Name _____ Date _____ Class _____

Energy ▪ *Skills Lab*

Soaring Straws

Problem

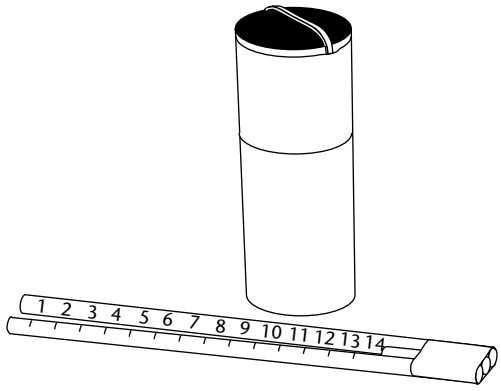
How does the gravitational potential energy of a straw rocket depend on the elastic potential energy of the rubber band launcher?

Skills Focus

controlling variables, graphing

Materials

scissors	rubber band
3 plastic straws	marker
metric ruler	meter stick
balance	masking tape
empty toilet paper tube	



Procedure

Review the safety guidelines in Appendix A.

1. Construct the rocket and launcher following the instructions below. Use a balance to find the mass of the rocket in grams. Record the mass.
2. Hold the launcher in one hand with your fingers over the ends of the rubber band. Load the launcher by placing the straw rocket on the rubber band and pulling down from the other end as shown in the illustration. Let go and launch the rocket straight up. **CAUTION:** *Be sure to aim the straw rocket into the air, not at classmates.*

Making a Rocket and Launcher

A. Cut a rubber band and tape it across the open end of a hollow cylinder, such as a toilet paper tube. The rubber band should be taut, but only stretched a tiny amount. This is the launcher.

B. Cut about 3 cm off a plastic straw.

C. Lay 2 full-length straws side by side on a flat surface with the 3-cm piece of straw between them. Arrange the straws so that their ends are even.

D. Tape the straws together side by side. Starting from the untaped end, make marks every centimeter on one of the long straws. This is the rocket.

Soaring Straws *(continued)*

3. Record your data in the data table below.
4. Have your partner hold a meter stick, or tape it to the wall, so that its zero end is even with the top of the rocket launcher. Measure the height, in meters, to which the rocket rises. If the rocket goes higher than a single meter stick, use two meter sticks.
5. You can measure the amount of stretch of the rubber band by noting where the markings on the rocket line up with the bottom of the launching cylinder. Launch the rocket using five different amounts of stretch. Record your measurements.
6. For each amount of stretch, find the average height to which the rocket rises. Record the height in your data table.
7. Find the gravitational potential energy for each amount of stretch:

   Gravitational potential energy = Mass × Gravitational acceleration × Height

   You have measured the mass in grams. So the unit of energy is the millijoule (mJ), which is one thousandth of a joule. Record the results in your data table.

Data Table

Amount of Stretch (cm)	Height (Trial 1) (m)	Height (Trial 2) (m)	Height (Trial 3) (m)	Average Height (m)	Gravitational Potential Energy(mJ)

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Analyze and Conclude

Write your answers in the space provided.

1. **Controlling Variables** Which variable in your data table is the manipulated variable? The responding variable? How do you know?

2. **Graphing** Graph your results. Show gravitational potential energy on the vertical axis and amount of stretch on the horizontal axis.

3. **Measuring** In this experiment what measurement is related to the elastic potential energy?

4. **Drawing Conclusions** Look at the shape of the graph. What conclusions can you reach about the relationship between the gravitational potential energy of the rocket and the elastic potential energy of the rubber band?

5. **Inferring** When you release the rocket, what kind of energy does the rocket have just after takeoff? What are the elastic potential energy and gravitational potential energy at this point?

Soaring Straws *(continued)*

6. **Developing Hypotheses** Make an additional column on the right side of the data table labeled Kinetic Energy (mJ). For each row, write down what you think the rocket's kinetic energy is right after takeoff.
7. **Communicating** Write an advertisement for your rocket launcher. Include a diagram explaining how the rocket gains potential energy, how its potential energy is transformed to kinetic energy, and how its kinetic energy is transformed back into potential energy.

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Design an Experiment

How would the height and distance the rocket travels be affected by the angle of launch? Design an experiment to measure the height and distance resulting from different launch angles. Keep the amount of stretch constant. *Obtain your teacher's permission before carrying out your investigation.*