**Externship Lesson PLan Bryce Johnson**

**West Albany High School**

**Volume and Surface Area in HVAC**

**Standard:** G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost)

**Objectives:** Students will learn to apply their knowledge of surface area and volume through designing a rectangular prism that meets the desired specifications. Students will also have the opportunity to extend their learning into an actual job related field.

**Professional Skills and Knowledge:** Collaboration, critical thinking, problem solving, and public speaking

**Academic Knowledge and Skills:** Geometry, Algebra, reading, and writing.

**Integration Possibilities:** This project is directly tied to job applications in the sheet metal industry all the way from design through construction a finished product.

**Project-Based Learning Opportunities:**

**Resources/Materials Needed:** Calculator, construction paper, scissors, and, scotch tape.

**Motivational Opener:** Guest speaker from a sheet metal installer or an HVAC technician. Speaker will give a 10 minute presentation on their job, how to get started in the industry, and what the pay and benefits are.

**Learning Activities:** After hearing from the guest speaker, students will be randomly placed into groups of four.

-Each group will be directed to design a rectangular prism that has a volume between 540 and 560 cubic inches. This prism will represent an air intake, typically made out of sheet metal, for an air duct system.

-After designing their prism, groups will need to figure out how much sheet metal, aka construction paper, that they will need to construct their rectangular prism.

-After determining their amount of material there prism requires, they will be asked to calculate the price of their product based on the amount of material they are using and the average price of sheet metal.

-After realizing the cost of their design, students will be challenged to alter their design to minimize the cost of their component that they are creating. By adjusting the length, width, or height of their component they might be able to lower the amount of surface area they are using while still maintaining the required amount of volume.

-Once a group has decided on their final design and dimensions of their product, one group member will collect the amount of construction paper needed to actually construct a model of their component.

-Each group will then present their finished project as well as discussing the volume, surface area, and price of their component.

**Homework:** For homework students will be asked to design a cylinder component that falls in the same volume range, 540 to 560 cubic inches, and then compare and contrast the surface area and price of the cylinder they designed compared to the rectangular prism design that they created in class.

**Assessment/Culminating Project/Evaluation:** Students will be asked to determine the volume and surface area of a variety of air duct components.

**Closure:** By the end of this lesson students should not only have a better understanding of how to determine the volume and surface area of a prism or cylinder, but also have a better understanding of how changing the dimensions of an object will alter the volume and the surface area.

Students will also gain a better understanding or a real world application of how these concepts are being applied on a daily basis in the HVAC industry.

**Lesson Plan Reflection:** I hope that this lesson plan will be a start at showing students how and why the skills they are learning in their math classes can directly translate to skills that are being used in a variety of industries.

**\*Below is work sheet that should guide groups through the lesson plan. Followed by an example of a possible homework assignment.**

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_ Class \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Today you are becoming an honorary member of the HVAC industry. Specifically you will be learning an aspect of the job required by HVAC installers who design and construct air ducts out of sheet metal. Your task is to work with your group to design a rectangular prism that fits the specific requirements that are requested by the plans for the building you are working on. After hearing the presentation from your guest speaker, please complete the following tasks.

1. Design a rectangular prism that has a volume in the range of 540 to 560 cubic inches.

Length\_\_\_\_\_\_\_\_\_ Height\_\_\_\_\_\_\_\_\_\_ Width\_\_\_\_\_\_\_\_\_\_

Volume of your prism \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Determine how much material would be required to build the component that you just designed (Hint: Think surface area).

Amount of material required \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. The metal you would be using to construct your component would cost $0.17 per square inch. Determine the price of the materials for your component.

Price \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. **CHALLENGE!** As the group the challenge now is to go back to your original design and see if you can change the dimensions of your rectangular prism to produce the cheapest possible product while still fitting into the volume requirements of 540 to 560 cubic inches. By adjusting the length, width, and or height of your prism, try to design a component that will be the cheapest possible component that you can build.

Lenght\_\_\_\_\_\_\_\_\_ Width\_\_\_\_\_\_\_\_\_\_\_ Height\_\_\_\_\_\_\_\_\_\_\_

Volume\_\_\_\_\_\_\_\_\_\_\_\_

Surface Area\_\_\_\_\_\_\_\_\_\_\_\_

Cost of Material \_\_\_\_\_\_\_\_\_\_\_

5. Once you have finalized your design, send one group member to to collect the amount of sheet metal(AKA CONSTRUCTION PAPER), that you will need to build your component. Use a ruler to build your component as close to the exact dimensions you designed as possible.

6. Once your component is complete, be prepared to present your project so the class to see which group was able to produce the cheapest product that meets the desired specifications.

HOMEWORK!

1. Now design a cylinder component that falls in the same volume range, 540 to 560 cubic inches.

Length\_\_\_\_\_\_\_\_\_\_ Diameter\_\_\_\_\_\_\_\_\_\_\_\_

2. Determine the Volume and Surface area of your cylinder, then calculate the price of material at the same cost of $0.17 per square inch.

Volume\_\_\_\_\_\_\_\_\_\_ Surface Area\_\_\_\_\_\_\_\_\_\_\_\_

Price\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Compare and contrast the surface area and price of the cylinder that you design to the rectangular prism design that you group created in class.

Would it make more sense to use a cylinder or a rectangular prism to produce this type of component?