Name____________________________________ Date______________________________ Block_________

MOTION AND FORCES

Applying Newton's Laws of Motion - "Straw Rockets" Lab

OVERVIEW AND PURPOSE:

Rocket engineers are consistently using Newton's three laws of Motion as they design Rockets and examine flight patterns of the Rockets they build. This investigation will allow each student to:

- build a "Straw Rocket" that is capable of flying a distance.
- identify and change one variable that will improve the performance of his/her “Straw Rocket.”
- relate variables in actual data to prove model the Laws of Motion (or use the Laws of Motion to predict how changing variables will affect the motion of the “Straw Rocket.”

MATERIALS:

- Plastic Drinking Straws (without perforation for bending)
- "Straw Rocket" Launcher
- modeling clay
- Oak Tag paper
- electronic balance
- scissors
- ruler
- meter stick
- tape
- glue

PROCEDURE (Part 1):

Class work/Homework - Day 2

- Using the template provided to you, design a “Straw Rocket” with features that may include, and are not limited to, fins, wings, stabilizer rings, etc...

Class work - Day 3

- Once satisfied with your design drawing, use scissors and oak tag to create the features/parts of your rocket. Plug the tip of the straw with clay and then utilize glue/tape to attach all pieces to the straw. (Be sure that parts are not obtrusive at the bottom of the "Straw Rocket" as it may impact how the Rocket leaves the "launch pad"). Allow glue to dry overnight (if used and if applicable).

Class work - Day 4

- Assure that your "Straw Rocket" glue is dry, and make last minute repairs before flight trials.

- Mass the entire "Straw Rocket" on the Electronic Balance and record this mass (in grams) on Data Table 1.

- Use the Rocket Launcher to assess how well your rocket flies. (Place straw onto metal tubing and turn this tubing to the 30-degree angle notation (away from classroom doors in the hallway.)

- With your “Straw Rocket” in place, pull the white pole on the "Launch Pad" to the same level during each trial. Be sure to note the level at which the pole is brought to and record it in Data Table 1. (This number is not needed to complete calculations, however it is related to force and must be consistent for each trial for each person.)

- Let go of the white pole and allow it to fall to ground/spring which in turn causes the “Straw Rocket” to launch.

- Measure the distance that the “Straw Rocket” flew and record the distance (in meters) in Data Table 1. Repeat two more times and find the average distance the “Straw Rocket” travels.

PROCEDURE (Part 2):

Class work/Homework - Day 5

- Identify one thing that you can change on your “Straw Rocket” that will allow it to fly farther than the first trial. Be sure you are able to link this variable to Newton's Laws of Motion in the end.

- Using the same materials from your original build, make the changes to the one variable you identified above and allow glue to dry overnight (if used and if applicable).

HYPOTHESIS:

Develop a hypothesis statement that will explain what will happen with the “Straw Rocket” during the second set of trials, and after modifying one variable on it. (5 points)

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PROCEDURE (Part 2) *continued*:

Class work/Homework - Day 6

- Assure that your “Straw Rocket” glue is dry, and make last minute repairs before flight trials.

- Mass the entire "Straw Rocket" on the Electronic Balance and record this mass (in grams) on Data Table 2.

- Use the Rocket Launcher to assess how well your rocket flies. (Place straw onto metal tubing and turn this tubing to the 30-degree angle notation (away from classroom doors in the hallway.)
- With your “Straw Rocket” in place, pull the white pole on the "Launch Pad" to the same level during each trial. Be sure to note the level at which the pole is brought to and record it in Data Table 1. (This number is not needed to complete calculations, however it is related to force and must be consistent for each trial for each person.)
- Let go of the white pole and allow it to fall to ground/spring which in turn causes the “Straw Rocket” to launch.
- Measure the distance that the “Straw Rocket” flew and record the distance (in meters) in Data Table 2. Repeat two more times and find the average distance the “Straw Rocket” travels.

DATA AND OBSERVATIONS:

Draw both “Straw Rocket” Designs in the areas below and be sure to label them with the key features you added to the Rocket, along with labels for the changes made to the Initial Design. (8 points)

Initial “Straw Rocket” Design Drawing:	**“Straw Rocket “Design Drawing After Structural Changes:**

Data Table 1: Initial Flight Trials of "Straw Rocket" (6 points)

Rocket Mass* (grams)	Initial Force to Launch Rocket* (N)	Distance Rocket Travels (meters)			Average Distance Rocket Travels (meters)
		Trial 1	Trial 2	Trial 3	

*Mass and Force are consistent for all three trials in this data set

Data Table 2: Flight Trials of "Straw Rocket" After Structural Change (6 points)

Rocket Mass* (grams)	Initial Force to Launch Rocket* (N)	Distance Rocket Travels (meters)			Average Distance Rocket Travels (meters)
		Trial 1	Trial 2	Trial 3	

*Mass and Force are consistent for all three trials in this data set

<u>ANALYSIS AND CONCLUSION QUESTIONS</u>:

1. What variable did you change in an attempt to improve the effectiveness of the "Straw Rocket"? Why did you choose this variable? (3 points)

2. What constants could you identify in the investigation? Why are they necessary to remain the same for each trial throughout the investigation? (5 points)

3. Explain how **Newton's First Law of Motion** is supported (found to be true) in this investigation. Provide and use data to help support your answer if necessary! (5 points)

4. Explain how **Newton's Second Law of Motion** is supported (found to be true) in this investigation. Provide and use data to help support your answer if necessary! (5 points)

5. Explain how **Newton's Third Law of Motion** is supported (found to be true) in this investigation. Provide and use data to help support your answer if necessary! (5 points)

6. What limitations or sources of error could you identify in this investigation? (2 points)