

Lisa Holt-Taylor  
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The E in Engineering

Parameters: Phase I – Research and Planning –

### **1. Identify the “Big” concept to be covered by the engineering design challenge.**

NASA in the year 2020 will be sending astronauts to the moon and they will need a moon rover to travel around the moon. The student engineer is asked to create a moon rover or vehicle for easy travel using wind energy.

First, students are asked to develop a balloon car as a prototype for traveling around the area. The balloon car must be able to travel in a straight line, travel at least 3 feet, and be foldable for easy storage. In part 2, this prototype will be altered to accommodate the conditions found on the moon (less friction and rocky and dusty terrain).

In part one, questions the student engineer must consider include:

- o How does a wheel and axle works?
- o How does the size and shape of a wheel affect the traveling of the vehicle?
- o How does the amount of released air affect the movement of a prototype balloon car or moon rover?
- o How does the moon’s surface affect the travel of the rover?
- o How does the weight of the vehicle when on the moon affect the amount of friction? If there is less friction, how does the vehicle need to be altered?

## **2. Research appropriate learning standards associated with the topic.**

### **Social Studies:**

CS 1 Events in local history can be year, decades, and centuries.

CS 2 Primary sources such as artifacts can be used to show change over time.

CS 3 Local communities change over time.

CS 6 Evidence of human modification of the environment can be observed in the local community.

CS 5 Daily life is influenced by agriculture, industry, and natural resources in different communities

CS 7 Systems of transportation and communication move people, products and ideas from place to place.

CS 10 Individuals make the community a better place by solving problems in a way that promotes the common good.

### **Ohio Science Standards**

3.ESS.2: Earth's resources can be used for energy.

3.PS.1: All objects and substances in the natural world are composed of matter

3.ESS.2: Earth's resources can be used for energy

### **Ohio Technology Standards**

Topic 2: Identify a problem and use an engineering design process to solve the problem

Topic 3: Explain how technology, society, and the individual impact one another.

### **Literacy**

RL.3. Describe the connection between a series of historical events, scientific concepts, or steps in technical procedures in a text.

EP5. Build upon the ideas of others and articulate his or her ideas when working collaboratively.

### **3. Identify and discuss the different types of problem solving and declarative/procedure knowledge needed.**

It has been my experience that many elementary engineering projects feel more like tinkering project and lack declarative knowledge in their implementation. I hope to incorporate different science content centered around the physical science topics of wheel and axles (simple machines), friction, gravitational pull, mass (versus weight), wind energy and potential versus kinetic energy.

Next, the student will explore how the Earth's atmosphere and surface is different than the moons and what accommodations need to be made on the lunar land rover to accommodate this.

Procedural knowledge would be students working through the engineering design process. Students will investigate various scientific inquiry questions which include:

- Determine which shape and sizes of wheels (and axles) work best.
  - o What size of wheel allows the rover to move travel the longest distance?
  - o How does the shape of the wheel affect the distance traveled?  
  
(From this data, students will determine what would be the best wheel to use on their rover.)
- How does fastening the balloon to different places on the balloon affect the distance the rover can travel?
- What distance will the rover move when using a 5 in., 9 in. or 11 inch balloon? If a second balloon is added, how will this affect distance?

- Lastly, students then research the atmosphere and surface of the moon and determine what will or will not work given the conditions of each. Student will determine what revisions will be needed
    - o Note: Typically air tires will explode due to the lack of air, so how will this impact the balloon? What other energy producing source can be used?
    - o How will lunar dust and the moon's rock surface affect the rover's tires?
    - o How will the weight affect the glide or movement of the tires?
    - o Ending the unit, the students make some revisions due to the moon's atmosphere and surface.
3. Explore objectives and ancillary concepts/content covered by the project.

Students research and gather information through a small video collection found at [holttayloengineering.weebly.com/car.html](http://holttayloengineering.weebly.com/car.html) in the area of Social Studies by beginning the project with biographies about Henry Ford and Thomas Edison and their impact. Henry Ford and the building of the car is further studied.

## **5. Identify possible activities.**

A year ago I tried the program "Go Green: Engineering Recycled Racers" from Engineering is Elementary program and felt this program did not have enough content or declarative knowledge to justify the time. When looking through other STEM units I came across a unit from Picture Perfect Stem for Grades 3-5 titled "The Inventor's Secret" and liked the literacy piece and social studies content tie in but was not quite satisfied with their written piece. After exploring the Design Squad Global PBS Kids Roving on the

Moon, I felt the third graders might really enjoy this although it was intended for the older middle school. I am attempting to combine the Picture Perfect “Inventor’s Secret” with the Design Squad’s Global “Roving on the Moon” adding our social studies curriculum and literacy curriculum to provide an enriching unit for this differentiation block.

**Part one:** Students will study some of the first cars and how technology has advanced. Students look closely at the wheel and axle of a car. Then students are asked to design a balloon car that can travel in a straight line, go at least 3 feet and can fold in for easy storage. This car is powered by an air source (balloon).

**Part two:** Students will take what they know about a car and design a rover for the moon after researching about the moon’s surface and atmosphere. Students will try different types of wheels (squares, triangles, and other shape) and test which works best for creating traction. Students will attach the car to a rocket for transporting to the moon. Students will end the unit looking at the energy source used and if it this is an appropriate energy source to be used at the moon.

## **6. Select the best activity for your classroom.**

Presenting this unit, I decided incorporated social studies standards in this engineering and a science unit. Looking back at my teaching of social studies, I feel presenting it this way will give this part of my social studies curriculum more meaning than in previous years. This unit is a combination of material found in the Engineering is Elementary lessons found in “Go Green: Engineering Recycled Racers”, Picture Perfect STEM Lessons, 3-5 the activity called “The Inventor’s Secret”, and the Design Squad Global “Roving On the Moon” activity.

I chose to complete this activity during a student differentiation block with 12 children. I was instructed by the district to use this

differentiation block to extend the curriculum as well as to incorporate more literacy into this block.

Typically I teach science and social studies 70 min. daily and have an additional 45 minutes for differentiation. I will use this 45 min slot to present this unit.)