Mars Habitation

Soda Straw Rockets

By building rockets out of simple drinking straws, students investigate how variations in a rocket's nose cone influences distance of flights

Supporting Video: https://mars.nasa.gov/msl/multimedia/videos/index.cfm?v=41

Overview:

In this lesson plan students will:

- Experience the processes involved in engineering a rocket.
- Conduct engineering tests.
- Collect and analyze data related to finding out the best nose cone length and predicting the motion of their model rockets.

Process/Skills:

- Creativity and Innovation
- Critical Thinking and Problem Solving
- Communication
- Collaboration
- Flexibility and Adaptability
- Initiative and Self-Direction
- Productivity and Accountability
- Algebra
- Measurement
- Data Analysis and Probability

Time:

45 minute prep time
90 minute lesson time

Materials:

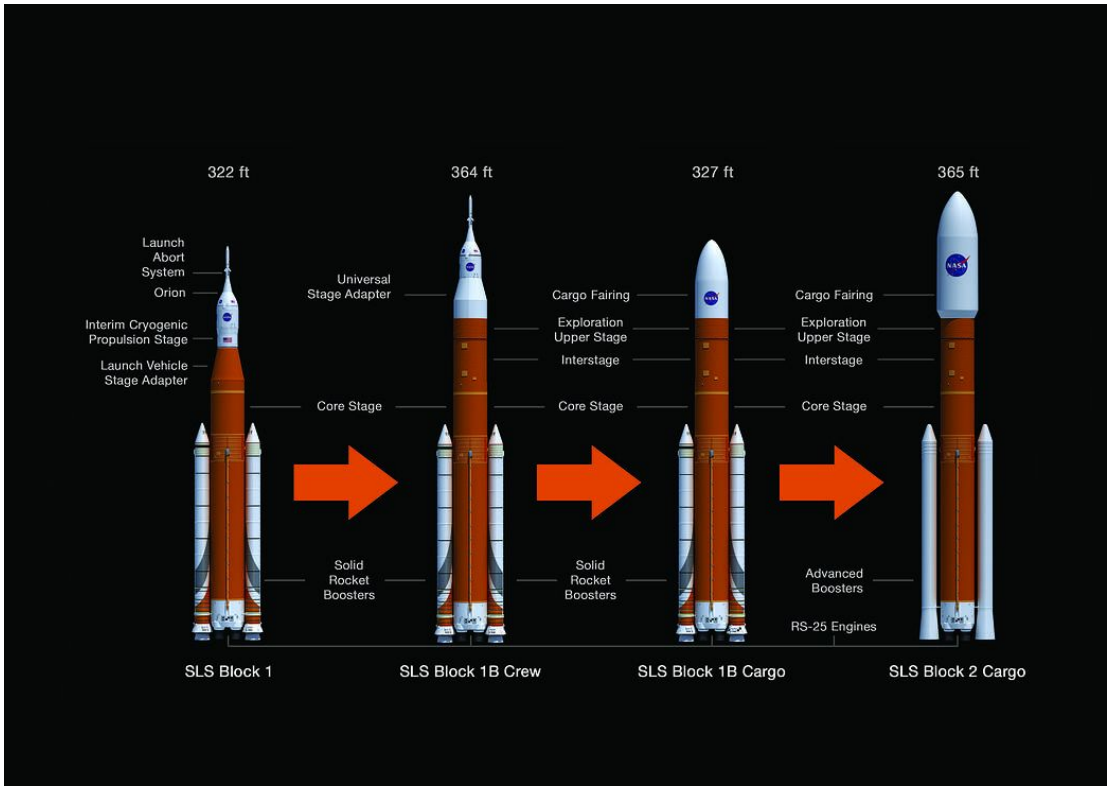
- 30 Sharpened Pencils (1 per person)
- 15 Scotch Tape Rolls – 1/4" tape if possible (2 per group)
- 30 Individually Wrapped Drinking Straws (1 per person)
- 15 Meter Sticks or Tape Measures (2 per group)
- 3-2-1 Template
- Templates for Creative Writing (Map, Postcard, Cinquain/Free Verse, Important/Sensory Poem)
- Writing journals

Objectives:

1. Students will consider data and results to look for patterns and compare possible solutions.
2. Students will be able to:
    a. Construct a model
    b. Hypothesize how the model will behave (i.e., given different nose cone lengths)
    c. Test the model

STEP 1: ENGAGE (~20 minutes) Research common rocket features

1. Blast off! Getting off Earth and toward a solar system destination is exciting. How do we know we can get where we want to go? Engineering design is important to helping us reach our goals. For this engagement, you will be modeling steps in the inquiry process for your students, from observation and questioning to testing and acquiring results, as well as engineering design. As students get older, they will be able to complete these steps on their own.
2. Show images of rockets. Ask students what they may notice about the rockets and the launches. Do they have something in common?
3. Guide the students to look directly at the nose cone of the rocket. Are there any differences? What would happen if a different cone were used? Maybe if it was shorter, longer, or didn't have one?
4. What do the students predict would happen to the distance a rocket will travel if changes were made to the cone?



5. Let's investigate that question! Have students fill out their hypothesis on the "Soda Straw Rocket Analysis" (Question 1).

STEP 2: EXPLORE (~30 minutes) Design and implement rocket investigation

1. Give students the "Soda-Straw Templates" and direct them to write their names on the fins of the rockets. Review the directions on how to construct their rocket.
    a. Tip: Have students work in pairs to construct the rocket tubes. One student can hold the tube tight on the pencil and the other student can apply the tape to the paper tube. Students build the rocket on the pencil. Tell them not to remove it from the pencil until you are ready to distribute the straws.
2. Students can be organized into groups of 4 so that each of the students within the group can build a rocket with a different length of nose cone.
3. Students should select a control for this investigation. Discuss that the purpose of a control is to have something to which you can compare the results. This control should be similar to what you are testing, but something that will be unaffected by the things you are changing. For this investigation, construct one control rocket that has almost no nose cone at all. Just tape the end of the paper tube closed.
4. Students will launch each rocket one at a time and record the distance it traveled (in centimeters) on the "Data Log."
5. Students may wish to write in any observations they want to remember as they perform their investigations (things such as direction for example).
6. Students should do five trials of the investigation and record the results on their "Data Log."
7. Students will then graph their data on the "Data Analysis Sheet" in order to draw a conclusion as to which nose cone length produced the best rocket.

STEP 3: EXPLAIN (~10 minutes) Drawing conclusions from data and evidence

1. Students will write a conclusion for their results. The conclusion should discuss the nose cone lengths used and what they saw happen in their investigation. You may even push the students a little further by asking them to explain why this is the result. What is the reason that a longer cone will have a longer or shorter distance?

STEP 4: ELABORATE (~10 minutes) Consider other possible variables

1. Give students the opportunity to evaluate other possible variables that could affect the flight pattern of a rocket. They may come up with examples such as: angle of launch, # of fins, length of the tube, weighted with paper clips, etc. This exercise helps to build your students to participation in a full inquiry model. If time permits, give them the opportunity to explore some of these different variables and report results out to the class.
2. If there is time, investigate the purpose of nose cones (they hold the payload of rockets) and some of the changes that have to be made to accommodate launching larger payloads into space (e.g., larger rockets, strap-on boosters to add more thrust, etc.).

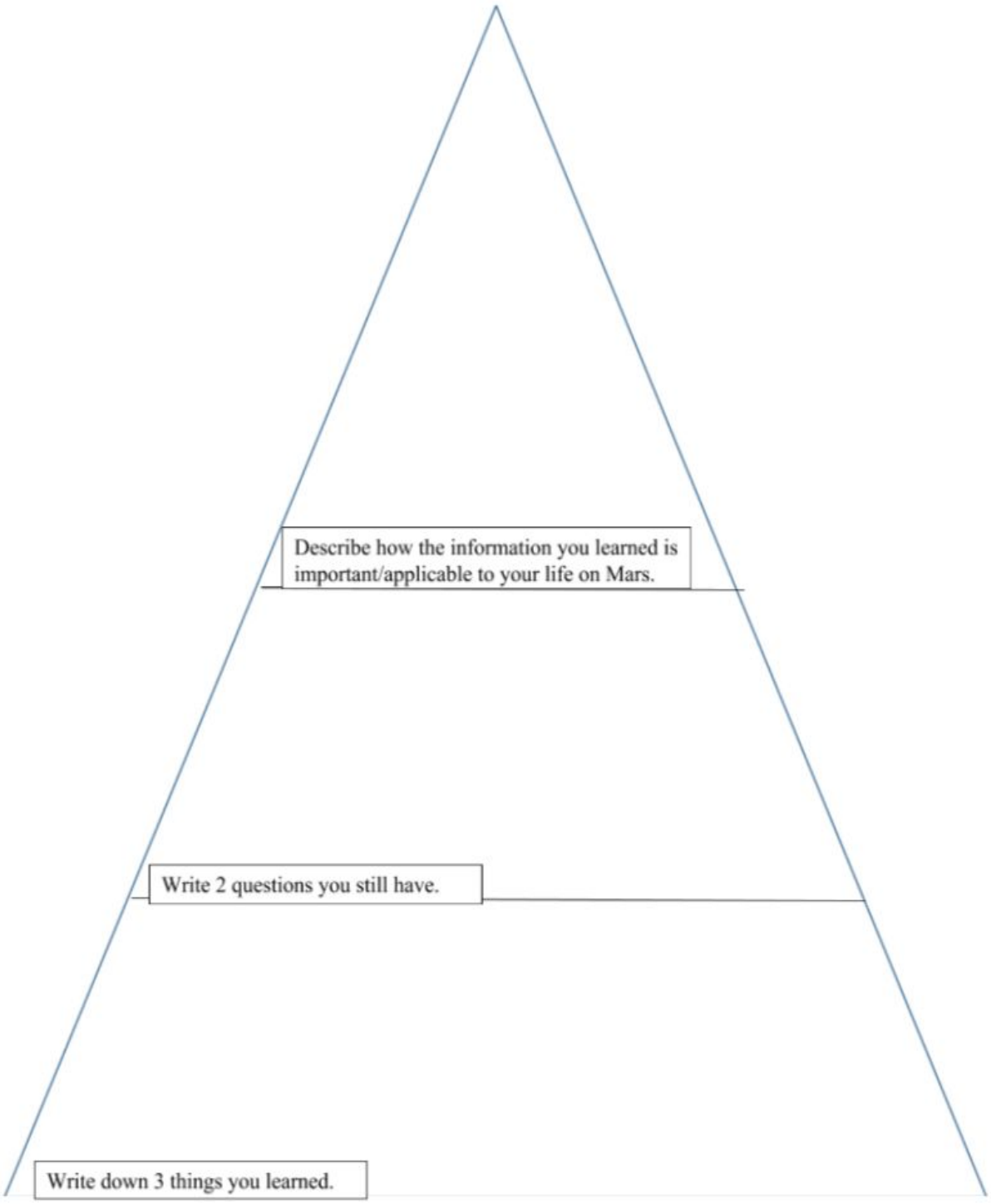
STEP 5: EVALUATE (~20 minutes) Reflect on findings from rocket testing

1. Ask students to complete the “Soda Straw Rocket Analysis Worksheets” so that they can draw conclusions based on evidence from their tests.

STEP 6: WRITING

1. Writing to Learn - Use the 3-2-1 Pyramid Model (See Template) to reflect on today’s activities.

3-2-1 Pyramid Model for Learning

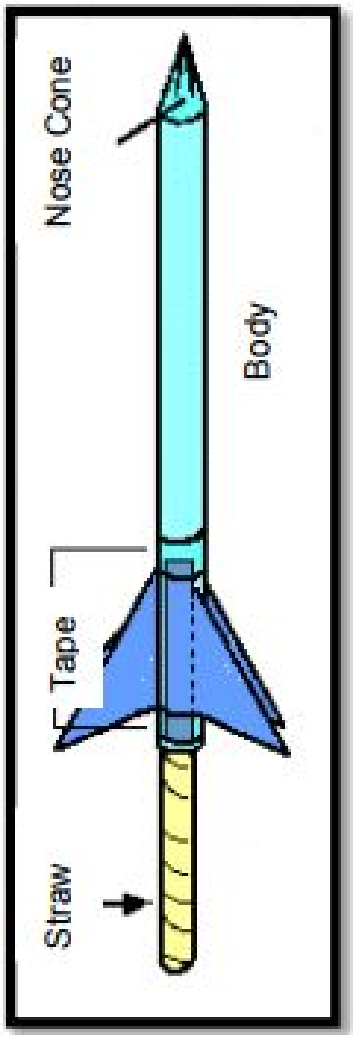


2.

Mars Habitation Handouts

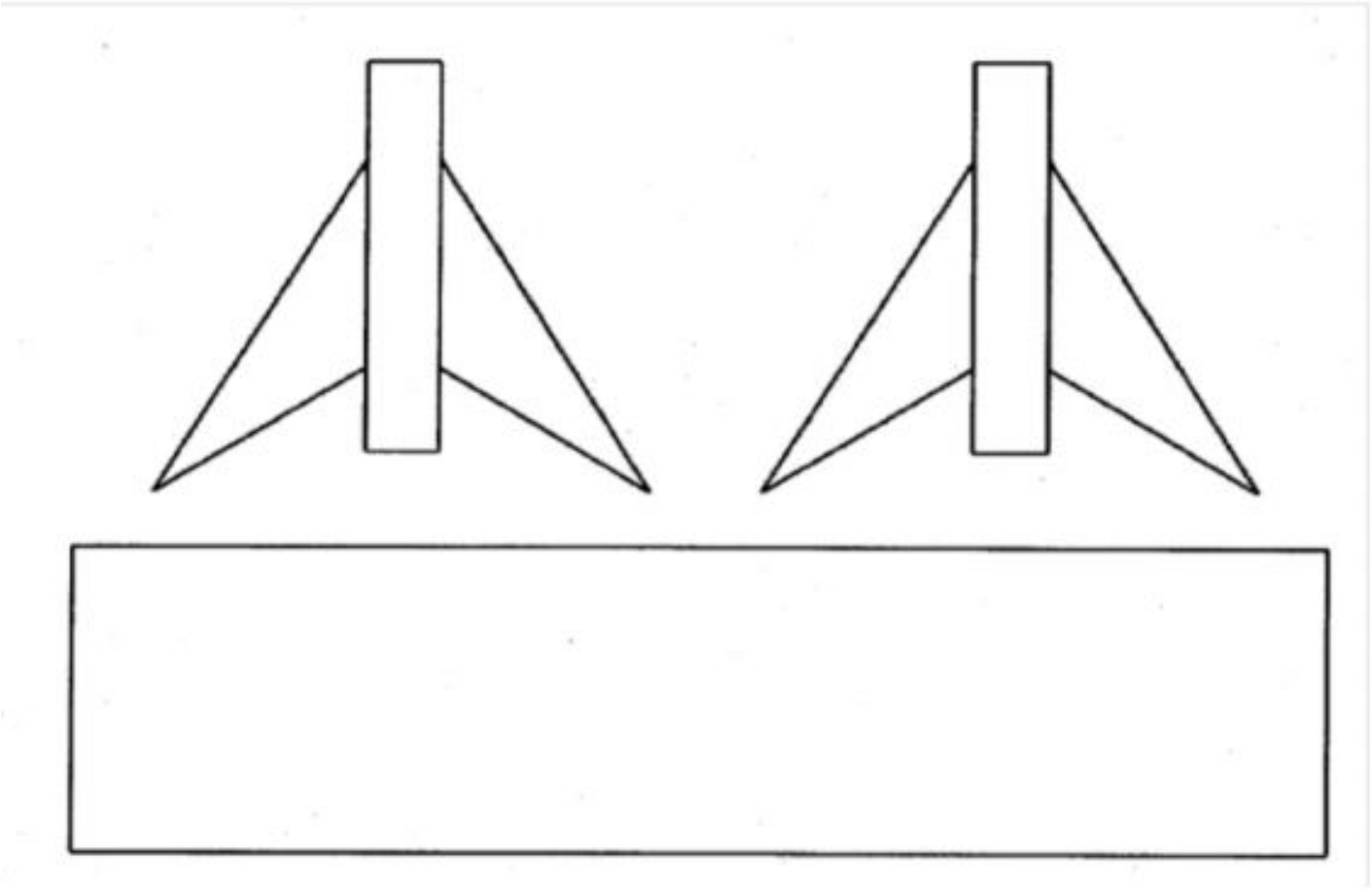
Student Handout - Student Worksheet. Soda-straw rocket template (1 of 2)

1. Carefully cut out the rectangle. It will be the body tube of the rocket. Wrap the rectangle around a #2 pencil, lengthwise, and tape the rectangle so that if forms a tube.
2. Carefully cut out the two fin units and align the rectangle between the two fins with the end of your body tube. Tape it to the body tube. Tape the tube about ¼" above the end of the tube. That helps to prevent the taping of the fin to the pencil. Do the same thing for the other fin unit, but tape it on the other side of the pencil, so you have a "fin sandwich."
3. Bend one fin on each fin unit 90 degrees so that each fin is at a right angle to its neighbor. When you look along the back of the rocket (near the pencil eraser), the fins should form a "+" mark.
4. At the sharpened end of your pencil, twist the top of the body tube into a nose cone. Measure your nose cone from the base to its tip and record the length on your "Data Log" and on the rocket itself.
5. Remove the pencil and replace it with a soda straw. Blow into the straw to launch your rocket. Remember launch safety! Never point your rocket at a person. Your goal is to get to your target destination! Record the distance it travels on your "Data Log."



Student Handout - Student Worksheet. Soda-straw rocket template (2 of 2)

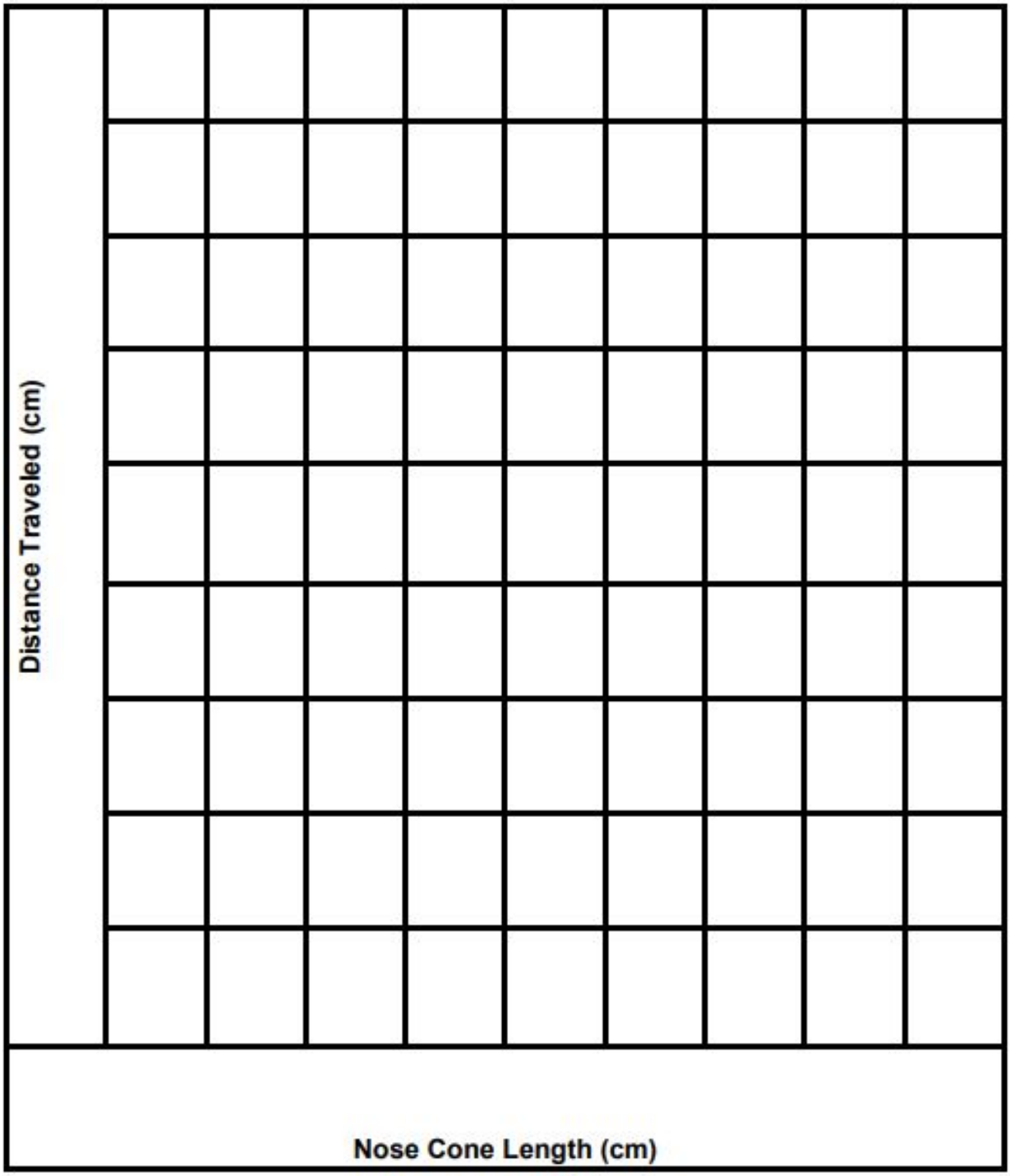
Soda Straw Rocket Template – Cut these three pieces out carefully.



Student Handout - Student Worksheet. Soda-straw rocket data log

Length of Nose Cone	Trial #1	Trial #2	Trial #3	Trial #4	Trial #5	Notes
Control						
Distance Traveled (in cm)						

Student Handout - Student Worksheet. Soda-straw data analysis graph



Student Handout - Student Worksheet. Soda-straw Rocket Analysis (1_ of 2)

Your Research Question:

How will changes to the rocket's' nose cone length affect the distance the rocket will travel?

1. Your Prediction (Your Hypothesis):

2. Your Conclusion:
    a. What Nose Cone Lengths did your team use? _____, _____, _____, _____.
    b. What happened to the Distance Traveled when you had a longer Nose Cone?

    c. What happened to the Distance Traveled when you had a shorter Nose Cone?

    d. Why do you think these results happened?

e. Did you have any problems during the investigation that might have changed the Distance Traveled?

f. Was your prediction supported? _____

g. If yes, what evidence do you have your prediction was supported? If no, why do you think it wasn't supported?

h. Other than nose cone length, give 3 examples of variables that might be changing the Distance Traveled.
   i. _____
   ii. _____
   iii. _____

i. Pick one of the examples and give a hypothesis (a suggested explanation that predicts a particular outcome, based on a model or theory) as to why this variable might change the Distance Traveled of the rocket.