

FSEA

PROJECT

PLANS

October 19, 1998

THE ROCKET RK1

Applicable Grades	4 th through 12 th
Number of Members Per Team	Two
Number of Kits Per Team	Not Applicable
Number of Sessions	Five or Six

SKILLS AND ENGINEERING CONCEPTS DEVELOPED:

Introduction to basic aerodynamics, rocket propulsion and Newton's Third Law of Motion. Development and implementation of concepts to prolong flight.

NOTE: This project requires launching of the rockets outdoors. Consideration must be given to possible weather conditions when scheduling this project.

INTRODUCTION

A rocket is defined as a device propelled by the expulsion of gasses, usually generated within the device itself. The rocket's motion results from the reaction to its exhaust blast (much like the recoil of a gun), and is explained by Newton's Third Law of Motion, "For every action there is an equal but opposite reaction."

The principle of a rocket motor may be understood by considering a closed container filled with a compressed gas. Within this container the gas exerts equal pressure on every point of its walls. If a hole were punched in the bottom of the container, the gas at the bottom would escape, and the pressure against the top of the container would no longer be equalized. Hence the internal gas pressure would tend to move the container as a reaction to the jet of air escaping downward.

For this project, propulsion of the rockets will be accomplished by a pressurized air/water mixture.

OBJECTIVE

The objective of this project is to introduce the students to some basic aerodynamics and a little physics (Newton's Third Law of Motion) This is accomplished by having student teams design, construct and test a rocket using a plastic bottle. The goal is to keep the body of the rocket aloft for the longest possible time. The rocket may utilize any design technique to maximize the altitude reached after launch (such as fins, nose cone, streamlining, etc.). It may also employ any technique which will curtail its rate of descent (such as parachute, wings, etc.), thereby maximizing its time aloft.

PROJECT DESCRIPTION

Each team will design, construct and test one or more rockets from the allowable materials.

THE ROCKETS WILL BE POWERED BY COMPRESSED AIR/WATER ONLY. NO FLAMMABLE OR EXPLOSIVE FUELS MAY BE USED.

Teams may decide to utilize one or more design concepts in their rocket to help maximize their “time aloft after launch” in the competition.

Teams are responsible for obtaining their own bottle for the rocket body and constructing any and all rocket attachments. FSEA will supply material for the construction as identified in the Facilities and Equipment (material) Required section.

After teams have constructed their rockets, the mentors will set up the launching mechanisms and conduct test launches for the teams. See Appendix 1 for details on launching rockets using the launcher provided by FSEA. Teams may try various configurations to determine which design works best. They should also vary the amount of water and pressure (pressure may not exceed 60 psi) in their rocket to determine which amount sends their rocket to the highest altitude.

At the completion of the testing phase (usually 2 to 3 weeks), a competition will be held to determine which teams’ rocket stays aloft for the longest period of time. Note that each team of two students will build two rockets, but each team may only enter one rocket in the competition.

DESIGN CONSTRAINTS

The volume of the bottle must not exceed two liters or be less than one liter.

The neck of the bottle must be compatible to the launch mechanism, which is designed to use a two liter bottle. Note that various bottle companies make various size rings on the neck of their plastic bottles. Some neck rings are too small, causing premature launch. Teams may want to try their bottle in the launcher before spending considerable time in the construction of a rocket.

NO METAL OR GLASS PARTS MAY BE USED ANYWHERE IN THE ROCKETS DESIGN (INCLUDING ADDED ITEMS SUCH AS PARACHUTES, ETC.).

COMPETITION

Each team will get two rocket launches (using either the same rocket or a different rocket. Same rocket need not be used for second launch.

Each flight will be timed from moment of launch until touchdown of main rocket body. The times will be recorded.

The team whose rocket has the longest flight duration (single flight) will be the winner.

The following rules will govern the competition:

1. All rockets must meet the specific requirements defined in the Design Constraints section.
2. Launch pressure cannot exceed 60 psi.
3. A malfunction of the rocket or launching mechanism prior to launch (loss of water, pressure, etc.) will not count against the team as a launch.
4. If pieces of the rocket separate during launch and/or flight, the time to touchdown will be recorded when the main body of the rocket (plastic bottle) lands.

CONSTRUCTION

A basic rocket is constructed by attaching fins around the circumference of the plastic bottle. The fins may be attached by a hot glue gun or a strong light weight cellophane or plastic tape. NOTE: Fill the bottle with water first and attach cap. This prevents distortion of the plastic bottle while putting on attachments. The fins may be of cardboard, foam board or any other non-metallic, non-glass material as appropriate (light weight yet non flexible).

To the basic rocket, students may elect to add streamlining, a nose cone, a parachute, wings, or any other attachment they choose. The only restrictions should be in the materials they select (see Design Constraints). As always, the appropriateness is left to the students, at the discretion of the mentors.

LESSON PLAN BY SESSION

This is a guide only.

Session #1 - Discuss rocket project.

Newton's Third Law of Motion

Demonstration/Discussion of letting go of blown up balloon - random flight

Directed flight - fins (drag) for direction and stability (orientation)

Have examples of one and two liter bottles

Demonstrate the launching of the rockets

Discuss parachutes - attaching them to rocket and ensuring they open, etc.

Form teams

Assignment - each team to bring in a plastic bottle for their rocket for next session.

Session #2

Construct rockets

Glue or tape on fins

Attach parachutes (if applicable)

Sessions #3 and #4

Test launch rockets

Repair and/or modify rockets as necessary

Continue test firings

Session #5

Competition

FACILITIES AND EQUIPMENT REQUIRED

Provided by Students

Plastic bottles (with cap preferred) One or more per team.

Provided by FSEA

Stop Watch

Tape

Launching mechanism

Air pump

Fins

Plastic parachute material

Carpet thread for parachute risers

Optional Material - Provided by mentor/students if desired

Glue gun and glue

Additional material for parachutes, wings, nose cones, etc.

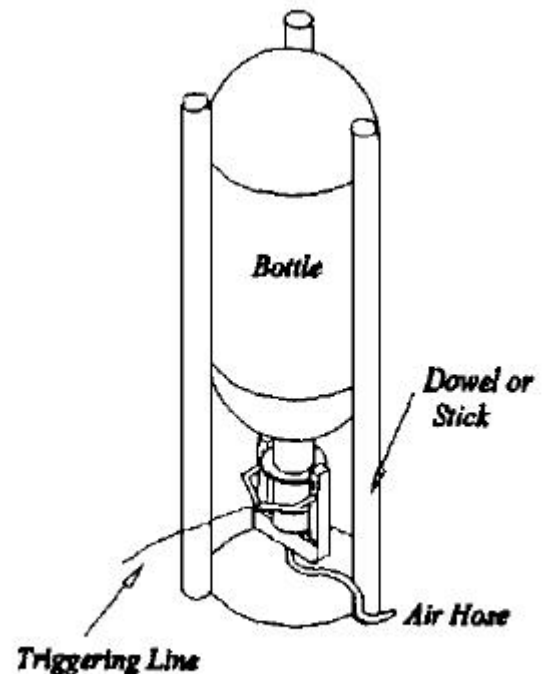
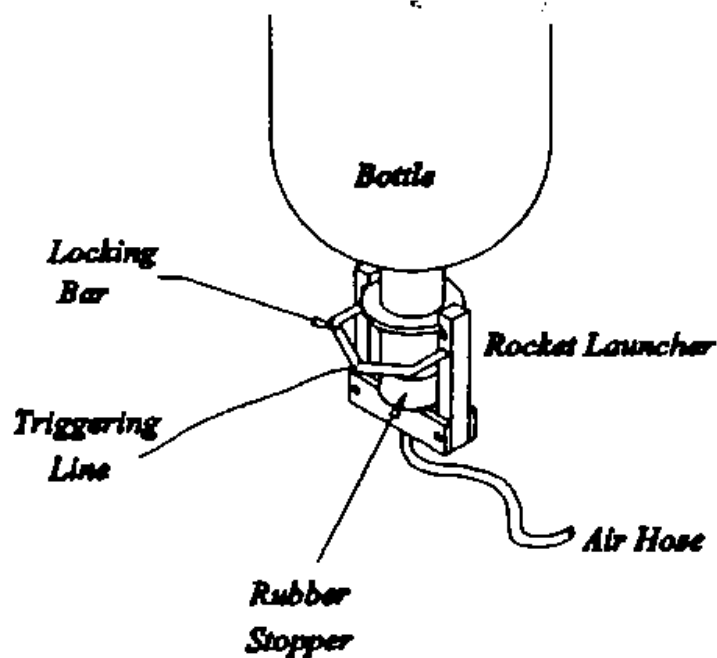
Plastic, string, cloth/material, cardboard tubes, cardboard etc.

APPENDIX 1

LAUNCHING THE ROCKET

To set the ready the launcher, push the two long legs firmly into the ground. You may want to push the legs through a piece of plastic to keep the ground from getting saturated during multiple launches. Be sure to set the rocket launcher well away from trees, telephone wires and buildings.

To attach the bottle to the launcher press the rubber stopper firmly into the neck of the bottle. Notice that each short arm of the launcher has a slot cut into its side. Swing these arms up so that each slot fits over the neck ring of the bottle. When the neck ring is firmly held in the slot of each arm, insert the u-shaped locking bar. See the assembly diagram for details. If necessary, you can stabilize the rocket upright by using dowels or sticks placed in the ground surrounding the rocket.



CAUTION

DO NOT LOOK DOWN AT THE ROCKET DURING PRESSURIZATION

DO NOT AIM THE ROCKET AT ANY PEOPLE OR STRUCTURES

WEAR PROTECTIVE EYE GEAR WHILE LAUNCHING

The stability of the rocket depends on many factors, length, fins, nose cone, all of these can affect the rocket. Cardboard tubes can be used to lengthen rocket bodies. Fins greatly improve the stability of the rocket. FSEA will provide fins, but should you have additional material and wish to experiment with the students, do so. Fins do not have to be large to be effective. They can be made from scrap cardboard, cardboard boxes or other material. Fins can be glued or taped to the rocket bodies. Fins tend to work best when placed near the base of the rocket, but you can also experiment with this.

The nose of the rocket is another point of consideration. The nose of the rocket does two things: first, it streamlines the rocket so that air passes over with efficiency; second, it must hold the parachute or other recovery system and be able to withstand and absorb the impact of the rocket landing.

The parachute can be made by cutting a circular patch from a large plastic garbage bag. Lengths of string about 60 centimeters long, (2 feet) can be cut and taped around the perimeter of the parachute. Gather the free ends and tie them in a not and attach to the bottle. Gently roll up the parachute and place on the top of the rocket or in a nose cone device.

