**Lesson Title:** Is Coke Leaving Money on the Table?

**Unit Title:** Modeling with Geometry

**Teacher Candidate:** Alex Heide

**Subject, Grade Level, and Date:** High School Geometry

**Placement of Lesson in Sequence**

This is an activity that will allow for students to use their knowledge of surface area and volume and apply it to a real-world scenario.

**Central Focus and Essential Questions**

The students will be working to find the cheapest dimensions of a soda can and relate it to the dimension of a normal Coke can. This will allow for the students to question the choices made by big corporations as to why they leave money on the table instead of making the cheapest can.

**Content Standards**

[CCSS.Math.Content.HSG.MG.A.1](http://www.corestandards.org/Math/Content/HSG/MG/A/1/): Use geometric shapes, their measures, and their properties to describe objects.

[CCSS.Math.Content.HSG.MG.A.3](http://www.corestandards.org/Math/Content/HSG/MG/A/3/): Apply geometric methods to solve design problems.

[CCSS.Math.Content.HSA.CED.A.1](http://www.corestandards.org/Math/Content/HSA/CED/A/1/): Create equations in one variable and use them to solve problems.

[CCSS.Math.Content.HSA.CED.A.4](http://www.corestandards.org/Math/Content/HSA/CED/A/4/): Rearrange formulas to highlight a quantity of interest.

[CCSS.Math.Content.HSF.IF.C.7](http://www.corestandards.org/Math/Content/HSF/IF/C/7/): Graph functions expressed symbolically and show key features of the graph using technology.

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| **Learning Outcomes** | **Assessment** |
| Students will be able to:   * Calculate surface area and volume of different cylinders. * Use technology to find a height and radius that minimizes the surface area of a cylinder with a fixed volume. | The students will be assessed on the worksheet from the class website that they will have to turn-in electronically. They will be assessed on how accurate their mathematical steps, ability to follow directions, and personal insight on the real-world connections. |

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| **Learning Targets** | **Student Voice** |
| * I can find the surface area and volume of cylinders. * I can find the minimal cost of a surface area with a fixed volume of a cylinder. | Students will show their knowledge of finding the surface area of a cylinder by sharing their own data with the whole class. The student will also discuss as a whole class what they the minimal cost for a Coke can with a fixed volume and why Coke decided not to use this model. |

**Prior Content Knowledge and Pre-Assessment**

The students have learned how to calculate the surface area and volume of a cylinder from formulas. The students will also know how to solve one variable equations and create a graph from the collected data to make conclusions about the information found. The students will also have a greater knowledge of using Geogebra.

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| **Academic Language Demands** | | |
| **Vocabulary & Symbols** | **Language Functions** | **Precision, Syntax & Discourse** |
| * Math terms: Cylinder, Radius, Height, Volume, Surface Area | * Students will justify their lowest cost by relating the surface area to the radius of a fixed volume. | **Mathematical Precision:**  Students must use the surface area of a cylinder to find the lowest cost for a given volume.  **Syntax:**  Students must be able to explain how they calculate their radius and height with a given volume.  **Discourse:**  The students will collect data in a table that comes from their own inputs and the random class findings. The students will be able to use this data to explain what the lowest cost for a Coke can by using correct terminology in their responses during a class discussion. |

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| **Language Target** | **Language Support** | **Assessment of Language Target** |
| I can find the minimal cost of a surface area with a fixed volume of a cylinder. | Explain what different radii of a cylinder will do to the cost of a Coke can as well as find a minimal cost for the can. | This assessment will consist of each of the students’ participation of working on the activity and sharing their data with class along with the use of correct terminology as they explain what the most cost effective Coke can is. |

**Lesson Rationale (Connection to previous instruction and Objective Standards)**

This lesson will give students an understanding of how surface area and volume relate to the real-world along with building on the students’ knowledge towards achieving the Common Core State Standards by using a modeling activity with technology.

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

To accommodate for any individual differences within the class, the lesson activity will be based on how well the students are able to work with their peers. Also proper accommodations will be made to any student that has an IEP or 504.

**Materials – Instructional and Technological Needs (attach worksheets used)**

Student worksheets distributed online, scratch paper, and computers that have Geogebra previously downloaded.

**Name:**

**Part One:**

1. A can of Coke has a height of 12.1 cm and a radius of 3.1 cm. Calculate its volume, then come up with two new cans with the same volume.



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| Height | 12.1 cm |  |  |
| Radius | 3.1 cm |  |  |
| Volume |  |  |  |
|  |  |  |  |

1. Aluminum costs $0.00016 per square centimeter. From this rate, calculate how much it would cost to produce a standard Coke can and your Coke cans?



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| Surface Area |  |  |  |
| Cost |  |  |  |

**Part Two:**

1. Use Geogebra to plot the radius (x-axis) and the surface area (y-axis) from the data collected by the class. Create an function that will fit these points (Paste the scatter plot below)
2. From the graph you created above, what is the radius that would result in the least expensive can to produce? What is the height?
3. Coke sells approximately 19 billion cans per year in the United States. From this number, how much money does Coke make per year? How much could they save if they used the cheapest radius and height? Why do you think they choose their current soda can model?

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| **Teaching & Instructional Activities** | | | |
| **Time (Minutes)** | **Teacher Activity** | **Student Activity** | **Purpose** |
| 5 | The teacher will give a quick introduction of the in-class activity. | The students will get their computers from the computer cart and download the worksheet from the class website. | The students are able to learn what they are doing during class and get the required materials. |
| 35-40 | The teacher will assist students as they work on mathematical procedures and facilitate classroom discussions that may arise. | The students will collect data that is calculated among their peers and come up with their own reasons. | The students are able to perform the computational work. |
| 5-10 | The teacher will aid the students in a classroom discussion about student’s responses to the real-world implications of this activity. | The students will use their own reasoning to why Coke chooses to not use the cheapest soda can dimensions and how this model was decided upon. | The students can relate this activity to the real-world by discussing with their peers. |