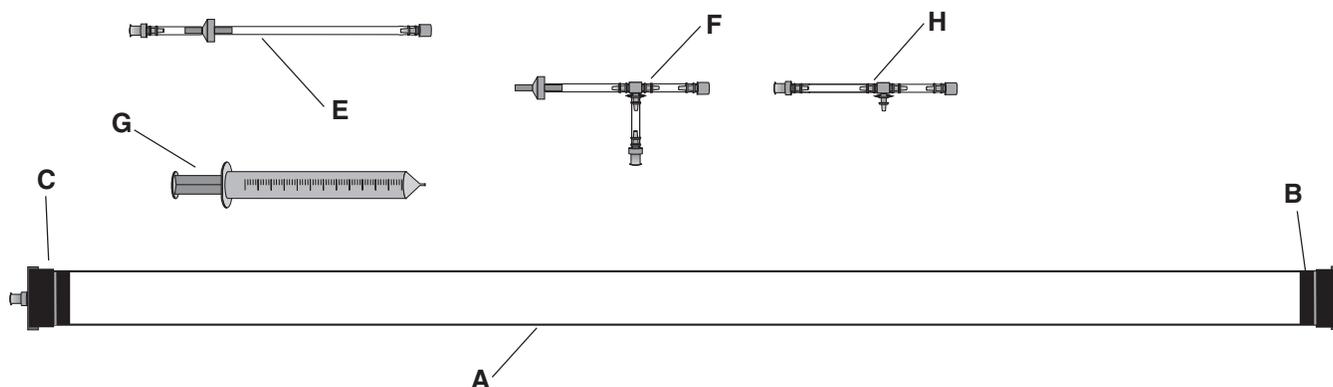


**Instruction Sheet
for the PASCO
Model SE-9788**

COIN AND FEATHER TUBE



Introduction

The PASCO SE-9788 Coin and Feather Tube demonstrates the effect due to gravity on objects falling through a vacuum, compared to the effect on objects falling through air.

In the demonstration, students see that in an environment in which air resistance is not countering the force of gravity (in a vacuum), any object— regardless of its mass or density—will require the same time period to reach the bottom of the tube. However, when air molecules are present, air resistance counters the force due to gravity. Students will observe that when air is present, objects of differing mass or density require differing time periods to reach the bottom of the tube.

Equipment

INCLUDED

Part Label	Part Name
A	clear plastic tube
B	end piece
C	end piece with connector
D	“coins”, Styrofoam pieces
E	tubing with check valve
F	tubing with T and check valve
G	60 cc syringe
H	tubing for connection with a PASCO Pressure Sensor

Note: Parts E, F, and G constitute the vacuum pump

ADDITIONAL SUGGESTED

- *ScienceWorkshop* Interface (300, 500, 700, or 750)
- Pressure Sensor (CI-6532, CI-6533, or CI-6559)
- computer and data acquisition software (*ScienceWorkshop* or *DataStudio*)

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Basic Setup and Operating Procedure

Note: The first time you set up the Coin and Feather Tube, you will need to assemble piece F by attaching the small tube to the T-connector (Figure 1). (These pieces are left unassembled for shipping.)

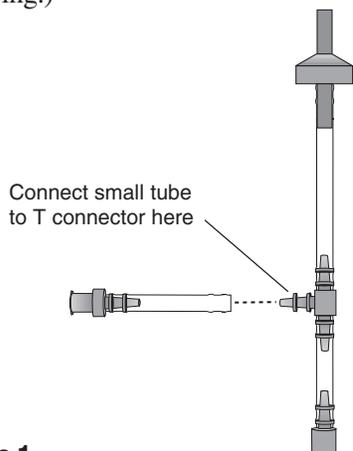


Figure 1
Assembly of Part F
(once only at first use)

1. Remove the end piece, put a coin and a feather or a Styrofoam peanut inside the tube, and replace the end piece.

Note: Exercise care that your hand or fingers do not get pinched between the end piece and the tube.

2. Assemble the vacuum pump as shown in Figure 2.

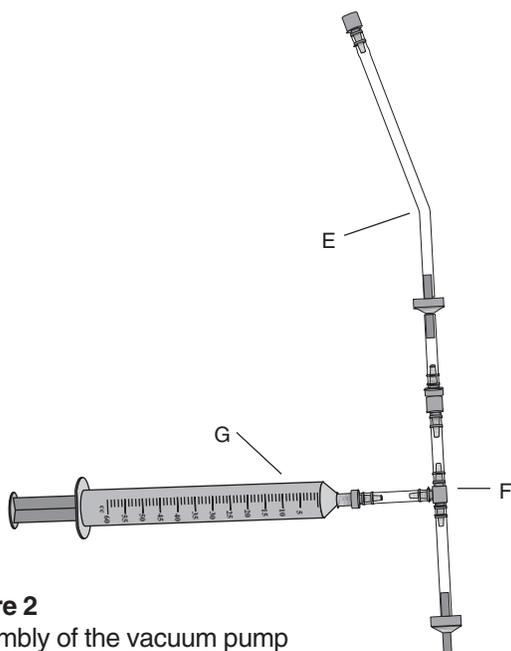
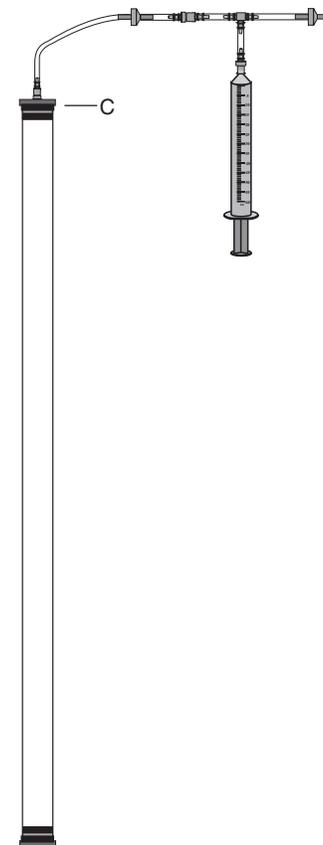


Figure 2
Assembly of the vacuum pump

3. Connect the vacuum pump to the Coin and Feather Tube at the connecting piece on end piece C (Figure 3).



4. Pull a vacuum in the tube by pumping the plunger on the syringe 50–60 times.

Note: You can tell approximately how much air is being expelled by the sound coming from the check valve.

Figure 3
Connecting the vacuum pump to end piece C

5. Disconnect piece E from piece F (Figure 4) to remove the vacuum pump.

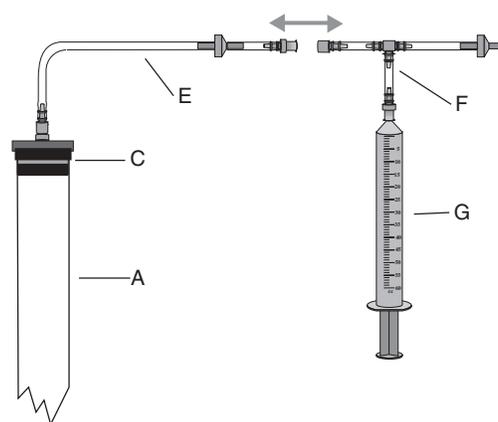


Figure 4
Removing the vacuum pump

6. Hold the tube in a horizontal position and then quickly tip the end with the objects up so the tube is in a vertical position (Figure 5). Watch the motion of the objects.

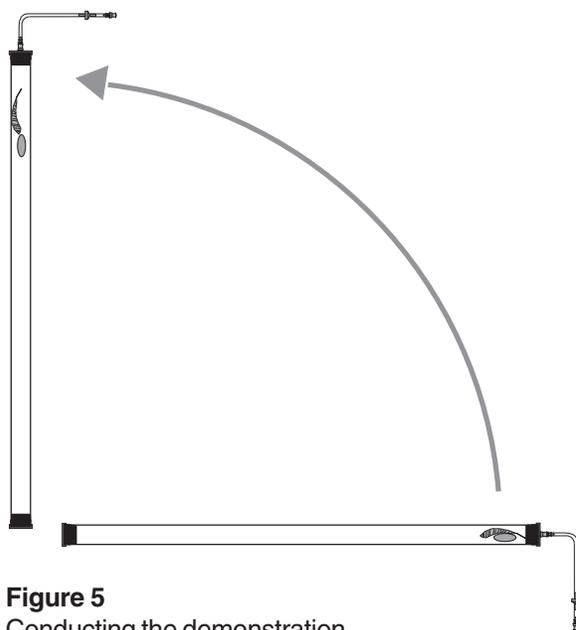


Figure 5
Conducting the demonstration

7. Disconnect piece E from end piece C (Figure 6) to release the vacuum and repeat Step 6.

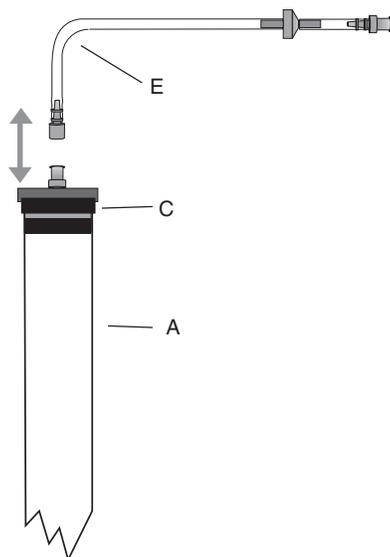


Figure 6
Releasing the vacuum

Note: If vapor forms on the inside wall of the tube when you release the vacuum, remove an end piece and allow air to circulate in the tube.

Setting up with *ScienceWorkshop*

1. Connect part H to the hose connector on part A (Figure 7).
2. Connect part E to part H.
3. Connect part F to part E.
4. Connect the syringe to the T of part F.
5. Connect the Pressure Sensor to the T on part H.

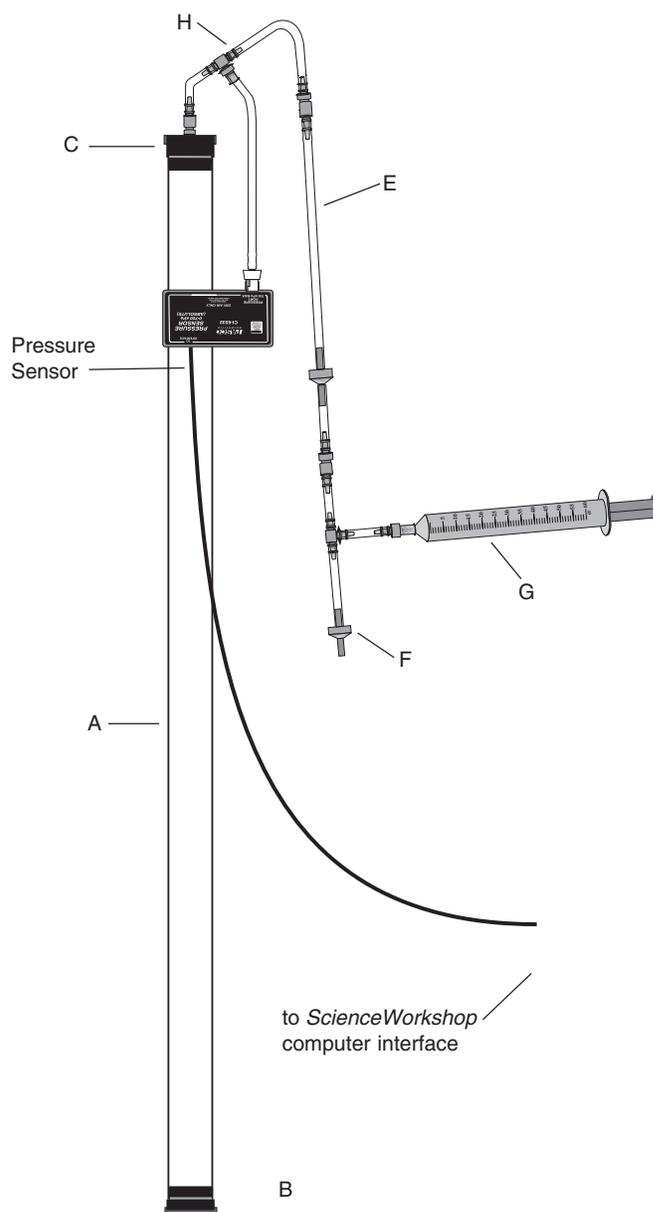


Figure 7
Setting up to measure the pressure inside the tube with a Pressure Sensor and a *ScienceWorkshop* computer interface

Removing a Static Electric Charge from the Inside of the Tube

A build-up of static electricity on the inside wall of the tube will cause the Styrofoam peanut to stick to the tube wall or be impeded in its fall through the vacuum.

To remove the static electrical charge, humidify the interior of the tube by putting a damp tissue inside it and sealing the ends several hours before the demonstration.

Maintenance

End Pieces

If necessary to achieve a vacuum, you may apply a small amount of Dow Corning vacuum grease to the small O-rings on the end pieces. Take care to avoid getting any of the grease on the inside of the tube under the end pieces, because the objects inside will stick to it.

Syringe

- Glycerin may be used on the plunger, but normally, no lubricant is required.



Caution:

- Do not use any petroleum-based lubricant on the syringe. The plunger is very intolerant to petroleum-based substances.

Tube

If you notice any scratches on the inside of the tube caused by debraiding by the coin, you may want to switch to a play-money plastic coin.



Safety Considerations

This set is intended to be used by teachers, and their students while working under appropriate supervision.

Any liquids entering the pump are apt to be discharged as a mist or spray. Only safe liquids such as water should be allowed to be used in association with the pump, and safety eyewear is definitely required.

The tube should be used only with the furnished end pieces. Attempting to evacuate the chamber while in contact with other surfaces could cause damage. Severe injury will result from evacuating the chamber while in contact with skin.

Do not put items in the tube that would be damaged by, or cause damage as a result of, reduced pressure. Examples would include sealed containers, wrist watches, batteries, etc. Certainly animals should not be placed in the bell jar, for reasons of law and human decency.

Do not use the apparatus if the bell jar or bottom plate have become cracked or otherwise damaged.

Limited Warranty

PASCO scientific warrants the product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. PASCO will repair or replace, at its option, any part of the product which is deemed to be defective in material or workmanship. The warranty does not cover damage to the product caused by abuse or improper use. Determination of whether a product failure is the result of a manufacturing defect or improper use by the customer shall be made solely by PASCO scientific. Responsibility for the return of equipment for warranty repair belongs to the customer. Equipment must be properly packed to prevent damage and shipped postage or freight prepaid. (Damage caused by improper packing of the equipment for return shipment will not be covered by the warranty.) Shipping costs for returning the equipment after repair will be paid by PASCO scientific.

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The exclamation point within an equilateral triangle is intended to alert the user of important operating and safety instructions that will help prevent damage to the equipment or injury to the user.