Name: _____ **Class:** ____ **Date:** _____

Phone Book Friction - Mythbusting

Learner Outcomes:

- Recognize and use units of force and mass, and identify and measure forces and laods
- Identify examples of frictional forces and their use in structures
- Communicate questions, ideas, intentions, plans and results using lists, notes in point form, sentences, data tables, graphs, drawings and other means

Key Terms:

Friction Force Load

Background Information: Frictional forces are forces that resist movement between two surfaces that rub together. Such forces for practical purposes such as to anchor nails into wood and to keep bricks stacked together. Even relatively smooth surfaces such as paper create some frictional forces. During the 2008 season of Mythbusters, the Mythbusting squad tested a myth that says 'it is impossible to separate two interlocking phone books, due to the massive amount of friction between the 800 or so pages of each book'.

Investigative Question: How does interlacing sheets of paper increase the frictional forces between them?

Research Design: Students will decide what factor they want to change to investigate frictional forces in this investigation. They may consider the type of paper, the amount of overlap when interlacing, or the number of sheets of paper.

Manipulated Variable -

Responding Variable -

2 Controlled Variables –

Materials:

Force meter Hole punch Ruler
Sheets of paper

Procedure:

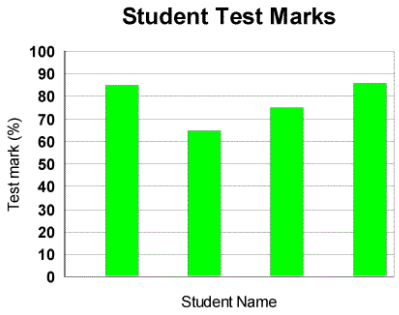
1. Interlace 10 pieces of paper that are the same size. Make sure the amount of overlap between each piece is approximately equal.
2. Cut the ends of the pages so that they are even. Make a hole in one side with the hole punch. This is where you will attach the force meter.
3. Holding the un-punched side of the paper stack with one hand, gently pull the force meter until the pages begin to slide. Record the force (in Newtons) required to overcome the frictional forces.
4. Repeat steps 1-3 but change by double or half, either; the number of sheets, the distance of overlap or the type or size of paper.
5. Repeat steps 1-4 again, changing your manipulated variable a third and then a fourth time. Record the force required in each instance.

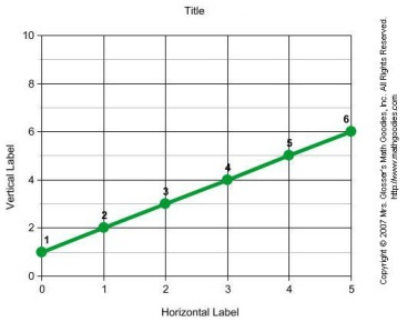
Observations:

Analysis: Graph and interpret your data.. You may choose a line graph, or a bar graph for this experiment as appropriate. Provide an explanation for your graphed results.

Line graph – use when you have a numerical manipulated and responding variable

Bar graph – use when one variable is numerical and the other is qualitative (categorical)





Conclusion: In your investigation, what factor increased the frictional forces between the sheets of paper?

Extension:

As a class, try out the phone book myth using a tug of war! (do this on the playground grass or in a gym with floor mats.

1. Drill large holes through two average sized telephone books close to the spine so that you can thread two strands of strong rope through them.
2. Thread the end of a long rope (about 50 feet) through the two holes of one of the books. Fasten the rope with a secure knot. Do the same for the

other phone book. (Tie a third rope so that the two ropes on each book are connected so that if they pull apart, they won't hit anybody.

3. Interlace every page of the two phone books using an overlap distance of at least 10 cm.
4. Start with one student pulling on each side of the phone book. Increase the number of students by one on each side until the phone book pages just begin to slip.

Questions:

1. How many students pulling on both sides did it take to get the pages to slip?
2. How could you estimate the force that was used to pull the books apart? (hint – each student is likely pulling with a force equal to about 80% of their body mass)
3. What would happen if you increased the number of pages in each phone book?
4. What would happen if you increased the distance that overlapped on each phone book?