

### **FRICITION LAB: (Work in groups, hand in INDIVIDUALLY!)**

Friction is a force we encounter daily in virtually everything that we do. Most people think of friction as harmful, something to be avoided as in the friction of wheel bearings or in an automobile engine. However, friction in many situations is beneficial; it is friction that enables us to walk across the floor or pick up a piece of paper. Friction is the large scale representation of the electromagnetic field force that is the basis of interactions between matter.

When two surfaces are in contact, the friction between them is expressed as static (starting) friction, kinetic (sliding) friction, and rolling friction.

#### **The Problem:**

The force of friction which we use and must deal with every day is influenced by many factors.

If you pull an object horizontally at a constant force, the applied force just balances the frictional force.

If an object is sliding at a constant velocity down an inclined plane, the frictional force just balances the diagonal component of the force of gravity (weight).

Identify the factors (mass, surface area, type of surface, other?? ) which affect the force of friction.

#### **The Experiment:**

Design and conduct an experiment to test the effect of each of the factors (area, mass, surface) by pulling an object at a CONSTANT velocity horizontally. ( $F_{net}=0$ , so  $F_f=F_{pull}$ )

Measure the force of friction  $F_f=F_{pull}$  and calculate the coefficient of friction  $\mu$  in each situation

( $F_f = \mu F_N = \mu W = \mu mg$ ).  $\mu = F_f / F_N$ )

Ideas: Spring scale, block, weights, sneakers, boxes, wood, string, etc...

Make sure to pull horizontally!

Repeat the experiments by placing the object on an inclined plane so that the object doesn't move. While gently tapping, lift the plane until the object just slides down the plane at a CONSTANT velocity. ( $F_{net} = 0$ , so  $F_{down}=F_{friction}$ ) Measure the force of friction  $F_{down}=W\sin\theta=mg\sin\theta$  and calculate the coefficient of friction  $\mu$  in each situation ( $F_f = \mu F_N = \mu W\cos\theta = \mu mg \cos\theta$ ).  $\mu = F_f / F_N$  so that  $\mu = \tan \theta$ .

MAKE SURE YOU HAVE CLEAR DIAGRAMS OF YOUR EXPERIMENTS, AS WELL AS DATA TABLES!!!

**Analysis:** Write analysis, graph results, and make conclusions on how each factor (mass, surface area, type of surface, other?) affected the force and coefficient of friction, and how the results of each experiment related to each other.

### **THE REPORT**

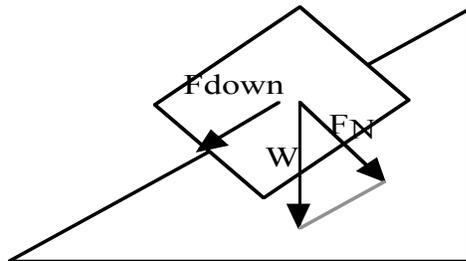
A clear statement of the problem you investigated. Include a clear identification of the independent and dependent variables that were studied.

A description of the experiment you carried out. Your description should be clear and complete enough so that someone could easily replicate your experiment.

The results of your experiment. Tables, charts, and/or graphs should be used where appropriate and should be properly labeled. Your graphs should show factors (mass, surface area, type of surface) as they affect friction (coefficient and force)

Your conclusions from your experiment. Your conclusions should be fully supported by data, graphs and calculations.

Comments about how valid you think your conclusions are. In other words, how much confidence do you have in your results and conclusions? Any factors that contribute to a lack of confidence in the results or conclusions should be discussed. Also, include the ways that your experiment could be improved if you were to do it again.



$$F_{\text{down}} = W \sin \theta$$
$$F_{\text{normal}} = W \cos \theta$$