Teacher: School: Grade Level: 5th

1. Begin with the End in Mind- Student Outcomes

Content Focus Areas

Math**:** Developing an understanding of Volume

Science**:** Understand the relationship between force and motion. (gravity, friction, effects of forces on an object, simple machines, applied forces)

ELA**:** Writing - (Opinion from Evidence)

Social Studies**:**

Content Standards

Math Standards**:** 5.MD.5a Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent three-fold whole-number products as volumes, e.g., to represent the associative property of multiplication., 5.MD.5b Apply the formulas V =(l)(w)(h) and V = (b)(h) for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems., 5.MD.5c Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems.

Science Standards**:** S3-C2-PO 3. Design and construct a technological solution to a common problem or need using common materials., S5-C2-PO 1. Describe the following forces: gravity, friction, S5-C2-PO 3. Examine forces and motion through investigations using simple machines (e.g., wedge, plane, wheel and axle, pulley, lever)., S5-C2-PO 4. Demonstrate effects of variables on an object's motion (e.g., incline angle, friction, applied forces).

ELA Standards**:** 5.R.I.9 Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably., 5.W.9 Draw evidence from literary or informational texts to support

analysis, reflection, and research.

Social Studies Standards**:**

Anticipated Mathematical Practices: Reason abstractly and quantitatively., Model with mathematics.	Where will the Mathematical Practices be evident? When students pack their feeder containers with volume unit cubes they are taking an abstract concept like volume, and making it more quantitatively. It will be more concrete to count the unit cubes to represent the actual volume of food their feeder will hold. They will be modeling with mathematics when they determine the volume.
Anticipated Science and Engineering Practices: Asking questions (for science) and defining problems (for engineering), Constructing explanations (for science) and designing solutions (for engineering)	Where will the Science Practices be evident? The students will be asking questions and defining problems when they research the dangerous animals they will be having to feed. They will use the volume measurements, and simple machines to design a solution to this problem.
Anticipated ELA Student Capacities: They build strong content knowledge., They value evidence.	Where will the ELA Student Capacities be evident? Students build strong science content knowledge during this project when they research the eating habits of the animals for which they are building the feeder. They will also learn about forces and motion and how to use simple machines to perform a task requiring an application of forces and motion. Students will value evidence as they present and defend the effectiveness of their prototype for their identified animal.
21st Century Skills Addressed: Critical Thinking, Problem Solving	Where will the 21st Century Skills be evident? Students will exhibit problem solving skills when they define the problem and design a solution based on research, math and science concepts. They will think critically as they analyze constraints, test prototypes and redesign. Students will be writing their ideas in an engineering journal, the teacher will use it to evaluate their critical thinking during design discussions and prototype evaluations.

Plan the Assessment

List Teacher/District Generated Assessments:
(ex, Galileo, Beyond Textbooks, Scantron, ALEX, STAR)

Beyond Textbooks Volume Formative (District Assessment Plan) Galileo Formative Simple Machines (Teacher Developed from Item Bank)

List any Rubrics to be used for assessment in this Project:

Design Rubric for Prototype (to evaluate knowledge of simple machines and animal constraints) Critical Thinking Rubric (evidence of criteria collected during group discussions and in engineering journal)

List any Self- Assessments in this Project:

Students will self assess their presentation for science and math content. Self assessment for problem solving using rubric.

2. RAP- Role, Audience, Products

Summary of Project Idea:

Students will be presented with the problem of having to feed dangerous animals with an automatic feeding system that will keep the animal keeper safe. Students will be placed in small groups and assigned a different dangerous animals that are often kept at zoos. Students will research their dangerous animals to begin identifying constraints. The problem of designing a feeder that addresses all the constraints including how much they eat (volume), how often they eat, the forces they can apply to feeding container, distance a person can safely approach, will all be used to design a prototype automatic feeder. Volunteer mechanical engineers will be asked to provide expert knowledge and assistance to students as they develop their prototypes. Students will present their final prototype to zoo officials.

Authentic Role:

Students will assume the role of engineers, working with animal trainers and zooligists.

Authentic Audience:

Students will present their design to Phoenix zoo officials and animal experts.

Products:

The culminating product will consist of either a working prototype, a scale model prototype, or a computer designed simulation prototype and a presentation to an expert panel explaining their design. Other Products: Students will research animals on eating habits and dangers to humans. these notes will be collected and used as evidence for the design of their feeding system. Sketches of models and blueprints will be collected as the students design and redesign. An engineering journal will be kept by all students with entries on reasoning for design specifications and feedback on design efficiency. Students will also interview zoo keepers to gather primary source evidence on animals eating habits and dangers. These will also be collected as a product.

Driving Question: How do we as engineers, design a safe and efficient feeding system to feed dangerous animals?

3. MAP the Project

List Task/Activities Attached
Unit Duration: 4 Weeks
Storyboard: Attached
Student Groupings: Students will be placed in groups of 4. Each group will be assigned a different dangerous animal. Students will rotate roles in their groups to ensure differentiation: Researcher, Mathematician, Engineer, Presenter
Resources/Personnel: Video clip, student journals, ipad sets, computer time reserved, building materials (cardboard paper, foil, aluminum, steel, etc.) levers, pulleys, twine, scissors, glue gun, containers of various sizes and shapes. simulation software. Personnel: Contact Zoo officials, Computer lab teacher, volunteer engineer

4. RUN the Project:

Share Project Goals: After posing the problem we will share the learning project goals with students. After the development of each product and stage, we will stop to revisit the goals. After the final product and presentation we will also revisit the goals and progress toward them. All goals will be communicated in relation to the driving question and culminating product

Describe Project Launch:

Show a video clip of animal trainer in a lion cage feeding lions with a bucket and pause before they attack him. Have a discussion about if this is a good idea to be in there. Next pose the problem of "Could we design a feeder that could feed the animals safely and not put humans in harms way?"

Evaluate Using Checkpoints:

To ensure that students are on pace to complete final product development and to ensure quality benchmarks are met. Assessments will be used as checkpoints for learning goals as well. Examples include, Research notes, sketches, journal entries, district assessments, prototypes. Students will use the above mentioned checkpoints to evaluate and self assess progress toward learning goals and culminating product. Teachers will use the checkpoints to evaluate and assess students on learning goals and to develop reteach and intervention opportunities. Teacher will also self assess the usefulness of the intermediate products

Reflection and Celebration:

Students presenting their ideas to an expert panel will serve as celebration of learning and the product completion. Teacher will set up a display opportunity at the zoo so that students' work is shared with the community.