PhyzLab: Angular Force

an investigation of lever arm and torque

PERIOD	1.		
	2.		
GROUP	3.		
	4.		

• Discussion •

In our study of rotation, we have learned that there are many parallels or *analogs* between the familiar concepts of translational (or linear) motion and rotational (or angular) motion. Thus far, we have only explored rotational kinematics (mathematical description of motion). We must now investigate rotational dynamics (physical explanation of motion).

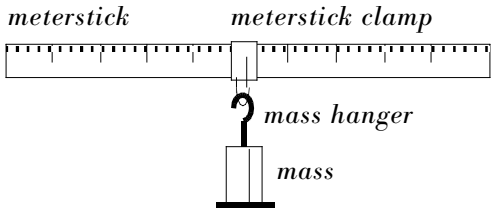
We already know the rotational analogs of position, speed, and acceleration. We now seek the rotational analogs of mass and force. We will eventually expand this investigation to find the rotational analogs for momentum, work, and kinetic energy.

• Purpose •

To investigate the difference between "linear force" and "angular force."

• Apparatus •

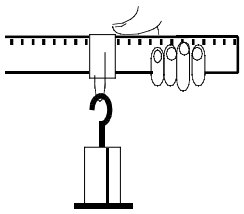
___ meterstick
___ meterstick clamp
___ mass hanger
___ slotted mass
(NOTE: If the mass hanger is not the angle-type, secure mass to hanger with tape so that mass can't slide off.)



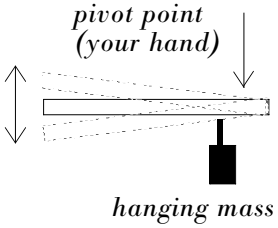
• Procedure •

If we were performing a lab to investigate linear force, we might hold objects of various masses and note how difficult they are to support (or raise) due to their weight (the linear force acting on them). To investigate "angular force," we need a different procedure.

1. Hold the end of the meterstick so that your index finger is between the 5 cm and 10 cm mark. Position the clamp at the 20 cm mark and use the mass hanger to suspend the 500 g mass there. Rotate the meterstick slightly (about 15° up and down) so that the free end is raised and lowered while the end you hold does not rise or fall. Do this **slowly** and **carefully**; do not allow the weight to hit anything during this process, since this will cause it to fall off the hanger. Note the level of difficulty associated with rotating this configuration.



2. Move the mass to the 40 cm mark and *without moving your hand from the original pivot-point* rotate the meterstick up and down again. Repeat this procedure with the mass at the 60 cm, 80 cm, and 95 cm marks. *Keep your hand at the 10 cm mark pivot-point so that the hanging weight is getting farther and farther from your hand.*



• Observation •

Regardless of where the hanging mass is positioned along the meterstick, its effect is to pull your hand down in a rotational sense—it tends to "twist" your wrist downward. Does this effect change as the position of the mass changes? If so, how? (Answer in a complete sentence or sentences.)

• Analysis •

Answer all questions in complete sentences.

1. Does the **weight** (linear force) of the mass increase, decrease, or stay the same as the mass gets further from the pivot point?

2. Does the **"twisting force"** acting on your hand increase, decrease, or stay the same as the mass gets further from the pivot point?

3. Suppose the mass was hanging at the 50 cm mark. What do you suppose would happen to the "twisting force" exerted on your hand if the mass was doubled?

4. What factors determine the strength of the "twisting force" or "angular force?"

5. Which configuration do you think would provide the most "twisting force?"
   a. 500 g at a distance of 10 cm from the pivot point
   b. 250 g at a distance of 20 cm from the pivot point
   c. same for both