

## Guiding Questions Activity 4

- What is friction?

**Purpose:** To understand that friction is a force that acts in a direction opposite to the motion of a moving body.

**Note:** NOVA once did a program titled *This Old Pyramid* sometime in the middle 1990's. The project dealt with an attempt to replicate the building of a pyramid. With the use of only simple iron tools, the building of the early pyramids required thousands of people laboring over a time frame spanning something like 20 years. The building of the pyramid at Giza in the early 1990's used some modern advantages. In studying this subject students can better understand the problem presented by inertia and friction and in addition discover the various ways to overcome the force of friction.

The force resulting from friction must be overcome if there is to be motion. Friction force works in the opposite direction of the force you are applying to move an object. To move an object you therefore must apply a greater force than the force of friction.

When two solid objects slide across each other the type of friction that results is called sliding friction. So as the builders pulled a granite rock along a ramp to a high point on the pyramid they were trying to overcome *sliding friction*. In the 1990's the builders used flat bed trucks to transport 60 ton granite blocks. They were overcoming *rolling friction*. Since there is only a small amount of friction between a wheel and the road, the force needed to overcome it is less than in sliding friction. One technique early builders did use was floating 60 ton granite blocks on barges down the river. By using *fluid*

*friction* they were able to use a smaller amount of force to move the blocks.

- Materials:** spring balance  
4 large fishing weights  
1 cart with removable wheels  
Spring scale  
Table top at least 1 meter long  
Oil or lubricant

**Procedure:**

1. Place one large fishing weight inside the cart without wheels. Next attach the spring scale to the cart.
2. Begin slowly pulling the cart along the table at a constant speed. Record the force reading on the spring scale. This is the force required to balance and overcome the force friction.
3. Place a second fishing weight into the cart and repeat Step 2. Remember to record the force.
4. Repeat step 2 using three weights then four.
5. Create a graph on a separate sheet of graph paper that shows how the force of friction is related to the number of weights pushing against the table. Connect the points on your graph. Use the number of weights along the *x* axis and the force of friction on the *y* axis.

		Number of weights			
		1	2	3	4
Force					

- 6. Now add the wheels to the cart and repeat steps one, two, three and four, and five. Remember to record your results in your data table. Note: Copy the data table from your first experiment and then fill in the data in this new table. Don't forget to graph your data.**
  
- 7. Finally, using the oil or lubricant wipe the table top until it has a smooth oily surface. Now repeat the first experiment using the cart without the wheels. Add the weights and repeat steps one, two, three, four and five. Remember to make another copy of the data table and then fill in the data for this experiment. Don't forget to graph your data.**

**Questions:**

- 1. What were the three types of friction you tested? \_\_\_\_\_**  
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- 2. Based upon your data how did the surface area influence the force of friction? \_\_\_\_\_**  
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- 3. Describe the appearance of your graphs. \_\_\_\_\_**  
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**Conclusion: Explain how the force of friction depends upon the weight of the moving object. \_\_\_\_\_**  
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