Alignment of Surface Area to Volume Ratio 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 Surface Area to Volume Ratio 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.

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

PRACTICE	***DCI***	***CROSSCUTTING CONCEPT***
HS. Using Mathematical and Computational Thinking: Use mathematical representations of phenomena to support claims.	*HS-PS1.B: Chemical Reactions:* Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.	*HS: Scale, Proportion, and Quantity:* The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.
Where is this Practice found in the lesson plan? In the Power Point, students are directed to find surface area to volume ratios and complete a Scaling assignment.	***Where is this DCI found in the lesson plan?*** An understanding that the rate of chemical processes can be understood in terms of the collision of molecules is prerequisite to understanding why the amount of exposed	***Where is this Crosscutting Concept found in the lesson plan?*** The Background Information, Activity, and Power Point slides all implicitly address this concept.

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

	surface area of a material effects the reaction rate.	
How well is this Practice aligned? Weak alignment. While students are asked to use mathematic representations, they are not using the representations to explicitly support a claim. This would be a stronger alignment if the Power Point exercise and the Activity were more explicitly linked, with a claim identified.	***How well is this DCI aligned?*** Weak alignment, as the concept is found only implicitly in the lesson, and the concept of chemical energy is not addressed.	***How well is this Cross Cutting Concept aligned?*** Strong alignment.

Alignment of Surface Area to Volume Ratio 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

STANDARD 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.
Where is this standard found in the module? Scientific words and phrases are used throughout the module, including within the background information, PowerPoint slides, activity instructions, and discussion questions.
How well is this standard aligned? Partial alignment. Familiarity with some scientific vocabulary is prerequisite, while some other conceptual vocabulary (e.g., non-linear scaling) may be part of instruction. Students must use scientific (domain-specific) words and phrases to accurately respond to discussion questions.
STANDARD 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.

Where is this standard found in the module?
Students read and follow multi-step procedure when completing the activity; students analyze the specific results through discussion questions.
How well is this standard aligned?
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.
STANDARD
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).
Where is this standard found in the module?
Students must understand a variety of graphics that are used within the PowerPoint slides.
How well is this standard aligned?
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 8th through 12th grade levels.

TABLE 4. ALIGNED COMMON CORE MATHEMATICS STANDARDS

Standard
8.EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.*
Where is this Standard found in the lesson plan?
The Power Point slides include a Scaling Assignment which includes creating a table of values of and graphing the surface area to volume ratios of a given shape of with different dimensions.
How well is this Standard aligned?
Weak alignment. Students are not asked to interpret the unit rate as the slope of the graph, and students are not explicitly told to compare different proportional relationships.

Standard
8.G.9 Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve real-world and mathematical problems.
Where is this Standard found in the lesson plan?
The Background Information, Activity, and Power Point slides all address this concept.
How well is this Standard aligned?
Strong alignment.
Standard
HS.G-GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.
Where is this Standard found in the lesson plan?
The Background Information, Activity, and Power Point slides all address this concept.
How well is this Standard aligned?
Strong alignment.
Standard
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)
Where is this Standard found in the lesson plan?
The Activity and Power Point slides require that students are able to view real world objects (such as Alka-Seltzer tablets) and model them as geometric shapes in order to calculate their volume and surface area.
How well is this Standard aligned?
Strong alignment.