Projectile Launcher

ME-6800

Introduction

The Projectile Launcher is designed for projectile motion experiments and demonstrations. The only additional equipment required to use the launcher is a C-clamp for mounting the launcher to a sturdy table or other horizontal surface. The device is also compatible with a wide array of other PASCO products.

Balls can be launched from the Projectile Launcher at any angle from 0° (horizontal) to 90° (vertical) while the launcher is mounted on its base. This angle can easily be adjusted using the mounting thumbscrews, and the built-in protractor and plumb bob provide an accurate way to easily measure the angle of inclination.

The piston prevents the ball from rubbing against the inside of the barrel as it travels, ensuring that the ball launches with almost no spin. When the base is secured to a table with a C-clamp, there is also very little recoil. The trigger is pulled with a string to minimize jerking.

You can use the Photogate Mounting Bracket (ME-6821A) to attach one or two photogates to the Projectile Launcher. When used with a PASCO interface and data collection software, these photogates can be used to measure the muzzle velocity of the ball. You can also use a photogate and the Time-of-Flight Accessory (ME-6810A) to measure the time of flight of a ball fired from the launcher.

Equipment

Included equipment:



- 1 Projectile Launcher
- 2 Launcher base
- **3** 2-D Collision Accessory
- $4 \quad 3 \times \text{ plastic balls, 25 mm}$
- **5** Ramrod
- 6 2× safety glasses (not pictured)

Required equipment

• Large C Clamp (SE-7285) or equivalent clamp

Recommended equipment:

- Ball Catcher (ME-1252)
- Launcher Spares Kit (ME-6802)
- Time-of-Flight Accessory (ME-6810A)
- Photogate Mounting Bracket (ME-6821A)
- Ballistic Pendulum without Launcher (ME-6831)
- Shoot-the-Target (ME-6853)
- Photogate Head (ME-9498A) or Wireless Smart Gate (PS-3225)

Features



- 1 Trigger string
- 2 Trigger
- 3 Thumbscrews
- 4 Protractor
- **5** Plumb bob
- 6 Range-setting slots
- Launch position of ball
- 8 Muzzle

Usage

General information

When using the Projectile Launcher, keep the following advice in mind:

- The muzzle velocity of launched projectiles will vary slightly with angle. Depending on the range setting, the difference in muzzle velocity when firing horizontally versus firing vertically may be as high as 8%.
- Although the muzzle end of the Projectile Launcher does not change height with angle when mounted in the top position, it is still about 30 cm above the bottom of the base. If you intend to show that projectiles fired with equal muzzle velocities at complementary angles will have the same range, you will need to shoot to a horizontal target that is at the same height as the muzzle.

- The position of the ball when it leaves the barrel is indicated by the circular marking adjacent to the muzzle. When measuring the vertical distance the ball drops, measure from the floor to the bottom of this launch position marker.
- To minimize the scatter pattern of launched projectiles, the Projectile Launcher must be securely clamped to a *sturdy* table. Any wobble in the table will affect the data.
- The angle of inclination can be measured to within 0.5° using the protractor and plumb bob.

Setup

▲ CAUTION: To avoid risk of injury, ALWAYS wear safety glasses when you are in a room where the Projectile Launcher is being used!

The base has two positions for mounting the launcher. The circular and curve-shaped slots near the top of the base are used when you want to change the launch angle. In this position, the Projectile Launcher pivots at the muzzle end so that the elevation of the ball as it leaves the barrel does not change, even as the launch angle varies. The parallel slots near the bottom of the base are used when you want to fire a ball horizontally into a target, such as a Ball Catcher (ME-1252) mounted on a cart.

To set up the apparatus:

- 1. Loosen and remove the thumbscrews from the square nuts on the side of the Projectile Launcher. (Make sure that the washers remain on the thumbscrews at all times.)
- 2. Clamp the launcher base to a sturdy table using a Large C Clamp (SE-7285) or equivalent clamp.
- 3. Insert one of the thumbscrews into one of the slots you intend to use to mount the Projectile Launcher.
- 4. Align the appropriate square nut on the Projectile Launcher with the thumbscrew, then tighten the thumbscrew to secure the launcher to the base.
- 5. Position the Projectile Launcher so that it is horizontal (for the lower position) or at the desired angle (for the horizontal position). The other square nut should be visible in the second slot.
- 6. Insert the second thumbscrew into the second slot and tighten to secure the Projectile Launcher in place.
- 7. Tie the included trigger string to the trigger.

Aim

You can adjust the Projectile Launcher's angle of inclination above the horizontal by loosening the two thumbscrews and rotating the barrel to the desired angle. Use the plumb bob and the protractor on the label to measure the angle. Once the angle is set properly, tighten the thumbscrews again to secure the launcher in place.

You can also "bore-sight" through the barrel at a target by looking through the back end of the barrel when the Launcher is *not* loaded. There are two three-spoke sights inside the barrel, with one located at the end of the barrel and the other at the end of the piston about halfway along the barrel. Each sight has a small sighting hole at the center. While adjusting the Projectile launcher as described above, adjust the angle and position of the Launcher so that the centers of *both* sights are aligned with your target (as shown in Figure 1), then secure the Launcher in place with the thumbscrews. **NOTE:** NEVER look down the barrel of the Projectile Launcher! Look through the range-setting slots on the barrel if you need to check whether or not the launcher is loaded.



Figure 1: Bore-sighting through the barrel.

Load

The Projectile Launcher features three range settings. At a launch angle of 45°, a fired projectile on each setting will travel 1.2 m, 3 m, and 5 m respectively. To load a ball into the launcher and cock the piston to the appropriate range setting, follow these steps:

1. Place a ball into the muzzle of the Projectile Launcher.

NOTE: Do NOT attempt to cock the piston when a ball is not loaded into the launcher. Doing so may damage the damage the piston.

- 2. Look down through the range-setting slots, then push the ball down the barrel using the ramrod until the trigger catches the edge of the piston at the desired range setting. The trigger will "click" into place.
- 3. Verify that the piston is at the correct setting. When the yellow indicator tape on the piston is in the middle range-setting slot, the piston is in the Short Range position. When the tape is visible in the next range-setting slot (the fourth from the muzzle), the piston is in the Medium Range position. When the tape is visible in the last range-setting slot, the piston is in the Long Range position.

Shoot

Before shooting the ball, make sure that there are no people or objects in the path of the projectile. To shoot the ball, pull straight up on the trigger string by about one centimeter. The trigger will automatically return to its initial position after the string is released and the ball is launched.

Maintenance and storage

The Projectile Launcher does not need any special maintenance. In particular, do NOT oil the launcher, as this can cause damage to its mechanisms.

To store the launcher, mount it on the base in the upper position, then rotate the barrel to be parallel to the base and secure it in position. This will minimize the amount of space the base takes up and allow for easier storage. The ramrod and the side of the base have hook-andloop material that allows you to attach the ramrod to the base when the device is not in use.



Install additional components

2-D Collision Accessory

The 2-D Collision Accessory is a plastic bar with a thumbscrew and a square nut. The bar features a post that allows you to balance a second ball in front of the Projectile Launcher's muzzle. When the launched ball collides with the second ball, they experience a two-dimensional collision.

To install the 2-D Collision Accessory onto the Projectile Launcher:

- 1. Orient the 2-D Collision Accessory so that the side with the word "PASCO" faces upward.
- 2. Loosen the square nut on the 2-D Collision Accessory.
- 3. Slide the square nut into the T-shaped slot on the bottom of the barrel, as shown in Figure 2.
- 4. Adjust the position of the 2-D Collision Accessory as needed, then tighten the thumbscrew.
- 5. Load a ball into the barrel of the Projectile Launcher, then place a second ball onto the post on the accessory.
- 6. Loosen the thumbscrew slightly, then rotate the accessory to one side or the other until the ball on the post is at the desired angle relative to the path of the ball in the launcher. Once the desired angle is reached, tighten the thumbscrew again.



Figure 2: Inserting the 2-D Collision Accessory.

Photogate Mounting Bracket

The Photogate Mounting Bracket (ME-6821A) can be used to mount one or two photogates on the Projectile Launcher, allowing you to measure the muzzle speed of the ball. If you are using a Smart Gate (PS-2180) or a Wireless Smart Gate (PS-3225), only one gate is required. If you are using Photogate Heads (ME-9498A) and will be measuring velocity, two gates should be used. To mount the gate or gates on the bracket:

- 1. Loosen the larger thumbscrew near the end of the bracket. Leave the square nut in place on the end of the thumbscrew.
- 2. Using the smaller thumbscrews stored on the underside of the bracket, mount one or two photogates to the bracket, as shown in Figure 3.
- 3. Align the square nut on the bracket with the T-shaped slot on the bottom of the Projectile Launcher barrel, as shown in Figure 3, then slide the nut into the slot until the nearest photogate is as close to the muzzle as possible without blocking the beam.
- 4. Tighten the larger thumbscrew to secure the bracket in place.



Figure 3: Installing the Photogate Mounting Bracket and photogates.

Repair the plumb bob

If the string that holds the plumb bob on the protractor breaks, you can replace it with an equal length of nylon thread, such as the thread included in the Launcher Spares Kit (ME-6802). To do so:

1. Cut a length of replacement string long enough that, when the Launcher is inclined at an angle of 50°, the string extends well below the corner of the launcher. (See Figure 4.)



Figure 4: Proper length of replacement string.

- 2. Carefully thread the replacement string through the small hole at the vertex of the protractor, then tie a triple knot at that end of the string to ensure it cannot slip back through.
- 3. To attach the plumb bob onto the string, thread the string through the hole in the center of the plumb bob, then tie the string to a small washer to keep it from slipping through the hole.

Specifications and accessories

Visit the product page at <u>pasco.com/product/ME-6800</u> to view the specifications and explore accessories. You can also download experiment files and support documents from the product page.

Experiment files

Download one of several student-ready activities from the PASCO Experiment Library. Experiments include student handouts and teacher notes. Visit <u>pasco.com/freelabs/ME-6800</u>.

Technical support

Need more help? Our knowledgeable and friendly Technical Support staff is ready to answer your questions or walk you through any issues.

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Limited warranty

For a description of the product warranty, see the Warranty and Returns page at www.pasco.com/legal.

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