**Name:**

**Students,**

**Friction Forces:** *Friction is the force that opposes a sliding motion. Friction is due to microscopic irregularities in even the smoothest of surfaces.*

Go to the following website:

<http://phet.colorado.edu/en/simulation/forces-and-motion>

Click “Run Now!”

This interactive simulation provides four components for exploring balanced and unbalanced forces. In the introductory activity, users choose from among 5 objects of different masses, set the surface with or without friction, then "push" the object along a straight line. The simulation displays force vectors and free body diagrams to match the motion. The second activity focuses on the role of friction when objects are pushed on a wood surface. Set your own gravitational constant and watch the effects on static and kinetic friction. The final activity, "Robot Moving Company", is a game where users apply a force to deliver objects of different mass from one point to another.

**Introduction:**

1. Apply a force to the crate. Continue increasing the force until the crate begins moving.
   1. While the crate is still, what type of friction is acting?
   2. How does the friction force compare to the applied force?
2. Apply a force to the crate again. Continue increasing the force until the crate begins moving.
   1. What happens to the magnitude of the friction force when at the instant that the crate beings moving?
   2. What does this tell you about static friction force compared to the kinetic friction force?
3. List all of the forces that are visual in this simulation.

1. How does the object begin to move?
2. What is resisting its initial motion?
3. Change the friction to ice, how does this change the action of the objects?
4. Change the object a few times, how does the amount of force necessary to move the object change?
5. Which object did you find to be the easiest to begin moving? Why do you think this is?
6. If you apply the same force to different objects how does the displacement of each object change?

**Friction Tab**

1. If you increase the amount of static friction, what does this change in the simulation?
2. If you decrease the amount of kinetic friction, what does this change in the simulation?
3. Change the object’s mass up and down a few times to identify a pattern. Does it require more or less force to move an object with a high mass in comparison to one with lower mass?
4. Without applying any force, change gravity to the different locations, what does this change in the free body diagram? Also, why does the up arrow increase?

1. Which planet was it easiest to move objects on? Why? Is there a relationship between this value and friction? If so, what is it?

**Robot Moving Company**

1. What was the goal of the robot moving company?
2. What factors had to be considered when completing this activity?

**Essay; use the following questions to guide you in an essay that reviews this material and activity.**

1. How does friction impact motion (two different ways)?
2. What was the purpose of this activity?
3. What knowledge was gained from this activity?
4. Explain two examples of how people interact with friction every day.
5. What would the world be like without friction?