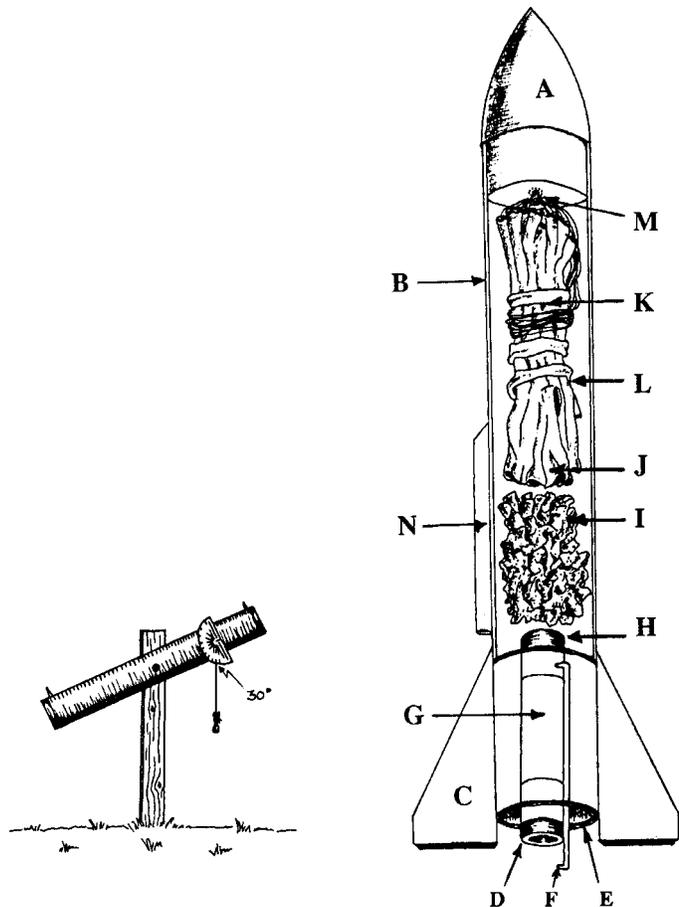




Agricultural Engineering
Leader's Guide
Unit 1

Rocketry



PENNSSTATE



College of Agricultural Sciences
Cooperative Extension

This 4-H Rocketry Project *Leader's Guide* belongs to:

Name	_____
Address	_____
4-H Club	_____
School	_____
County	_____
4-H Coordinator	_____

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Introduction

This leader's guide is to be used in conjunction with the 4-H Model Rocketry Unit I member's guide. The two manuals should be all you need for information. However, much can be learned from **[model]** rocket catalogs.

Prior to the first meeting, send for or obtain from a hobby dealer, a rocket supply catalog. If hobby stores are not handy, model rocket companies are listed in the classified ad sections of magazines such as *Popular Science* and *Popular Mechanics*.

One company manufactures rocket kits that use a **[noncombustible]** liquid fuel and aluminum engines. Many principles in the construction of these rockets differ from those behind the replaceable engine type models for which this project is written. It is advisable not to use the aforementioned rockets for this project even though they are very good products.

Safety note: This project is designed for club or group activity under the supervision of an adult leader or teacher. Activities involving electricity, rocket fuel, and flying objects require extra safety precautions.

Tips for Starting a Rocketry Project Club

1. Consider opportunities to go on rocketry-related field trips. These sites are the best possible classrooms. Encourage club members to coordinate trips to help them develop life skills (interpersonal relationships, leadership, citizenship, etc.)
2. Involve parents in classes, trips, and other activities (**so they also learn**). Involving parents can help club members develop communications skills, leadership, and a sense of values.
3. Don't be afraid to try new things or to use creativity.
4. Offer a variety of projects and activities in an order that will keep 4-H'ers interested, learning, and under control. Encourage them to read directions and to help each other during projects. Ask them to give short talks about their project activities.
5. For some projects, have 4-H'ers bring materials. This will help them learn to assume responsibility.
6. Many new words and terminologies come up while you work on a project. Have a dictionary (or a few) available, so that 4-H'ers can look up that troublesome word.
7. Remember to plan ahead. Some of the suggested projects may need to be set up before the meeting. Involve your 4-H'ers in planning club and project schedules.
8. Safety should be a major concern in all 4-H projects. Do not allow members to run around the work area, as this is a sure way to create accidents. Have a first-aid kit to deal with minor accidents, and plan ahead in case an injury does occur. Treat all injuries, no matter how slight !

9. Be sure to inform your county 4-H agent about your project club. Your agent will be able to tell you about insurance coverage for 4-H clubs, leaders, members, and activities.

10. Read this guide. Following is a list of life skills 4-H'ers can develop by participating in the rocketry project and other 4-H activities. If you need further information and/or training in certain subjects or 4-H leadership areas, please contact your 4-H agent.

4-H Life Skills Development

Personal development

- Develop pride, confidence, and self-esteem
- Understand and use talents and abilities
- Think and make decisions
- Set and meet goals

Value development

- Develop personal work habits
- Develop respect for others
- Become motivated to do quality work

Social and interpersonal relationships

- Work cooperatively with groups or individuals
- Meet new people and make new friends
- Cope with new and changing situations
- Practice sportsmanship and assertiveness
- Accept diversity

Leadership

- Perform officer or committee chairman duties
- Plan and organize group activities
- Teach a skill to others
- Observe and listen
- Identify and solve problems
- Assume responsibility

Citizenship

- Understand one's cultural heritage
- Understand and exercise one's freedoms, rights, and responsibilities
- Understand one's role in family, community, and society
- Plan and implement projects for community benefit

Communications

- Demonstrate skills to a group
- Speak before a group
- Participate in and lead discussions
- Give directions
- Ask questions and make requests
- Listen effectively
- Keep written records

- Express ideas or opinions
- Speak and write persuasively
- Use body language and personal appearance to communicate

Career education

- Plan and prepare for the future
- Determine interests and priorities
- Set and pursue personal goals
- Acquire and budget financial resources

First Meeting

At the first meeting organize the club and have officers elected. Hold the standard 4-H meeting and when the project time arrives start by handing out the member's guides. (From this point on, the member's guide is set up so you can progress at the rate that best suits the club. [Figure 1] shows a 4-H member constructing a model rocket. [Figure 2] can be used as a guide for constructing the items needed for this project.

Requirements for 4-H Model Rocketry—Unit I

(see **Member's Guide**, page 1)

1. Option A will give the club a variety of rockets. (Members may choose any single stage model they wish.) Option B will inspire more competition, as various construction and finishing techniques will produce different results on the same model. (Each member will build a single stage model rocket agreed upon by the whole club. In either case be sure they choose a single engine, single stage, rocket kit.)
2. Most kits have a list of different engines recommended for that particular model. Each member must purchase one low-powered engine and one high-powered engine for this project. The members should at this point be looking at catalogs to decide what kits they want. At the next meeting be sure to collect the money and order as a group. Order rockets and engines at the same time.
- 3-7. This becomes self-explanatory as the project progresses.
8. Members must have at least one photo of their rocket or their rocket and themselves to be placed on page 20 of the member's guide. If a club member has a knack for photography, this person might take pictures for each member.
- 9-10. Self-explanatory.

Project Score

Items (3) and (4) will normally be judged at roundup by the judging team.

Safety Code

The rules in this code should be easily understood. Members will understand the rules more as the project goes on. They should read and discuss the rules.

When discussing rules (1), (2), and (4), you may refer to the construction of the launch panel, (5) to recovery methods, and #6 to launch pad construction.

Necessary Equipment

Members may wish to construct all three devices for their own use, launch pad, launch panel, and tracking scope, *but the club needs only one of each*. Members can be divided into three groups, each group being responsible for constructing one of the devices, or the leader may choose another method for obtaining them.

All of these items are for sale from the leading model rocket manufacturing companies, but many clubs will prefer to build their own.

The construction plans given in this manual are very simple yet contain all necessary safety precautions. Each device can be built with more features than shown, as you will see in units to follow.

The wood base for the launch pad can be obtained from a lumber yard or from a home supply. The launch rod can be purchased from a hobby store or a hardware store. Parts for the safety flag can be easily obtained. For the launch control panel, large and small battery clips, doorbell button, and key switches are available from an electrical supply store, along with the wire. Some auto ignition switches are ideal and might be gotten from a junked car.

The box to hold the launch control switches can be constructed by members from scrap wood. Tracking scope materials can mostly be found around the house, items such as the broom handle, small pine board for the sighting stick, some string, and a nut or fishing sinker for weight. The bolt and wing nut should be about 1/8 inch in diameter and about 2 inches long. It can be obtained from a hardware store along with eye screws and brads. The protractor might be found in an old pencil box kit or bought at a dime store.

Building Your Rocket

Many tips and ideas will be suggested in the rocket catalog that you order from. The kit will include instructions for building the model. You will probably have to read over the instructions carefully so

that you are able to help members with any problems. The tools needed for constructing model rockets are a razor blade or knife, glue, sandpaper, and a pair of scissors.

In this unit, rocket stability, balance, center of gravity, and center of pressure are not discussed. Since you will be working with kits that have been constructed many times, there should be no stability problems if the instructions are followed.

Launching Your Rocket

As leader of this project you are also the Launch Safety Officer. You will watch the loading of the rocket engines, packing of the chutes, and installing of the igniter wires, and you will be responsible for all-around safety of the project. You will be in charge of the launch key and will only turn it over to the launch commander at the proper time and then recover it after the rocket is launched each time.

The Rocket Engine

How the engine works and propels the rocket into the air can be explained by the rule “for every action there is an equal reaction in the opposite direction.” Therefore, as the propellant charge burns and pushes the gas out the bottom (the action), the reaction will be to push the rocket in the opposite direction (up). The different parts of the rocket engine illustrated [in Figure 6] can be named and colored.

The Model Rocket

Emphasize that the rocket illustrated might contain more or fewer parts than the model members chose to build. There are two engine mounting methods listed. Only one of these will be used on a rocket. Emphasize using enough fireproof wadding, because not using enough could cause the plastic chute to melt together by the ejection charge gases. Different parts can be named and colored in.

Recovery Systems

Point out that there is a fourth type of recovery method called *featherweight*. This method is used for rockets that are extremely light and small. If featherweight is given as an answer to one of the questions in the quiz, you will then have to count it correct.

Launch Personnel and Their Duties

The titles and their duties are self-explanatory. Your task as Range Safety Officer and leader will be to see that the titles rotate so everyone gets a chance at every position on the field. It would be advisable to have a first aid kit some place near the Launch Control Center.

The Launch Range

For large engines the launch range should be at least a quarter mile lengthwise. Many fields will not be square or rectangular. As illustrated, use whatever is available to the best advantage. Avoid fields

with high grass or weeds, as finding the rocket after it comes down could be difficult. Also, hidden rocks and branches might cause injuries.

Launch Day

The launch day section gives the typical procedure to follow on launch days. This will be a thrilling experience for members. Watch for safety. You will be initialing the launch record sheets and making sure everything is being done correctly. If there is extra time and it can be managed, you might want to be the timekeeper for the flight duration part of the launch record sheet. This will take some of the burden off the launch recorder. Younger members may have difficulty in multiplication. If so, with your help, the correct answers can be achieved.

Rocketry Quiz

Read the questions. The members will fill in the spaces on their answer sheet.

Rocketry Report

A report is to be written by each member and will be judged at roundup. Emphasize neatness.

Angles and Tangents

The angles and tangents chart is used to help figure the altitude a rocket reaches. The chart is simple to use. When the tracking team reports in an angle, say 41 degrees, go to the chart. Under angle, find 41, which is degrees, and slide right across to the tangent column. You find the tangent is .87. This number is multiplied by the baseline distance used at that particular launch. (See example given in member's guide.)

4-H Model Rocketry Quiz and Answers, Unit I

Identify the parts labeled as 1-5. For question 6, tell what the circled number 3 means.

(Answers)

1. *Ceramic nozzle*
2. *Propellant charge*
3. *Delay charge*
4. *Ejection charge*
5. *Retaining cap (paper)*
6. *Delay time in seconds*

Answer the following questions:

7. Name any two popular recovery systems. (*Parachute, streamer, or tumble recovery system*)
8. What does the fireproof wadding protect? (*Recovery system*)
9. What keeps model rockets out of the fireworks classification? [**sugg. change: what distinguishes model rockets from fireworks?**] (*Being ignited electrically and not by fuse*)
10. What powers your model rocket? (*Premanufactured model rocket engines*)
11. What are nose cones most often made of ? (*Balsa wood*)
12. What is the maximum propellant weight allowed? (*4 oz.*)
13. The launch rod should be at least _____ long. When not in use, it should have a _____ on it. (*3 feet; safety flag*)
14. Circle the engine with the highest average thrust. (***B 14-5***)
15. In the space provided and with the use of your tangent chart, figure the altitude of this rocket: Tracking station reports an angle of 67 degrees. The baseline is 450 feet. (***Tangent is 2.36; the final altitude is 1,062 feet***)

True or false?

16. Homemade fuels are best. (***F***)
17. The weight limit for model rockets is 16 pounds. (***F***)
18. Rocket engines made from metal are recommended. (***F***)

19. Federal regulations govern model rocketry. (*T*)
20. Model rockets fly in the same direction the wind is blowing. (*F*)
21. The main purpose of the key switch is to add “good looks” to the launch panel. (*F*)
22. The launch rod is used to guide rockets during lift-off. (*T*)
23. Fuses are a sure and safe means of igniting rockets. (*F*)
24. The angle on the tracking scope is multiplied by the baseline distance, in feet, to give you the altitude, in feet. (*F*)
25. Because of the way fins are designed, rockets are best launched vertically. (*T*)

