Project Proposal - Group 2

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Introduction

We are planning to analyze the coefficients of friction of objects whose frictional interactions with certain surfaces are lesser known. Using multiple setups with different objects, we will attempt to determine the coefficients of friction between several combinations of objects and surfaces and confirm the following relation:

$$F_k = \mu_k F_n.$$

We plan to run experiments with inclined and flat surfaces, as well as with both rolling and sliding objects. Thereafter, we will further categorize the objects based on their foundational material, so that we can define more general physical properties of everyday objects. Our list will include common objects such as books and empty water bottles, and we expect to add materials to our list in the coming weeks. The idea for this object came from the previous experiments we have run, in which a significant amount of energy was lost to friction.

In short, we will determine the masses of our objects to find normal force, apply an initial force to the object, and use Tracker to analyze the resultant acceleration on the object due to the frictional force. Alternatively, we can use the work-energy theorem, with Tracker's velocity data collector and a known stopping distance, to find the average frictional force. We know some application of this alternative method will be used for rolling objects, which also have rotational energy.

Materials

- Tracker Software
- Scale

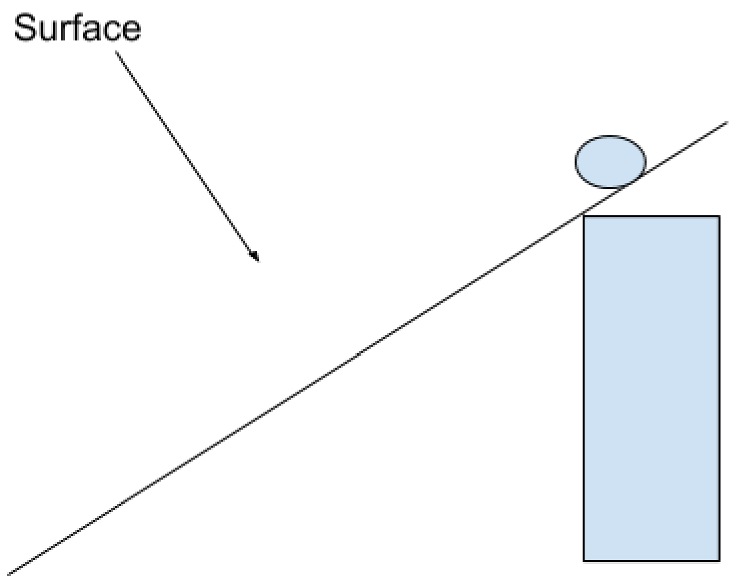
Objects

- Water Bottles
- Books (Hardcover)
- Meter Stick
- Baseball
- Tennis Ball
- Binder
- Laptop

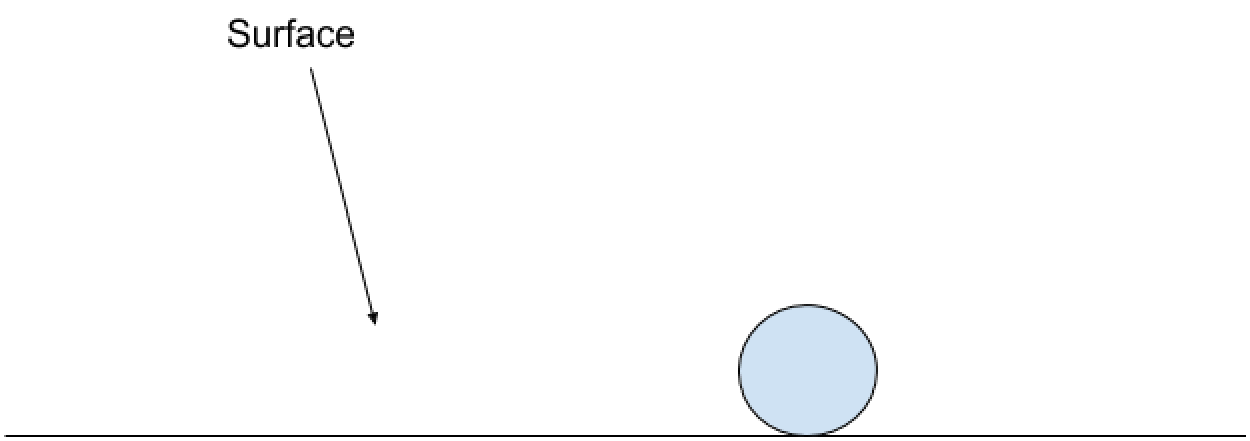
- Eraser

Surfaces

- Carpet
- Cardboard
- Smooth wooden table
- Rough wood



Setup 1: Inclined Surface



Setup 2: Flat Surface

Predictions and Analysis Method

Based on our goals of finding the coefficients of kinetic friction for multiple surfaces, we predict that rougher surfaces will have a higher coefficient of friction than do the smoother surfaces. Since it takes a larger push (a larger applied force) to get the object moving on a rougher surface, then we predict rougher surfaces to have a higher coefficient of static friction. From there, we predict that surfaces that have a high coefficient of static friction will also have a high coefficient of kinetic friction in relation. Thus, the coefficients of kinetic friction are predictable.

We will employ Newton's second law, ΣF = ma, the work-energy theorem, W = ΔE, or F*d = ΔE, where ΔE is the final kinetic (both translational, $K = 0.5mv^2$, and rotational, $K = 0.5I\omega^2$ in the case of rotating objects) and gravitational potential energy, U = mgh. Finally, we will use the relation between the frictional force and normal force, $F_k = \mu_k F_n$. After giving the object an initial applied force and letting go, the only force acting on the object in the horizontal direction (or at an angle in the case of inclined planes) is the force of friction, and this force can either be found using Newton's second law or the work-energy theorem. After finding the force, we can use the relation between the normal and friction force to find the coefficient of kinetic friction.

Timeline

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
8 (5/18)		**Data Collection**		**Data Collection**		**Data Collection (buffer)**	**Data Collection (buffer)**
9 (5/25)		**Data Analysis**		**Data Analysis**		**Data Analysis (buffer)**	**Data Analysis (buffer)**
10 (6/1)		**Report & Slides**		**Report & Slides**		**Report**	**Report**

Task Allocation

All of us will collaborate on the report.

Neil: Programming
Charles: Data Collection
Claire: Slides

Ryan: Data Collection
Brendan: Slides