Physics **Newtonian Physics** **Mr. McMullen**

Names_____ _____ Date _____ Period ____

Newtonian Physics – Tug-of-War

In this activity you will investigate the tension in a string, the function of a simple pulley, and a simple "Tug-of-War".

Materials:

2m of String	Two 500 g Masses	Two Pulleys
Two Ring Stands	Two Newton Scales	Ruler

Discussion:

Suppose you attach a string to a wall and pull on the free end. Anyone can see that you pull on the string, but only careful observers see that the wall also pulls on the string. If the wall is replaced with a person pulling on the string a tug-of-war takes place and it is easier to see that the string is pulled at both ends. Place two fingers inside a rubber band and use them to stretch the band. Which finger is doing the stretching? Both fingers are required to stretch the band. Both are involved in the holding and the pulling because both have a force you can feel, and these forces should feel equal. A force cannot exist alone. Forces always exist in pairs, because all forces are interactions between two objects.

Procedure:

Step 1: Suspend a 500 g load from a string that is held by a newton scale as shown in figure A.

Fig. A

1. What does the reading on the scale tell you about the tension in the string?

_____
_____
_____
_____

Step 2: Drape the string over a pulley such that both ends of the string hang vertically, as shown in Figure B. Hold the scale steady so that it supports the hanging load.

2. What does the scale read, and how does this force compare to the weight of the load?

_____
_____
_____
_____

3. How does it compare to the tension in the string?

_____
_____

Step 3: Move the string scale first to a higher, then a lower position, keeping the strings on each side of the pulley vertical.

4. Does the reading at the higher position change?

_____
_____

5. Move the scale to a lower position. Does the reading at the lower position change? Briefly explain the results.

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_____
_____
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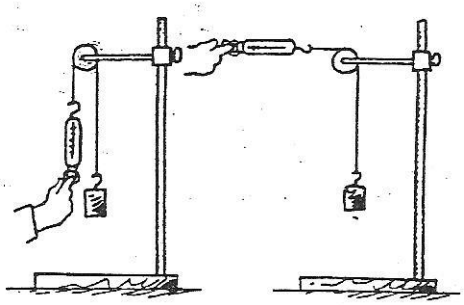

Fig. B

Fig. C

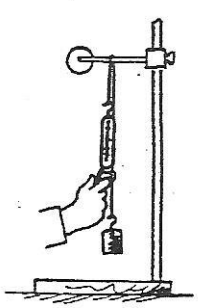

Fig. D

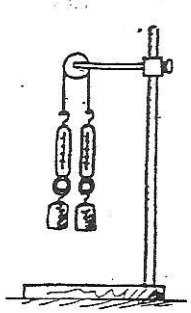

Fig. E

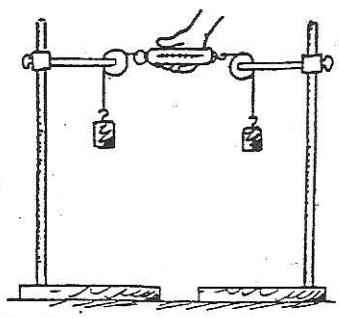

Fig. F

Step 4: Move the spring scale to various angles to the vertical, until the scale is horizontal, as shown in Figure C.

6. Does the reading on the scale ever deviate from what you measured in the previous steps? Briefly explain your results.

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_____
_____

Step 5: Remove the string from the pulley and drape it over a horizontal rod. Repeat Step 4, as shown in figure D.

7. Do you find a difference between the results of Steps 4 and 5? Explain.

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_____
_____
_____

Step 6: Attach a spring scale to each end of the string. Drape the string over the pulley and attach equal masses to each end, as shown in figure E.

8. What do the scales read?

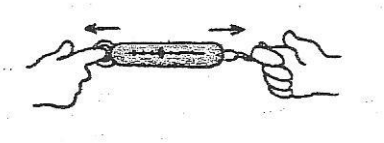
_____
_____

9. What role does friction play in the function of a pulley?

_____
_____
_____
_____

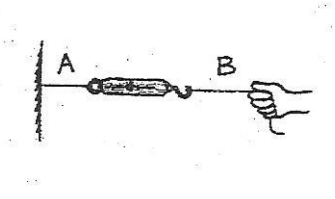
Step 7 Have your partner hold one end of a spring scale stationary while you pull on the other end. Pull until the scale reads the same force as it did when suspending the mass. Record the following observations.

Force you exert on the scale = _____
Force the scale exerts on you = _____
Force your partner exerts on the scale = _____
Force the scale exerts on your partner = _____



Step 8 Attach strings on both ends of the string scale. Fasten one end to the wall or a steady support. Call this String A. Pull horizontally on the other string, String B, until the scale reads the same as in the previous step Record the following observation.

Force you exert on String A = _____
Force String A exerts on scale = _____
Force the scale exerts on String B = _____
Force the scale exerts on the wall = _____
Force the wall exerts on String B = _____



10. What is the essential difference between the situations in Step 7 & and Step8?

_____
_____
_____
_____

Step 9: Study figure F and predict the reading on the scale when two 500 g loads are supported at each end of the strings. Then assemble the apparatus and check your prediction.

Prediction scale reading = _____
Actual scale reading = _____