### UNIT DESCRIPTION:
This STEM unit focuses on the Engineering Design Process (EDP) and should be implemented at the end of a Forces and Motion unit. Possible forces and motion lessons to teach prior to this EDP project are included. After students gain knowledge about forces and motion, they then apply their scientific knowledge to engineering a bottle rocket that will travel to great heights.

### Big Ideas (Student Insights that Will Be Developed Over the Course of the Unit):
The motion of an object can be changed by a force (push or pull). Force can be seen all around us. Wind pushes and pulls trees and earth materials around, lava pushes through the earth’s surface, and living things use forces to keep their bodies alive. Force is very important to our lives. In this unit students will be collecting data while observing forces in motion. Students will engage in the scientific and engineering processes.

### Essential Questions (Questions that Will Prompt Students to Connect to the Big Ideas):
- How do forces affect us?
- What is the Scientific Inquiry Process?
- Why is the Scientific Inquiry Process important for us to practice?
- What is the Engineering Design Process?
- How does the Engineering Design Process help us?
- Why is being able to shoot a rocket into space important to our lives?
<table>
<thead>
<tr>
<th>BENCHMARKS/STANDARDS/LEARNING GOALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Science</strong></td>
</tr>
<tr>
<td>SC.1.1.1 Collect, record, and organize data using simple tools, equipment, and techniques safely</td>
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<tr>
<td>SC.1.1.2 Explain the results of an investigation to an audience using simple data organizers (e.g. charts, graphs, pictures)</td>
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<tr>
<td>SC.1.7.1 Describe how the motion of an object can be changed by force (push or pull)</td>
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<tr>
<td><strong>Technology</strong></td>
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<tr>
<td>Standard 1: TECHNOLOGICAL DESIGN: Design, modify, and apply technology to effectively and efficiently solve problems</td>
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<tr>
<td><strong>Mathematics</strong></td>
</tr>
<tr>
<td><strong>Supporting Common Core MATH Standards:</strong></td>
</tr>
<tr>
<td>CCSS.Math.Content.1.MD.A.2 Express the length of an object as a whole number of length units by laying multiple copies of a shorter object (the length unit) end to end; understand that the length measurement of an object is the number of same-size length units that span it with no gaps or overlaps. Limit to context where the object being measured is spanned by a whole number of length units with no gaps or overlaps.</td>
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<tr>
<td>CCSS.Math.Content.1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.</td>
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<tr>
<td><strong>English Language Arts and Literacy</strong></td>
</tr>
<tr>
<td><strong>Supporting Common Core LANGUAGE ARTS Standards:</strong></td>
</tr>
<tr>
<td>CCSS.ELA-Literacy.SL.1.1 Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.</td>
</tr>
<tr>
<td>CCSS.ELA-Literacy.W.1.8 With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.</td>
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<tr>
<td><strong>STEM Competencies</strong></td>
</tr>
<tr>
<td>Indicator 2.2: Collaborates with, helps and encourages others in group situations</td>
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<tr>
<td>Indicator 4.1: Recognizes and understands what quality performances and products are</td>
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<tr>
<td>Lesson Title/Description</td>
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<tr>
<td>1 Forces and Motion</td>
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<td>2 Lift Off Scientific Inquiry Process</td>
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<td>3 Build a Rocket Engineering Design Process</td>
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</tbody>
</table>
Unit Title: Forces and Motion  
Lesson Title: Forces and Motion  
Date Developed/Last Revised: 6/5/13  
Unit Author(s): JoAnn Ishida  
Lesson: 1  
Grade Level: 1  
Primary Content Area: Science  
Time Frame: 45 minutes

### PLANNING (Steps 1, 2, & 3)

1. **Standards/Benchmarks and Process Skills Assessed in this Lesson:**
   - **SC.1.7.1** Describe how the motion of an object can be changed by force (push or pull)

2A. **Criteria- What Students Should Know and Be Able to Do:**

   Students will know ...
   - Motion is movement
   - A force is a push or a pull

   Students will be able to ...
   - Create motion with their bodies and observe objects in motion
   - Change the motion of objects using a force

2B. **Assessment Tools/Evidence:**

   **Formative:**
   - Teacher Observations/Discussions

   **Summative:**
   - Summative Assessment on Motion
   - Summative Assessment on Force

3. **Learning Experiences (Lesson Plan)**

   **Procedure:**

   What is motion?
   - Teacher discusses examples of motion created by our bodies. (walking, running, jumping, hopping, skipping, swimming, etc.)
   - Students demonstrate various motions with their bodies.
   - Teacher demonstrates various motions created by objects. (rolling, sliding, lifting, etc.)
   - Students play with various toys/models that move.
   - Elicit the definition of “motion” from the students. (Motion is movement. Motion occurs whenever something changes place or moves.)

   **Summative Assessment on Motion:**
   What is motion? Draw an example of something in motion. Explain the motion that is occurring in your picture.
What is force?
- Introduce the words “push” and “pull.”
- Have students use their body parts to push or pull objects/toys across the floor (cars, balls, tables, etc.)
- Elicit the definition of “force” from the students. (a force is a push or pull)
- Discuss which “force” is moving the object. (push or pull)

Worksheet Example:

<table>
<thead>
<tr>
<th>Action</th>
<th>What object is being moved?</th>
<th>What force is being used?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roll ball across the floor</td>
<td></td>
<td>Push or pull</td>
</tr>
<tr>
<td>Open a desk drawer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lift box off the floor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summative Assessment on Force:
What is force? Draw an example of someone using force. Label the type of force being used on your drawing. (Example: someone pulling a wagon)

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place
4. Teaching and Collecting of Evidence of Student Learning:
   Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
   Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
   Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
   Teacher Notes:
**Unit Title:** Forces and Motion  
**Lesson Title:** Lift Off Scientific Inquiry Process  
**Date Developed/Last Revised:** 6/6/13  
**Unit Author(s):** JoAnn Ishida, Lynn Lum  
**Lesson #:** 2  
**Grade Level:** 1  
**Primary Content Area:** Science  
**Time Frame:** 3-4 45-minute sessions

### PLANNING (Steps 1, 2, & 3)

**1. Standards/Benchmarks and Process Skills Assessed in this Lesson:**
- **SC.1.1.1** Collect, record, and organize data using simple tools, equipment, and techniques safely.
- **SC.1.1.2** Explain the results of an investigation to an audience using simple data organizers. (e.g. charts, graphs, pictures)

Supporting Content Standard:
- **SC.1.7.1** Describe how the motion of an object can be changed by force (push or pull)

**2A. Criteria- What Students Should Know and Be Able to Do:**
Students will know ...
- People use their five senses to make observations
- The motion of an object can be changed with a push or a pull

Students will be able to ...
- Use their five senses to make observations
- Observe the forces of rocket propulsion through the Scientific Inquiry Process

**2B. Assessment Tools/Evidence:**

**Formative:**
- Teacher Observations/Discussions

**Summative:**
- Lift Off Scientific Inquiry Process Journal (Use Scientific Method Rubric for Gr. 1)

**3. Learning Experiences (Lesson Plan)**

**Materials:**
- Small, medium, and large plastic squeeze bottles (1 set per team is ideal. Each team would need to test with the same set of squeeze bottles to control the variables. Suggestions: dishwashing liquid bottles with squeeze tops)
- Small paper cups that fit nicely on top of smallest bottle (1 per set of bottles)

**Handouts/Other Resources:**
- Lift Off Scientific Inquiry Process Journal (1 per student)
- Scientific Method Rubric for Gr. 1
Materials:
- Small, medium, and large plastic squeeze bottles (1 set per team is ideal. Each team would need to test with the same set of squeeze bottles to control the variables. Suggestions: dishwashing liquid bottles with squeeze tops)
- Small paper cups that fit nicely on top of smallest bottle (1 per set of bottles)

Handouts/Other Resources:
- Lift Off Scientific Inquiry Process Journal (1 per student)
- Scientific Method Rubric for Gr. 1

Procedure:
Pre-assessment of the Scientific Inquiry Process
Ask students:
- What are scientists? What do they do? How do scientists find answers to questions they have about the world?
- What is the Scientific Inquiry Process? Responses will be recorded on a class KWL chart.

Scientific Inquiry Process
Distribute “Lift Off Scientific Inquiry Process Journal” to each student. (The class will go through each step of the process together with teacher.)

Step 1: Make Observations
- Students record observations in journal.
- Why is being able to shoot a rocket into space important to our lives?

Step 2: Ask Questions
- Students ask questions based on their observations. Ex. What is making the rocket fly upwards? What force is making the rocket move up? How much force does it need to make that heavy rocket move up?

Step 3: Gather Information
- Optional: Read more on forces and motion if students need more exposure. Discuss possible answers to the questions above with students.

Go back to Step 2: Ask Questions:
- Show students the paper cup “rocket” and the 3 squeeze bottle “launchers.”
- Have students ask more questions and record them on their journals.
- Ask students:
  - Which of their questions are researchable? (Researchable means that students are able to set up an experiment that would answer their question with evidence/data.)
- Choose/Give the research question that students will be working on together as a class. (You may do other experiments with the class later.)
Research Question: Which launcher will make the rocket fly the highest?

Step 4: Make a Hypothesis
- Students write a hypothesis.
  Example:

  If plastic bottles of different sizes are used to launch the rocket, then the rocket will go farthest with the largest bottle because the large bottle is holds the most air.

Step 5: Design the Study to Conduct the Experiment
- Read the step-by-step procedures.
- Make sure students understand what they are going to be doing.

Step 6: Analyze the Results
- Collect and record data onto the data table in the Scientific Inquiry Process Journal.
- Analyze data by answering the questions located below the table.

Step 7: Discussion and Conclusion
- Was the hypothesis supported or not supported?
- Why did this happen? (force not strong enough, not enough air in bottle, couldn’t squeeze it because plastic is too hard, etc.)
- Discuss discoveries and new knowledge.
- Discuss new questions.

Complete KWL Chart. Discuss the components of the Scientific Inquiry Process.

<table>
<thead>
<tr>
<th>TEACHING &amp; ASSESSMENT (Steps 4, 5, 6, &amp; 7)</th>
<th>Completed by teacher after instruction has taken place</th>
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<td></td>
</tr>
<tr>
<td>Teacher Notes:</td>
<td></td>
</tr>
</tbody>
</table>
STEP 1: Make Observations:

1. _____________________________________________
2. _____________________________________________
3. _____________________________________________

STEP 2: Ask Question(s): Mark the questions that are researchable.

________________________________________________
________________________________________________
________________________________________________
________________________________________________

Research Question that our class will be working on together:

________________________________________________

STEP 3: Gather Information:

________________________________________________
________________________________________________
________________________________________________
________________________________________________
________________________________________________
STEP 4: Make a Hypothesis:

If ____________________________________________________________

then __________________________________________________________

because _______________________________________________________

STEP 5: Design the Study to Conduct the Experiment:

Materials Needed:
  • Plastic cups that fit on launchers
  • Construction paper
  • Markers
  • Glue
  • Tape
  • Scissors

Procedure:
Step 1: Place cup on top of small launcher.
Step 2: Squeeze small launcher and measure how high the rocket flies upward.
Step 3: Record your data on the table below.
Step 4: Place rocket on top of medium launcher.
Step 5: Squeeze medium launcher and measure how high the rocket flies upward.
Step 6: Record your data on the table below.
Step 7: Place rocket on top of large launcher.
Step 8: Squeeze large launcher and measure how high the rocket flies upward.
Step 9: Record your data on the table below.
STEP 6: Analyze the Results:

Data Table 1: Height of Rocket Lift-Offs

<table>
<thead>
<tr>
<th></th>
<th>Small launcher</th>
<th>Medium launcher</th>
<th>Large launcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Trial 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What is the highest height for the small launcher?
What is the highest height for the medium launcher?
What is the highest height for the large launcher?

Which launcher made your rocket fly the highest? Why?

______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

Step 7: Discussion and Conclusions:

From my data, the hypothesis I made was (supported or not supported).

______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________

I know this because the cup ____________________________________________________________

I think this happened because ________________________________________________________
New questions that I now have...

What did you learn about forces and motion?

**Big Idea:** Why is being able to shoot a rocket into space important to our lives?

Be prepared to share your conclusions with the class.
# Scientific Method Rubric

<table>
<thead>
<tr>
<th>SC.1.1.1: Collect, record, and organize data using simple tools, equipment, and techniques safely</th>
<th>Advanced</th>
<th>Proficient</th>
<th>Partially Proficient</th>
<th>Novice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect, record, and organize data accurately, using a variety of simple tools, equipment, and techniques safely</td>
<td>Collect, record, and organize data using simple tools, equipment, and techniques safely</td>
<td>Collect, record, and organize data using simple tools, equipment, or techniques safely, with assistance</td>
<td>Collect, record, and organize data safely, with much assistance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SC.1.1.2: Explain the results of an investigation to an audience using simple data organizers (e.g., charts, graphs, pictures)</th>
<th>Advanced</th>
<th>Proficient</th>
<th>Partially Proficient</th>
<th>Novice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearly explain, in detail, the results of an investigation to an audience using data organizers</td>
<td>Explain significant results of an investigation to an audience using simple data organizers</td>
<td>Explain, with assistance, the results of an investigation to an audience</td>
<td>Explain, with much assistance, a part of an investigation to an audience</td>
<td></td>
</tr>
</tbody>
</table>
## PLANNING (Steps 1, 2, & 3)

### 1. Standards/Benchmarks and Process Skills Assessed in this Lesson:
- CTE Standard 1: TECHNOLOGICAL DESIGN: Design, modify, and apply technology to effectively and efficiently solve problems

### 2A. Criteria- What Students Should Know and Be Able to Do:
**Students will know ...**
- The six steps of the Engineering Design Process

**Students will be able to ...**
- Use the Engineering Design Process to design a rocket that will fly the highest

### 2B. Assessment Tools/Evidence:
**Formative:**
- Teacher Observations/Conversations

**Summative:**
- Build a Rocket Engineering Design Process Journal
- Engineering Design Process Summative Assessment
- Engineering Design Process Reflections
- Engineering Design Process Rubric

### 3. Learning Experiences (Lesson Plan)
**Materials:**
- Small cups (1 per team)
- Large plastic squeeze bottle as the launcher (e.g. dishwashing liquid squeeze bottle)
- Construction paper
- Glue
- Scissors
- Balance/digital scale to weigh the rocket

**Handouts/Other Resources:**
- Build a Rocket Engineering Design Process Journal
- Engineering Design Process Rubric
- Engineering Design Process Reflections
- Engineering Design Process Summative Assessment
**Procedure:  
Before the lesson**  
Make a launching pad site. The site should be located next to a wall with an “X” to mark the spot where the “launcher” (squeeze bottle) will be set. Place a measuring tape on the wall behind the pad site for students to measure the height of the lift-off. To measure the distance of the flight upwards, position the measuring tape so that it is above the cap of the launcher. Students can take the measurement to the nearest inch or unit of measure.

**Pre-assessment of the Engineering Design Process**  
Ask students:
- What is an engineer? What do they do? How do they design/improve models that help solve the problems in our world?
- What is the Engineering Design Process? Responses will be recorded on a class KWL chart.

We have just learned about forces and motion. In this lesson, students will be engineering a rocket that can fly upward with the force of air from a squeeze bottle.

**Engineering Design Process**
- Pass out a “Build a Rocket Engineering Design Process Journal” to each student. Note that the class will go through each step of the process together. Stop after each step to discuss what the students did and the criteria needed. Teacher may refer to “Engineering Design Rubric” to help guide discussions. Do the number of steps you feel your students can handle in the time allotted. It may take 1 day or many days to go through and understand these steps. Don’t worry… it’s the process that’s important.

- Just as they would in the real world, assign students to work with a partner. Note: Although students are part of a team, each student is responsible for completing each part of their own engineering design process journal. The team is there to help brainstorm, share ideas, and create one product, but each student must participate and contribute their individual ideas to help the group.

- Read performance task to students...

**Performance Task**  
NASA needs your help! There’s something wrong with a satellite that is circling Earth. You are a rocket engineer and your assignment is to design a rocket that will fly high into the sky to reach that satellite. Your rocket will be tested with a launcher to see how high it goes upward. Good luck on your mission! The people on Earth are counting on you!
Step 1: Ask
- Read the criteria/constraints to the students.
- Show students the materials available to create their rockets. Consider keeping all of the materials on a “materials station” for easy access.
- Show students the launcher that will be used to test their rockets.
- Have students identify and write in their journals:
  - the problem of the performance task
  - what they are creating
  - Have students write further questions they may have about constructing this rocket
  - Have students share questions with the class for teacher to answer

Stop and go over the criteria for the “Ask” section of the process. Teacher monitors student learning by recording observations of the questions students are asking. (See Engineering Design Process Rubric)

Step 2: Imagine
- Instruct students to independently brainstorm ideas for building a rocket and draw or write out ideas in their journal.
- After each student has the chance to express their own ideas, encourage them to discuss their ideas with the rest of the engineering team. Students should defend their reasons for using specific ideas from their prototype. (Ex. Lightweight so rocket can shoot higher into the air)
- Tell students that each engineering team may then decide on ONE person’s design to use or create ONE new hybrid idea incorporating all the differing ideas.

Stop and go over the criteria for the “Imagine” section of the process. Teacher monitors student learning by recording observations of the ideas students are generating. (See Engineering Design Process Rubric)

Step 3: Plan
- Designate one person to sketch a diagram of the team’s “rocket” prototype onto a piece of paper. This sketch should include labels for each of the parts and possible measurements. The sketcher must be sure to incorporate all the agreed upon ideas into the design. Students then list all possible materials that will be needed to create the prototype.
- Inform students that when all team members are satisfied with the prototype design, each member should copy this diagram of the rocket onto their own journals.
- Instruct team members to check with each other to see if all drawings and labels are completed and everyone has the same plan to follow.

Stop and go over the criteria for the “Plan” section of the process. Teacher monitors student learning by recording observations of the plan students are creating. (See Engineering Design Process Rubric)
**Step 4: Create**
- Instruct students to follow their team plan as closely as possible when building their prototype. If they are modifying their original prototype to make their prototype work, guide students to be sure each person writes down and adds that information to their journal diagram plans as well.
- Ask teams to share their prototype rocket to the large group, stating what modifications were made to the plan and why.

Stop and go over the criteria for the “Create” section of the process. Teacher monitors student learning by recording observations to see if students are following/modifying their plans. (See Engineering Design Process Rubric)

**Step 5: Experiment** Test it out!
- Measure the weight of your rocket.
- Bring your rocket to the launching pad.
- Place rocket on bottle and squeeze!
- Measure the height that the rocket flew.
- Log data onto student journals. Circle the trial with the highest height.

Have teams share out their data and the reasons for their results to the class. Teacher may chart the heights of each rocket for all students to see and compare. (Students will be learning from each other and using other people’s ideas, as well as their own, as they are improving upon their prototype)

Stop and go over the criteria for the “Experiment” section of the process. Teacher monitors student learning by recording observations of how students collected and analyzed their data. (See Engineering Design Process Rubric)

**Step 6: Improve**
- Have each team review the results of their data.
- Repeat the EDP to optimize the product. Students would continue to record the following in their journal...
  - Ask: What worked? What didn’t work? Why?
    Fill in “Things to consider” part of the journal. This helps the students to think about certain aspects of their rocket that they may not have thought of that they may want to change in the redesign. Students write their ideas on how they are going to modify their rockets.
  - Imagine: Which variables will they change to make their rocket fly higher? What’s the rationale for the changes?
o Plan: Draw the diagram of the team’s 2nd prototype. Label the parts with measurements.

o Create: Build your second prototype following your team’s design. Keep to the plan.

o Experiment:
  o Measure the weight of your rocket.
  o Bring your rocket to the launching pad.
  o Place rocket on bottle and squeeze!
  o Measure the height that the rocket flew.
  o Log data onto student journals. Circle the trial with the highest height.
  o Write 3 facts comparing the data tables for prototypes 1 and 2.
  o Analyze data and explain the results that you find.

Note: You may go through this EDP cycle many times to get an optimized product. It all depends on the amount of time you have available.

Summary and Conclusions:
• Have each team share their rocket design, how they modified their rocket, a rationale for their changes, and the results. They may also share what they learned about the forces of push and pull and motion.
• Complete the KWL chart. Discuss what students have learned about the Engineering Design Process.
• Complete EDP Journal
• Have students complete EDP Reflections
• Have students complete EDP Summative Assessment (Use EDP Rubric)

TEACHING & ASSESSMENT (Steps 4, 5, 6, &7)
Completed by teacher after instruction has taken place

4. Teaching and Collecting of Evidence of Student Learning:
Teacher Notes:

5. Analysis of Student Products/Performances - Formative:
Teacher Notes:

6. Evaluation of Student Products/Performances – Summative (Not necessary for every lesson):
Teacher Notes:

7. Teacher Reflection: Replanning, Reteaching, Next Steps:
Teacher Notes:
Performance Task: NASA needs your help! There’s something wrong with a satellite that is circling Earth. You are a rocket engineer and your assignment is to design a rocket that will fly high into the sky to reach that satellite. Your rocket will be tested with a launcher to see how high it goes upward. Good luck on your mission! The people on Earth are counting on you!

Criteria/Constraints:

• The rocket will be made with materials provided.
• The launcher is a large plastic bottle.

What is the problem? ________________________________

What is your task? ________________________________

STEP 1: ASK - Ask questions that pertain to completing the performance task.

1. ________________________________
2. ________________________________

STEP 2: IMAGINE - Use your background knowledge of forces and gravity to design a rocket. These are some ideas you should consider when creating your rocket: weight, size of cup, shape

Draw your possible designs and label the parts. Be ready to share and discuss your design and explain the rationale for your design choices. Your design team will be choosing one to develop.
**STEP 3: PLAN** - Draw the diagram of your team’s prototype. Label each part. Also state the type of material used for each part and the possible measurements.

Side view:

**STEP 4: CREATE** - Build your prototype following your team’s design. Keep to the plan.

What modifications did you need to make in order to be sure that your design would hold together and work?

**STEP 5: EXPERIMENT** -

<table>
<thead>
<tr>
<th>Data Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Weight of Rocket</strong></td>
</tr>
<tr>
<td><strong>Trial 1</strong></td>
</tr>
<tr>
<td><strong>Trial 2</strong></td>
</tr>
<tr>
<td><strong>Trial 3</strong></td>
</tr>
</tbody>
</table>
**STEP 6: IMPROVE** - Go through the process again to redesign and optimize your product.

**ASK:** Looking at your data, answer the following questions:
- What worked? Why?
- What didn’t work? Why?

<table>
<thead>
<tr>
<th>Things to Consider</th>
<th>Did it work?</th>
<th>Why or why not?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape of body (aerodynamics)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A little No</td>
<td></td>
</tr>
<tr>
<td>Weight of rocket</td>
<td>Yes</td>
<td></td>
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<tr>
<td></td>
<td>A little No</td>
<td></td>
</tr>
<tr>
<td>Size of rocket</td>
<td>Yes</td>
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<tr>
<td></td>
<td>A little No</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A little No</td>
<td></td>
</tr>
</tbody>
</table>

**IMAGINE:** What will you change to help the rocket fly higher? Why do think that idea will work?
PLAN: Draw out a diagram of your team's 2nd prototype. Remember to label your parts, state the type of material used for the part, and possible measurements.

Side View:

CREATE: Build your 2nd prototype following your team’s design. Keep to the plan.

EXPERIMENT:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Weight of Rocket</th>
<th>Height of Flight (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Write at least three facts comparing data tables 1 and 2.

1. ________________________________________________

2. ________________________________________________

3. ________________________________________________
Data Analysis:

Which prototype was more effective?  

- **Prototype 1**  
- **Prototype 2**  

(circle one)

Why was it more effective?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

If you had more time and materials, what would you do to make your rocket fly even higher? Explain your thinking.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
## Engineering Design Process Rubric

<table>
<thead>
<tr>
<th></th>
<th>Advanced (ME)</th>
<th>Proficient (M)</th>
<th>Partially Proficient (DP)</th>
<th>Novice (WB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASK</td>
<td>D Clarifies the problem clearly</td>
<td>D Clarifies the problem</td>
<td>D Needs more clarification of the problem</td>
<td>D Problem is unclear</td>
</tr>
<tr>
<td></td>
<td>D Forms the conditions and limitations on their own</td>
<td>D States all the conditions and limitations</td>
<td>D States most conditions and limitations</td>
<td>D States few (or no) conditions and limitations</td>
</tr>
<tr>
<td></td>
<td>D Obtains information from prior knowledge and other sources with citation by self</td>
<td>D Obtains information from prior knowledge by self</td>
<td>D Obtains information from prior knowledge (drawn out by teacher)</td>
<td>D Information given by teacher</td>
</tr>
<tr>
<td>IMAGINE</td>
<td>D Brainstorms a variety of innovative ideas</td>
<td>D Brainstorms a complete idea that is relevant to the problem</td>
<td>D Brainstorms an incomplete idea that is somewhat relevant to the problem</td>
<td>D Unable to brainstorm ideas</td>
</tr>
<tr>
<td></td>
<td>D Innovative ideas are relevant to the problem</td>
<td></td>
<td>D Idea is relevant to the problem</td>
<td>D Teacher assistance needed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D States obvious patterns or relationships</td>
<td>D Brainstormed ideas have little relevance to the problem</td>
</tr>
<tr>
<td>PLAN</td>
<td>D Chooses the best possible idea that is testable</td>
<td>D Chooses one idea that is testable</td>
<td>D Chooses an idea that may be testable</td>
<td>D Chooses an idea that is not testable</td>
</tr>
<tr>
<td></td>
<td>D Draws a useable and accurate prototype design with more than 2 views to scale</td>
<td>D Draws a useable prototype design with multiple views to scale</td>
<td>D Draws a somewhat useable prototype design with multiple views with inaccurate or incomplete measurements</td>
<td>D Draws an unusable prototype design with one or more views</td>
</tr>
<tr>
<td></td>
<td>D Lists all materials needed that are affordable, obtainable, and safe</td>
<td>D Lists all materials needed</td>
<td>D Most materials needed are listed</td>
<td>D Incomplete or inaccurate lists of materials. (Assistance needed)</td>
</tr>
<tr>
<td>CREATE</td>
<td>D Able to follow their design plan accurately</td>
<td>D Able to follow their design plan, with some inaccuracies</td>
<td>D Able to follow most of their design plan with multiple inaccuracies</td>
<td>D Unable to follow their design plan</td>
</tr>
<tr>
<td></td>
<td>D Able to improve original design to optimize performance</td>
<td>D Able to add to the original design to make the design work</td>
<td>D Able to add to the original design, but design may still not work</td>
<td>D Sticks to original design although it may not work</td>
</tr>
<tr>
<td>EXPERIMENT</td>
<td>D Collects and records detailed data accurately and completely</td>
<td>D Collects and records data accurately and completely</td>
<td>D Collects and records data, some data may be incomplete or inaccurate.</td>
<td>D Data collection inaccurate and incomplete</td>
</tr>
<tr>
<td></td>
<td>D Analyzes data by comparing patterns and relationships accurately with logic</td>
<td>D Analyzes data by showing patterns or relationships accurately</td>
<td>D States obvious patterns or relationships</td>
<td>D States obvious patterns or relationships with assistance</td>
</tr>
<tr>
<td>IMPROVE</td>
<td>D Reviews data to make logical decisions to optimize product</td>
<td>D Reviews data to make decisions to redesign product</td>
<td>D Reviews data to make decisions to redesign product with some assistance.</td>
<td>D Unable to review data to make decisions to redesign product (assistance needed)</td>
</tr>
<tr>
<td></td>
<td>D Repeats process until an optimized product is reached with greatly improved data</td>
<td>D Repeats process to optimize a product. Data may/may not show improvement</td>
<td>D Repeats process to improve product with some assistance.</td>
<td>D Does not repeat process to improve product or repeats process with much assistance</td>
</tr>
</tbody>
</table>
Engineering Design Process Reflections

What did you learn about the Engineering Design Process?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Which part was easy for you? Why
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Which part was harder for you? Why?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
## Engineering Design Process Summative Assessment

Draw yourself doing each part of the Engineering Design Process.

<table>
<thead>
<tr>
<th>Ask</th>
<th>Imagine</th>
<th>Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>I ask questions to help me understand what I need to know and do.</td>
<td>I think of different ideas of how to make my product.</td>
<td>I choose one of my ideas and draw a picture of it.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Create</th>
<th>Experiment</th>
<th>Improve</th>
</tr>
</thead>
<tbody>
<tr>
<td>I follow my plan as I make my product.</td>
<td>I test my product and collect and record my data on tables and graphs.</td>
<td>I think about what worked and didn’t work and how I can improve my product.</td>
</tr>
</tbody>
</table>