

## Alignment of Thin Film Interference Module to the Next Generation Science Standards

The Next Generation Science Standards (NGSS) were published in April 2013. They consist of statements that convey the performance expectations for students. Each performance expectation is a single statement that is built from three parts: science and engineering practices (Practices), disciplinary core ideas (DCI) and crosscutting concepts.

Since the Thin Film Module was created prior to the release of these standards one would expect that it aligns most readily to the individual statements that articulate the practices, DCIs, and crosscutting concepts. The background material, reading, and the slides from the module address the aspects of the NGSS shown in Table 1.

<b>TABLE 1. ALIGNED PRACTICES, DISCIPLINARY CORE IDEAS, AND CROSSCUTTING CONCEPTS</b>		
<b>PRACTICE</b>	<b>DCI</b>	<b>CROSSCUTTING CONCEPT</b>
<i>None found</i>	<i>MS. PS4.A: When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.</i>	<i>Connections to Engineering, Technology, and Application of Science: Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.</i>
<b>Where is this Practice found in the lesson plan?</b>  NA	<b>Where is this DCI found in the lesson plan?</b>  The teacher Background Information section and the Power Point slides describe what happens to light when it hits an object in great detail.	<b>Where is this Crosscutting Concept found in the lesson plan?</b>  The Power Point slides include a discussion about the application of thin films, which includes a brief description of engineering advances in optics related to the DCI.

**TABLE 1. ALIGNED PRACTICES, DISCIPLINARY CORE IDEAS, AND CROSSCUTTING CONCEPTS**

<p><b>How well is this Practice aligned?</b></p> <p>NA</p>	<p><b>How well is this DCI aligned?</b></p> <p>Strong alignment, within the two sections.</p>	<p><b>How well is this Cross Cutting Concept aligned?</b></p> <p>Weak alignment, as students are not explicitly helped to understand this concept, and are not assessed on their understanding.</p>
<p><b>PRACTICE</b></p> <p>None found</p>	<p><b>DCI</b></p> <p>MS. PS4.A: The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.</p>	<p><b>CROSSCUTTING CONCEPT</b></p> <p>See above</p>
<p><b>Where is this Practice found in the lesson plan?</b></p> <p>NA</p>	<p><b>Where is this DCI found in the lesson plan?</b></p> <p>The teacher Background Information section and the Power Point slides describe what happens to light when it hits an object in great detail.</p>	<p><b>Where is this Crosscutting Concept found in the lesson plan?</b></p> <p>NA</p>
<p><b>How well is this Practice aligned?</b></p> <p>NA</p>	<p><b>How well is this DCI aligned?</b></p> <p>Strong alignment, within the two sections.</p>	<p><b>How well is this Cross Cutting Concept aligned?</b></p> <p>NA</p>
<p><b>PRACTICE</b></p> <p>None Found</p>	<p><b>DCI</b></p> <p>MS. PS4.A: A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of</p>	<p><b>CROSSCUTTING CONCEPT</b></p> <p>None Found</p>

**TABLE 1. ALIGNED PRACTICES, DISCIPLINARY CORE IDEAS, AND CROSSCUTTING CONCEPTS**

	light at a surface between media.	
<b>Where is this Practice found in the lesson plan?</b>  NA	<b>Where is this DCI found in the lesson plan?</b>  The teacher Background Information section and the Power Point slides describe the wave model of light.	<b>Where is this Crosscutting Concept found in the lesson plan?</b>  NA
<b>How well is this Practice aligned?</b>  NA	<b>How well is this DCI aligned?</b>  Strong alignment, within the two sections.	<b>How well is this Cross Cutting Concept aligned?</b>  NA
<b>PRACTICE</b>  None Found	<b>DCI</b>  HS.PS4.A: Waves can add or cancel one another as they cross, depending on their relative phase (i.e., relative position of peaks and troughs of the waves), but they emerge unaffected by each other.	<b>CROSSCUTTING CONCEPT</b>  None Found
<b>Where is this Practice found in the lesson plan?</b>  NA	<b>Where is this DCI found in the lesson plan?</b>  The teacher Background Information section and the Power Point slides describe the superposition of waves.	<b>Where is this Crosscutting Concept found in the lesson plan?</b>  NA
<b>How well is this Practice aligned?</b>  NA	<b>How well is this DCI aligned?</b>  Strong alignment, within the two sections.	<b>How well is this Cross Cutting Concept aligned?</b>  NA

## Alignment of Thin Films Module to the Common Core State Standards in English Language Arts/Literacy and Mathematics

The Common Core State Standards (CCSS) were published in June 2010. They articulate student skills for English language arts/literacy and mathematics. The content of the module addresses the concepts and skills shown in Tables 3 and 4.

For English language arts/literacy, the CCSS is organized around College and Career Anchor Standards (CCR) that articulate the over-arching skills that students need to be prepared for college and career. There are grade level versions of each Anchor Standard, as well as versions for science and social studies classrooms (literacy standards). Alignments in Table 3 were made to the Anchor Standards, unless a more specific version of the standard was a closer fit to the skills in the module. Additional alignments may be warranted, depending on the use of associated videos that are provided as links in the module and whether students engage in discussions.

**TABLE 3. ALIGNED COMMON CORE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY**

<p><b>STANDARD</b></p> <p>CCR.L.6: Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when encountering an unknown term important to comprehension or expression.</p>
<p><b>Where is this standard found in the module?</b></p> <p>Scientific words and phrases are used throughout the module, including within the background information, PowerPoint slides, activity instructions, and discussion questions.</p>
<p><b>How well is this standard aligned?</b></p> <p>Partial alignment. Familiarity with some scientific vocabulary is prerequisite, while some other conceptual vocabulary (e.g., reflection, refraction) may be part of instruction. Students must use scientific (domain-specific) words and phrases to accurately respond to discussion questions.</p>
<p><b>STANDARD</b></p> <p>RST.11–12.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.</p>
<p><b>Where is this standard found in the module?</b></p>

Students read and follow multi-step procedure when completing the activity; students analyze the specific results through discussion questions.
<b><i>How well is this standard aligned?</i></b>  Weak alignment. The ability to follow written procedures is prerequisite to the module and not part of direct instruction; students' analysis of results is not based on explanations in the text.
<b>STANDARD</b>  RST.6–8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
<b><i>Where is this standard found in the module?</i></b>  Students must understand a variety of graphics that are used within the background information and PowerPoint slides.
<b><i>How well is this standard aligned?</i></b>  Weak alignment. The ability to connect graphic images with a description of phenomena is assumed (prerequisite) and not part of instruction or assessment in the module.

For mathematics, Table 4 shows alignments to standards found in the 8<sup>th</sup> through 12<sup>th</sup> grade levels.

<b>TABLE 4. ALIGNED COMMON CORE MATHEMATICS STANDARDS</b>
<b>STANDARD</b>  HS.G-MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
<b><i>Where is this Standard found in the lesson plan?</i></b>  In the Activity, students are asked how thin the film is on the surface of the water. To determine this, students may model the surface of the water as a geometric shape.
<b><i>How well is this Standard aligned?</i></b>  Weak alignment. Students may not be required to complete this task.