Forced Motion on Air Track Teacher's Notes

Main Topic	Forces
Subtopic	Newton's Laws
Learning Level	High
Technology Level	Mid
Activity Type	Student

Description: Basic air track lab using photogates to verify Newton's Second Law.

Required Equipment	Air track with end pulley, 1 glider, 2 photogates, ruler or meter stick, balance, hooked masses, string
Optional Equipment	

Educational Objectives

- Observe the motion of a glider pulled by hanging weights. Calculate the glider's acceleration in two ways.

Concept Overview

In this lab using an Air Track, students will quantitatively observe the motion of a glider pulled by hanging weights. They will measure the acceleration of the glider and weights, and then calculate the expected acceleration by using a = F/m.

Lab Tips

Simple connected photogates are needed for this lab. They need to display the time they are blocked, and the time between. Note that "time between" is from the beginning of one gate to the beginning of the other.

Set up the air track beforehand with an end pulley, so that the glider can be attached with string to a weight that hangs over the edge of the table.

Since glider masses vary, it is up to the teacher to assign a hanging mass to each group. You may choose to assign all groups the same mass or different masses.

"Motion on an Inclined Air Track," in which students calculate acceleration of a glider under the influence of gravity, should be completed prior to this lab.

Forced Motion on Air Track Name: _____
Class: _____

Goal:

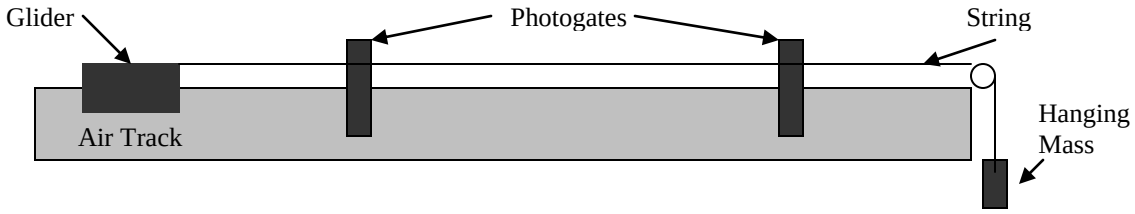
Observe and describe the motion of a glider on a level air track.

Materials:

Air track with end pulley, 1 glider, 2 photogates, ruler or meterstick, balance, hooked masses, string

Procedure:

1. Turn on the air blower. Place a glider in the center of the track. If the glider starts to slide on its own, adjust the track's feet until it is perfectly level and the glider does not move when put down.
2. Arrange two photogates at least half the track length apart, so that the glider flag triggers the gates when it passes through.
3. Measure and record the length of the part of the glider that passes through the photogate, in cm _____ and in m _____
4. Your teacher will assign you a mass to hang over the edge of the table. Record the mass, making sure to include the mass of any hanger you use. _____



5. Set the photogates to measure the quantities needed to find the glider's acceleration (time 1, time 2, time between). Arrange the glider, string and hanging mass as shown in the diagram. When you are ready, release the glider.
6. Record the times reported by the gates:
   a. Gate 1: _____
   b. Gate 2: _____
7. Record the time elapsed between the glider beginning to pass through Gate 1 and reaching Gate 2. _____
8. Calculate the speed (in m/s) of the glider as it passed through each gate by dividing the length in #3 by the times in #4.
   a. Gate 1: _____
   b. Gate 2: _____
9. Calculate the glider's acceleration as it passed from Gate 1 to Gate 2.

10. The hanging mass creates tension in the string. That tension provides the force that accelerates the glider. What is the magnitude of the force on the glider?

11. Since the accelerating system includes both the glider and the hanging mass, measure and record the mass of everything in the accelerating system.

    _____

12. Use Newton's Second Law to calculate the expected acceleration of the system in #11 when acted on by the force in #10.

13. Find the percent difference between the expected acceleration (#12) and the measured acceleration (#9).

$$\%difference = \frac{\exp ected - \exp erimental}{\exp ected} * 100\% =$$

14. If the difference is significant, go back and try to locate a source of error, and repeat your measurement and calculations.