence starters to help increase the engagement of higher levels of cognition when engaging students in argumentation. Research showed constructing scientific arguments tended to be more problematic than the construction of general arguments, even with the implementation of scaffolding, such as sentence starters. Osborne also found using multiple-choice assessments lends itself to a convenient method of testing argument construction. Unlike most existing research, Osborne et. al (2016) concluded that most argumentation should be taught as a general curriculum that is not tied to a specific content area.

Osborne et. al., (2004) set out to determine if the “process of argumentation” (p.1015) helped with student development of claims and evidence, regardless of the content of the argumentation. The results showed that it did. The study analyzed audio recordings and transcripts looking for dialogue of rebuttals in which students not only
disagreed with an opponent’s claim but with the addition of counter evidence and claims.

Five levels of argumentation were used to classify student’s pre- and post-arguments, as seen below (Osborne et al., 2004, p. 1008):

- “Level 1 argumentation consists of arguments that are a simple claim versus a counterclaim or a claim versus claim.
- Level 2 argumentation has arguments consisting of claims with data, warrants, or backings, but do not contain any rebuttals.
- Level 3 argumentation has arguments with a series of claims or counterclaims with either data, warrants, or backings with the occasional weak rebuttal.
- Level 4 argumentation shows arguments with a claim with a clearly identifiable rebuttal. Such an argument may have several claims and counterclaims as well, but this is not necessary.
- Level 5 argumentation displays an extended argument with more than one rebuttal”

Results showed there was a 15% increase in students engaging at a level 3 or higher by the end of the year and there was a decrease in student’s making arguments classified at level 1 (Osborne et al., 2004). These outcomes represent a shift to higher quality arguments in the form of student rebuttals. Improving students’ ability to use and apply quality scientific argumentation must be done explicitly and for an extended period of time, which is typically longer than nine months or a semester.
Definition of Science Literacy

Feinstein (2011) describes science literacy as the ability to see science within everyday life, rather than simply possessing a body of knowledge. This means being able to articulate science as applicable to everyday life or blend science content with practicality. Feinstein calls this practice, “Engaging with science in more desirable ways” (Feinstein, 2011, p. 182). Much of his research describes how education has attempted to yield a definition of what makes a student scientifically literate. However, Feinstein defines it as a combination of both what a student demonstrates in school and what a student should know and/or do. If the intended post-secondary goal for students is to be scientifically literate citizens, then the focus should be on creating a strong, universal definition of science literacy and then building curriculum around this definition (Feinstein et al., 2013). However, many previous attempts at this idea ultimately lead to a checklist of skills and knowledge in the hopes that a student who checks all boxes can be defined as literate.

An alternative description of science literacy is defined as “competent outsiders” or “citizens who identify relevant pieces of science and understand their local and personal implications without relying on school-based knowledge of particular scientific methods or concepts” (Allen, Feinstein & Jenkins, 2013, p. 314). The authors discuss the need to use specific strategies, such as Project-Based Learning (PBL) and/or Socio-Scientific Issue Discussions (SSID) to help drive students toward becoming competent outsiders. Inviting students to pursue science for their own personal interest
can achieve this. This may help with motivating students to continue learning science in the future (Feinstein et al., 2013). Potvin & Hasni (2014) found science and technology interest declines as a student ages. Their research also indicates that while interest in school science and technology declined, especially at the secondary level, interest in science careers and personal interest in science increased. This indirect relationship can possibly be attributed to a social perception of science that outweighs students’ negative school experiences in science and technology (Potvin & Hasni, 2014). Potvin & Hansi and Feinstein consistently refer to science literacy as opposed to scientific literacy. However, after much review educators can no longer use science literacy and scientific literacy interchangeably.

**Science Literacy vs. Scientific Literacy**

Science literacy is a phrase in the United States that became popular with no strong, universal definition attached to it (Roberts & Bybee, 2014). Even more so, scientific literacy cannot be used as a synonym for science literacy. The following will present an argument as to why science literacy and scientific literacy are not interchangeable and how this project will use one phrase over the other.

The discussion of science vs. scientific literacy stems from two different visions of the concept (Roberts, 2007). Vision I is defined as a student’s knowledge of science concepts and is represented by the term science literacy; Vision II is defined as knowledge of science as related to specific situations and is represented by the term scientific literacy (Roberts & Bybee, 2014). These may seem like small distinctions but
they actually have large implications in science education. Roberts (2007) covers much of the historical evolution of science literacy. Derived from a slogan starting soon after Sputnik and coinciding with the following rise of science education, educators and researchers began developing their own versions. Over the next 30 years, research slowly toggled between science literacy and scientific literacy. Originally, the model which stated that “all students can learn” was at the forefront of science education; however, specifically in the United States, this slowly changed over time. In 2012, the Framework for K-12 Science Education started to move away from addressing social and societal issues in science; which would fall under the definition of scientific literacy. The Framework states these types of topics should be taught in social sciences or humanities as opposed to science (Roberts & Bybee, 2014). During this time, the Programme for International Student Assessment (PISA), a worldwide assessment of all 15-year-old students and their scientific literacy, was created. PISA measured scientific literacy as, “…the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity” (OECD, 1999, p. 60). The United States quickly reacted by moving the focus from science literacy back to scientific literacy.

The question was whether the focus of science education should be on science concepts alone or the application of science into cultural and societal situations. Science literacy centers on the learning of science concepts and processes while scientific literacy
takes science and applies the content within the world outside the classroom to prepare post-secondary students for citizenship. Scientific literacy adheres to linking social and societal issues to content prior to teaching the content. In order to truly move students forward in scientific literacy, instruction should not focus on teaching science content alone but integrating content with data analysis, societal issues, and applications to scientific processes (Bybee, 2009).

The Framework for K-12 Science Education was the basis of Roberts & Bybee (2014) perception of student literacy in science. At the time, both authors operated within the current research; this included classifying students as being science literate. Yet as more research surfaced, Roberts & Bybee’s (2014) perspective became outdated. As the NGSS were developed and gained popularity across the United States in the following years, its implementation revealed the need to shift from scientific literacy back to scientific literacy. This transition came about through the use of phenomena to engage students by integrating a social and/or societal issue as an overarching theme for Performance Expectations (PEs).

The cycle of discussion around literacy in science is not new. While the new direction of science education places high value in emphasizing a link between personal, societal and moral issues and science content knowledge, scientific literacy would be the choice. As such, scientific literacy will be the preferred term used to define student’s literacy in a physical science class for the purpose of this project.
Next Generation Science Standards (NGSS)

Back in 2011, the National Research Council (NRC) and the National Academy of Science developed the Framework for K-12 Science Education. This set of guidelines created and refined standards for scientific learners in preparation for college, careers and everyday life outside of school. These standards were vetted by a variety of states, “other stakeholders in science and even industries outside of education in order to provide the best for students” (NGSS Lead States, 2013a, Paragraph 2). This Framework would become the basis of where NGSS evolved. From public drafts and input, two years were spent in Fidelity Review to ensure consistency with the original Framework. By 2013, NGSS was ready for state adoption. However, it was not until 2015 when Iowa adopted NGSS, performance standards only, with full implementation expected by the start of the 2020 school year. The purpose of updated standards came with the ever-changing education world (Iowa Department of Education, 2015).

NGSS centers on the idea of three-dimensional learning (3D-Learning) to prepare students for life after high school. This idea combines knowledge, practices and connections to other science concepts. Specifically, the three dimensions are Disciplinary Core Ideas (DCIs), Science and Engineering Practices (SEPs), and Cross-Cutting Concepts (CCCs). The purpose of these three dimensions of learning were to help refine science learning into practical use after high school, in comparison to traditional memorization of facts (Iowa Department of Education, 2015). SEPs derive from the idea that scientists combine skills, inquiry, and concepts to investigate the world. Engineering,
similarly, is investigating the world while using skills and concepts to solve problems that may arise. CCCs, such as cause and effect, scale and stability/change, connect all areas of science and are based on the Framework’s emphasis on organizing information of the natural world. DCIs are the content knowledge or concepts used to describe the phenomena occurring; they can be equated to basic scientific knowledge but are grounded in more than just facts of the world. To be classified as a DCI, core ideas must meet two of the following criteria:

- “Have broad importance across multiple sciences or engineering disciplines or be a key organizing concept of a single discipline;
- Provide a key tool for understanding or investigating more complex ideas and solving problems;
- Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge;
- Be teachable and learnable over multiple grades at increasing levels of depth and sophistication” (NGSS Lead States, 2013d).

3D-Learning is a process of learning that combines the three dimensions of the NGSS equally to generate a benchmark for student proficiency on a standard or performance expectation (PE). Each PE statement consists of the DCIs, SEPs, and CCCs a student needs to demonstrate to display their learning. There are a variety of combinations of the three dimensions and is what makes up each performance expectation (Teaching Channel,
Each dimension implemented or demonstrated alone does not fully encompass scientific learning; content or DCI is only purposeful if it is put into action by an SEP and organized in connection with the CCCs. In reading the NGSS, PEs encompass the 3 dimensions within a science discipline and are written in the form of a statement. This project will evaluate assessments designed for Waves & Its Interactions, HS PS4-4 & 4-5:

- **HS-PS4-4**: Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter

- **HS-PS-4-5**: Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy (NGSS Lead States, 2013c).

These specific PEs ask students to engage in science anchored in a societal issue while requiring them to communicate their understanding. This lends directly into literacy as communication can be in the form of writing, specifically argumentation when presenting the information. Students will be assessed on not only content knowledge, but also their own perspectives on validity and reliability of claims when researching this topic. The integration of both content knowledge and relevance to students’ lives works towards generating scientifically literate students.

The Common Core State Standards (CCSS) in literacy overlap with NGSS. These literacy standards engage students in science content and support learning science rather than just memorizing science facts. Creating authentic learning in science means
purposefully engaging students in the practice of science. The NGSS focuses on student centered learning, and using students’ experiences as a means to comprehend the world around them. This comes from cognitively working through student questions and misconceptions.

**Science Writing Heuristic**

One of the ways to assess scientific literacy through writing to learn literacy strategies is through the Science Writing Heuristic (SWH). This specific type of instructional approach is a method grounded in and tailored specifically for the science content area. It is a tool to help facilitate inquiry-based learning utilized by students and teachers as a writing-to-learn strategy to promote a connection between science understanding and laboratory data. Using specific, open-ended prompts, students form questions to investigate then, after conducting the investigation, engage in argumentation using claims, evidence and collaboration among peers (Keys, Hand, Prain, & Collins, 1999).

The SWH provides a guide for teachers to help students develop a clear understanding through inquiry, dialogue, and argumentation for learning. Students drive the learning by collaborating on the creation of questions to test, method of data collection, and analysis of evidence before a final discussion of evidence as it supports the groups’ claim/questions. This then drives content reading and post-laboratory reflections. This technique encourages student ownership of the learning process with less emphasis on direct instruction of step-by-step, didactic learning; instead of
instructing, the teacher now adopts the role of facilitator. Scientists engage in their own social learning, which the SWH models in a classroom environment. Inquiry-based learning is rooted in social learning and therefore, is a skill that needs to be taught to all students. The facilitator works to build an environment for all students to succeed and grow in their learning by allowing them to take an active lead in its fruition.

The SWH allows students to “engage with the ideas of science” (Burke, Greenbowe, & Hand, 2006, p. 1036); this means it gives all students the opportunity to learn science, not from notes, set readings and cookie-cutter labs, but by constructing their own understanding of concepts through experiences, discussion and argumentation. The SWH is a specific WTL strategy used to blend science practice, knowledge and understanding by becoming the central contributor to student learning. Emphasis is not on quantity of writing but quality of what is written and communicated.

When comparing traditional teaching to SWH teaching in various disciplines, across multiple grade levels, Akkus, Gunel and Hand (2007) found student performance on a post-test increased for the experimental group by as much as four points more than the control group. Additionally, this study showed the achievement gap was much smaller with high-quality SWH implementation when compared to low-quality SWH implementation, or traditional teaching (Akkus, Gunel & Hand, 2007). Similar results were found in a Turkish high school chemistry class; the treatment group of students using the SWH consistently scored higher on conceptual post-tests compared to students taught in a traditional manner of lecture, lab, and test.
However, the SWH not only helps in conceptual understanding, but additionally closes the misconception gap between prior knowledge and final understanding. The writing requirements of the SWH allow students to activate their prior knowledge, address “conflict between prior understanding and new information” (Akkus, Gunel & Hand, 2007, p. 1660), and then allow students opportunities to use their new concepts in alternate situations. Part of this is due to the fact that the SWH requires students to be actively involved in their own learning process and “experience scientific phenomena” while using argumentation skills to help with construction of learning (Kingir, Geban & Gunel, 2013, p. 1660). The idea that students construct their own knowledge is foundational to the effectiveness of the SWH.

**Theoretical Framework**

Students develop their own knowledge (i.e. learn) from previous experience and prior beliefs. By creating new connections from presented material and what they have previously come to know or learn, students begin building a new knowledge base (Adams, 2006). Teaching under this theory means that simply giving information to students with the expectation that they will mold it into their own knowledge is not effective. The role of teacher must shift to that of facilitator, by providing opportunities and experiences for the students to engage with the content. This allows the teacher to help all students construct their knowledge based on a student’s current held beliefs. In order for this to occur, continuous dialogue must happen (Adams, 2006).
This fits directly into the goal of student learning and assessment under the NGSS. Literacy, writing, and reading specifically for this project, develop student learning based on relevant and engaging problems to help students in the construction of new knowledge and skills.

Student development of content understanding, acquiring knowledge, and assembling new knowledge from prior experiences align with a constructivist approach to learning. To dive deeper, students work to test knowledge against their own current view of understanding. As Bodner (1986) describes, sense making is not done haphazardly; student sense-making should be intentional. By creating a structured environment where students are put into situations that disrupt their current understanding then given the opportunity to piece together their learning to gain or expand their current knowledge comprehension. However, in order to be done with fidelity, there needs to be a grasp of where students are going and where they will end at the conclusion of the knowledge construction. Authentic scientific inquiry is an activity that perfectly models constructivism (Bodner, 1986). First, a problem or phenomena is presented where students use what prior knowledge they have in an attempt to solve this problem. Moving forward, students are presented with situations and/or problems then asked to apply their current knowledge to validate their understanding. As more information and/or data is presented, students will begin forming connections as a method to develop highly sophisticated solutions (Bodner, 1986). To put simply, not only is content knowledge important in constructivism, but the situations and/or problems
provided to students become critical to their knowledge construction. The NGSS is foundationally built around these very ideas: providing problems or questions relevant to students then requiring them to engage in learning.

In order to meet students where they are in their knowledge development, science education works from the idea of immersing students in problem-based situations to determine what the student's current understanding is of the content in a real-world application. Vygotsky (1978) describes this process in two parts: actual vs. potential developmental level. Actual development level is what a student can independently accomplish without assistance, while potential development is just the opposite; development in which a student has yet to master independently but might successfully accomplish with help from adults or peers. The middle ground between the two levels is the zone of proximal development (ZPD) (Vygotsky, 1978). The ZPD supports continual growth in working towards actual development level. Dissonance, also, does not happen equally among all individuals (Bodner, 1986); each student comes to new understandings at different times. This means allowing students the opportunity to communicate via writing and speaking when working in groups, which helps students with their current ideas on the content. Writing allows individual students an opportunity to self-assess where they think they are in their learning while also giving the teacher evidence of their understanding. Collectively, between development levels and constructivism, argumentation emerges.
The emerging skill of argumentation of students through ZPD and constructivism is accomplished through scientific literacy; argumentation is a continuous process in which students draft and redraft claims and reasoning based on new evidence. As such, argumentation needs to be taught as a separate skill and not a tool for teaching content (Jime´nez-Aleixandre, 2002). The idea that students naturally possess this skill is false (Hogan & Magleinti, 2001; Kuhn, 1991; Zohar & Nemet, 2002). Like any other skill, it must be practiced and done consistently for mastery (Jime´nez-Aleixandre, 2002).

Scientific literacy focuses on the application of relevant science content to societal and personal issues (Bybee, 2009); when addressing student construction of knowledge through argumentation, this is done by the use of high-quality phenomenon, alignment of intended targets and integration of three dimensional learning based on individual students.
Chapter 3 Methodology

Purpose of Project

This project is partly driven by SWH as writing to learn is part of a larger objective to help students develop literacy. While research on the SWH examines its own effectiveness through the lens of literacy, it only looked at its impact on science content knowledge. This project will examine five assessment tasks structured around the practice of argumentation. Data collected will measure use and inclusion of phenomena, three dimensional learning, and alignment to Performance Expectations. The content of the performance expectations center around two standards focused on electromagnetic radiation’s effect on matter and technological devices used to communicate information and energy transmission.

Research Questions

Based on the previously discussed literature review, there is a gap in research that addresses scientific literacy through alignment of NGSS PEs. This project attempts to address this through the following research questions:

1. How do previously developed assessments provide evidence for argumentation and scientific literacy based on:

   a. alignment to performance expectation(s)?

   b. three-dimensional learning
c. tasks centered around phenomena?

Course and School Context

The course selected for this study is a required freshman level physical science course. Content is selected based on Iowa Core State Standards and performance expectations designed to build on previous skills and expand on concepts such as energy, Newton’s Laws, forces, wave properties, electromagnetic spectrum, and Earth’s processes; biology and chemistry courses cover the remaining standards, as all students are required to take these courses as well.

The high school where this course is taught enrolls 495 students, on average, with 52.7% female. Of this population, 10.3% of students are classified with an IEP (or Students with Disabilities), 35.6% rank as low socioeconomic status and over 90% of the population is Caucasian; less than 2% is multi-racial, Black/African-American or Hispanic (Iowa Department of Education, 2015).

The community has around 7200 people, an average age of 40 years old and 95% of the population being Caucasian. Economically, the town’s median income is around $45,000 with 25% of families being single earners and only 17% of families with no one in the household working. Within city limits, there is a 3M factory, Weiler Equipment, and Hormel Foods. In addition, a mere 20 miles East, there are two other companies, Pella Corporation and Vermeer centered around manufacturing (in various capacities) all of which represent the majority of the workforce in the area. The town is located just 40 miles outside of Des Moines (capital and one of the largest cities in the state of Iowa); on
average, residents of the town have a 20 minute commute to work. There are many parents of high school students who commute to Des Moines or Pella for work. Parents are actively involved both in the community and school as their children are second generation residents (Marion County Board of Supervisors, n.d.). Based on these statistics and demographics, using and including relevant phenomena is critical to engaging all students. Choosing rural, agricultural and industrial phenomena best engages students in this area. This information should continue to be utilized to help inform decisions around phenomena and developed assessments.

**Data Collection**

For these research questions, five developed assessment tasks were evaluated through the NGSS Task Screener as described below; each individual task was evaluated through the entire Task Screener. The assessment tasks cover wave properties and behaviors, their effects on matter and how some technology utilizes this energy and how it is used to communicate information. The Task Screener provided evidence from the developed unit assessments to show how aligned each task was to PEs, three-dimensional learning and their connection to phenomena.

**NGSS Task Screener**

This evaluation tool focuses on evaluating previously created assessments. This tool is a guide in evaluating an assessment with common expectations of what student performance shows three-dimensional learning using the four criteria listed above (Lead States, 2013e).
This is based on the following four criteria:

A. Phenomena based situations

B. Connections between the three dimensions

C. Fair and equitable

D. Purposeful towards a specified target

Developed Assessments

The assessment developed for the selected unit included five tasks. Each task covers the topics of electromagnetic radiation, its effect on matter, validity and reliability of the research, wave properties/behaviors and how information is communicated using technological devices. The literacy standards in this project are already mapped to these specific PEs. They cover both reading and writing; specifically, these standards discuss citing contextual evidence with an author’s claim, evaluating a variety of media sources, validating sources and their conclusions as well as collecting information from multiple sources coherently summarizing and communicating to an audience (NGSS Lead States, 2013b). Each prompt will address one or more of these literacy standards to create a final argument (Table 1).

Table 1

Summary of Task and Corresponding Literacy Standard

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Summary of Task</th>
<th>Literacy Standard Addressed</th>
<th>Literacy Standards Defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Develop claims and research</td>
<td>RST.11-12.7</td>
<td>RST 11-12.7→ Use multiple</td>
</tr>
<tr>
<td></td>
<td>Evidence of chosen electromagnetic wave’s usefulness, helpfulness &amp; technological value to society</td>
<td>RST 11-12.8, WHST 11-12.8</td>
<td>Medium formats and sources to answer a question</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>---------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>Write an opening paragraph with claims &amp; evidence from task 1. Begin researching claims &amp; evidence on opponents wave is NOT useful, helpful or technologically valuable to society</td>
<td>RST.11-12.7, RST 11-12.8, WHST 11-12.8</td>
<td>RST 11-12.8 → Use scientific text to evaluate data &amp; conclusions and compare to similar texts</td>
</tr>
<tr>
<td>3</td>
<td>Write a rebuttal paragraph using claims &amp; evidence from task 2 &amp; develop two questions to ask opponent over their wave’s usefulness, helpfulness &amp; technological value to society</td>
<td>RST.11-12.7, RST 11-12.8, WHST 11-12.8</td>
<td>WHST 11-12.8 → Gather relative information from multiple sources and assess the validity of each source based on task, purpose &amp; target audience while avoiding plagiarism (NGSS Lead States, 2013b)</td>
</tr>
<tr>
<td>4</td>
<td>Research &amp; develop counterclaims of chosen electromagnetic wave, from task 1.</td>
<td>RST 9-10.8, RST 11-12.1</td>
<td>RST 9-10.8 → Determine if scientific text provides evidence &amp; reasoning to support claim in solving a problem</td>
</tr>
<tr>
<td>5</td>
<td>Write a closing paragraph using information from all previous tasks &amp; organize to present.</td>
<td>RST 9-10.8, RST 11-12.1, RST.11-12.7, RST 11-12.8, WHST 11-12.8</td>
<td>See above</td>
</tr>
</tbody>
</table>

Students begin in the first task, with background learning around electromagnetic radiation, which includes the types, uses, and effects on matter. As a class, students develop criteria for reliable and valid resources. These criteria are applied to specific website examples to demonstrate the process students take in order to do their own research. Students then choose one of the seven types (i.e. frequency range) of electromagnetic waves on the spectrum to focus their research. Research is conducted on
their specific frequency range, with the purpose of finding three reasons their chosen wave is superior in usefulness, value, and technological support to society. Research must be evidence-based and include citations for valid and reliable sources based on the criteria developed previously in class. All research is done by students individually. In the second task, students are paired or grouped by their chosen electromagnetic waves to collaborate with students who researched the same wave; students help each other write and develop an opening statement or introduction paragraph over their three reasons for choosing their wave. Students then individually submit a video of their opening statement for feedback on Flipgrid. Once completed, “opponents” are randomly selected by the teacher and assigned to students; students research their opponent’s wave to determine three reasons their opponent's choice is not valuable, useful, or technologically supportive to society. The third task asks students to write a counter-argument paragraph, or rebuttal, over their opponent’s wave making sure to include citations for reliable and valid sources in their argument. On a discussion board, students post their rebuttal for peer feedback over both content and the presence of citations of sources. In the fourth task, students look at counterclaims against the electromagnetic radiation wave they chose. In addition, a teacher of the students’ choosing in the building, provides feedback on their current writing. The fifth task centers on writing their closing argument and organizing all sections together for their final summative presentation as well as an individual meeting with the instructor for final feedback and comments before the final assessment.
Data Analysis

Each assessment task prompt was evaluated through a process that collects evidence through questioning, improvement prompts and a rating; this process includes four criteria, as outlined in the NGSS Science Task Screener (Appendix A). The NGSS Task Screener contains four overall criteria but only three criteria were relevant to this research: alignment to PEs, 3D learning, and phenomena. The third criteria, fair and equitable or Criteria C, was omitted from data analysis as it played no significant role towards answering any of the research questions. Criteria A centered on aligning the prompts to a high quality phenomena. Phenomena presented should be high-leverage problems used to help engage students, and make it relevant and attainable to all learners. The focus of Criteria B includes evidence of a collective thinking or learning from the integration of the SEP, DCI & CCC encompassing the phenomena. Equity, criteria C, addresses the task’s ability to accommodate a diverse range of student cognitive levels and whether the task allows opportunities for multiple responses. The task needed to include all three-dimensions as related to the PE. The final criteria, D, discusses the purpose of the task and what student evidence will be collected. Guidance, direction, and the supporting materials should help scaffold a student’s ability to complete the task as outlined from the previous mentioned criteria. After the Task Screener was completed for all assessment tasks, data were analyzed through the lens of each research question: alignment to PEs, phenomena centered and 3D learning.
Results

The NGSS Task Screener was used to collect evidence around each task of the developed assessment. After completing the entire Task Screener for all five tasks, data were organized based on the three research questions. As mentioned previously, the NGSS Task Screener contains four overall criteria but only three criteria (A, B, and D) were relevant to this research: alignment to PEs, 3D learning, and phenomena. All elements of the Task screener were completed for analysis, however, only the data that directly addresses the research questions are presented here. Indicators within each criteria asked for an evaluation of “yes, somewhat, or no” as evidence while other indicators asked for more detailed information and explanation. The results for all relevant indicators were placed in a data table. More detailed information on the justification of this evidence was also provided. Finally, indicators were quantified by counting the number of “yes, somewhat, or no’s” indicated in each of the three criteria. After organizing the data by indicators and criteria, it was found that all but one indicator was “yes, somewhat, or no” evidence based. This overall quantified analysis was used to determine if the criteria as applied to each task was met.

Alignment to PEs

In addressing the first research question, alignment to PEs, all evidence was collected under criterion D: “Tasks support their intended targets and purposes” (Task Screener Page, 2nd paragraph). Within this criterion, four indicators were examined (Table 2). Three of the four indicators prompted a “yes or no” response while the final indicator
looked at the type of assessment from the task. When analyzing “Does task state purpose or intended assessment targets” there were only two indicators that explicitly stated target or intended purpose. The indicator of “Anything NOT targeted but necessary to respond to a task” yielded yes responses for all five tasks. Based on additional evidence provided in Table 2, this indicator shows the untargeted purpose was researching capabilities of students. In the final indicator presented in Table 2, “Do student responses elicit support for the purpose of the task?” no student work was analyzed in this project. However, answers to this indicator were based on recollections of student work from previous implementation of the developed assessments. This indicator resulted in all “yes” responses. Based on the indicators below, there was supporting evidence of alignment to the PEs presented in these assessments.

Table 2

Alignment to PEs Indicators from Criterion D

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Type of Assessment?</th>
<th>Does the task state purpose or intended assessment target?</th>
<th>Anything NOT targeted but necessary to respond to a task?</th>
<th>Do student responses elicit support for the purpose of the task?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Formative</td>
<td>Yes (making claims with evidence)</td>
<td>Yes (research capabilities)</td>
<td>Yes (responses are in claims/evidence format)</td>
</tr>
<tr>
<td>2</td>
<td>Formative &amp; Application of what they learned to a similar but new context</td>
<td>Yes (creating counter-arguments)</td>
<td>Yes (research capabilities)</td>
<td>Yes (responses are still in claims/evidence format but with counter view)</td>
</tr>
<tr>
<td>3</td>
<td>Formative &amp; Generalizing their learning to a different</td>
<td>No (No direct statement towards final)</td>
<td>Yes (peer feedback which helps develop)</td>
<td>Yes (shows progression towards completion of)</td>
</tr>
</tbody>
</table>
**3D Learning**

3D learning was addressed in three of the four criteria from the Task Screener. Within each criteria, more detailed and specific indicators were used to elicit evidence of 3D Learning from the developed assessment tasks. These indicators have been separated by topic and included in the following tables. The first Criteria, A focuses primarily on phenomenon but includes one indicator related to 3D learning (Table 3). It evaluated whether the task was “Explainable using grade-appropriate SEPs, CCCs, & DCIs”. This indicator asks for evidence that task responses can be done at grade-level using all three dimensions. When analyzing this indicator, only two tasks (2 and 5) show evidence in support of using all three dimensions together while the other three tasks (1, 3 and 4) show evidence of partial or somewhat 3D learning (Table 3). Much of the additional evidence or comments in this indicator show two of the three dimensions of learning are occurring.
Table 3

*Grade-Appropriate 3D Learning from Criterion A*

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Explainable using grade-appropriate SEPs, CCCs, &amp; DCIs (Yes, Somewhat or No)</th>
<th>Additional Comments &amp; Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Somewhat</td>
<td>Hitting content and skill hard but not really touching on CCC</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Engaging in argumentation while evaluating various sources. Need to be able to communicate the information to a larger audience, verbally and written, to show learning.</td>
</tr>
<tr>
<td>3</td>
<td>Somewhat</td>
<td>Focus is still on SEP &amp; DCIs but fails to do much for cause/effect (CCC)</td>
</tr>
<tr>
<td>4</td>
<td>Somewhat</td>
<td>Definitely using SEP &amp; DCI to write arguments. Not completely three-dimensional</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>Bringing together all pieces. Still not sure CCCs are happening</td>
</tr>
</tbody>
</table>

Continuing with 3D learning, Criteria B, focused on what evidence exists to show each of the individual dimensions were being displayed separately and collectively. Each task came out the same; there was evidence of both the SEP & DCI but with little to no evidence for the CCC (Table 4). Evidence was determined by explicit instruction around each dimension based on the task’s directions. Moving to the later tasks, use of evidence of CCCs may be occurring but this is not happening explicitly. As it stands, this collection of evidence indicates only 2D learning is occurring.
Table 4

Evidence of 3D Learning Indicators from Criterion B

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Evidence of SEP</th>
<th>Evidence of CCC</th>
<th>Evidence of DCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(SEP obtains, evaluates and communicates information. Students are doing all of this during the task. They find and/or gather information around their EM wave, they determine if the information is worth citing or keeping, then having to find a way to communicate (via writing currently) the information they learned.)</td>
<td>(CCC is cause and effect. This is not explicitly stated; it happens indirectly but never purposefully)</td>
<td>(DCI for the two standards are around electromagnetic radiation’s effect on matter and the technological pieces/instrumentation and its function. Both are present as that is one of the three reasons students need to find in their research)</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(Constantly (throughout this task) evaluating valid/reliable claims for published materials (journal articles, websites, data, etc.) found online. This is in addition communicating this information out based on their learning.)</td>
<td>(Should be looking at the cause/effect but not sure this is actually happening or if there is even any evidence to say this may indirectly be happening)</td>
<td>(The research is all about content, specifically around which EM wave they choose to focus on. The content in this task is tied directly to the standards (4-4 → how matter responds to absorbing EM waves &amp; 4-5 → explaining technological devices).)</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(Students are now obtaining, evaluating and communicating, like they have done previously, with similar content but now on the opposite side of the argument. This is happening in writing, verbal practice/simulations and even in recorded videos.)</td>
<td>(If this is happening, it is out of chance and not explicit instruction)</td>
<td>(Students are still researching content focused on wave effects on matter and how waves can capture and transmit information in the form of energy. This is still what is required of students to learn but the opposite side of their original argument)</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>(Continuing to obtain/evaluate/communicate information. Happening with the counterarguments with)</td>
<td>(Unofficially happening; not focusing or directly asking students to make the connections of cause/effect.</td>
<td>(Research is around specific content (electromagnetic spectrum wave(s) effect on matter. Looking at technology,</td>
</tr>
</tbody>
</table>
The last criterion, D, focused on targets and purposes of presented tasks. When looking at the data within this criterion, one indicator asked if there was evidence of multiple dimensions. Two dimensions showed evidence across all five tasks based on their intended objective (Table 5). This shows the use of multiple dimensions, yet does not give any evidence of three dimensional learning. Similar to Criteria A and B, looking specifically at 3D learning, Criterion D only provides evidence 2D learning is explicitly being addressed when in connection to the alignment of the purpose of the tasks. Based on this evidence, 3D learning is not happening throughout the developed assessment.

Table 5

Support for and Use of Multiple Dimensions Indicators from Criterion D

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Using multiple dimensions together for sense-making</th>
<th>Rubric guidance around using all three dimensions AND calling out for support of specific individual dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes (Using SEP &amp; DCI for content driven obtainment &amp; evaluation of)</td>
<td>SEP focused (obtaining/evaluating information). DCI is happening but no mention of CCCs</td>
</tr>
<tr>
<td>Task</td>
<td>Yes</td>
<td>DCI &amp; SEP Focused</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>-------------------</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>SEP focused (obtaining/communicating information)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Little discussion of DCI or CCC</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>DCI &amp; SEP Focused (No mention of CCC &amp; here is where students need to be both moving towards mastery of SEP &amp; more emphasis DCI accuracy begins)</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>DCI &amp; SEP Focused (No mention of CCC but it could be happening unintentionally by either teacher or student. Support and guidance is around mastery of SEP &amp; DCI accuracy)</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>DCI &amp; SEP Focused (Still no mention of CCC but it may happen unintentionally by students. Much of what is the focus is around the SEP and organization of information. Some emphasis on content)</td>
</tr>
</tbody>
</table>

**High-Quality Phenomenon**

Criterion A, which focused on the use of phenomena, resulted in a total of 30 pieces of evidence. However, only seven pieces of evidence across all five tasks illustrated that high-quality phenomenon was explicitly addressed and integrated within each task. When assessing high-quality phenomenon, this takes into account multiple pieces of evidence such as continuous presence, complexity, explainability and interconnectivity. Similar to 3D Learning, phenomenon indicators are found throughout the Criteria of the Task Screener, even if the main goal of the criterion is not focused on phenomenon. Starting with Criterion A, which does focus specifically on phenomenon,
two of the six indicators had no supporting evidence, while the remaining four have at least one piece of supporting evidence across the five tasks (Table 6). The first indicator, “Phenomena/problem presented,” is supported with evidence within the first two tasks but tasks 3-5 failed to provide any evidence for this indicator. In addition, the indicator “Presents real-world observations” contains no evidence across the tasks; between these first two indicators, presence of phenomenon and explainability measures of high-quality phenomenon are not being met. The majority of evidence is classified as “somewhat” and “no” which means there is not sufficient evidence to confidently show all tasks are adequate for high-quality phenomenon. As a result, when looking at the amount of supporting evidence alone, the developed assessment tasks are not well grounded in the given phenomena.

Table 6

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Phenomena/Problem Presented (Yes, Somewhat or No)</th>
<th>Presents real-world observations (Yes, Somewhat or No)</th>
<th>Puzzling &amp; Intriguing (Yes, Somewhat or No)</th>
<th>Local, Global &amp; Universal relevance made clear (Yes, Somewhat or No)</th>
<th>Comprehensible to wide range of students at grade level (Yes, Somewhat or No)</th>
<th>Sufficiently rich to drive task (Yes, Somewhat or No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>No</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>No</td>
<td>Somewhat</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>No</td>
<td>Somewhat</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Somewhat</td>
<td>Yes</td>
<td>Somewhat</td>
</tr>
</tbody>
</table>
The evidence was compiled, quantified, and examined across all three Task Screener criteria and indicators for all five assessment tasks to determine if evidence was present; this evidence was then used to make the claim that argumentation and scientific literacy are adequately assessed in developed assessment tasks. This analysis shows that three dimensional learning and alignment to PEs has a majority of supporting evidence to show these two criteria are met (Table 7). However, when analyzing the Tasks for evidence of high-quality phenomenon, less than a quarter of all evidence indicates quality phenomena are present.

Table 7

*Summary of Total Pieces of Evidence from the NGSS Task Screener*

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Total Pieces of Evidence</th>
<th>Yes</th>
<th>Somewhat</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenomena</td>
<td>30</td>
<td>7 (23%)</td>
<td>12 (40%)</td>
<td>11 (37%)</td>
</tr>
<tr>
<td>3D Learning</td>
<td>25</td>
<td>17 (68%)</td>
<td>3 (12%)</td>
<td>5 (20%)</td>
</tr>
<tr>
<td>Alignment to PEs</td>
<td>15</td>
<td>13 (87%)</td>
<td>0 (0%)</td>
<td>2 (13%)</td>
</tr>
</tbody>
</table>

Based on these results, the developed assessments showed adequate evidence for both 3D learning and alignment to PEs but did not show adequate evidence for assessments focused on phenomena.

The results above provide evidence of argumentation through the developed assessments by alignment of PEs and 3D learning. The SEP dimension of these PEs,
obtain, evaluate & communicate information is a form of argumentation; this means with both alignment and 3D learning present, argumentation is also present and adequately addressed. Phenomenon presence, which was not consistently found throughout the assessment tasks, would provide even more evidence of argumentation and show scientific literacy being addressed. As mentioned in previous chapters, scientific literacy centers on the basis of providing a real-world problem or situation in which to apply science knowledge. Using a phenomenon to root curriculum, specifically an assessment, gives evidence of addressing scientific literacy. Since the results show inconsistent evidence throughout all five tasks, scientific literacy is not adequately addressed. Based on Table 7, the five tasks must undergo changes to address more integration of high-quality phenomena.
Chapter 4 Conclusions and Reflection

This project focused on developed assessments around argumentation and scientific literacy on specific high school PEs. Evidence, as described in the previous chapter, was looking for alignment to PEs, 3D learning and high-quality phenomenon. The following sections describe in more detail claims and reasoning based on the evidence from the Task Screener.

Alignment to PEs

When looking at the evidence for alignment, Table 7 presents evidence of alignment of PEs, with only two pieces of evidence (13%) not showing evidence of alignment. From this, the developed assessments provided adequate evidence of alignment to the PEs. As such, this evidence shows three of the five tasks are providing all students with argumentative writing skills. Since argumentative writing is directly correlated with the literacy standards from the PEs of the developed assessments, aligning to the PEs and literacy standards show evidence of argumentative writing skills being taught and met; from this conclusion, task three and five need to be reworked in order to show adequate evidence of such intended purpose. Developing clear, targeted and purposeful expectations on developed curriculum will help give equitable access to all students regardless of race, gender, or socioeconomic status.

3D Learning

When evaluating 3D learning, it can be concluded that 3D learning is occurring; however, evidence from Table 3 and 4 indicators show a need for more explicit
instruction around one of the three dimensions: cross-cutting concepts (CCCs). It should be emphasized the importance of grade-level accessibility for all students; this is happening for two of the five tasks but not all. These developed assessments are focused on the content (DCI) and communication of information (SEP) more than the relationship between the two and across other science disciplines (CCC). However, there is evidence indicating multiple-dimensions are used (Table 5). True 3D learning demonstrates the scientific literacy of students through their proficiency on a PE (Teaching Channel, 2020). Argumentation is not just stating a claim but presenting a claim with evidence from a variety of valid sources to communicate a student’s current stance on a relevant topic (Feinstein et. al, 2013; Phillip & Norris, 1999; Roberts & Bybee, 2014). These assessments provide evidence of students engaging in argumentation through 3D learning, especially with evidence supporting the implementation of SEPs throughout the five tasks. While most of the tasks provide evidence of DCI and SEP, they lack evidence for explicit instruction around the CCCs (Table 4). As discussed above, like argumentation, this should also be explicitly instructed and not assumed to be known or done by students (Jime´nez-Aleixandre, 2002).

**High-Quality Phenomenon**

It is clear from the collected evidence that the phenomenon is not consistently present nor interwoven throughout the five assessment tasks. Only the first two assessment tasks provide any evidence for the explicit presence of a phenomenon (Table 6). Additionally, less than 25% of the indicators for Criteria A indicated strong evidence
of phenomenon (Table 7). When choosing and using a phenomenon, it should appear consistently and repeatedly to enforce the idea behind answering the question posed. Students create higher-level scientific arguments when they are attached to a societal or personal issue (Jime´nez-Aleixandre, 2002). As such, these developed assessments fall short in continually addressing the posed problem or question. Most students in this project come from lower socioeconomic backgrounds and predominantly blue-collar working families. As such, the phenomenon in this project should reflect and build on this. Not only should it be present within all five tasks, it should be relevant to what students relate to in their personal lives or what a community issue would be that directly affects them.

The lack of presence and focus of phenomenon correlates to the underdevelopment of scientific literacy within the assessments. Scientific literacy is defined, for this paper, as connecting social and personal issues to content; this means presenting some problem or phenomenon to students to make connections between their lives and the content/skills they are learning. With the assessments missing a focus or anchor in a relevant phenomenon, scientific literacy is not occurring.

Moving forward, changing the phenomenon to technology devices students encounter daily or have been exposed to previously will help drive a rich assessment centered on a phenomenon. Currently, the phenomenon is any and all devices utilizing the student's chosen electromagnetic spectrum wave. Using technology devices students are unaware of, have never been around or are even interested did not give accessibility
nor engage all students in the curriculum. Not only was the phenomenon not appropriate, it was not adequately woven into the curriculum from start to finish. Creating a purpose statement or question to introduce each task refers students back to the phenomenon. This will drive their research from start to finish, integrate it into the purpose and product of each task, and make connections and relationships that move these assessments from 2D to 3D learning. Only then will the assessments be able to provide evidence of the scientific literacy of students.

**Impact on Classroom and Future Work**

The Task Screener is but one tool to utilize in the evaluation of curriculum. But as evidenced above, these developed assessments are far from ideal. One of the major implications of this work can be seen in the form of implementation of relevant and engaging use of high-quality phenomenon and explicit instruction and assessment of 3D learning of students, specifically explicit instruction around the CCCs across the five tasks. The results also revealed a need in choosing more relevant, engaging phenomenon based on the student population while also focusing on all three dimensions of learning and assessment. One way to accomplish integration of a phenomenon can be done by surveying students of interests and giving choice in what aligns with their interests or personal experiences. In addition, choosing a phenomenon which builds across all five tasks will maintain student engagement and complexity for the entirety of all five tasks.

Results also indicate the lack of explicit instruction around CCCs (NGSS Lead States, 2013b); emphasis was placed on both SEPs and DCIs more than CCCs. This
means rewriting tasks to include more explicit prompts from the teacher and writing from the students on the relationship between energy, matter and the phenomenon.

**Impact on Science Education**

NGSS centers on using and mastering the skill of argumentation throughout a student’s tenure of school but with various science content. Argumentation should be taught explicitly, with content used to facilitate the learning of said skill from kindergarten to high school. This can be done when NGSS developed assessments focus on PE alignment and the literacy standards within each PE. If science teachers tackle this feat only at the secondary level, students will not practice or master argumentation (Feinstein et. al, 2013). As stated by Zohar and Nemet (2002), Hogan and Magleinti (2001), and Kuhn (1991), argumentation is not a known innate skill for students and should be taught explicitly with the use of various content for practice and mastery. Similar to teaching content, explicit and intentional instruction on what makes something a well-rounded argument must be done consistently across a school and with engaging, relevant content (Jiménez-Aleixandre, 2002; Osborne et. al, 2016).

In addition, if the goal is to achieve scientific literacy through the skill of argumentation, there is a need for any developed assessment to be validated using a credible tool, specifically the NGSS Task Screener. Without a societal or personal connection to the content (i.e. a relevant anchoring phenomenon), scientific literacy reverts back to science literacy and understanding science concepts as a series of disconnected facts (Roberts & Bybee, 2014). The use of a high-quality phenomena also
grounds curriculum in 3D learning by utilizing the science concepts (DCIs) and skills (SEPs) while making connections and relationships (CCCs) to their lives. Not only are these improvements necessary for the curriculum examined here, but these principles need to become the norm for all NGSS aligned curriculum if educators hope to accurately teach and assess students using this as a guidance in that process.
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Appendix A: IRB Letter of Approval

IRB PreK-12 Exempt 1 Determination

Todd Evans <todd.evans@uni.edu>

Dear Investigator(s):

Your study, Enhancing Scientific Literacy through Attention to Argumentation as a Disciplinary Literacy Practice, has been determined by the UNI IRB to meet the criteria for Exempt status, category 1. You may begin recruitment, data collection, and/or analysis for your project.

You are required to adhere to the study procedures reported in your IRB form, and to monitor the project to ensure that the rights and privacy of the participants in your study are protected.

If you need to make any changes to the study, you must request approval of the changes before continuing with the research. Requests for modifications should be emailed to the IRB Chair Todd Evans at todd.evans@uni.edu.

Your study will not require annual review or closure.

If during the study you observe any problems or events pertaining to participation in your study that are serious and unexpected, you must pause data collection and report this to the IRB immediately (at least within 10 days) to receive guidance on next steps. Examples include unexpected injury or emotional stress, missteps in the consent documentation, or breaches of confidentiality.

Best wishes for your project success.

Todd Evans
IRB Chair
Appendix B: Developed Assessments

Task #1

1. Create a Google Doc to organize your information

2. List three reasons your EM wave is most useful, valuable and technologically helpful to society?

3. Find three pieces of evidence for each of your reasons/viewpoints
   a. What facts/statistics can I find that help PROVE that my EM Spectrum wave is useful, helpful and/or valuable to society?
   b. "According to..."
   c. "Mayo Clinic said..."

4. Copy all website URLs in shared Google Doc to cite later
Task #2

1.) Cite all sources and alphabetize from Checkpoint #1
   a.) www.easybib.com
   b.) www.citationmachine.com
   c.) Attach your citations for review!

2.) Take your three reasons (checkpoint #1) & create an opening statement or stance
   a. "Few Good Men" video

3.) Using Flipgrid, video your opening statement for feedback from a peer!

4.) List three reasons your opponents EM wave is NOT most useful, valuable and technologically helpful to society?

3. Find three pieces of evidence for each of your reasons
   a. What facts/statistics can I find that help PROVE your opponent EM Spectrum wave is NOT useful, helpful and/or valuable to society?

4. Write these down on your Google Doc
Task #3

1.) Using your reasons and evidence (checkpoint #2) against your opponent, write a rebuttal
   a. Write a paragraph that talks about the reasons and evidence that your opponent IS NOT the best wave for human society

2.) Using your rebuttal, claims evidence you researched (checkpoint #2), write two questions to ask the other group
   a. Ask them a question that will be difficult to answer and they will have to defend!
   b. "Few Good Men" scene

3.) Cite all sources and alphabetize
   a. www.easybib.com
   b. www.citationmachine.com
   c. Attach ALL sources for review & feedback!

4.) In Discussions, find your EM Wave Discussion thread then write down your opening statement and rebuttal. Give feedback to at least two other groups on ways they can improve. See this Guide Sheet for help with ways to give constructive, respectful feedback to peers.
Task #4

1.) Research three (3) negative reasons about YOUR part of the EM Spectrum viewpoint
   a. What negative reasons will the other group say about your wave and why your part of the EM Spectrum is NOT the best to human society?

2.) Write down counter-arguments for the above (this will help you answering crossfire questions)
   a. How can I make my negatives not look so bad OR how can I disprove them?

3.) Cite all sources and alphabetize from Checkpoint #1
   a.) www.easybib.com
   b.) www.citationmachine.com
   c.) Attach your citations for review!

4.) Practice reading your pieces to your advisor. Have them give feedback on what you did well and things you can improve.
   a. Your advisor will sign sheet below stating you read/practiced your pieces of debate

   Presentation Signature Form.docx
Task #5

1. Create a closing argument
   
   a. Take your opening statement & rebuttal and make a NEW paragraph to sum up why yours is the best and your opponent is not.

2. Create a NEW Google Document sheet you will use the day of your presentation to read from and take notes.

3. Organize NEW Google Doc so it is in the following order and ONLY THESE THINGS, and title **FINAL DEBATE**
   
   a. Opening
   b. Rebuttal
   c. Crossfire Questions
   d. Possible Answers to the crossfire questions your opponent will ask
   e. Closing
   f. ALL Citations in alphabetical order and cited correctly

Practice reading your pieces to your partner, Mrs. McWilliams
Appendix C: NGSS Task Screener Raw Data

NGSS Task Screener Task #1

CRITERION A:

Okay so this is for my very first prompt in my master's program. The Prompt is from Canvas where students are given directions in which they are asked to list three reasons their EM wave is most useful, valuable and technologically helpful to society. Then they are to find three pieces of evidence for each of their reasons with a prompt within it that says, “What facts or statistics can I find that help prove that my EM wave is useful, helpful and or valuable to society”

What I'm going to do now is I'm going to take this prompt through Criterion A on the NGSS Task screener so Criterion says, “tasks are driven by high-quality scenarios that are grounded and phenomena or problems.” The first thing is what was in the task, where was it and why is this evidence. So the part is asking if making sense of phenomena or addressing a problem is necessary to accomplish the task. So the first question I have to ask is whether there is a phenomenon and or problem present. I would say yes they mean students are finding and using evidence to make a claim if their EM wave is best.

Next part, “Is information from the scenario necessary to respond successfully to the task?” I'm going to go ahead and say that I'm not really sure what this is asking but I'm going to go ahead and assume that it means from my scenario to respond to the task we're going to leave that blank because I'm not really sure what that's asking so I'll have to come back and look at that later.

So the next part is the task scenario is engaging, relevant and accessible to a wide range of students. So basically I need to decide if in this first prompt they meet one of the following criteria which would be an answer of yes, somewhat or no. Scenario number one says scenario presents real-world observations. I'm going to say no; I'm not a hundred percent sure what it means by observations but I think it's asking it to do is list reasons so maybe I'm going to say something.

The next scenario says scenarios are based around at least one specific instance not a topic or general observed occurrence which is an example of observations related to a specific hurricane rather than hurricane is in general so it needs to be specific not in general. One specific in and I would say that this is a know we are talking about multiple uses so multiple things and not necessarily specific so it's not specific here.
The next scenario says, scenarios are presented as puzzling or intriguing. I would say that this is somewhat as they are to decide how one always outweighs another electromagnetic wave. I think when you look at the Spectrum itself that it would be hard to decide one over the other so I feel like that would be an intriguing topic.

The next scenario says scenarios create a need-to-know. I would say yes they need to know how it's useful, valuable, and technologically helpful to society so they need to know the reasons behind their claims, if they don't know they won't be able to justify them later in their prompts.

The last scenario says scenarios are explainable using grade appropriate SEPs, CCCs, and DCIs. So it's somewhat; we're definitely hitting the content. I would need to look into whether I'm hitting the cross-cutting concepts and SEPs on this.

Continuing on with the next one scenario, it says effectively use at least two modalities which can include images, diagrams, video simulations or textural descriptions. When looking at modalities I would definitely say yes students can find any or all the above mentioned for evidence or reasons or claims. The other part of that is if data are used scenarios present real / well-crafted. Much of this should be real as it's pertinable to society and they are part of society so I'm going to say yes on this. Well crafted? Depending on the reasoning behind what a student decides to go with I would say that it also falls under this as a yes.

The next one says the local, global or universal relevance of the scenario is made clear to students so when looking at relevance to students they can pick how it most affects their life I'm not sure if I made that specifically clear in this specific prompt when previously doing this we've talked about the importance of electromagnetic waves in their lives but I don't think it's necessarily clear in this direct prompt.

The next one says scenarios are comprehensible to a wide range of students at grade level. I'm going to say somewhat again much of the reading and what they're looking at it gives them kind of free-range kind of a broad, general chance to engage in and something that they're interested in especially at grade level you know they're going to be reading High leverage tax scientific articles deciphering good and bad data so I'm going to say somewhat I'm sure that there are different things out there that kids can find that are not at grade level or not as wide of a range for their specific electromagnetic wave but it is available to them the second to last scenario says use as many words as needed no more I would say that I try not to be wordy when I make these so I'm going to say yes as a way to get a point to get my point across.

The last one says scenarios are sufficiently rich to drive the text the task I'm going to say somewhat I'm not sure that it's sufficiently rich but it could be depending on how
it's presented but just in the writing itself without any explanation I'm going to say it's probably on the somewhat maybe even the no side just because it is pretty general overall.

So when looking at all the different indicators for Criterion a I'm going to say that there's probably an adequate amount of evidence well I did have at least three yeses I felt like the majority of the rest of it was somewhat and nose so I can't really justify it being grounded in phenomenon are problems.

**CRITERION B:**

Criterion B: Task requires sense-making using the three dimensions. First, completing the tasks require students to use reasoning to sense-make about phenomena or problems. The question asks, consider in what ways the tasks require students to use reasoning to engage in sense-making and or problem-solving. I would say much of this task requires them to give reason so they're processing through what reasons make sense to them in terms of useful, valuable and technological helpfulness. They have to make a decision on which electromagnetic wave is the best.

The next part asked to break down the three dimensions of ngss. I need to look at what evidence of scientific engineering practices and how the tasks require students to demonstrate this element in use. The actual one is to obtain, evaluate and communicate information. I would say much of what the students are doing our is finding information to obtaining it they're going to have to communicate it eventually in the way they both write it and present it verbally so I would say that the evidence would be right now of writing

The second one is cross-cutting Concepts and how the tasks require students to demonstrate this element in use. The one used is cause and effect. Not sure that it asked them to maybe do much cause and effect.

The last one is disciplinary core ideas. The disciplinary core idea for both of them that's related is electromagnetic radiation. Both talk about that in some way mostly in the sense that what is made up of and its effect on matter mostly. The other one also talks about technological pieces and instrumentation in terms of electromagnetic radiation and how that works. I would say that both things are are happening because in the prompt itself it is basically asking to look at not only how this wave is used but even specifically technologically used so it's going to talk directly about the effect of an electromagnetic wave but also its technological of fact so when they look at their reasons they should be having at least one technology-related reason behind that.

Consider in what ways the tasks require students to use multiple Dimensions together to sense me and or problem solve. Well it's definitely using content which would
be a DCI, I would also say it's definitely making use of the SEP but is definitely lacking in crosscutting Concepts. In order for them to make their claims they have to have some kind of reasons and evidence which is directly tied back to both standards and their use of obtained evaluate information so they're doing that with reasoning and evidence and then they are clearly using the SCP in the form of electromagnetic radiation for content.

The last part of this Criterion B asks, “Consider in what ways the task explicitly prompts students to make your thinking visible. Look for evidence of how the task surfaces current understanding, abilities, gaps, and problematic ideas”. This prompt is really truly asking them to do research on a topic that they probably have maybe a little background in but also gives me a surface-level understanding of where they're at, how they're going to be able to find reasons and it's also going to give me an opportunity to see what gaps they have in terms of research, how to write research, how to write evidence and claims, what that looks like, and how I need to as an instructor fill in those gaps, especially since this is the first prompt it's almost as if this is the first attempt to do this and so it gives me an opportunity to say where each of my students at and how can I take where they're at and move them forward into the final piece.

So cross all my indicators I would say there's probably at least adequate evidence of this Criterion I would say that I'm definitely on the right track one of the things I need to improve for this would definitely be trying to incorporate the cross-cutting concept element a lot more and maybe even refining my content element and really truly looking at what the SCP is asking of my students and making sure that ties back to my original standard.

So across all my indicators I would say there's probably at least adequate evidence of this Criterion. I would say that I'm definitely on the right track. One of the things I need to improve for this would definitely be trying to incorporate the cross-cutting concept element a lot more and maybe even refining my content element and really truly looking at what the SEP is asking of my students and making sure that ties back to my original standard.

CRITERION C:

Criterion C: Tasks are fair and equitable. Consider specific features of the tasks that enable students to make local, global, or universal connections to the phenomena / problem and task at hand. This Criterion emphasizes ways for students to meet to find meaning in the task; this does not mean interest. Consider whether the task is a meaningful, valuable Endeavor that has a real-world relevance that some stakeholder group locally, globally, or universally would be invested in. That's kind of intense. I'm
pretty sure this is going to go back to the idea of making a connection to a phenomenon or problem. I would say that maybe a little bit of a connection is not directly stated in this but how does it connect to them and their lives. Electromagnetic waves are found and realize every day we come and count in contact with him in multiple different ways so I would say whether it's meaningful or valuable to the real world I would say a little bit in terms that it it's trying to find a way that it's it's viable useful helpful and valuable and technologically you know relevant to them would be a way to describe it I think that's the intent of this prompt I'm not sure if that's maybe directly stated as it should be.

Describe what modes written oral video simulation direct observation, Pier discussion are expected / possible for student responses. As of right now students are able to type it out it's not again directly stated that they can't video it they are having peer discussions this is done in a group again that's not specifically stated in this prompt but it is happening they are welcome to video something so that could be but most of this is happening in the written mode.

Task includes appropriate scaffolds. This is the first draft so I would count that as a scaffold so somewhat this isn't the final thing that they're able to do. They can make corrections. The whole point of this is to make corrections. So I would count that as somewhat there are also other modified prompts that can be given to students in order to help make finding research & writing claims/evidence as well. The prompt also gives examples of how to actually write about evidence and statistics too, so that would count as a scaffold, in my mind.

Tasks are coherent from a student perspective. So one of the first things we look at before this prompt as an overall whole is that they're going to be doing this in terms of a debate so they are going to see all the different pieces. Each individual prompt comes from a different piece of the debate and that they're going to be doing it in that order just not all at once. I'm going to say yes to that.

Task respect and advantage students’ cultural and linguistic background. This is probably a no because well maybe it could be. Only reason I say that is our demographic here is very, very one sided. There are not many cultural or linguistic differences; most of the differences come in socioeconomic status and learning disabilities. In order to make this more equitable maybe it's looking at changing the wording of helpful to society to helpful to your life or to a specific culture? So I would say that this definitely does not hit that.

Task provides both low and high achieving students with an opportunity to show what they know. I think the point of this would be yes in that there can be more or less tassels or there could be an easier way for students to find a way to shine and show what they know.
Task uses accessible language. I would say that it's using grade appropriate language and if it's not accessible to them in terms of grade level then that's where maybe some scaffold would come in terms of accessible language again as stated before my demographic has very little if any cultural or linguistic barriers.

Consider how the task cultivates students' interest in and confidence with science and engineering, including opportunities for students to reflect their own ideas as a meaningful part of the task; make decisions about how to approach a task; engage and appear / self-reflection; and engage with tasks that matter to students. Call Dwayne of this and both standards in this is to look at obtaining evaluating and communicating information it gives students the opportunity to basically decide on their own which electromagnetic wave they wish to do and then in their own mind and how it relates to them and how they find it to be helpful, useful, technologically appropriate for society. I think this is based mostly on choice and so this actually gives them a choice in what they engage in and research.

Consider the ways in which provided information about students prior learning (instructional materials, storylines, assumed instructional experiences) enables or prevents students engagement with the task and educator interpretation of student responses. I would say that much of the assumed instructional experiences would be that students know how to properly research. So that's how this is kind of hard. So making sure that we scaffold that. Much of the reading is very informational text based and adorable of grade-level so that is hard for low level students to engage with the tasks because of learning barriers or informational text experiences that they don't have and so that is a true way that'll prevent students to engage with it and doesn't always give an accurate interpretation of what a student knows.

Describe evidence of scientific inaccuracies explicitly or implicitly promoted by the task. This might mean electromagnetic radiation as both bad and good. I don't know I think it's assuming that but they all can't be helpful. I'm not sure what exactly to pull from that. I'm sure there are inaccuracies in the prompts. I'm just not sure I see them so I can't speak to them.

Across all indicators I would say there's probably inaccurate amounts of evidence, maybe even no evidence that is fair and Equitable especially directly in this prompt.

**CRITERION D:**

The assessment Target is necessary to respond to the task. yes since this is the first part of the final or summative piece. This is definitely a formative piece.
Any ideas, practices or experiences not targeted by the assessment are necessary to respond to the past and consider the impact this has on students' ability to complete the task and interpretation of student responses. Students have to be able to research and make claims and evidence in this it is targeted by the assessment but it's an experience or practice that they may or may not have. The student responses elicit support the purpose of the task. This task wants them to basically make three claims and find evidence for each claim. That is directly what the prompt is saying or the task is saying and I think that that's the response I want from students.

Consider what student artifacts are produced and how these provide students the opportunity to make visible their sense making processes, thinking across all three dimensions, inability to see multiple Dimensions together. I would say that this is definitely happening because their artifact is making three claims or giving three reasons and then finding evidence that supports each of those reasons.

Consider how well the material supports teachers and students and makes sense of student responses and planning for follow-up, consistent with the purpose of and targets for the assessment. Consider guidance for interpreting student thinking using an integrated approach considering all three dimensions together as well as calling out specific supports for individual Dimensions if appropriate. Basically I'm deciding if students are researching correctly which accounts under SEP. And if they are using their electromagnetic radiation correctly as part of their DCI and this will give me an idea of where they're at in both sets of bad and how to move forward.

Consider support for interpreting a range of student responses, including those that might reflect partial scientific understanding or mask / misinterpret students to science understanding. Since this is a formative I would say that this definitely allows for student responses to be partial and to misrepresent science so that it gives an opportunity for both the student and myself to do more instruction around it since this isn't this isn't the final time we'll be able to do this.

Ways to connect student responses to prior experiences and future plan instruction by teachers and participation by students. I think I already answered that. This task is going to help plan how I instruct moving forward. Do we need to do extensive instruction on researching on writing? Do I think we need to look into more scientific content over this or is it mostly centered around the SEP?

Considering you're confusing prompts are directions and evidence for too much or too little scaffolding supports for students. I think I could probably take out a few things before and after the initial prompt. But overall I think I keep it pretty short because I want it to be short. I want the focus to be truly on claims evidence for their specific electromagnetic wave.
Across all indicators I would say there is adequate evidence for quality of this Criterion I would say one of the things I could work on is maybe in the specific prompt really truly saying what the intent of this first one is and what its purpose is related back to my original phenomena and and or final summative assessment.

OVERALL SUMMARY:

I would say overall this task needs to be modified looking back across all my criteria I would say one of the first one is really grounding it in a phenomena up in my crosscutting Concepts and making it more fair and Equitable I think I have pieces of all these but I'm not making adequate and extensive evidence of that in my prompt in order for me to justify I would say that this task definitely can be used just definitely needs to be modified.
NGSS Task Screener Task #2

CRITERION A:

Criterion A what was in the task, where was it and why is this evidence? First one is a phenomenon and or problem present? Directly looking at the prompt itself it doesn't list it once however it is not front and center they are trying to look for reasons why whoever they are debating against the wave their opposite so reasons it is not useful, valuable and technologically helpful to society. so I would say for the most part it does cover that yes.

Number two. Is information from the scenario necessary to respond successfully to the task? My understanding is that the phenomena are helpful to the task and can students be successful without the presence of the phenomena? I don't know I think the phenomena maybe a little unclear on what exactly it is I think it's just a problem that's being presented of like which one of the electromagnetic radiation ways is most useful, valuable, and technologically helpful I guess if they didn't have that question I think it'd be hard to do cuz those are kind of the driving points of what students are researching so in order to be successful yeah they almost have to have the problem that has been presented.

Next part is we're going to be looking at the phenomena task itself so the scenario in which we present the phenomena. First one, scenario presented with real-world observations. I would say somewhat I'm hoping students pull from experience. I also give them an experience in which we watch bits and pieces of the movie A Few Good Men. So I am presenting real world types of ways in which this is useful.

Scenarios are based around at least one specific instance not a topic or generally observe occurrence. I would say this is a very general instance. I guess I have a slight amount of specificity in terms of the three ways in which it's contributing to society otherwise now.

Scenarios are presented as puzzling or intriguing. I would say somewhat puzzling or intriguing. For some kids it's intriguing to look up just one that they picked in life for others and might be puzzling as to why those three broad General headings I gave them in terms of valuable, useful and technologically helpful.

Scenarios create a “need to know”. I mean the phenomena is really based on how it's impactful to society since they are part of society I would say it's something that they should know. Whether they believe that they should or shouldn't know or need to know it is something different. I think most could carry on without needing to know so I'm going to say somewhat.
Scenarios are explainable using great appropriate SEP, CCC, DCI. I would say yes to this, definitely making it grade appropriate they're definitely engaging in argumentation here they're evaluating various sources and then their goal is to communicate both verbally and in written form about the content they're learning as well.

Scenarios effectively use at least two modalities. This is a definite yes. We use videos both to watch and to use for feedback they're writing their talking so definitely yes if Dad as Dad are you scenarios present Real well-crafted data I think when using data here we are constantly trying to find real data. Or find data that is centered around topics that are reliable.

The local, Global, or Universal relevance of the scenario is made clear to students. I would say no in the prompt itself it's not necessarily super clear about any relevance to them I'm sure it's talked about in class but never directly written down on the prompt itself.

Scenarios are comprehensible to a wide range of students at grade level. There are many different ways in which this could be comprehensible there are many proms or many ways to explain this with in here so I would say somewhat again this isn't necessarily explicit in the prompt itself but I know there are supports and scaffolds that are given to students who can participate in this no matter where they are and they're learning.

Scenarios use as many words as needed no more. I would say somewhat it gets wordy but I think if I took out any more words that it would not make sense.

Scenarios are sufficiently rich to drive the task. Yeah I would say yes to this it is significantly rich. They know the task overall itself is to find reasons specific electromagnetic radiation waves are useful, valuable and technologically helpful in order to keep moving forward with that task. This prompt helps that.

Summation of all of these I would say that there is probably inadequate evidence to support this and criterion a. I still think my phenomena needs to be more direct and bolded and used to really drive what we're doing and why we're doing it. I think for the most part I hate all the other ones fairly well.

**CRITERION B:**

Consider in what ways the tasks require students to use reasoning to engage in sense-making and or problem-solving. I would say most of this comes in what they view as useful, valuable and technologically helpful. That's something that they have to make sense of and the problem solved through it's not necessarily given to them. So the task itself is asking them to really think about why that makes sense to solve the problem that they're trying to solve. So evidence of the SCP which elements and how the tasks require
students to demonstrate this element in use. When they're evaluating valid and reliable claims and published materials I mean they're looking things up online they're finding Journal articles, just any online published materials and really looking at does this accomplish what I wanted to in terms of my task. Evidence of ccc's how the tasks require students to demonstrate this element in use.

So here they should be looking at the cause and the effect of the task. I'm not sure I would give this a high score. I'm not sure there's a whole lot of evidence in terms of cause and effect here. I know a lot of this is grounded in the SCP and the content itself so I'm not sure there's much evidence here to support the use of this dimension. Evidence of the DCI which element and how the tasks require students to demonstrate this element in use. All this is content-rich we're looking directly at the electromagnetic radiation we're looking at how it's useful and valuable to society. Specifically, the standard for 4-4 has to do with it being absorbed by matter and 4-5 specifically talks about technological devices which are directly in the task itself.

Consider in what ways the tasks require students to use multiple dimensions together to sense-make and/or problem-solve. Yeah definitely it uses two of the three dimensions uses its SEPs and DCIs but it lacks CCCs. I think that needs to be a bigger emphasis so they have to be able to obtain and communicate information and they also have to do that around Natalie technology but Ultra radiation technology and the frequency of it and how all of that is relevant to society but they're not really talking about the cause and effect as much at least not directly. Considering what way the task explicitly prompts students to make their thinking visible, look for evidence of how the task surfaces current understanding abilities gaps and problematic ideas. well to make their visit thinking visible you know they have to write it down there constantly you know writing something they're having discussions only with myself but with peers The Prompt itself is asking for feedback from peers they have to do a checkpoint with me which is directly in the prompt so they are showing their thinking throughout the whole thing as they go. This gives the teacher the opportunity to see where they're at and what help they need and in what ways to support students when gaps are problems to occur.

Overall across all the indicators I would say this probably has adequate evidence for Criterion B. I still think I need to really focus on cross-cutting Concepts and incorporating those to truly make it three dimensional. Right now I'm still only two dimensional and it's a huge Focus probably on one of the dimensions more than the other specifically the SEP but overall I would say this is pretty good

CRITERION C:
So this is asking whether the task enables students to make connections to the phenomenon. Some ask students to basically define why we need electromagnetic radiation and if we could do without one. I would say overall I'm not sure this gives all students meaning in the task. I think it makes some connections. I'm just not sure it's making the right ones or I'm not making them explicit. But with that being said I think some stakeholder groups would find this valuable locally and globally just not sure what they are I know that a lot of electromagnetic radiation is used in airports for security is used in the medical field so I don't wonder if this would be something that would make that connection for them. I just am not sure that's happening right now for them.

Describe what modes are expected in possible student responses. Right now they definitely have to do any type of written one they're going to be expected to do orally. Discussions I mean they're interacting with myself and having dialogue with me so they're doing all kinds of different ones on there also doing some video so some stimulating as well.

Task includes appropriate scaffolds. I would say yes you know we're tiering this so they're not doing everything at once; we're showing them one piece at a time the second piece they're getting feedback from what they did previously and then they're moving to doing something very similar but for a different wave and the opposite lens of why a wave is not useful, valuable and technologically helpful.

Tasks are coherent from a perspective. I would say somewhat; the goal is to not overwhelm them but I would say that as an overall hold this could be seen as noncoherent and disjointed from the previous prompt.

Task respect and Advantage students cultural and linguistic backgrounds. Answer that is no. I'm in a place where there are not very many differences culturally and linguistically and so this is not considered and I consider that a downfall.

Tasks provide both low and high achieving students with an opportunity to show what they know. Yeah I would say this does it gives kids who are really great at researching and writing to just shine but it also gives kids who maybe not I'm an opportunity to show what they know in a different way.

Tasks music accessible language I would say yes musing grade appropriate language rephrasing a few things making sure that they know what to expect.

The second part asks whether the task basically gives students a say and what they want to do in terms of learning, reflecting on their ideas, making decisions and engaging in any kind of reflections. This definitely does all the above it really truly ask kids to think about you know why it's useful, valuable and technologically helpful to society but in their perspective they're constantly getting peer feedback when they're working with their group feedback from myself they're approaching it how they view it so they have a
huge thing and all this most kids get to choose their electromagnetic wave so hopefully they have some kind of interest in what they're doing. The second part asks them about ways that the information that I give about their engagement, decisions and/or their prior knowledge or how I interpret the responses. I would say much of this is opinion so you know they have the option to agree or disagree with something. I would say that I don't necessarily base it whether their opinion is right or wrong since it's an opinion it's really based on facts they present. One of the things that I do assume here is students have done research before and they know how to do research and can effectively do it. This tends to prevent student engagement with the tasks they can get down a rabbit hole of research or research from sources that are not valid/reliable.

So this talks about scientific inaccuracies explicitly or implicitly by the task. I would say that this basically implies that all electromagnetic radiation waves are useful, valuable and technologically helpful to society. I would say you're promoting that every single one has to be all three of those things but that's not necessarily true that could be misleading but since it is part of the electromagnetic spectrum it's nice to look into those types of things.

Overall across all the indicators I would say that there's probably adequate evidence for this Criterion see I see one of the things I definitely need to work on his making it a little more coherent in my writing and a culturally and linguistically I'm relevant to students especially making it of interest to them and focusing on the idea of student learning and prior knowledge.

**CRITERION D:**

Criterion D is asking what is being assessed. Right now we're assessing check my timer 1 which I think doesn't have any true targets per se and we're looking at the two dimensions on a silly all three and this prompt definitely looks at both standards or performance expectations. The purpose of this assessment is definitely formative it's also I would say not just formative it's also determining whether students can apply what they have learned with similar similar but new contacts since prompto is very similar to what they just did but it's not the same applying if it's kind of in the opposite direction.

Assessment Target is necessary to respond to the task so essentially is this assessing the task itself yes. I would say you know the end result is that they're going to debate and so they have to be able to not only create an opening statement but they also have to find reasons against their opponent. Part 2: Are there any thoughts not targeted by the assessment? I think this goes back to the earlier Criterion on is this too wordy or is it fair to what you're asking of students? I don't think there's anything that I'm asking of students that are already there. Part 3: Do student responses support the purpose of the
task. Yeah I want to have a complete opening statement, I want students to have reasons against their opponent and that's kind of what I am assessing here. I'm looking at if students have that down, whether it is in the first draft or the final draft. They need to have some kind of information for me to determine where they're at with their learning and their argument. Now looking at student artifacts and what students are going to provide me, they are turning in basically they're working document of what they're writing down, whether it's Snippets of final pieces, whether it's all the information in a final draft. They are also thinking in terms of you obtaining and communicating information in the argumentative form as well as speaking on part of the electromagnetic spectrum and doing that together both in a written form, orally, peer feedback, self-reflections, and/or all of the above. So I would say they are giving multiple opportunities to do this and during this task it doesn't have to be the final one but it does give me a snapshot of what students know at that moment and what kind of support I can give them looking forward to.

So looking at you know any type of supporting materials I would say as the teacher I'm looking at this as the final product in terms of the feedback given trying to have them do this with all dimensions in mind but most of the time feedback is coming from the SEP dimension. When looking at the science behind it the actual content really tries to support students' understanding of responses and how to help scaffold their understanding, and then how do I connect student responses to Prior experiences in each of the prompts we watch a snippet of A Few Good Men the video and how I can take that experience and you know connected to what I'm asking of students both planned and unplanned.

This is scripted enough that hopefully content is not lost and all that the big focus is on the sap and soul really trying to focus on the DCI and making sure students understand that part without losing the other dimension but also making sure to also include the third dimension. Overall across this I would say this Criterion how's an adequate evidence I'm not sure my intended targets and purpose is written there this is definitely a formative piece of formative prompt leading up to a summative piece is giving kids the opportunity to do the same thing again but in a different contacts giving kids more supports but I think sometimes some of that gets lost and so that's where this may or may not need to be revised in terms of what I'm asking why I'm asking it and how it relates to the summit of part and the phenomena.

OVERALL SUMMARY:

Overall this prompt I would say I would probably modify and use this prompt. I think this prompt captures a lot of what I'm wanting to do but still think that I need to
improve explicit communication on what's being assessed in terms of targets and purpose. I think the other part that needs is really focusing on making it three-dimensional since right now it's just two-dimensional and then really grounding it in a phenomenon or problem would be better. If modified those things, it I think this overall it is a good task.
NGSS Task Screener Task #3

**CRITERION A:**

Criterion at is a phenomena and or problems present. This is not explicitly stated so I would say mostly a no for this one. Is information from the scenario necessary to respond successfully to the task? I would say this is probably also no. Students could answer all of this without having to know what the phenomena is although it is slightly mentioned as a secondary scaffold for understanding and the prompt but not necessarily needed in order for them to respond.

Scenario presents real world observations. Again I show a scene from the movie A Few Good Men. This would be one way to see observations of how this is important to that.

Scenarios are based around at least one specific instrument not a topic or general observed occurrence. I still have to say that this is pretty General and I was talking about the best way, especially here I use the word best wave. scenarios are presented as puzzling / intriguing. This scenario itself would be slightly intriguing as it's very much open-ended could be puzzling from us to as a point of fact word start so I would say no but in the sense of what it's asking like puzzling intriguing for them to find the answer or as I see this is puzzling for students to try and find a way to answer the question.

Scenarios create a need to know. I don't think that this is something that they need to know. I don't think it creates that for them, especially here.

Scenarios are explainable using grade appropriate SEPs, CCCs, DCIs. This prompt is asking students to communicate again their understanding and they're thinking which is part of the SEP that the standard is talking about. They talk about relevant content which is the DCI but I think it still fails to make that connection of cause and effect of the CCC for this task.

Scenarios effectively use at least two modalities. This one again had them doing writing they were going to be asking questions from their peers and they're also watching a video but they're on a survey making a video they're doing a simulation of the actual debate and that they're going to be giving feedback on what they've done up until this point from peers so that's a simulated summative assessment.

If data is used in areas present Real / well-crafted data. I don't necessarily use any data but they are still trying to find data in their research that they're doing.

The local Global or Universal relevance of the scenario is made clear to students. I still don't think the relevance of this scenario is clear. I think that's maybe where the Few Good Men comes in as making it somewhat relevant but I'm not sure that that's made specifically clear here in this prompt.
Scenarios are comprehensible to a wide range of students at grade level. not sure if this is explicit in this but there are still ways in which the product can be scaffold to help students at any grade level or any point in their learning (above or below grade-level). I would take this as a “somewhat” here.

Scenarios use as many words as needed, no more. I would say yes I try not to make things wordy but it can look this way when you look at it. If I was to take any words out it may not be clear to my expectations.

Scenarios are significantly Rich to drive the task. I think the phenomenon itself could be rich. I'm just not making That explicit here, I also think that the problem that's presented maybe with the video of a Few Good Men could be counted at this but I don't think that I do a great job of that in this prompt.

Across all indicators I think that there is inadequate almost no evidence here I'm going to go with inadequate definitely needs a lot of work in terms of being explicit in terms of the phenomena I don't think that it's creating engaging and relevant pass for students to do here unlike the other promise that I've been giving. This Criterion needs quite a bit of work and one of the things I really want to focus on for this one is bringing back the phenomenon a problem when you're solving, making that the center point I feel like that's getting lost as we're getting closer to the end of the formative and towards the summative assessment piece. I think it's not quite as engaging and relevant as it should be especially this far into the prompts/assessment.

**CRITERION B:**

Criterion B is looking at using the three dimensions to make sense for students. I would say this task definitely requires students to use reasoning and sense making here. They really take an abstract look at what question they should ask the other group. They need to put themselves in the mindset of what questions I want to ask that Wade imply that my ideals of this wave are true and that it's not good for society. The problem is to defend their electromagnetic radiation wave and not let the other group show that there's is better and these questions are really going to make students think not only when they have to answer them but the types of questions I should be asking that other group.

Evidence of the SCP here would be that students are still obtaining information they're communicating that information out again and writing and verbally. Evidence of the CCC is definitely non-existent. I'm not sure if there's a cause and effect here and if there is it is very hidden and not explicit. Evidence of the DCI this is really having them look into both their own electromagnetic radiation way that they packed but also their other groups digging into the idea of how it affects matter specifically society and people as well as those technological devices and a lot of their focus will be on the technology piece.
Besides, it also requires kids to not only use the three dimensions separately but also makes them bring it together. So they're obtaining information about it from the internet and they're making sense of it in terms of the content that they're reading but then they're also having to communicate that out in a way that would show their understanding in their learning but also that they are using it in the argumentative form in which the summative assessment is set up for the debate. And this prompt especially their problem solving through what their opponent has bad qualities for an electromagnetic wave so just kind of thinking through what would be a negative for them as well which I think is a true problem. They're trying to solve a certain problem by going through this task.

This prompt has also made students’ thinking very visible. They are writing down their actual rebuttals instead of just phrases and information they're making it into a true paragraph to actually communicate out. They are engaging in peer feedback on a discussion board. This is also giving them the ability to show what they know right now. It's going to also give me a really great idea of where they're at in their understanding of any gaps or problem ideas and I need to address this especially late into the prompts.

I think for Criterion B, this definitely has adequate evidence to show this Criterion has been met. I still need to work on the cross-cutting concepts and incorporate that in there but I think that this really truly engages students into thinking in three dimensions and not just one or two however I need to get better at including all three and not just two.

**CRITERION C:**

Criterion C. Cats are fair and equitable. We're looking at this first task. It's talking about giving the students the opportunity to make connections to the phenomenon locally, globally and universally. I have to find meaning in the task, not necessarily that they're interested in it but they find that it's meaningful and valuable to real real-world relevance. I think having the Few Good Men video in their brains a little bit to it I don't think that it's necessarily completely meaningful you're really getting into the core of argumentation in terms of rebuttals and claims and evidence but I'm not sure that there's any connection being made to the phenomenon.

What modes are expected for student responses in this prompt specifically is mostly writing they do with a little bit of peer discussion but it's mostly writing. Some peer feedback happens on a discussion board and they have the opportunity to do that but definitely not as many as in previous prompts.

Here when it talks about the tasks including appropriate scaffolds again there's nothing that's explicit there and turns of scaffolds I was somewhat you know I I definitely don't give them as many scaffolds here as I did previously.
Tasks are coherent from a student perspective. I would assume that they should see the relevance and taking the step-by-step I again can understand that this gets wordy and difficult sometimes.

The task respects and takes advantage of students' cultural and linguistic backgrounds as previously mentioned this does not happen as the area that I'm in is very non diverse so this is never considered so this is definitely not in there.

Tasks provide both low and hygiene students with an opportunity to show what they know. Here directly I would say that this would be a chance for them to shine in terms of creating questions that are difficult to ask of their peers. It also gives them an opportunity to really think about what will be asked of them and if they have the knowledge to answer those questions.

Tasks use accessible language. My students don't have any language barriers so I assume that that's where the accessible languages come into play. I'm not sure that there's a word on here that I shouldn't use in terms of grade level appropriateness. So I'm going to say yes to the accessible language.

The task cultivates students' interest in and confidence with science and engineering. Students definitely get to make decisions about how they wish to ask the questions you know in what way they want to write their rebuttal they get to engage and as much. Reflection as possible yeah they get to engage with me as much as possible in terms of how to set and structure this for themselves so I think that it really takes their perspective and their interest in this task both from the science perspective of how much they want to learn in the engineering perspective of how they're going to solve the problem that has been presented. The task focuses on performances for student learning experiences. I would say many of the students still struggle with writing while making claims, evidence and reasoning come together. I think their prior knowledge is very limited which is why A Few Good Men the movie has been used as an experience to give students so they understand where this is coming from. This also gives in the idea of what's expected of their responsiveness and how I want them to be structuring their responses.

The task implicitly promotes that again each wave has to have a negative for it and isn't good for society so I think it's making it seem as if you know there's a one-size-fits-all and you know there has to only be good in the world and not bad.

Across all indicators I would say that there is probably adequate evidence for the quality of this Criterion I still think in order to make this extensive evidence I really need to focus on you know cultivating that student interest and really focusing on you no relevance to two students and giving them the opportunity to work where they're at and
they're learning especially students from different cultures and backgrounds. Overall I would say that this accomplishes Criterion C fairly well.

**CRITERION D:**

Criterion D talks about supported intended targets and purpose for the task. I would say the task you know talks a little bit about what it wants to accomplish. You know it always hits the idea of the SC\EP and the DCI but definitely not all three dimensions (no CCC0. It’s a formative assessment where we're trying to determine whether students learned what they experienced, especially if students have never been to a courtroom or been in court or seen a court movie/show and how to apply that to a debate. You want students to try to use evidence against another claim to determine if they can generalize their learning into a different context.. In terms of writing a rebuttal it's very similar to writing claims, evidence and reasoning just from the negative perspective instead of the positive. I'm so this really just quite a few things.

The assessment target is necessary to respond to the task because in order for them to complete the actual summative assessment of this this is just one piece that needs to be completed. Swit ass is necessary for any Target current and future being assessed. Any practices ideas or experiences not targeted by the assessments respond to the task I would say that the only thing here would be the peer feedback it's not necessarily going to be required but it's something that students it's not targeted by the assessment it's not you know necessary but it is helpful to help with students responses and summative piece of it. Those who wish to not engage in that are up to them; they are getting other feedback for myself and peers and other teachers on the way. I would say that that might be something to look into for the future of making that required but also making sure that it's intended to support the purpose of this task. As your responses I want in this part is they should have most of the some of the pieces completed which would include an opening statement of their claims and evidence for their own electromagnetic wave they need to have a rebuttal against their opponent and they need to have at least two questions to ask the opponent in order for them to justify why there's is good. This will give me an idea of where students are at how much support they need moving forward both in the actual summative piece that will be assessed and little details throughout the task itself.

The task still elicits observable evidence for them to show that they are not only making sense of the problem but they're also putting together the multiple Dimensions they need to be obtaining evaluating and using information to communicate their understanding of the content over electromagnetic radiation and inform the having pure discussions over this so I think that's all ways in which that they can do that.
Now we're going to consider materials to support both teachers and students when planning for the purpose and targets of the assessment. The first one is guidance for interpreting students thinking he's an integrated approach considering all three dimensions together as well as calling out specific supports for individual dimensions. I think and I still don't have all three dimensions here. You know students thinking since this isn't truly a final draft it's going to show me what soon as you're thinking at this point in a grade in terms of the pieces and which is broken up. I think it does that really well.

The second one is support for interpreting a range of student responses. This definitely shows that it's going to be partial, it's not going to be fully done and that's fine. That is the point of this variety of communication approaches. You know they're communicating via oral and written approaches and so that is going to show them what they know.

The third one is ways to connect student responses to Prior experiences and future plan instruction by myself. I guess the prior experience / is in the movie but they're going to watch A Few Good Men scene from the movie A Few Good Men. Some students might not have prior experiences so that won't be possible. I'm not sure that they're getting ways to connect right now.

The last part is asking if there is a sufficient amount of supports or scaffolds or too many. I would say overall that this probably gives them I would say a sufficient amount. I would say that it gives them examples and things to think about when they're doing this but doesn't necessarily Point them in a direction. give them the opportunity to script their own responses and not follow something that I've previously done for them. Overall across all these indicators I would say the Navy has adequate evidence for quality Cabinets and do some of the evening here to really truly think about what this Criterion is walking I don't think that my targets or purposes are clearly stated here so that would need to be something I am a be making the supporting materials in the screening guidelines again more clear and and explicit I think they were there for students to see but it's not directly for them to see right now. I can maybe restructure this so that the scaffold and support doesn't look messy so that could also be something to do. Most of the pieces are here though so that's why I would give this adequate evidence.

OVERALL SUMMARY:

Overall summary of everything I would say modify and use this task, definitely need to look into adjusting my phenomena and my problem and grounding task in that. I'll need to work on making explicit and clear targets and purposes in these prompts/formative assessments along with the overall summative. definitely still not three-dimensional that needs to be fixed and a few other categories she'll probably need
tweaking but I think those are over all the biggest pieces that I find in this task that needs fixed is that there really isn't anything grounded in a phenomena it's not three-dimensional and my targets and purposes are not explicitly mentioned we're on the Forefront of this actual task and that should be.
NGSS Task Screener Task #4

CRITERION A:

Is a phenomenon and or problem present? I would say yes it doesn't say it directly but it talks about how the Viewpoint of which wave specifically the one that student chose is relevant to society. Is information from the scenario necessary to respond successfully to the task? Would say yes because if you didn't have the phenomena of your viewpoint not sure you'd be able to figure out what's negative about yours. I'm sure it could be a little more explicit. I think it is a yes.

Scenario presents real-world observations. Probably not. I don't think it really presents any type of real-world observation per se. Scenarios are based around at least one specific instance of a topic or generally observed occurrence. Be more specific in the fact that it's one specific electromagnetic spectrum wave or radiation. Although we're taking it as this particular wave as a general whole, I would say somewhat here.

Scenarios are presented as puzzling / intriguing. I'm going to say yes to this is puzzling as they have to try and think about the way that they think is the best but then taking it in the opposite light as in why is your way Baxley not the best so really getting them to think on both sides of the argument piece I only why they agree with it but why someone else would disagree with it. Scenarios create a need to know. I mean it's important in the overall scheme of the argument of the need to know why there's an 100% the perfect solution there are some what are some drawbacks to their wave especially when you get back into the argument piece of this is that it's important to look at it that way but I would say that the scenario doesn't Creed a true need to know.

Scenarios are explainable using grade appropriate SEPs, CCCs and DCIs. Well they're definitely using their SEP for argumentation or communicating, obtaining and evaluating information. Students look at published materials to evaluate the effect of radiation, specifically electromagnetic waves on different matter. Most students will look at the way waves transfer energy which is specifically more than transmitting information. They're definitely looking at the effect of their wave. I would say that this still has to be somewhat because I don't think that this is totally three-dimensional which is kind of what this is asking.

Scenarios effectively use at least two modalities. I'm going to say yes. They do have to do the writing and Reading part from text but then they're also presenting it in some way whether this is a simulation of their presentation on it could be a video that they submit. They don't necessarily use diagrams or images of any kind. It depends on what resources they find in published materials on the web. If data is used, scenarios could not real well-crafted data. The purpose is to find data and to create well crafted
data-driven arguments but I wouldn't say this present data directly to the students. the local Global or Universal relevance of the scenario is made clear to the students. Don't say no I don't think it's made relevant or clear to the students about this. I think that's something that could be changed. Scenarios are comprehensible to a wide range of students at grade level. I think this is probably something I think I make it very clear about what the expectations are. It is still at grade level you know but there are hopeful scaffolds within this they can help all students be successful.

Scenarios use as many words as needed, no more. I think if I pare down anything more it's not going to make sense. So I'm going to have to say yes. If I pared it down any more, the scaffolding part would go away in terms of comprehensibility to students. Scenarios are sufficiently rich to drive the task. Not sure it's sufficiently rich but it does drive the overall task of the debate to get them ready. But then again they are also practicing their SCEP skills with their DCsI so maybe it is that they said it is sufficiently rich they're going to get feedback. I'm going to change my answer and say that it probably is sufficiently rich just because of what it's asking students to do in this prompt

Overall I think there is and I'll probably have adequate evidence of quality for this Criterion. I still think my phenomenon needs to be better grounded and I think I'm not using my phenomena to help drive everything else in this task. answer the questions to be intriguing. I think that would be the biggest thing to change, especially the relevance to students. I can change the way a phenomenon is presented. I think that would make this Criterion even stronger in going rom adequate to extensive evidence

CRITERION B:

Considering what ways the task requires students use reasoning to engage in sense-making and our problem solving. This has really made them think about their Viewpoint and up until this point I thought about how their specific electromagnetic radiation wave is the best and now it requires them to think the opposite. I have to think about how it's not good. I think that's really challenging for kids once I have a mindset of wow why there's good they don't ever look at the opposing side. Then I have to figure out ways to counteract that or kind of argue back for why there's good using evidence or counter-arguments. I think this is a really powerful thing for kids. I think it requires them to think outside the box and problem-solve around things I've never done before.

Evidence of SEPs. Again they're continually obtaining and evaluating published materials and information to try and figure out what's the best way to prepare arguments and evidence. Evidence of CCCs. I think there's a little bit unofficially in the content of how radiation affects humans specifically but it's also not really looking at cause and effect. Or at least that is not being explicitly said out loud. I think it's there indirectly as a
result of what students are doing but I don't think it's explicitly taught, talked about or addressed. Evidence of DCI. This is all about content, it's all about electromagnetic radiation and is all about the radiation on matter specifically humans. It's also looking at technology, specifically around the transmission in capture of that wave energy.

Consider in what ways the tasks require students to use multiple Dimensions together to sense make and/or problem solve. they're definitely doing their recipes and their DCI together. Again, indirectly there using the CCC to address that content or the DCI in order to actually communicate out this information that they have they have to talk about their content. So I think they're definitely using at least two of the three dimensions together. I just don't think they're doing all three of them justice.

Consider in what ways that the task explicitly prompts students to make their thinking visible. Look for evidence of how the task surfaces current understanding, abilities, gaps, and problematic ideas. This task specifically asked them to not only write down their information in a way that they have to communicate what they know but also that they have to communicate it verbally eventually. This is where they're going to start practicing the actual communicating out the information that they found. It wont exclusively be written. I would again say that this is really addressing their ability to public speak. This is going to show any gaps that they may have about counter-arguments compared to the actual making of arguments of their own. This will help really figure out what still needs to be refined if it's the actual writing of arguments and evidence or counter-arguments or presenting information (public speaking).

Across all indicators, there is I would say inadequate evidence of the quality of this Criterion. I still don't think this is truly three-dimensional. I think that we are still lacking the direct and explicit teaching of the cross-cutting concepts. I think this one still addresses it a little bit. I just don't think it's explicit which makes me think that it's actually inadequate. So if there's a way to help address that not only in this prompt with the other promise I think that's going to make it better especially for the specific Criterion

**CRITERION C:**

So for this piece of evidence we're looking at if it is that task enables students to make local, Global, or Universal connections to the phenomena or problem. So basically do they find meaning in it, is it relevant to them in terms of the real world. I don't think it's explicitly taught but I think that it candy you know we're talking about arguments and counter-arguments which is especially relevant in today's world. Is it actually of engaging interest to them that's the question. They can make connections locally, globally or universally. Just not sure but they're making those connections and I'm not making them in the prompts itself so I'm going to have to say this is probably no it's just not really
doing what I want. I think there's an underlying or indirect tone that addresses it but again I don't think if it's explicitly stated, it does not exist.

For student responses, there has to be a written mode and an oral mode. There's also a simulation in which they're going to practice this in front of an adult. These are all expected because we want them to practice not only for somebody else to look at their writing but also to listen to them speak sense painting and communicating information comes in multiple modes. There is also direct observation from both myself as the teacher and another student/adult as well.

The task includes appropriate scaffolding. This whole task itself is lending to scaffold. So I would say that this definitely does. I don't think this has as many scaffolds as previous prompts but it does give them a chance to practice what they have so far. It also helps give them feedback on an appropriate scaffold from somebody outside of the content area or classroom.

Tasks are coherent from a student perspective. Hopefully this is true. I don't know if I'm going to stay somewhat. I think they should see that this is getting towards the end of the overall product, not sure that they know that but hopefully that's what they see based on conversations.

The task respects and Advantage students’ cultural and linguistic backgrounds. No I don't think this really truly addresses anything like that it hasn't I think that's been the biggest downfall of this.

Task provides both low and high achieving students with an opportunity to show what they know. Since this really still isn't the total summative, this is still a pretty formative assessment. I think it gives kids the opportunity to show what they've done to this point and get help or assistance in order to move forward. This can be in the form of the teacher giving feedback, another adult giving feedback for all the different modes that are required here.

Task uses accessible language. I think the only thing here that I would say needs to be addressed in terms of accessibility is what the word Crossfire means and counter-arguments. Those are language barriers for not only e l l students but also some low cheating students who might not understand what that is implying or meaning for them to do.

This wants me to consider how the task cultivates student interns and confidence with science and engineering to also include opportunities for them to reflect on their ideas. I would say that this definitely gets them to engage with science and engineering as well as reflecting on what they've done. They have to think about science and engineering from the argumentation standpoint but also make decisions about the tasks based on what counter arguments they should focus on. Students need to think about what their
opponent would focus on and then also think about how they are going to address those counter-arguments to not make them sound as negative as they may appear or will appear. It really gives them a chance to engage in peer or self-reflection as they're going to get feedback from myself, other peers, but also now an adult. This will help get them to think about the task and where they stand.

So the provided information will tell us about student prior learning not only about what they know about counter-arguments or words/language such as “crossfire:. This might prevent them from understanding what the actual task is asking them to do and what they should do to complete it. This might hinder this actual prompt and get students to complete the way it should be completed for feedback but I think it also gives an opportunity to show where reteaching needs to happen and what to address for specific students. This also assumes students have either seen a movie or a video around a debate or a courtroom or have been a part of a trial and then having them really think about how to relate back to the task itself.

The scientific inaccuracies by the prompt. I think this is saying that there's always going to be an answer or a counter argument to any argument that is presented. Sometimes that's not the case, sometimes there needs to be a way to address the counterargument in saying that we acknowledge these counter-arguments but we are not going to focus on them because they're not a big hindrance to the overall success of the original argument. I think this gives students the false idea that everything always has an answer and that is not necessarily the case. I think that's where this will need to be discussed with them.

Across all indicators, there is adequate evidence of the quality of this Criterion. I think this Criterion really shows whether it's Equitable I think the one thing that this doesn't do a great job of like some of the other promise is addressing cultural and linguistic experiences and backgrounds so I think that would be something that needs to happen I think overall it really gives students the opportunity to the Equitable and fair based on what's being asked of them and in what ways they can show their learning.

**CRITERION D:**

Describe what is being assessed. Include any targets provided, such as dimensions, elements, PEs. In this prompt where they are making counter-arguments so we're looking at whether students can create counter arguments against their own viewpoint and then we're also looking to have them practice their communication or presentation.

What is the purpose of the assessment? I would say it's still pretty formative; they're getting lots of feedback from peers, adults, and myself. I would also say this
The prompt is looking at determining whether students can apply what they have learned to a similar but new context. In this they're doing counter-arguments not just arguments and evidence but they're looking at the opposite side of their own perspective and so that's kind of a new context but it's similar because you're still talking about creating an argument and using evidence.

The assessment Target is necessary to respond to the task. I would say yes without any of this task students cannot complete the final assessment Target which is creating a presentation in a debate form. They need this as part of their final assessment piece (summative).

Any ideas, practices, or experiences not targeted by the assessment are necessary to respond to the task. Again I think this is where the research comes in. Students are assumed at this level that they know how to research how to find it. They are also assumed to have had lots of practice with writing arguments and using evidence and that's also not the case and so that'll also be a piece that is assumed here. Same thing with counter-argument: the students have to be able to write those and understand those in order to make this effective and I think that's also an assumed piece here as well.

The student responses elicited support the purpose of the task. I would say yes here we want students to be able to take what they've been doing in terms of writing arguments and using evidence and doing the same thing but with counter arguments and evidence. They also will be looking at the communication piece of this and making sure that they are ready to present this and communicate this out both in what they're writing and what they're saying.

What artifacts are students producing? In this specific prompt or task they are producing counter-arguments for which they have to be able to answer when they're presenting. In terms of sense making students will need to try and find counter argument they think will be asked of them just because I find those counter-arguments doesn't mean that that's what the opposing groups will be asking them so they have to kind of really think about their Viewpoint and all the all the counter Arguments for it. Are they using all the multiple Dimensions together? I would say they're using at least two of the three again. I still don't think that we're really truly digging into the cause and effect of this but we are looking at the obtained communicated information as well as the content around electromagnetic waves and its effect on how it is transmitted and communicated out.

So here we're going to take a look at supporting materials which can include answer keys, rubric scoring guidelines, Etc. You are looking at if this is an integrated approach with all three dimensions. Again I would say that this is definitely not three-dimensional; it's probably more two-dimensional with a huge emphasis on the SEP and the content. Most of the support given here would be around both of those maybe
less on the content and more on the skill. Especially bit obtaining and evaluating information pieces of the skill. I think the content helps develop that but it is not always on the forefront of supporting materials and I would say cause and effect which would be the CCC isn't really discussed at all.

This next one talks about support for different ranges of student responses. I think at this point in time the biggest support would be feedback from the adult they are practicing to see what kind of things are missing. Hopefully at this point most of the science understanding or the scientific interpretation of the skill is better.

What's the last question is asking about ways to connect student responses to Prior experiences or future planned instruction by teachers. I think this is where it's good to bring in the video we've been showing throughout the different problems you could walk to news media, there's always some kind of unofficial debate going back and forth with using arguments counter arguments and evidence about why one side is wrong and they are right I can also try and see if they've ever wanted to convince whether it's a parent or another adult or a supervisor of something and ways that they could take this skill and practice and apply it to that. so I think there's a lot of different angles you could take here for students to make it responsive to them and relevant.

The last one is looking at any confusing Prosser directions in the task. Or even over scripting or scaffolding students too much. This could be a possibility. I think that I wouldn't prompt or give more directions here for the majority of my students. I think that anything less might not give them enough direction to move on their own. definitely heavy in the skill or SEP area and sometimes I think maybe that overshadows the content of the DCI.

Across all indicators I would say there is adequate evidence of quality of this Criterion I think one of the things I could still improve on is still giving a general kind of large Target and purpose for each of these individual promise I think the pieces within the prompter good and the task but I think maybe tying it back to the overall summative were big picture purpose and Target would be good. I still think that a lot of the evidence is pointing to plenty of scaffold for the majority of students there are other scaffolds that could be built in that are maybe not seen here for other students but could be available to everybody and I think that it is Broad enough to be able to connect to students to make relevant for them

OVERALL SUMMARY:

My final recommendation for this specific task or prompt would be to modify and use this task in terms of Criterion I think I need to work on three dimensional and trying to incorporate the CCC as much as possible since it's really not in there and it's very skill
focus with content I also think targets and purpose needs to be revamped there needs to
be more emphasis on the purpose of the specific prompt why we're doing it and tie it back
to the big picture Target in Purpose with mostly the summative assessment piece of this I
think it would be why is too many queens have it up and look at taking out some things
and then just tweaking a few other things.
NGSS Task Screener Task #5

CRITERION A

Is a phenomenon in our problem present? So based on what I'm seeing here is what is clearly written down. That's not our problem; it says that they have to create a final draft of this but it doesn't actually say what the problem is. Is information from the scenario necessary to respond successfully to the task? I would say yes because without putting it all together I mean you don't really have anything. They also create a closing argument here so part of the final inside the final piece of the puzzle.

Scenarios present real-world observations here no it's a kind of just putting it all together so there's no real observation piece to this.

Scenarios are based around at least one specific instant on a topic or generally observed occurrence. I mean this is General this is an overview overall putting everything together so I'm going to say no.

Scenarios are presented as puzzling intriguing now this is basically a wrap-up bringing everything together so that would not make this puzzling or intriguing.

Scenarios created need to know. I would say no it doesn't really...well it might. The need to disconnect the disciplinary core ideas with the students' knowledge means tying everything together so I would say yes but it's also not. I mean it is solving the problem right here. This is where they culminate and bring everything together. I am going with somewhat.

Scenarios are explainable using grade appropriate SEP, CCC, DCI.i I would say yeah since its culminating everything together it's talking about waves radiation matter and its effect on matter how information is transmitted through technology and all those different pieces were obtaining valuation and communicating information. This whole time they're still doing this in this last piece and maybe a little bit doing some cause and effect here not a lot but I would say this definitely is a yes.

Scenarios effectively use at least two modalities. And this specific scenario I would say no we're not using more but one modality let's text although it does ask them to practice reading which is a simulation of what they're supposed to be giving. If they are using her as for that real world craft of data I'm going to say no to this.

The local, Global, or Universal relevance of the scenarios made clear to the students. I'm going to say somewhat. I mean trying to tie this back again to the courtroom, basic argumentation principles you know where they see this in their everyday lives so I would say someone but it's not directly stated here.

Scenarios are comprehensible to a wide range of students at grade level. here I would say yes I mean it's pretty straightforward to ask to do it in terms of making a final
argument and then organizing their information. Scenarios use as many words as needed no more are they definitely yes here this is short sweet very to the point not super wordy taking anything out would mean that it is just not understandable.

Scenarios are sufficiently rich to drive the task. It's somewhat. I can't say that this is super rich and drives the overall task but it's definitely pertinent to what students need to be doing creating a closing argument and organizing their information as well as practicing communicating that information out.

Across all indicators, there is inadequate evidence of this Criterion. Unfortunately here I didn't face it again back around the phenomenon a problem they're trying to solve I didn't really refer back to that I just kind of wrapped it up and looking back I think it needs to be wrapped back around almost you know like you're reintroducing the phenomenon a problem to make sure that they know that they are ready for that I think there were a few pieces where there was a good thing but I think for the most part in order to make this Criterion all the evidence I needed to do more so I would think I need to add again more bases around the phenomena focus on culminating this making this still Rich tasks.

**CRITERION B:**

Considering what ways the tasks require students to use reasoning to engage in sense-making in our problem solving. So one of the pieces they have to do is I have to create a closing argument which is basically taking they're opening statement in the rebuttal and there no ever eat basically it's a culminating factor of everything they've learned and collected across all prompts and making it into a final paragraph that's a little different that basically still stayed there stands on their electromagnetic wave radiation. Apps outside of that it's mostly organizational pieces and making sure that they have everything in the correct order ready to go and or they're practicing the communication piece in which they have to do at the end.

Evidence of SEP. Meaning this task is still asking them to communicate information. The closing argument is basically taking all the information they have in organizing it into a culminating kind of this is the last thing you get to stay. And then they have to figure out an organizational way to write down all the things that have collected in order to prevent then they practice the communication piece so this is really one piece of the ICP but they're so organizing and you know taking the information that have and making it in a way that they can communicate about.

Evidence of CCC. I would say here there is a very little cousin of fact I mean I am hoping that they can talk about that in a closing argument it is not directly stated I don't think they're necessarily using that in this prompt at all or this task.
Evidence of DCI. Again they're still talking directly about the content in terms of radiations effect on matter technology pieces and how it transmitted captures information and sends it out there the point of this whole debate after pick a stance and go forward with it so I think that they're definitely using those type of things in this especially in their closing argument.

Considering what ways the task requires students to use multiple Dimensions together to make sense and/or problem solve. I would definitely say that we're not three-dimensional here, it's still only using the SEP, that DCI. But this is definitely where in your closing argument you have to take all the information you obtained throughout all these different prompts and you have to organize it in a way to communicate it out based on what you're learning and what you have on that content so I think this is a really great place to do that happening but I still don't think that we're making a focus of the CCC so really this isn't three-dimensional at really just two-dimensional.

Considering what ways the task explicitly prompts students to make their thinking visible. This is kind of weird because you make all the learning across all the different tests visible. This is kind of your summative assessment. It's your final way to show and organize all that you have learned. This is going to definitely show their current understanding of their abilities. It's going to bring out any gaps and problem ideas again. This will be where the instructor or teacher will know what gaps truly are missing from the student even after multiple prompts and multiple interventions with students. This is basically the end-all-be-all to make their thinking visible; this is what they are thinking now around this topic (DCI) and this skill (SEP)

Across all indicators, there is adequate evidence of the quality of this Criterion. I still think this crazy Syrian is very limited and not it's not three-dimensional we are not addressing CCC like we are addressing the other two Dimensions hardcore. Especially in this prompt this prompt is all about working both the SEP and the DCI together as much as possible. I think the biggest thing I would change is again addressing cause and effect here I'm at work. I would also say that you know I'll try. I think this prompt as a really great job of Leaning heavily on working towards two to three dimensions of learning

CRITERION C:
Consider specific features of the task that enable students to make global, local, or Universal connections to the phenomena / problem and task at hand. So basically is this writing a connection for students locally,globally and/or Universally. I don't think they're special features of the tasks that do that. I'm hoping that maybe that they Define relevance in. They hear their relevance when talking about this. I don't think that there's
anything to connect that to the problem, especially not in the specific prompt. I know it's discussed in the beginning, just not explicitly here.

Describe what modes are expected for student responses. Here right now it's just finishing writing a conclusion and organizing their final presentations. I mean they do practice orally what they're going to say but there is not a lot of oral responses.

The tasks include appropriate scaffolds. Scaffolds the order in which they need to put things in I would say the one piece it's really not scaffold very well would be how to put together a closing argument it's kind of big in what it wanted to do but I think that's part of why this is the final product is that this is the part where they need to start showing more of their learning so I think that the amount of scaffolds it's fine I give him a pretty General kind of outline of what to think about but without giving them too much because this is the part where they need to start showing their own learning. I'm going to say somewhat.

Tasks are coherent from a student perspective. I'm hoping they see that this is the final piece of the actual presentation and that's were putting things in order and organizing it because we're at the end.

Tasks respect Advantage students' cultural and linguistic backgrounds. Probably going to say no I don't think that's ever been considering any of these prompts. I think that's one of the downfalls linguistically. I don't think there's anything here that's still terrible but I don't think that it's taken into consideration.

Tasks provide both low and high achieving students with an opportunity to show what they know. We're going to say yes this is a part where they show their learning so they're going to have an opportunity to show what they weren't much of at this point. That gives low-achieving students the opportunity to do that in the best way they know how to do the same thing with high-achieving students. I don't think that what Task really limits either one. I think it gives it enough open-endedness to let them show their learning.

Tasks use accessible language. I think the only thing in here that I can see that we've discussed previously is the idea of a crossfire question. You discussed it before. I'm hoping that it's not super known that would be something to think about in this so I'm going to say yes that uses accessible language.

Consider how the task cultivates student interest in incontinence with science and engineering including opportunities for students to reflect on their own ideas, make decisions about the task and Gage and peers self-reflection. Hoping that this drives confidence in the communicating piece of the SEP. I don't think there's a lot of decision-making here outside the closing argument and there's really not a lot of peer and self-reflection happening. I will say that they are asked to read and communicate their
pieces to their Partners as a way to practice but I don't think there's any kind of feedback being given at that point.

Consider the ways in which provided information about students prior learning enables or prevents student engagement with the task. I don't think I don't think this is going to hinder them from doing anything. I think this is really going to show what they know and give a picture of what they've learned to this point. I think the only thing here would be really checking in to make sure students have organize their thoughts in a coherent manner for them to present I feel like that could be a piece that would hold students back or prevent students I'm really showing what they actually know their lack of organization but that can be addressed when they practice both with their partner and myself.

Describe evidence of scientific inaccuracies explicitly or implicitly promoted by the task. I would say maybe a closing argument could be implicitly saying that this is the final thing you say and you don't ever say anything afterward. You can't continue having a discussion around evidence in claims after this I think that kind of implies this based on the format.

Across all indicators there is adequate evidence of quality of this Criterion. I'm thinking this is still pretty fair and Equitable even though there are some pieces that are missing here especially in terms of relevance and connections for students facing the phenomena in the multiple modes however this is the culminating pieces it's almost the last prompt for them so it needs to be a Mindless scaffold not saying there can't be any scaffold on to make it fair and Equitable.

CRITERION D:

Describe what is being assessed. So here they are being assessed over their closing argument and just making sure they have everything completed. So basically having all of their dimensions in order and kind of the final piece of the puzzle to seek. the purpose of this assessment is definitely very close to Summit of this is kind of what they're going to actually present at the very end there's probably only very little tweaking at this point not there can't be it'll probably be very little formative they're still be I mean they're still be a little bit of formative here in that they can make changes there is some Pierre conversation still happening or even some self-reflection happening but I would say overall this is definitely closer to your summative piece of everything.

The assessment target is necessary to respond to the task. I would say there's no actual Define Target here but in order to complete the overall task this has to be done they have to complete a closing argument and I have to make sure that they're organized and ready to present.
Any ideas, practices, or experiences not targeted by the assessment are necessary to respond to the task. I would say here they would need to have experience or an idea of how they want to organize it overall even though I've kind of done that for them but what is the best way to do that this my impact students ability to actually complete the task because they have to have an organized in a way not only for myself to give feedback in assets at the end also for them to actually present.

The student responses elicited support the purpose of the task. The purpose of the task is not only to create a closing argument but to organize their data in order to prevent it, so yes if they don't do those thing I can access them so I don't have evidence of any of their learning.

Consider what student artifacts are produced and how these provide students the opportunity to make visible their sense making, thinking across all three dimensions and ability to use multiple Dimensions together. The final artifact is all of their work up until this point organized in a coherent Manner and not only for myself to assess but also for them to present so it makes visible what they've learned up to this point. This is the cumulative or summative piece of their learning. It's going to show both their ability to obtain, evaluate and communicate information as well as talk about the content they learned. Still missing the CCC's, explicitly here.

Consider how well the material supports teachers and students in making sense of student responses and planning for follow up. This can include guidance for interpreting student thinking using an integrated approach considering all three dimensions together as well as calling out specific supports for individual dimensions. I think this is a call out for the individual dimension of Science and Engineering practices mostly in terms of how they plan to communicate their information since I've done the obtaining and evaluating already. But they're going to put it all together to make sure they have the background knowledge on the content they're using.

support for interpreting a range of student responses including those that might reflect partial scientific understanding or misrepresent student action science understanding. I think at this point there will still be some support in terms of allowing students the ability to work with someone in organizing it whether you myself up here or another adult working on the communication approach of this.

Ways to connect student responses to Prior experiences and future plan instruction by teachers and participation by students. I think this final prompt really is asking students to take everything they have organized and practice presenting it as one of the last pieces of this task for students to practice reading their parts to their partner and even to myself.
Consider any confusing prompts or evidence for too much or too little scaffolding. I think this is a good job of creating straightforward directions and what I'm asking there might be not enough Scaffolding in terms of the organizational piece. Some students might not be great at organizing all their information so that might be something to consider moving forward but I don't think adding anything more or taking anything out would be helpful to the majority of students I think the organizational piece would be for a small select few which would be additional scaffolding for those kids that would need it.

Across all indicators there is adequate evidence of quality of this Criterion and overall this Criterion is Matt fairly well one of the things that needs to do better is really looking. Assessment targets or just providing those Targets in general and being very specific of how this relates to the intended purpose of the overall task. I think that's just where much of this is happening and then any type of prompt within the task should also mention or go back and talk about any of the targets which I don't think is being done very often I think it's still pretty blocky or chunky and maybe you was intended target or purposeful targets and outcomes that will help students really understand the purpose and tie it back to the overarching phenomena are problem

OVERALL SUMMARY:

Overall summary I would say that I'm definitely going to use this task but modify it I need to focus on the grounding and some not our problems I feel like especially with this prompt this definitely lacks a lot of that and grounding it in in the original problem which maybe was seen a little more at the beginning with a few more of those problems I think they are inequities is looking good three dimensions is good except for we still need to focus on cross-cutting Concepts but that's kind of a commonality I'm seeing across all the prompts that I've done. And then the last one would be intended targets and purposes Criterion still had some good evidence for it but I think one of the things that's missing is clear and purposeful targets and/or outcomes for students that are not being explicitly stated.
Appendix D: Data Analysis of Raw Data

Measurement of Alignment to PE

● Task 1 → Criterion D
  ○ Necessary to respond to the task?
    ■ Yes; asking students to make claims with evidence from various online resources around content of EM waves
  ○ What is not targeted by the assessment but necessary to respond to the task
    ■ Research abilities and searching via search engines
  ○ Overall there is adequate evidence; missing specific, purpose/intent of prompt in relation to the phenomena/final assessment piece

● Task 2 → Criterion D
  ○ Looks at both PEs
    ○ Formative assessment; looking to see if students can apply what they learned to a similar but new context. Now looking at counter-arguments instead
    ○ Do responses support the task; must have an opening statement and counter arguments for their opponent as this is part of final assessment
      ■ Gives me (teacher) direction for instruction. Do I need to give more instruction around content (DCI), research or writing of claims/evidence (SEP). Does not need to be in final draft format but present for feedback
    ○ What is not targeted by the assessment but necessary to respond to the task
      ■ nothing ; no evidence
  ○ Overall there is adequate evidence from this criterion. Intended targets/purposes are not explicitly stated but responses from students lend themselves to the purpose for the final assessment or the actual intent of the task

● Task 3 → Criterion D
  ○ Still a formative assessment trying to determine whether students can generalize their learning to a different context
    ○ Does not directly state purpose or intended target but student responses do determine if students are on track for task completion or summative assessment later
  ○ What is not targeted by the assessment but necessary to respond to the task
Peer feedback; it is not targeted by the assessment but it is helpful for students to respond and for their summative piece
  ○ Overall there is adequate evidence for this; still need to be more explicit

● Task 4 → Criterion D
  ○ Still formative assessment; this task will have ample opportunity for students to receive feedback (from peers, myself, other teachers, etc.).
  ○ Again looking at counter-arguments but for their own perspective.
    ■ Determining where students can apply what they have learned to a similar but new context.
  ○ Without this task, students will not have a completed final assessment presentation (debate)
  ○ What is not targeted by the assessment but necessary to respond to the task
    ■ Research of textual evidence. Assumption of writing or making claims/evidence statements
  ○ Student responses support the task; asking students to write claims/evidence but on a specific side of an argument.
  ○ Overall there is adequate evidence for this criterion. Still a need for an explicit target/purpose of this task. Still purposeful in what students are being asked to produce as it leads towards the summative assessment (debate)

● Task 5 → Criterion D
  ○ Slightly formative here; this is the final “piece to the puzzle” so the task responses should look very much like the final draft
  ○ No actual target discussed but responses still hit intended purpose
  ○ What is not targeted by the assessment but necessary to respond to the task
    ■ Organization of ideas/thoughts/responses
  ○ Overall this has adequate evidence; Still a need for an explicit target/purpose of this task. Still purposeful in what students are being asked to produce towards the summative assessment

3D Learning as related to phenomena

● Task 1
  ○ Criterion A → Phenomena
    ■ Phenomenon or problem is presented
      ● Yes; stated that students are finding and using evidence to make a claim if their EM wave is the best
    ■ Features engaging, relevant & accessible tasks
• Presents real-world observations
  ○ No; not sure what it is asking but fell back on somewhat.
  ○ Students may or may not be able to experience their EM wave so this is somewhat
• Based on at least one specific instance
  ○ No; not specific. Talking in general terms of the entire section of the spectrum which is still broad
• Puzzling/intriguing
  ○ Somewhat; decide one over another wave on the spectrum. Hard to decide if one is better than the other but hopeful they find the discussion/argumentation intriguing
• Create a “need to know”
  ○ Yes; connections to their lives and the content being presented
• Explainable using grade-appropriate SEPs, CCCs & DCIs
  ○ Somewhat; hitting content and skill hard but not really touching on CCC
• Effectively use at least 2 modalities
  ○ Yes; can watch videos, read, look at diagrams, etc. for all their research. Just needs cited
• Scenarios present real/well-crafted data
  ○ Yes; students are research real data to use as evidence. Not sure it can be classified as “well-crafted” but still a yes in this category
• Local, global and universal relevance made clear
  ○ Somewhat; unclear if relevance was made explicit to students.
• Comprehensible to a wide range of students at grade level
  ○ Somewhat; can be reading, researching and engaging with high leverage texts, determining what is “good/bad” data, etc. This is hopefully being done at grade level but can see where it might not be comprehensible to all
• Use as many as needed, no more
Yes; try to get to the point without including too much information

- Sufficiently rich to drive the task
  - Somewhat; the problem needs explanation and research will drive the task. But there could be a limited approach to how a student answers this task

Criterion B → Sense-making using the three-dimensions

- Consider ways the task requires students to use reasoning to engage in problem solving (sense-making around phenomena)
  - Requires students to give evidence/reasons to support their claim of the best EM wave for society.

Evidence of SEPs

- SEP obtains, evaluates and communicates information. Students are doing all of this during the task. They find and/or gather information around their EM wave, they determine if the information is worth citing or keeping, then having to find a way to communicate (via writing currently) the information they learned.

Evidence of CCCs

- CCC is cause and effect. This is not explicitly stated; it happens indirectly but never purposefully

Evidence of DCIs

- DCI for the two standards are around electromagnetic radiation’s effect on matter and the technological pieces/instrumentation and its function. Both are present as that is one of the three reasons students need to find in their research

Consider ways task requires students to use multiple dimensions together for sense-making

- Uses DCI & SEP together but does not directly address the CCC. Researching specific content & evaluating and communicating the information out to an audience (via writing currently)

Criterion D → support intended targets & purpose
Consider what artifacts are produced and how these provide opportunities to make visible 1) sense-making processes 2) thinking across all three dimensions 3) ability to use multiple dimensions together
- Trying to make claims with evidence based on information collected. Since the content is not already held, the biggest piece of sense-making is whether the information is valid/reliable based on other factors.

Consider how the rubric includes guidance for using all three dimensions together as well as calling out specific supports for individual dimensions
- This task is focused on SEP of obtaining, evaluating and communicating information. The content I will help them along the way of determining if this is accurate (it also helps me provide any additional scaffolding in the future tasks) BUT this is done through the use of the SEP. Still not 100% sure any form of the CCCs are making direct appearances in this task.

Task 2
- Criterion A → Phenomena
  - Phenomenon or problem is presented
    - Yes but not directed listed or stated; the purpose behind the task describes the phenomena or problems itself (which wave, of student choice, is the best based on being valuable, useful and technologically helpful to society. Indirectly covers this.

Features engaging, relevant & accessible tasks
- Presents real-world observations
  - Somewhat; hoping students ull from experience. Also give them an experience by having them watch a small clip of “A Few Good Men”. Presenting “real-world” examples. Not guaranteed.
- Based on at least one specific instance
  - No; this is a very general experience. However there is the one experience all students are part of when they watch the movie clip but not sure this counts
• Puzzling/intriguing
  ○ Somewhat; since there was student choice hoping this sparks some intrigue and while it could be puzzling as how can a student choose one when they view multiple equally.

• Create a “need to know”
  ○ Somewhat; using the content is that they choose yet trying to find ways they view this wave useful, valuable and technologically helpful. This could be different for various students. Relevant for them.

• Explainable using grade-appropriate SEPs, CCCs & DCIs
  ○ Yes; engaging in argumentation while evaluating various sources. Then need to be able to communicate the information to a larger audience, verbally and written, to show learning.

• Effectively use at least 2 modalities
  ○ Yes; video watching, reading, diagrams, discussion/talking, peer feedback are all happening in this task.

• Scenarios present real/well-crafted data
  ○ Yes; the intent of this task is for students to find and apply evidence (data) to support their claim of which is best.

• Local, global and universal relevance made clear
  ○ No; this is not super clear nor stated directly

• Comprehensible to a wide range of students at grade level
  ○ Somewhat; there are various ways in which students can comprehend the expectation of the task but at grade-level. There are scaffolds and supports available but this is not explicitly stated in the task.

• Use as many as needed, no more
  ○ Somewhat; it looks and sounds wordy. However, taking any words out would not make the task understandable.

• Sufficiently rich to drive the task
  ○ Yes; the problem or phenomena is driving the task. What claim are they using, what evidence is in
support of this and what reasoning is relevant to this. This is driving the intent of this task.

○ Criterion B → Sense-making using the three-dimensions
  ■ Consider ways the task requires students to use reasoning to engage in problem solving (sense-making around phenomena)
    ● They need to make sense of their decision behind what makes their wave “the best” (useful, valuable, technologically). The task is asking students to question their own thoughts and beliefs in order to research and share to a larger audience.
  ■ Evidence of SEPs
    ● Constantly (throughout this task) evaluating valid/reliable claims for published materials (journal articles, websites, data, etc.) found online. This is in addition communicating this information out based on their learning
  ■ Evidence of CCCs
    ● Should be looking at the cause/effect but not sure this is actually happening or if there is even any evidence to say this may indirectly be happening.
  ■ Evidence of DCIs
    ● The research is all about content, specifically around which EM wave they choose to focus on. The content in this task is tied directly to the standards (4-4 → how matter responds to absorbing EM waves & 4-5 → explaining technological devices).
  ■ Consider ways task requires students to use multiple dimensions together for sense-making
    ● This task has a high emphasis on two of the three dimensions: SEP & DCI. Lacking any, if at all, CCC relationships.

○ Criterion D → support intended targets & purpose
  ■ Consider what artifacts are produced and how these provide opportunities to make visible 1) sense-making processes 2) thinking across all three dimensions 3) ability to use multiple dimensions together
Students are producing a working document that is showing their progression in learning or sense-making and how they are using the two dimensions together (SEP & DCIs). This is done in written form but also in discussions with the teacher, peer feedback and self-reflections. This is giving students multiple opportunities to practice all three criteria listed here.

Consider how the rubric includes guidance for using all three dimensions together as well as calling out specific supports for individual dimensions.

In this task, feedback is given around what the expectation of the final product should be in order to help see where they are in their learning process. Most feedback is centered around the SEP dimension.

Task 3

- Criterion A → Phenomena
  - Phenomenon or problem is presented
    - Not explicitly stated in the task. The information they are producing here is still grounded in the phenomena but not found in writing in the task

- Features engaging, relevant & accessible tasks
  - Presents real-world observations
    - Somewhat; the teacher shows another movie clip from “A Few Good Men”. Not sure there are other opportunities in this or that kids can pull from.
  - Based on at least one specific instance
    - No; talking about which one is the best. Not sure this is considered to be specific enough
  - Puzzling/intriguing
    - Somewhat; open-ended which can be puzzling for some (either in a good or bad way). Could be intriguing in finding a way to answer the counter-argument against them.
  - Create a “need to know”
    - No; they are still researching content but not sure there is relevance present
  - Explainable using grade-appropriate SEPs, CCCs & DCIs
Somewhat; focus is still on SEP & DCIs but fails to do much for cause/effect (CCC).

- Effectively use at least 2 modalities
  - Yes; students are still writing, watching video as a whole class, they will be doing reading, diagrams are still a viable option for research, simulating the final assessment by practicing what they have accomplished currently.

- Scenarios present real/well-crafted data
  - Somewhat; I am not presenting any data specifically but students are still obtaining and evaluating data to help with their claims/evidence

- Local, global and universal relevance made clear
  - No; not confident this task is making it clear what the relevance is. Again, the work is grounded in this concept but not stated.

- Comprehensible to a wide range of students at grade level
  - Somewhat; not explicit in the task but the process of feedback, practice and scaffolds/supports (not shown in the task directly) lend this as attainable to all students

- Use as many as needed, no more
  - Yes; if any words/directions were left out, expectations may be unclear.

- Sufficiently rich to drive the task
  - No; phenomena/problem is rich but that is not being stated directly in this task. The movie clip could count but again, I think there are no connections being made.

Criterion B → Sense-making using the three-dimensions

- Consider ways the task requires students to use reasoning to engage in problem solving (sense-making around phenomena)
  - The problem is grounded in making a claim of which EM wave is the “best”. In this task, it is asking students to look at the opposing side of their own argument. They need to make sense of what now makes their wave not the best. It is
a true application of what students have been learning in the first two tasks.

- **Evidence of SEPs**
  - Students are now obtaining, evaluating and communicating, like they have done previously, with similar content but now on the opposite side of the argument. This is happening in writing, verbal practice/simulations and even in recorded videos.

- **Evidence of CCCs**
  - If this is happening, it is out of chance and not explicit instruction

- **Evidence of DCIs**
  - Students are still researching content focused on wave effects on matter and how waves can capture and transmit information in the form of energy. This is still what is required of students to learn but the opposite side of their original argument.

- **Consider ways task requires students to use multiple dimensions together for sense-making**
  - This is now the third task and they are still working on making the content they have researched/learned and found ways to share out what they have learned while validating the reliability of research. This is getting them ready for the final task (summative assessment). The biggest challenge here is making the communication out of information. Students are working on trying to show what they know and articulate that to a larger audience.

  - **Criterion D → support intended targets & purpose**
    - Consider what artifacts are produced and how these provide opportunities to make visible 1) sense-making processes 2) thinking across all three dimensions 3) ability to use multiple dimensions together
    - Produced work includes their written evidence and the written feedback they will be getting from peers; the hope is each piece can help student’s sense-making process
visible to any audience and everyone can see the work of all dimensions (DCI & SEP) also visible.

- Consider how the rubric includes guidance for using all three dimensions together as well as calling out specific supports for individual dimensions
  - All three dimensions are not present but it is still giving me an accurate picture of where each student is at in their learning around the content (DCI) and how they plan to articulate it (SEP). Guidance will be around what students produce at this point

- Task 4
  - Criterion A → Phenomena
    - Phenomenon or problem is presented
      - Yes; but not explicitly mentioned. Students need to write their claim on which wave is “best” which is indirectly the problem/phenomena
    - Features engaging, relevant & accessible tasks
      - Presents real-world observations
        - No; nothing is presented for real-world observations here.
      - Based on at least one specific instance
        - Somewhat; it is still over one or two specific electromagnetic waves. Looking at the spectrum as a whole class
      - Puzzling/intriguing
        - Yes; they are taking and applying their claim/evidence but for a counterargument against their viewpoint. This prompt is asking them to think on both sides of the argument
      - Create a “need to know”
        - Somewhat; important to the overall argument/debate but this task does not create this “need to know”
    - Explainable using grade-appropriate SEPs, CCCs & DCIs
      - Somewhat; definitely using SEP & DCI to write arguments. Not completely three-dimensional
    - Effectively use at least 2 modalities
Yes; reading to obtain/evaluate information then writing to do the communicating piece. In addition, they are practicing or simulating the presentation of the information they have read and wrote about. Diagrams/images are possible, just dependent on the source students find.

- Scenarios present real/well-crafted data
  - Somewhat; no data is presented but students are finding data for themselves.
- Local, global and universal relevance made clear
  - No; not made clear or relevant to students in this specific task. Needs to be changed
- Comprehensible to a wide range of students at grade level
  - Yes; scaffolds and supports are present in the task
- Use as many as needed, no more
  - Yes; paring down anymore words would not make the task comprehensible.
- Sufficiently rich to drive the task
  - Yes; this task drives the overall purpose/problem. They are practicing the SEP & DCI and this is important for the task

- Criterion B → Sense-making using the three-dimensions
  - Consider ways the task requires students to use reasoning to engage in problem solving (sense-making around phenomena)
    - Reflect and react to the opposite side of their original viewpoint on which wave is the “best”. Challenging for students to figure out how to counteract or argue back against their own claim/viewpoint. Lots of problem solving.
  - Evidence of SEPs
    - Continuing to obtain/evaluate/communicate information. Happening with the counterarguments with evidence.
  - Evidence of CCCs
    - Unofficially happening; not focusing or directly ask students to make the connections of cause/effect. Might be happening without prompting
Evidence of DCIs
- Research is around specific content (electromagnetic spectrum wave(s) effect on matter. Looking at technology, and how their specific wave and its impact on communication.

Consider ways task requires students to use multiple dimensions together for sense-making
- Indirectly using the CCCs to address content (DCI) to communicate out information (SEP). Definitely the focus is around two of the three. The third is happening unofficially but is not focused. No emphasis on all three together just two.

Criterion D → support intended targets & purpose
Consider what artifacts are produced and how these provide opportunities to make visible 1) sense-making processes 2) thinking across all three dimensions 3) ability to use multiple dimensions together
- Researching and writing counterarguments to present in the final summative assessment (debate). This is again definitely calling out the use of two of the three dimensions

Consider how the rubric includes guidance for using all three dimensions together as well as calling out specific supports for individual dimensions
- Not three-dimensional. Huge emphasis on SEP & DCI. Support and guidance is only directly students on both of those dimensions and not around CCCs, as it is not discussed at all.

Task 5
- Criterion A → Phenomena
Phenomenon or problem is presented
- What is written down in the task is not the overall problem or phenomena. Doesn’t really address what the problem/phenomena is.

Features engaging, relevant & accessible tasks
- Presents real-world observations
- No; this task is really just having students put together all information
- Based on at least one specific instance
  - No; this is a general overview of what to expect
- Puzzling/intriguing
  - No; this is a wrap-up and bringing all the tasks together so there is no puzzle/intrigue to this task
- Create a “need to know”
  - Somewhat; connect the content (DCI) with students' current understanding by how they communicate this learning. But not problem solving just more organizational than anything.
- Explainable using grade-appropriate SEPs, CCCs & DCIs
  - Yes; bringing together all pieces. Still not sure CCCs are happening
- Effectively use at least 2 modalities
  - Somewhat; could be finishing up writing and reading research. Also practicing their presentations. But the focus is not around multiple modalities.
- Scenarios present real/well-crafted data
  - No; no evidence here
- Local, global and universal relevance made clear
  - Somewhat; trying to tie back this to experiences or observations made in earlier tasks. Giving them relevance around basic argumentation principles to use moving forward (both in and out of school)
- Comprehensible to a wide range of students at grade level
  - Yes; straightforward in having students continue with making an argument and organizing their information coherently
- Use as many as needed, no more
  - Yes; taking anything out would make it non-comprehensible
- Sufficiently rich to drive the task
  - Somewhat; pertinent information for them to complete this task and overall summative task.
○ Criterion B → Sense-making using the three-dimensions
  ■ Consider ways the task requires students to use reasoning to engage in problem solving (sense-making around phenomena)
    ● Not too much sense making happening; students are taking their opening statement & rebuttal to write a closing statement. This may take a little sense-making but not sufficiently rich.
  ■ Evidence of SEPs
    ● Asking to communicate information as a closing argument. Organization of information can help with the communication piece as you need to find what to share out to the audience when the time comes.
  ■ Evidence of CCCs
    ● Teacher hopes this happens but no intentional evidence of CC happening here in this task
  ■ Evidence of DCIs
    ● Communicating about EM wave content.
  ■ Consider ways task requires students to use multiple dimensions together for sense-making
    ● Not three-dimensional; much of the emphasis is still around SEP & DCI. No focus on CCC but this MAY or could happen just was not intentional from the teacher to student.

○ Criterion D → support intended targets & purpose
  ■ Consider what artifacts are produced and how these provide opportunities to make visible 1) sense-making processes 2) thinking across all three dimensions 3) ability to use multiple dimensions together
  ●
  ■ Consider how the rubric includes guidance for using all three dimensions together as well as calling out specific supports for individual dimensions
    ● This final task is focused mainly on SEP and the way information is presented and obtained. They also need to be using content knowledge correctly but not sure this is the emphasis in this particular task.
Claim (Answer to Question[s]):

- Alignment to PE(s)
  - The assessment tasks show there was adequate evidence to show relation for alignment to PEs. When looking at how the PEs are assessed, the progression from strictly formative to application of learning to summative, this shows a sequential scaffold of assessment of learning.

- 3D Learning
  - When looking at the data, the assessment tasks were not adequately related to 3D Learning. Evidence is plentiful for 2D learning around both the SEP & DCIs but not enough, or any, instruction was provided to drive this part of student learning for the CCC

- Phenomena
  - When looking at the data below, the assessment prompts were not adequately related to phenomena. While there are pieces in which the phenomena or problem was presented throughout the different assessment tasks, it was not consistent through all tasks.

Evidence (Data Analysis):

Alignment to PE(s) Table

<table>
<thead>
<tr>
<th>Task Number &amp; Criterion D</th>
<th>Type of Assessment?</th>
<th>Does task state purpose or intended assessment target?</th>
<th>Anything NOT targeted but necessary to respond to a task?</th>
<th>Do student responses elicit support for the purpose of the task?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Formative</td>
<td>Yes (making claims with evidence)</td>
<td>Yes (research capabilities)</td>
<td>Yes (responses are in claims/evidence format)</td>
</tr>
<tr>
<td>2</td>
<td>Formative &amp; Application of what they learned to a similar but new context</td>
<td>Yes (creating counter-arguments)</td>
<td>Yes (research capabilities)</td>
<td>Yes (responses are still in claims/evidence format but with counter view)</td>
</tr>
</tbody>
</table>
### ARGUMENTATION & SCIENTIFIC LITERACY

<table>
<thead>
<tr>
<th>3</th>
<th>Formative &amp; Generalizing their learning to a different context</th>
<th>No (No direct statement towards final assessment)</th>
<th>Yes (peer feedback which helps develop student claims but not necessary to respond)</th>
<th>Yes (shows progression towards completion of summative assessment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Formative &amp; Application of what they learned to a similar but new context</td>
<td>Yes (formatting arguments for final assessment)</td>
<td>Yes (research capabilities &amp; possible writing of arguments)</td>
<td>Yes (responses are in claims/evidence format)</td>
</tr>
<tr>
<td>5</td>
<td>Formative &amp; Summative</td>
<td>No (no direct statement)</td>
<td>Yes (organization of ideas)</td>
<td>Yes (shows final towards completion of summative assessment)</td>
</tr>
</tbody>
</table>

### 3D LEARNING

#### Grade-Appropriate 3D Learning Table

<table>
<thead>
<tr>
<th>Task Number &amp; Criterion A</th>
<th>Explainable using grade-appropriate SEPs, CCCs, &amp; DCIs (Yes, Somewhat or No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Somewhat</strong> (Hitting content and skill hard but not really touching on CCC)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Yes</strong> (Engaging in argumentation while evaluating various sources. Then need to be able to communicate the information to a larger audience, verbally and written, to show learning.)</td>
</tr>
<tr>
<td>3</td>
<td><strong>Somewhat</strong> (Focus is still on SEP &amp; DCIs but fails to do much for cause/effect (CCC)).</td>
</tr>
<tr>
<td>4</td>
<td><strong>Somewhat</strong> (Definitely using SEP &amp; DCI to write arguments. Not completely three-dimensional)</td>
</tr>
</tbody>
</table>
Evidence of 3D Learning Indicators

Table

<table>
<thead>
<tr>
<th>Task Number &amp; Criterion B</th>
<th>Evidence of SEP</th>
<th>Evidence of CCC</th>
<th>Evidence of DCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes (SEP obtains, evaluates and communicates information. Students are doing all of this during the task. They find and/or gather information around their EM wave, they determine if the information is worth citing or keeping, then having to find a way to communicate (via writing currently) the information they learned.)</td>
<td>No (CCC is cause and effect. This is not explicitly stated; it happens indirectly but never purposefully)</td>
<td>Yes (DCI for the two standards are around electromagnetic radiation’s effect on matter and the technological pieces/instrumentation and its function. Both are present as that is one of the three reasons students need to find in their research)</td>
</tr>
<tr>
<td>2</td>
<td>Yes (Constantly (throughout this task) evaluating valid/reliable claims for published materials (journal articles, websites, data, etc.) found online. This is in addition communicating this information out based on their learning )</td>
<td>No (Should be looking at the cause/effect but not sure this is actually happening or if there is even any evidence to say this may indirectly be happening)</td>
<td>Yes (The research is all about content, specifically around which EM wave they choose to focus on. The content in this task is tied directly to the standards (4-4 → how matter responds to absorbing EM waves &amp; 4-5 →</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>---</td>
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<td>-----</td>
</tr>
<tr>
<td>3</td>
<td>(Students are now obtaining, evaluating and communicating, like they have done previously, with similar content but now on the opposite side of the argument. This is happening in writing, verbal practice/simulations and even in recorded videos.)</td>
<td>(If this is happening, it is out of chance and not explicit instruction)</td>
<td>(Students are still researching content focused on wave effects on matter and how waves can capture and transmit information in the form of energy. This is still what is required of students to learn but the opposite side of their original argument)</td>
</tr>
<tr>
<td>4</td>
<td>(Continuing to obtain/evaluate/communicate information. Happening with the counterarguments with evidence)</td>
<td>(Unofficially happening; not focusing or directly asking students to make the connections of cause/effect. Might be happening without prompting)</td>
<td>(Research is around specific content (electromagnetic spectrum wave(s) effect on matter. Looking at technology, and how their specific wave and its impact on communication)</td>
</tr>
<tr>
<td>5</td>
<td>(Asking to communicate information as a closing argument. Organization of information can help with the communication piece as you need to find what to share out to the audience when the time comes)</td>
<td>(Teacher hopes this happens but no intentional evidence of CC happening here in this task)</td>
<td>(Communicating about EM wave content)</td>
</tr>
</tbody>
</table>
Support for and Use of Multiple Dimensions Indicators

Table

<table>
<thead>
<tr>
<th>Task Number &amp; Criterion D</th>
<th>Using multiple dimensions together for sense-making</th>
<th>Rubric guidance around using all three dimensions AND calling out for support of specific individual dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes (Using SEP &amp; DCI for content driven obtainment &amp; evaluation of information)</td>
<td>SEP focused (obtaining/evaluating information). DCI is happening but no mention of CCCs</td>
</tr>
<tr>
<td>2</td>
<td>Yes (Using SEP &amp; DCI together for content driven obtainment &amp; communication of information)</td>
<td>SEP focused (obtaining/communicating information) Little discussion of DCI or CCC</td>
</tr>
<tr>
<td>3</td>
<td>Yes (Using SEP &amp; DCI together for content driven evaluation &amp; communication of information)</td>
<td>DCI &amp; SEP Focused (No mention of CCC &amp; here is where students need to be both moving towards mastery of SEP &amp; more emphasis DCI accuracy begins)</td>
</tr>
<tr>
<td>4</td>
<td>Yes (Using SEP &amp; DCI together for content driven evaluation &amp; communication of information but CCC is starting to make an appearance indirectly. No direct mention or emphasis is placed on this dimension)</td>
<td>DCI &amp; SEP Focused (No mention of CCC but it could be happening (unintentionally by either teacher or student). Support and guidance is around mastery of SEP &amp; DCI accuracy)</td>
</tr>
<tr>
<td>5</td>
<td>Yes (Using SEP &amp; DCI together for content driven communication of information; this would be a point</td>
<td>DCI &amp; SEP Focused (Still no mention of CCC but it may happen unintentionally by students. Much of what is the focus is around</td>
</tr>
</tbody>
</table>

ARGUMENTATION & SCIENTIFIC LITERACY

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where most sense-making has already taken place) | the SEP and organization of information. Some emphasis on content)

Indicators of Phenomena

<table>
<thead>
<tr>
<th>Task Number &amp; Criteria on A</th>
<th>Phenomena/Problem Presented (Yes, Somewhat or No)</th>
<th>Presents real-world observations (Yes, Somewhat or No)</th>
<th>Puzzling &amp; Intriguing (Yes, Somewhat or No)</th>
<th>Local, Global &amp; Universal relevance made clear (Yes, Somewhat or No)</th>
<th>Comprehensible to wide range of students at grade level (Yes, Somewhat or No)</th>
<th>Sufficiently rich to drive task (Yes, Somewhat or No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>No</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>Somewhat</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>No</td>
<td>Somewhat</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>Somewhat</td>
<td>Somewhat</td>
<td>No</td>
<td>Somewhat</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Somewhat</td>
<td>Yes</td>
<td>Somewhat</td>
</tr>
</tbody>
</table>

Overall Evidence for All Criteria & Indicators

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Total Pieces of Evidence</th>
<th>Yes (Percentage)</th>
<th>Somewhat (Percentage)</th>
<th>No (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenomena</td>
<td>30</td>
<td>7 (23%)</td>
<td>12 (40%)</td>
<td>11 (37%)</td>
</tr>
<tr>
<td>3D Learning</td>
<td>25</td>
<td>17 (68%)</td>
<td>3 (12%)</td>
<td>5 (20%)</td>
</tr>
<tr>
<td>Alignment to PEs</td>
<td>15</td>
<td>13 (87%)</td>
<td>0 (0%)</td>
<td>2 (13%)</td>
</tr>
</tbody>
</table>