PhyzLab: Inertia in Action!

a variety of investigations of inertia
USE PENCIL ON ALL LABS

• Introduction •
You may have heard the term “inertia” before. You may even have some idea of what it is. The following activities are intended to give you a hands-on feel for certain aspects of inertia. Do them in any order (they are not sequential). Please do not use the term “inertia” in any of the explanations or answers to questions. Your answers here will serve as a definition of inertia (and you can’t define a word using the word itself).

• Card Trick •
SETUP
The materials are a cup (or beaker or equivalent), a card, and a coin (or cap or equivalent).

1. Place the cup right side up on a table.
2. Place a card horizontally on the cup, covering the cup’s mouth.
3. Lay the coin on the card.
4. Remove the card such that
   • the coin will fall directly into the cup
   • no part of the card will rise above its current location
   • the performer will leave no fingerprints on the coin or the card while removing the card. Holding the cup is acceptable during the performance.

QUESTION: Describe your technique; include one or more diagrams. Why does it work while other techniques do not?
• Hoop Dreams •

SETUP
The set-up is a few small objects resting atop a hoop balanced on a vessel. The small objects may be coins, hex nuts, marker pens, drilled spheres, etc. The hoop is an embroidery hoop. The vessel may be a flask, a roll of paper towels, etc.

1. Balance the hoop on the open “mouth” of the vessel. You may find it helpful to press downward on the inside bottom of the hoop while trying to find the balancing position. Let go when you think you have it; adjust and try again if the hoop falls over. This may require practice.

2. When you have the hoop balanced on the vessel, place the objects on top of the hoop so as to not upset the balance of the hoop. This may require practice, too.

3. Without touching the objects or the vessel, remove the hoop in such a way as to allow the objects to fall into the vessel. You can touch the hoop with only one hand and you cannot touch the hoop for more than one second.

GOOD TECHNIQUE: Good technique allows the pen to fall directly into the tube (without moving upward at all). Describe good technique; show on the top diagram sequence where to grab the hoop. (Show where to grab it and the direction to move it so that the result is the final diagram in the sequence.)

BAD TECHNIQUE: Bad technique launches the marker; show on the top diagram sequence where to grab the hoop. (Show where to grab it and the direction to move it so that the result is the final diagram in the sequence.)
• Tablecloth Trick •
1. Is it possible to remove the tablecloth without significantly disturbing the books lying on the table? If so, describe your method.

2. Is it possible to remove the tablecloth without disturbing pieces of paper lying on top of the tablecloth? If so, describe your method.

QUESTIONS
1. Why don’t the books fly off the table when you pull the tablecloth out in Activity 1?

2. Explain the difference between Activity 1 (books on the table) and Activity 2 (paper on the table).

3. Would it be easier or more difficult to do this trick with many more books? Explain.
SetUp
PASCO Dynamics cart on track and air track with glider. Both systems are arranged to allow elastic collisions at the endpoints of the track. The glider functions properly when the air track's power is turned on. The key is to make the cart and glider move **slowly**.

1. What are the similarities of the cart and the glider?

2. What are the differences?

3. What keeps the air track glider moving from side to side?

4. If you think it’s the springs, why does the glider move after the springs have sprung (and the glider is no longer in contact with the spring)? If you think it’s the air, why does the glider move both ways with equal speed? Does the air switch direction when the glider bounces?
• **CD Glider** • (Do this after constructing your CD Glider.)

SetUp ADDENDUM

1. You will get one balloon. **One.** Please treat it well.

Questions (to answer after building a successful CD Glider)

1. How is the behavior of the glider different from that of most objects (e.g., a textbook) when sliding across the table?

2. Does the air coming out of the glider propel the glider horizontally? Or is the glider’s motion dictated by external forces, such as you pushing it or the unevenness of the table’s surface?

3. Straw catch. Obtain a straw for each person in the group. Learn to blow at the base of the balloon (at the PVC neck). Learn to “play catch.” Each person should be able to catch a moving glider and pass it to the next team mate using only the straw.

4. Imagine a glider on flat, level, smooth surface.
   a. If the glider were at rest, would it start moving on its own? Why? Why not?

   b. If the glider were at rest, how would you set it in motion? Describe your answer below and illustrate it on the diagram to the right.

   ![Diagram](image1)

   c. If the glider were moving, how would you bring it to a stop? Describe your answer below and illustrate it on the diagram to the right.

   ![Diagram](image2)

   d. If the glider were coasting in a straight line, how would you change the **direction** of its course without changing its speed? Describe your answer below and illustrate it on the diagram to the right.

   ![Diagram](image3)
CONSTRUCTION
A. What You’ll Need
1. A discarded compact disc (CD), DVD, or Blu-ray Disc.
2. Hot glue gun and glue (or equivalent). Hot glue is preferred because it has some flexibility.
3. Nylon bushing (1/2" base, 7/8" tall, 5/16" OD neck)
4. Nylon washer (7/8" OD, 3/8" ID, 1/16" thick)
5. Masking tape
6. Small party balloon (4" diameter)
7. Pencil or pen

B. Putting it Together
1. Glue the nylon washer to the center of the CD on the mirror side. Avoid getting hot glue on the other side of the CD. The seal must be air tight. (See figures a and b below)
2. Glue the nylon bushing to the nylon washer.
3. Cover the PVC "stem" with a short length masking tape. (Figure c)
4. Poke a small hole in the masking tape with a pencil or pen. (Figure d)

Making it Work
1. Blow up the balloon.
2. Twist the balloon stem so air will not leak out.
3. Attach the balloon to the PVC stem. (Figure e)
4. With the glider placed on a smooth, flat surface, allow the balloon to "untwist" itself. Air should flow through the PVC stem and form a thin layer between the CD and the smooth, flat surface. Give your glider a push and see what can happen when friction is greatly reduced.
5. If your glider does not work to your satisfaction
   a. make sure the surface your CD is gliding on is smooth, flat, and clean.
   b. make sure the bottom (printed side) of your glider is smooth and flat with no residual hot glue.
   c. vary the size of the hole in your masking tape. If the glider doesn’t seem to be getting off the ground, make the hole larger. If the air comes out too rapidly, try another piece of masking tape with a smaller hole.