This lesson was created for a Collection of Evidence class at Ellensburg High School. The class consists of roughly 30 students, broken into two classes of about 15 students each. This class is designed for students who are in jeopardy of not graduating. Getting the students interested and engaged in the lessons is challenging, since many of them have no will or desire to learn. By using problems that students could potentially see happening in life gets these students more engaged and wanting to figure the problems out. Especially if the answers yield larger values than they are used to working with (answers in the millions and above usually generate some sort of “OH MY GOSH!” or “That would be a MASSIVE tank! I don’t even want to know what they were trying to transport!” response, specifically from the male students). The incorporation of a document camera in the lesson enables me to assist the class with their worksheet, while being able to keep an eye on the students more easily than up at the white board. Though the use of a document camera may seem like a simple, less-advanced piece of technology than others being incorporated into the classrooms, when working with students who are disengaged with their learning, it is more important to make a connection with the class than it is to try and bring in expensive pieces of technology. And most classrooms are already equipped with a document camera or some variation (overhead projector, ELMO, etc.).

For these students in particular, I have found it useful to go over the first packet using the document camera the day after the students had a chance to complete it themselves. This way the students are given ample opportunity to complete the packet on their own time and then ask specific questions. This has also proven to be useful to help show the students how to arrange their answers on their official state tasks that they take which align with each homework packet set.

The nice thing about this homework packet is that the questions and values are easily changed and can still meet the state standard as well as the needs of the students. With the use of the document camera, students are able to see the work being done in the same manner that appears on their paper. This has proven important for one of my students in particular who has a very difficult time transferring information from one format to the other: white board to notes, notes to homework, and even as severe as from in his own mind to on his paper. So having him able to see the work being laid out how it should appear in his packet has been an immense help. Giving him, and all students, multiple forms of instruction help solidify learning and understanding material. Every student learns differently- some can simply listen to instruction and are ready to complete a task, others need to see what is being asked of them, and others still need to work with the material hands-on to retain the information and gain understanding. These students are no exception. Most of who are a combination of the various learning styles, so giving them multiple forms of instruction will help them retain the information. And in doing so, strengthen their learning and mathematical education and take it from the classroom to higher education or out in the workforce.

Another nice aspect of this packet is that it can be easily changed for a later assessment to monitor student learning and progress. Come back to it and see if students retained as much as you had previously thought when they first completed the packet. Change around the values, and even connect it to other lessons. Make sure the students really did learn the information and not just memorized it for the sake of passing the test. You could even make multi-part questions: give either the volume or surface area, ask students to find the other, and then using that maximize/minimize cost/materials/size/etc. **Lesson Title:** “Hazardous Waste”

**Unit Title:** Calculating volume and surface area

**Teacher Candidate:** Anna Cockrum

**Subject, Grade Level, and Date:** High School Algebra, Collection of Evidence, October 20, 2014

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| **Placement of Lesson in Sequence** |

This is the 1st lesson on the volume and surface area unit. This particular packet is the first of three. Each packet has questions worded similarly with change in specific values to demonstrate mastery and understanding of each question type.

**Central Focus and Essential Questions**

Students will be able to find volume and surface area based on the data they are given in their lessons. Can students calculate volume and surface area when given an edge length? Are students able to calculate volume given surface area and/or find surface area given volume? Do students know which exponent represents either volume or surface area? Can students use this information to find volume, area, and cost of materials in real-world applications?

**Content Standards**

CCSS.MATH.CONTENT.G-GMD: I can find volume and surface area of a square and/or rectangular object given an edge length, surface area, or volume.

[CCSS.MATH.CONTENT.HSG.MG.A.3](http://www.corestandards.org/Math/Content/HSG/MG/A/3/): Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).\*

*I can use what I know about surface are and volume to minimize cost of building material and/or maximize volume of a container.*

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| **Learning Outcomes (Objectives)** | **Assessment** |
| Students will be able to be able to find surface area and volume. | Before, during, and after the lessons, students were prompted with questions regarding the next steps in the lesson to see where students are, and how the lesson may need to be changed to accommodate the students’ needs. |

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| **Learning Targets** | **Student Voice** |
| Students can identify volume and surface area of square/rectangular objects. | I can calculate volume and surface area given an edge length. I can also calculate volume given surface area and vice versa. |

**Prior Content Knowledge and Pre-Assessment**

Students did not receive formal pre-assessments; they were prompted with questions before each lesson about what they knew about volume and surface area and finding one given the other.

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| **Academic Language Demands** | | |
| **Vocabulary & Symbols** | **Language Functions** | **Mathematical Precision, Syntax, & Discourse** |
| Surface Area  Volume  Cubic  Cube root  Square root | Students can calculate surface area and volume. Students can also find one given information about the other. | Students will be able to explain their answers, and the process they used by using appropriate language. |

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| **Language Target** | **Language Support** | **Assessment of Language Target** |
| Students will be able to identify and use appropriate language as necessary, and know they differ, and when to use each. | Students will be given opportunities to practice language everyday and show their understanding of appropriate use of language. | Students will be able to identify the proper use of mathematical language. |

**Lesson Rationale**

This lesson is targeted toward a small group of high school students who are on their last chance toward graduation. Most instruction for this lesson will be given verbally, if students receive too many directions at one time (written on the board or within the lesson) they have the tendency to pay less attention to the instructor and focus too much on what all is being asked of them to do.

This lesson teaches students how to calculate volume and surface area, apply real-world applications to the equations, and explain the reasoning and work behind their answers. The vocabulary we will focus on for this lesson is: surface area, volume, cubic, cube root, and square root. Previous vocabulary reviewed for this lesson was squared, cubed, exponents, length, width, and depth. The students are given both equations in two ways, the “easy way” and the “hard way”. The two sets of equations the students were given are: Volume: V=e\*e\*e or V=e3 and Surface area: SA= (l\*w) + (l\*w) + (l\*w) + (l\*w) + (l\*w) + (l\*w) or SA=6\*e2, and explained how and why this works in calculating volume and surface area.

**Differentiation, Cultural Responsiveness and/or Accommodation for Individual Differences**

This lesson was written for students who have various levels of mathematical ability and willingness to learn that cause them to easily lose focus and attention in a standard classroom setting. This class is built around students’ need to show evidence of algebraic understanding to graduate high school. By allowing the students to do hands-on lessons, it gives them the chance to understand the material on many levels: verbally with instruction, and visually by seeing it done as an example. By applying the material to real-world applications, students are able to get a sense of how these skills can be used outside of the classroom. Every student learns and understands material differently, so it is important to give students multiple ways of instruction to best math their learning style.

**Materials**

Lesson packet, calculator, and writing utensil

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| **Teaching & Instructional Activities** | | | |
| **Time** | **Teacher Activity** | **Student Activity** | **Purpose** |
| **x min.** | (Fill in using sentences.) | (Fill in using sentences.) | (Fill in using sentences.) |
| **15 min.** | Introduce equations, meaning, how to calculate each, and how to find one given the other. | Copy notes into notebook for use on the packet. | To make sure students know the required vocabulary, equations, and proper process for completing the task. |
| **35 min.** | Hand out lesson packet to students. Answer questions students have about assignment. | Complete the worksheet, asking questions as they go to strengthen understanding. | Get students started on lesson project, clear up any misunderstandings, and help make connections between lesson and how it can be applied in aspects of life. |

**Hazardous Waste!**

**Volume: V=e3**

**Surface Area: SA=6\*e2**

Use the equations to answer the following questions. As always, remember to show your work for full credit. Write explanations in complete sentences. Do not round answers until your final answer, then round to nearest hundredth.

1. Find the volume of a cube with edge length of 4 ft.
2. Find the surface area of a cube with edge length of 12 inches.
3. Find the surface area of a cube whose volume is 72 meters3.
4. Find the volume of a cube whose surface area is 185 ft2.
5. Given the surface area of a cubic container with a lid with side length measuring 12 feet, find a) the surface area and b) the volume.
6. A hazardous waste company wants to build a container that will hold 2,358,473 cubic liters. If you have 29,843 feet of plexi-glass, will you have enough material to build the container? Why or why not?
7. This same hazardous waste company now wants to build a container with a lid that can has a surface area of 845,285 meters2. What is the volume a container of this size can hold?

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1. A hazardous waste company wants to build a container that will hold 2,358,473 cubic liters. If you have 29,843 feet of plexi-glass, will you have enough material to build the container? Why or why not?

No, you would not have enough plexi-glass because the surface area of the container exceeds the amount of given plexi-glass.

1. This same hazardous waste company now wants to build a container with a lid that can has a surface area of 845,285 meters2. What is the volume a container of this size can hold?