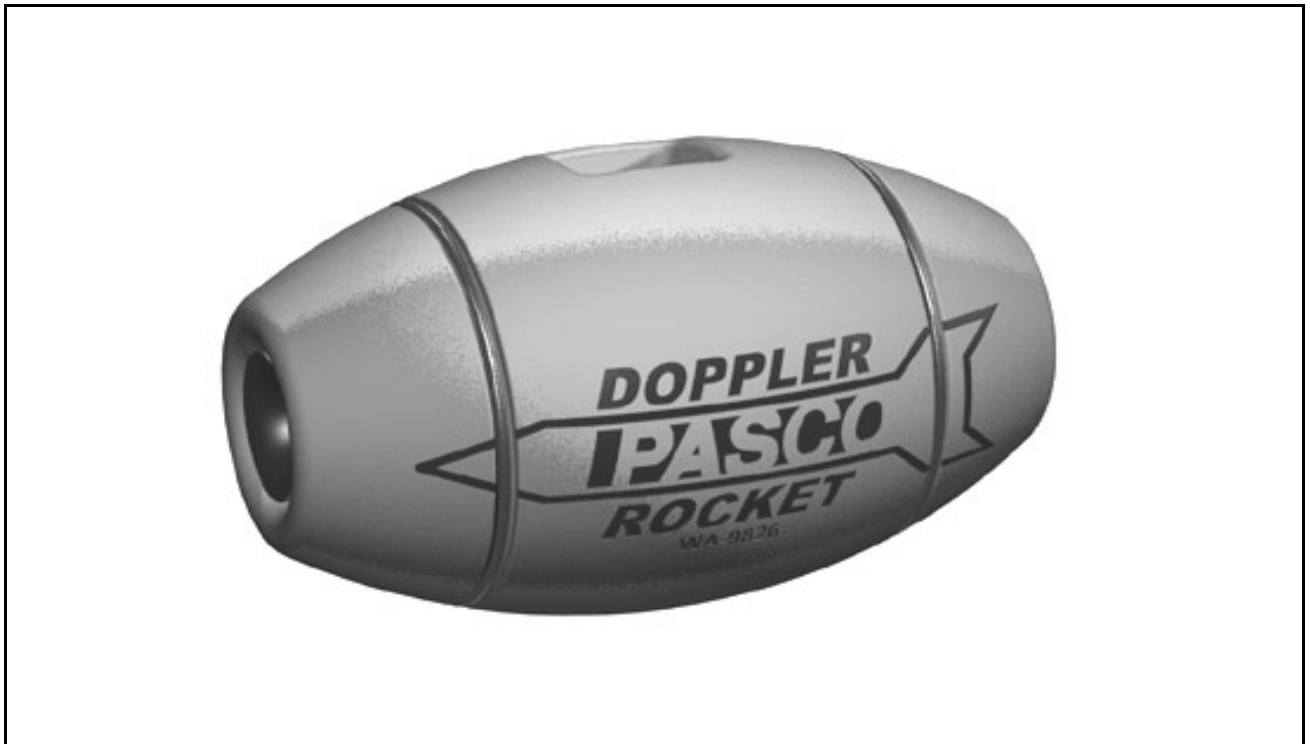




# Doppler Rocket

Model No. WA-9826

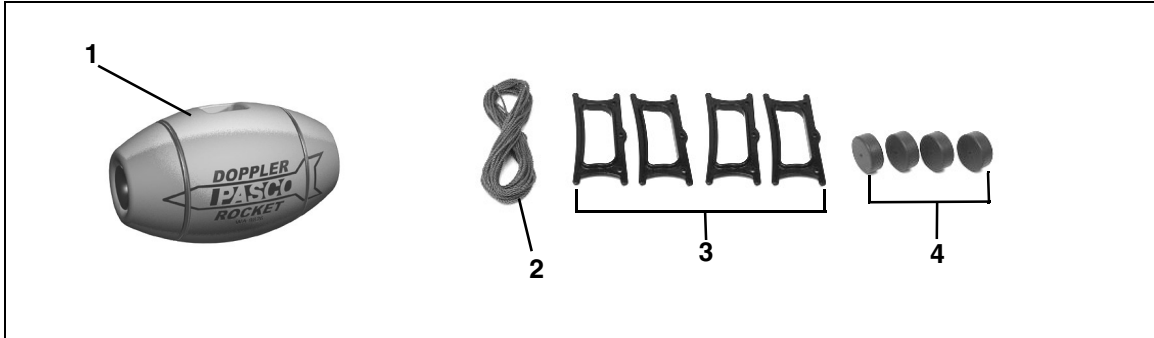




# Doppler Rocket

Model No. WA-9826

## Equipment List



Included Equipment	Replacement Model Number*
1. Doppler Rocket (1)	WA-9826
2. Rope, 30 meters (1)	699-146
3. Handles (4)	648-08210
4. Handle cushions (4)	648-08172

\*Use Replacement Model Numbers to expedite replacement orders.

## Introduction

The Doppler Rocket combines the excitement of a toy and an audio Doppler shift to create an educational experience your students will remember. The Doppler shift in sound waves is an interesting phenomenon that we all experience in everyday life. Teaching about the Doppler shift is not always easy to accommodate in the classroom. As the Doppler Rocket passes the students, they will hear a noticeable shift in the frequency. Not only is the Doppler Rocket designed to effectively teach the frequency shift concept, but its rugged design will provide years of use in the classroom.

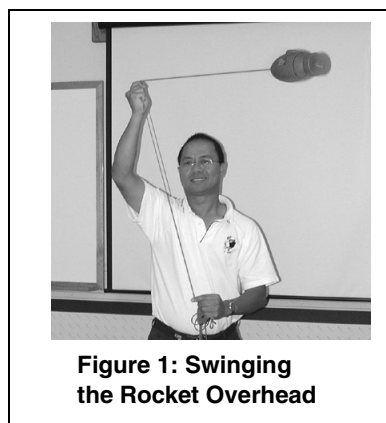
The Doppler Rocket is designed to emit a true, sinusoidal sound waveform at a constant frequency of approximately 620 Hz. The circuit board and speaker are housed in skinned foam that will protect the unit during normal impacts. The circuit is powered by a small 9V battery that can be easily replaced.

Included with the Doppler Rocket are accessories for a variety of activities, like swinging the rocket overhead, flying the rocket horizontally, and playing catch.

## Demonstrations and Activities with the Doppler Rocket

### a) Swinging the Doppler Rocket Overhead

Swinging the Doppler Rocket overhead will allow students to hear the Doppler shift as the sound source moves in a circular pattern. As the rocket moves toward the students, the pitch will sound higher. As the rocket recedes (moves away from the students), the pitch will sound lower.



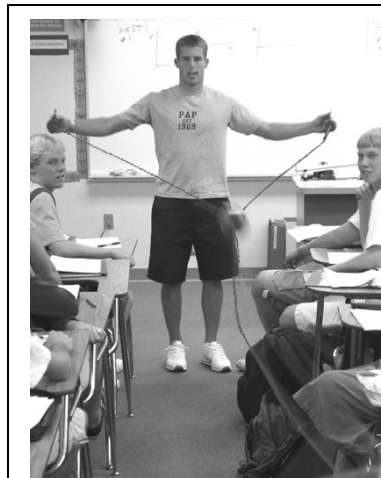
**Figure 1: Swinging the Rocket Overhead**

1. Pass one length of rope through the center of the unit and tie the rope to itself. (Note: Be sure to use a reliable knot as the Doppler Rocket will reach high velocities during this activity.)

2. Turn on the sound from the Doppler Rocket. (Use the switch on the side of the rocket to turn on the sound.)
3. Lower the Doppler Rocket until it is about 1 meter below your hand.
4. Swing the Doppler Rocket around in a circle over your head (See Figure 1). A period of about one second will allow students to hear the Doppler shift.

### b) Flying the Doppler Rocket Horizontally

Another interesting demonstration of the Doppler shift involves “flying” the Doppler Rocket horizontally. Again, the students will hear an increased pitch as the rocket approaches and a decreased pitch as the rocket moves away from them. One main advantage of this demonstration is that the amount of time the Doppler Rocket approaches and recedes is much greater. This allows students a better opportunity to hear the Doppler shift.



**Figure 2: Flying the Doppler Rocket Along a Taut Rope**

1. Pass two equal lengths of rope through the center of the rocket.
2. Thread each free end of rope through a handle cushion and tie each end through a rope handle. Again, be certain to use a reliable knot, as the Doppler Rocket will be moving at high velocities.
3. Position a student at each end of the rope, with each student holding two handles.
4. Move the students apart until the rope is taut.
5. Slide the Doppler Rocket to one end of the rope.
6. Ask the student at the other end to rotate the ropes around one another until they are not tangled.
7. Turn on the sound from the Doppler Rocket using the switch on the side.

8. Have the student nearest the rocket quickly pull apart their handles in a snapping motion. The Doppler Rocket should “fly” down the ropes to the other student (See Figure 2).
9. As the rocket approaches, the student at the other end needs to slightly separate the ropes to slow the rocket.

### **c) Playing Catch with the Doppler Rocket**

An alternative to using the ropes is to have students play a gentle game of catch with the Doppler Rocket. Simply turn the sound on and have students toss the rocket around like a ball. As the rocket approaches them, they should listen for the perceived increase in pitch. As the rocket moves away from them, they should listen for a decrease in pitch.

## **Replacing the Batteries**

The Doppler Rocket uses an alkaline, 9-volt battery that will require periodic replacement.

To replace the battery, remove the O-rings on each end and separate the two adjoining foam halves of the rocket. Insert the replacement battery, align and combine the adjoining foam halves, and replace the O-rings.

## Appendix A: Technical Support

For assistance with the WA-9826 Doppler Rocket or any other PASCO products, contact PASCO as follows:

Address: PASCO scientific

10101 Foothills Blvd.

Roseville, CA 95747-7100

Phone: (916) 786-3800

FAX: (916) 786-3292

Web: [www.pasco.com](http://www.pasco.com)

Email: [techsupp@pasco.com](mailto:techsupp@pasco.com)

## Appendix B: Copyright and Warranty Information

### Copyright Notice

The PASCO scientific 012-08189A *Doppler Rocket Manual* is copyrighted and all rights reserved. However, permission is granted to non-profit educational institutions for reproduction of any part of the 012-08189A *Doppler Rocket Manual*, providing the reproductions are used only for their laboratories and are not sold for profit. Reproduction under any other circumstances, without the written consent of PASCO scientific, is prohibited.

### 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.