Name(s)____ Date___________________

Cosmo's Planetary Challenge

Background: One cold clear winter night in 1991, a single subatomic particle came hurtling through the atmosphere destroying atoms, causing the air to glow, and in general behaving like a normal cosmic ray, except for its energy. This single cosmic rayhad an energy of nearly 1020 electron volts, or nearly 50 joules! To put it in perspective,that is roughly equivalent to a 1 kg mass moving at 10 m/s, or a 90 mph fastball. The energy of a fastball is shared by 1025 atoms. Imagine one atomic nucleus having all that energy! This was the most energetic cosmic ray ever recorded, and it was observed bythe University of Utah's Fly's Eye detector.

The Fly's Eye detector is a detector that "looks" for cosmic rays. Of course cosmic raysare sub-atomic particles and are far to small to actually be seen. What the detector actually sees is the trail left by the cosmic ray as it bumps into the nitrogen in the atmosphere. The Fly's Eye detector is a series of mirrors, each pointed in a different direction. Because the mirrors are pointed all around, the Fly's Eye detector can "see" in all directions, the same as a fly. Which is why it is named the Fly's Eye detector.

Statement of Purpose: Scientists studying cosmic rays must know about the energy that cosmic rays have. The purpose of this lab is to investigate the relationship between mass, speed and energy.

Materials: Computer with Internet connection and lab notebook.

Procedure: Your teacher will instruct you on how to access the lab site. Follow those directions carefully.

Once you have accessed the lab site you will want to follow the instructions on the introductory pages. Read each page carefully, so that you know how to complete the lab.

For this lab you will want to complete 2 data tables. You remember that a scientist can only look at one variable at a time? Well, you are the scientist. There are three variables: mass, speed, and energy. You will have to hold one variable constant.

The first time you conduct the investigation, hold either mass or speed constant, and change the other one.
Which is the independent variable?_______________
Which is the dependent variable?________________
Which is the constant?_________________________

The second time you conduct the experiment change the variable you previously held constant.
Which is the independent variable?______________
Which is the dependent variable?_______________
Which is the constant?_______________________

Record the data on different data tables. Be sure to complete at least 8 trials for each investigation.

Once you have two sets of data you can graph the data. Graphing is a good way to see relationships. Draw your graphs on the graph paper provided.

Table 1: Investigation 1

Mass (kg)	**Speed (m/s)**	**Energy (J)**

Table 2: Investigation 2

Mass (kg)	Speed (m/s)	Energy (J)

Questions: Using the data you just collected answer the questions below.

1) How can a small object (small mass) have the same energy as a large object (large mass)?

2) From your data, which trials support your conclusion?

3) What seems to be the relationship between mass and kinetic energy?

4) What seems to be the relationship between speed and kinetic energy?

Now graph your data!

Questions: Using the data you just graphed answer the questions below.

1) Do the graphs look the same?

2) How does the energy change with the mass?

3) How does the energy change with the speed?

4) What happens to the energy when the mass doubles?

5) What happens to the energy when the speed doubles?

6) See if you can find a mathematical relationship between energy, mass and speed? (Give it a try!)

What is Newton's formula?

What is the average mass and energy for a cosmic ray?