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MODEL ROCKETRY

Leader's Guide

—Beginner Level

4-H Aerospace Program

MINNESOTA EXTENSION SERVICE • UNIVERSITY OF MINNESOTA

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Welcome

Watch a model rocket blast off the launch pad and streak toward the heavens—it's a fun and exciting experience.

And preparing for a launch can even be more exciting. You and your members will learn about engine thrust, recovery systems, stability, decision making and cooperation. Being a project leader is both a challenge and an opportunity.

No special skills are needed to lead this project other than an inquisitive mind and a desire to learn and work with youth. Some adults may think you need a background in science or engineering to be a model rocketry project leader. Granted, such skills are helpful, but they are not necessary.

Model rocketry is timely; it's a Space Age project. The project may encourage members to explore careers in aerospace or other science fields. There's no limit to what they may explore. And you'll feel proud as you watch them build and launch their first rockets!

This guide will help you plan your meetings. It will direct you toward experiences that promote positive development for young people in a safe and supportive setting. Each of the 14 meeting guides uses a learn-by-doing method. Rather than telling or showing members how to do a project activity, you allow them to first show you how they would do it and then you follow with questions and discussion. By using a "member-centered" rather than "leader-centered" approach you and your members will both enjoy the project meetings.

Project leaders say that this approach provides more opportunities for members to develop inquiring minds, gain self-confidence, work together to solve problems, practice decision making and increase their leadership abilities.

Get Organized

The first step is to find young people interested in model rocketry. They may already be 4-H members or be youth not previously a part of the 4-H program. Whether you are leading a project group within a 4-H community club setting or have organized your own 4-H rocketry or aerospace project club, the ideas which follow will be helpful.

Experiences you will have during meetings are designed to include the five building blocks of a positive self-concept: belonging, affection, achievement, independence and new experiences.

Well-planned meetings include learning opportunities to help you achieve these important outcomes.

Call the First Meeting

Your first meeting will be your most challenging because you are working with new people, and you may be dealing with a topic that's new to you. Don't worry. Quickly involve your group members. Concentrate on helping them, and your stresses will disappear right away.

Here are objectives for your first meeting.

1. Get aquainted.
2. Talk about 4-H. What are the roles of members, parents, leaders and the extension office?
3. Introduce the project materials and project expenses.
4. Be sure everyone is enrolled.
5. Do a short learn-by-doing activity.
6. Brainstorm ideas for future meetings and schedule them. An outline is included inside the back cover.
7. Select a name for the club and elect officers.
8. Choose an activity for next time.

Some clubs use the first meeting to schedule future activites, decide who's responsible for each topic, elect officers and set personal goals. Others wait until the second meeting when everyone is better acquainted and has more information about the project.

You may want to visit with each member's parents between the first and second meetings. Talk with them about the project and the parents' roles.

Build an Agenda

Typically, a 4-H project meeting has certain distinct parts. You'll put the parts together according to the life skills and project skills you want to accomplish.

You might divide a 1 1/2-hour meeting like this:

Short Activity Related to Meeting Topic	10 minutes
Flag Pledges, Roll Call, Demonstrations	10 minutes
Project Activity	45 minutes
Business/Next Meeting	10 minutes
Refreshments/Recreation	10 minutes
	1 1/2 hours

Open with an Activity

As soon as members arrive, involve them in a warm-up activity. Display a series of posters with half-completed sentences and tell 4-H'ers to fill in the blanks.

You could also pin the name of an item on each members' backs and have them guess the words they're wearing.

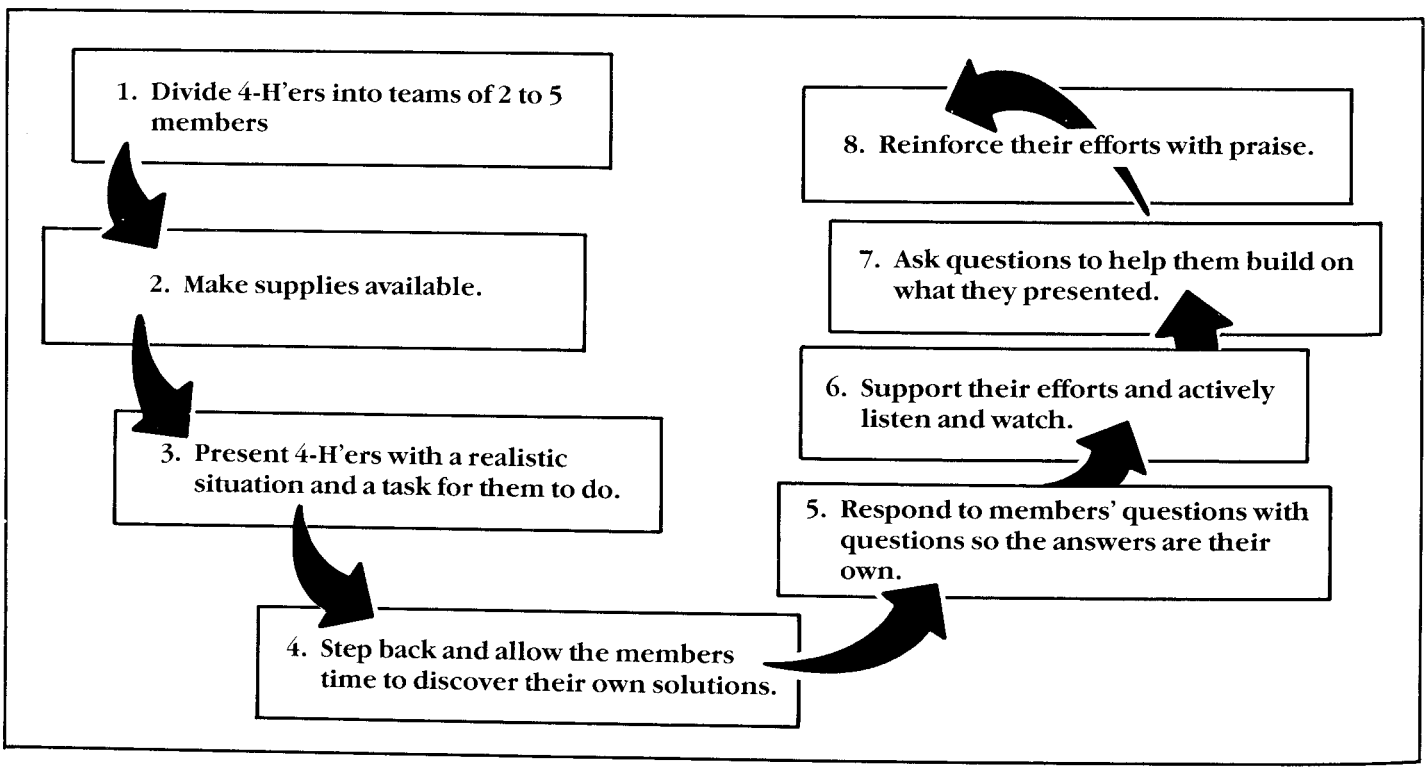
Send 4-H'ers on a scavenger hunt or have them make something. Junior leaders are generally good at helping you explain the warmup rules.

Call Roll

Even "roll call" can be fun. When the secretary calls out their names, have members answer with words that focus on the meeting topic.

Program reports and demonstrations are another chance for members to express themselves and be recongnized. Let 4-H'ers review what happened at the last meeting, which provides continuity from one meeting to the next.

Be a Coach! Use this Model to Involve Members.



Learn by Doing

Take a look at the coaching model.

Your goal is to involve everyone in "learn-by-doing" activities. "Doing" is the key. Don't let them simply sit back. Rather than simply sitting and listening, they can get involved. Encourage them to cooperate. When 4-H'ers actually do an activity, they learn skills such as decision making that can be used in other situations.

Leaders say the following criteria help them have successful activity periods in their meetings.

- Members choose the topic and plan the meeting.
- Meetings center on one specific topic that can be shaped into a learn-by-doing activity in the time alloted.
- Members cooperate, share ideas and have fun.
- Leaders find out what members know and build on that base by asking questions and allowing members to figure out the answers.
- Leaders have a clear idea of what they want 4-H'ers to know, feel and be able to do after a session.

You can use a variety of teaching methods. Choose one that works with the subject you're teaching and that allows members to participate in the learning process.

The above eight steps can also be used on tours, in judging contests, skillathons, role playing, discussion groups and record keeping activities.

Plan Your Next Meeting

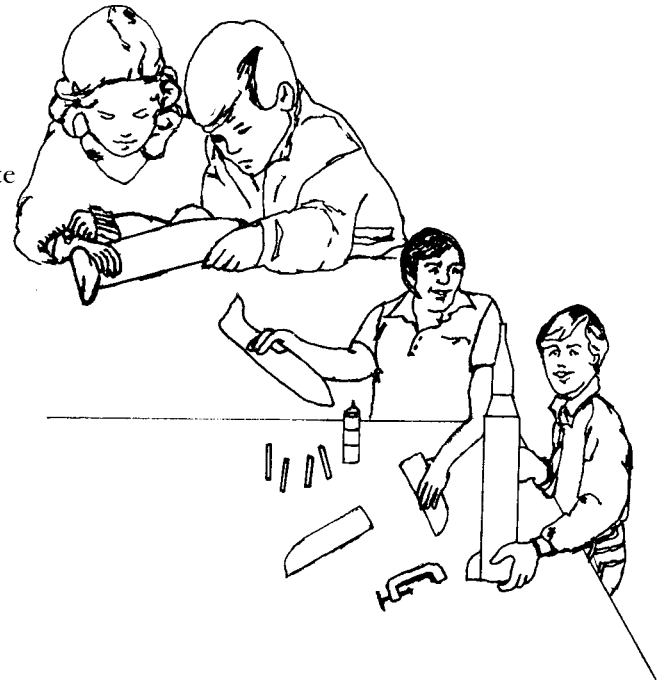
Each meeting should lead to the next. Be sure everyone knows what to do between meetings and what they're supposed to bring next time. Make a list of meeting dates and topics so families can plan ahead and get involved.

Food and Games

Here's another chance to develop responsibility and leadership. Add something delicious and enjoyable to your next meeting. Let those in charge make the plans.

Hats Off!

As a project leader, you have the opportunity to touch the lives of young people. Through your efforts they grow into confident, productive and contributing members of the community.



ONE
Planning Your 4-H Project Year

The project meeting offers an exciting setting for 4-H'ers to develop project and life skills. One of the important personal development experiences that 4-H offers is the opportunity to participate in planning programs. As the project leader you will find that these programs more closely meet the needs of your members when everyone is involved in identifying what to do, when to do it, and how.

This guide has been designed to help your group plan its year's program of five or more project experiences. You will find ideas for involving your group in the planning process. Lists of meeting topics for the 4-H model rocketry project are included in this leader's guide.

What Your 4-H'ers Will Do

- Develop life skills of planning, decision making, working together, accepting a group decision, and feeling a sense of ownership and responsibility for a program
- Plan the year's program to include what, when and how

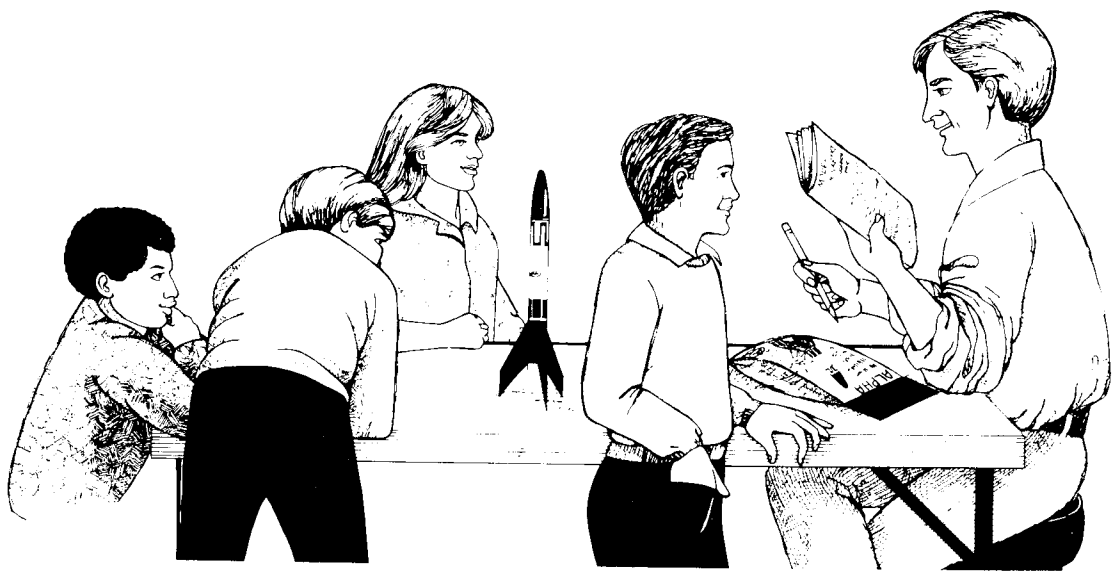
Prepare for the Meeting

As you plan this meeting you may want to ask your members and their parents to discuss what they would like to learn and do. This also helps you involve the parents early in the project's course. Suggest looking through the 4-H project manual for ideas. You may also want to talk to the parents ahead of time to see what they feel to be the needs of their children and how they see 4-H helping to meet those needs.

Supplies needed: Pencils, paper, blackboard (optional), project leader's guide, members' manual, 4-H records, members' advancement program, list of county 4-H programs and dates, and list of your community 4-H club's programs and dates if your club is a part of a community 4-H club.

Involve the Members

As the project leader, your role is to create situations in which the members (and their parents) can develop both project and life skills. Helping a group plan a year's program or just one meeting takes a lot of patience and the ability to "sit on one's hands" while the members work together.



Here is a technique for generating ideas and arriving at decisions. Have each person write down ideas for project meetings. Provide members with appropriate member manuals and other resource materials. Sometimes members can generate more ideas by working together in groups of two or three with one member of each group writing down the ideas. Allow five to 10 minutes for this activity.

Have each person share his or her ideas in "round robin" fashion. One person shares an idea, then the next person shares, and so on around and around the group until all ideas have been given and recorded on a blackboard or a large sheet of paper. List the ideas quickly without discussion. Then provide time for the person who suggested an idea to clarify or explain it. Others can add support or comments. After a short discussion move to the next idea.

From all the ideas generated and discussed (and possibly combined together), have each individual rate the items numerically on a separate sheet of paper in the order of preference. You may want them to indicate their top five, 10 or whatever. If 10 choices are indicated, the top choice would receive a 10 and the last choice a one.

Have each person give their ranking as each idea is read. Add up the numbers. Allow time to discuss the choices as they relate to the group's overall goals. From the decision made, make a list of topics for the year's program.

Decide Who

Now that the members has decided what they want to learn more about, you want to be sure everyone shares the responsibility of seeing that it happens. Allow as many members and families as possible to have a specific job on the year's program. Recreation, demonstrations, refreshments and hosting the main program are all possibilities. If the group is large, a team approach is encouraged.

Complete the Program

Sometimes filling in an outline is helpful for everyone to see the plan taking shape. An example of one possible format follows. After the program is completed make copies for each family. Some project groups include a list of everyone's name and phone number. Be sure information is also included in the 4-H community club program.

Summarizing the Activity

Help members and parents understand the skills they have practiced in the planning process. Emphasize learning how to cooperate, to delegate responsibility and to provide for maximum involvement.

My 4-H Project Club Calendar

NAME OF GROUP OR CLUB_____ NAME OF LEADER(S)_____

NAME OF COMMUNITY 4-H CLUB_____

PROJECT CLUB GOALS FOR THE YEAR

1. Each member make a model rocket.
2. Further develop the life skill of decision making.
3. Involve each family in activities.

Meeting Date Place	Meeting Topic and Activities	Who is Responsible	What To Do Before The Next Meeting
November 6, 7:00 p.m. Johnson's	Identifying parts of model rocket Recreation Presentation Refreshments	Dave & jr. leader Mark & Jim Mary Peterson family	Review parts of a model rocket & make drawing of your ideal rocket

TWO
Selecting A Model Rocket

Selecting model rockets appropriate for the members' abilities will add directly to the success they enjoy in the project. Beginning model rocket builders will often select a large, complicated model because it looks nice. A model which is too difficult may lead to a frustrating and disappointing experience.

What Your 4-H'ers Will Do

- Discover the four skill levels assigned to model rockets
- Decide which levels best meet their needs
- Develop the life skills of decision making, priority setting and value clarification

Prepare for the Meeting

Time required: Allow 40 minutes
Supplies needed: Model rocket catalogues, two or more rocket kits of different levels.
Resource: 4-H Project Manual

Involve the Members

Your challenge as project leader is to help your members discover for themselves how and why one rocket is better suited to their abilities than another. By allowing each one the satisfaction which comes from the "I figured it out myself" approach, you contribute to a greater understanding of the project skills and also help your members develop important life skills. One way of being a helper instead of an "up front" teacher is to use a learn-by- discovery experiential approach outlined such as the following.

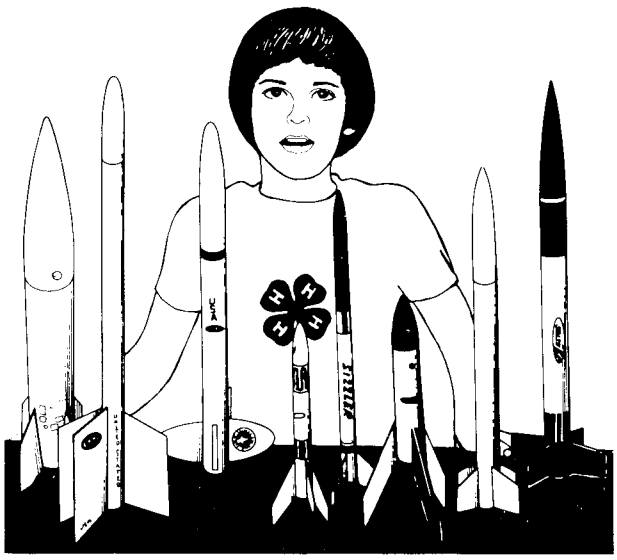
After setting out the catalogues plus two or more rockets, give the teams a challenge such as the following.

Situation: Model rockets are designated according to skill levels 1 to 4.

Your task: Choose a model with a skill level you believe is best suited for you and explain the reasons for your choice.

At this point, the activity moves from centering on the leader and becomes member centered. Once members tell you what they know, you are better able to help them build on their experience and knowledge base. Often the major points can be brought out during the meeting by asking questions such as those included in this meeting guide. Frequently the answers can be included in the questions to allow members the opportunity to feel good about their response.

Give each member time to tell about the model selected and why that particular model was chosen.



Ask Questions

Q. *What do the skill levels indicate?*

A. The skill levels recommend skills and experience necessary for a rocketeer to successfully complete a kit.

Q. *How many model rocket skill levels are there?*

A. Four, designated from skill level 1 to skill level 4.

Q. *What do each of the skill levels indicate about the degree of difficulty?*

A. Skill level 1—very simple, recommended for beginners; skill level 2—fairly easy, recommended for individuals with some model building experience; skill level 3—average challenge, recommended for the advanced model builder; skill level 4—very challenging, recommended for the master model builder.

Q. *Which skill level models usually cost the most money?*

A. Levels 3 or 4.

Q. *What is the price range of model rockets?*

A. From about $1 to $20.

Q. *What if you are a 12-year-old who has built several model airplanes but has not built a model rocket? What skill level should you be able to handle?*

A. Because of the previous experience, a rocket of skill level 2 is recommended.

Q. *Is there more than one choice of models in each skill level?*

A. Yes, there are many models to choose from in each skill level.

Q. *In addition to skill level and cost, what else enters into the decision?*

A. Time available for construction, personal preference, availability, etc.

Q. *What items are needed in addition to the kit to make the rocket?*

A. White glue, fine sand paper, spray paint, masking tape, sanding sealer (optional) and sometimes special construction supplies.

THREE
Identify Rocket Parts

Knowing the parts of model rockets helps a member have a successful experience in building a rocket. Kit directions may be difficult to follow if the terminology is not understood. Building an aerospace vocabulary makes the project interesting and exciting to the member.

What Your 4-H'ers Will Do

- Identify parts of a model rocket
- Discover the function of each part
- Discover where each part goes
- Develop decision-making skills

Prepare for the Meeting

Time required: 30 to 40 minutes.
Supplies needed: One model rocket kit per 3 members, table space, extra rocket parts, notecards with rocket part names on one side and their functions on the reverse side. (See listing of parts and functions in the "Questions" section.)

Involve the Members

Your challenge as a project leader is to help members discover for themselves the name and function of each part of a model rocket.

Parts—One method leaders have used to help members identify parts is to lay out all the parts of the rocket and number each. Then give each team a set of cards with the name of a part on one side and the number on the other side that corresponds to a number on the model rocket. If you have a large group, teams of three or four can make their own set of 14 cards listing only the names.

When each team has matched the cards with numbers on the actual parts, have the teams compare their answers. Discuss any differences of opinion.

Functions—Discover the function of each part in a similar manner. Write the function on one side of the card and the part on the other side. Members match the function with the part or number of each part. Teams check their pairings by comparison or by simply turning over the cards to see if they are the same as the cards used to identify the parts.

CARD A

Side One:

Igniter

Side Two:

1

CARD B

Side One:

Launch Lug

Side Two:

Guides rocket on launch lug during lift-off

These two activities can be used in a parts identification contest and in a model rocketry skillathon.

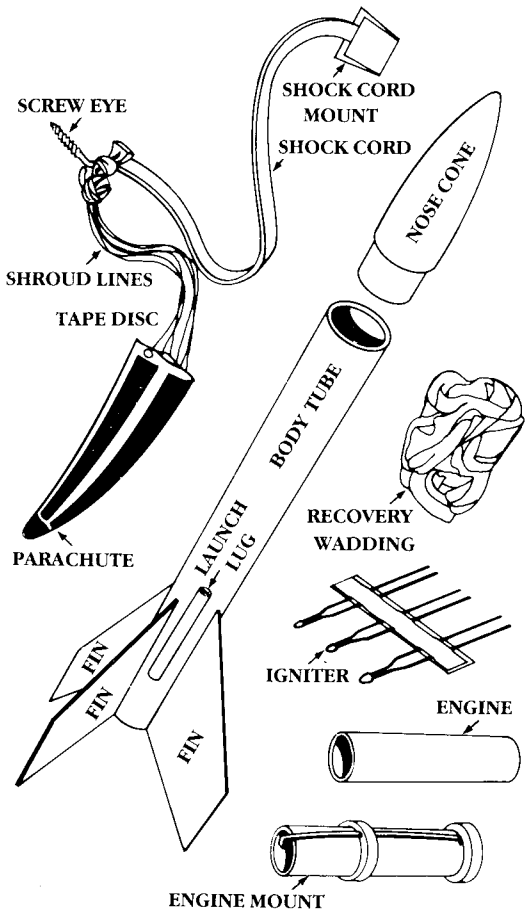
Location—Ask members to take one or more parts, and show and tell where and how they believe the part goes. By the time everyone has contributed, members should have an excellent grasp of names, functions and locations, all without you as the leader telling or showing them first. In addition, they will have developed operating skills and confidence in their own abilities.

Ask Questions

Q. *What are the major parts of a model rocket?*

A. Nose cone, body tube, launch lug, igniter, engine mount, fins, engine and recovery system (includes parachute, shroud lines, tape discs, shock cord, shock cord mount, screw eye and recovery wadding).

RECOVERY SYSTEM:

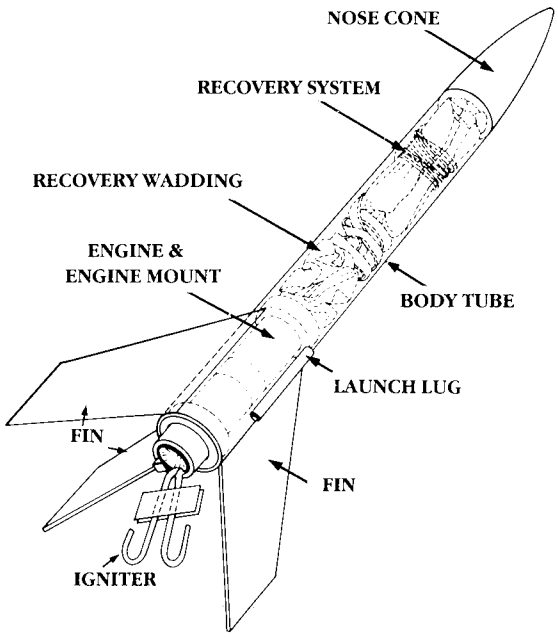


Q. *What is the function of each part?*

A. **Body tube**—serves as the main body of the rocket.
Launch lug—holds the rocket on the launch rod.
Recovery wadding—protects the parachute or streamer (recovery system) from damage when the ejection charge goes off.
Parachute—Recovery system.
Shroud lines—Fastens the parachute to rocket.
Engine mount—Holds the engine in place.
Fins—helps to give the rocket stability.
Model rocket engine—Provides the thrust.
Igniter—Starts the propellant in the engine burning.
Shock cord mount—Holds the shock cord to the body tube.
Shock cord—Connects the body tube to the nose cone and absorbs the shock when the recovery. system is ejected.
Nose cone—Rocket's front end, usually shaped for low air resistance.
Screw eye—Holds shock cord to nose cone.
Tape disc—Holds the parachute shroud line (string) to parachute.

Q. *On the completed model rocket, where is each part located?*

A. See diagram in first question and the completed rocket below.



Supporting Activities

Selecting a Model Rocket
Building a Model Rocket
Launching a Model Rocket

FOUR
Visiting a Hobby Shop

A visit to a hobby shop makes an exciting field trip or tour for the club. When the visit is well planned, members gain a greater understanding of model rockets and the supplies and equipment available.

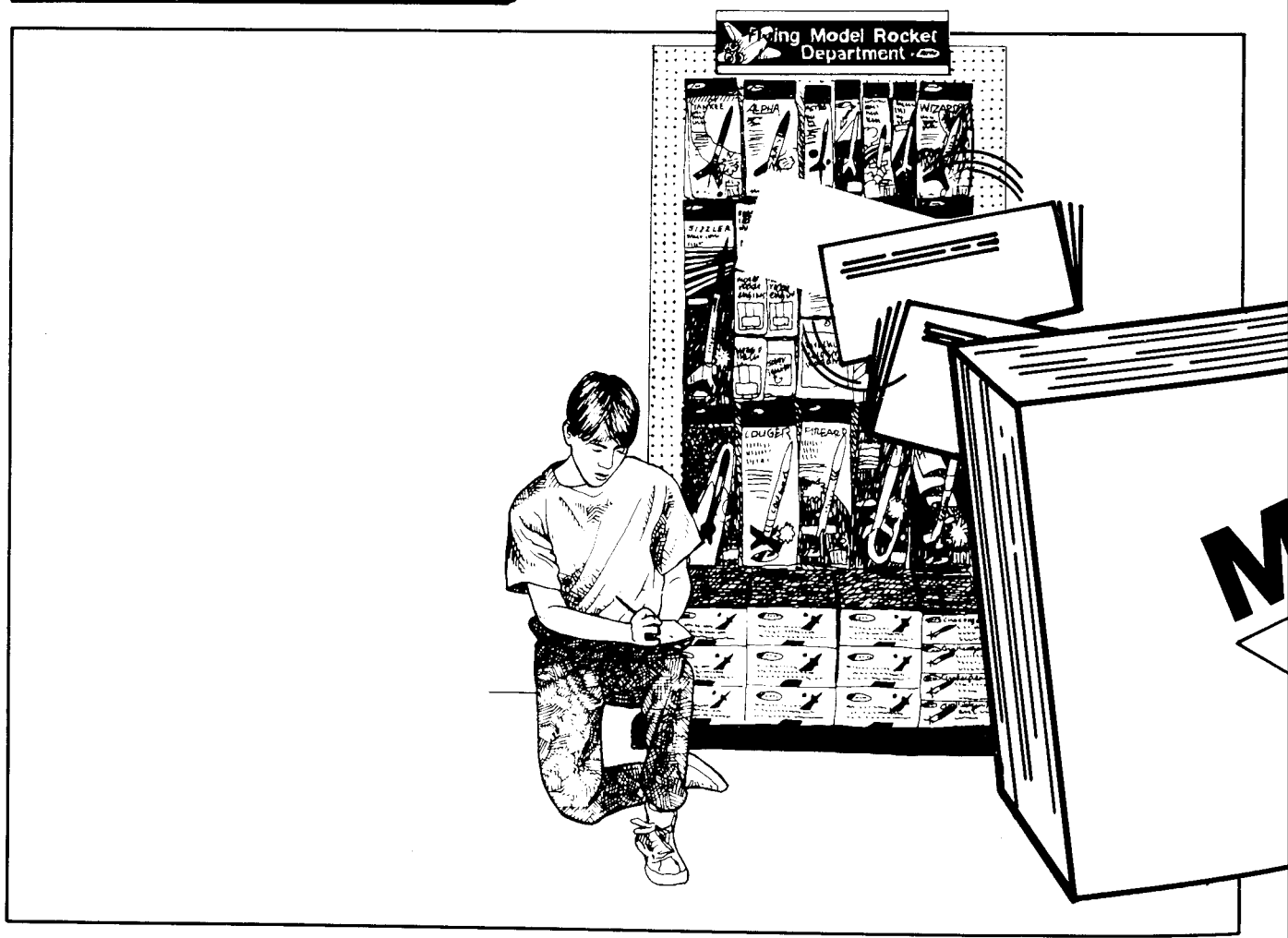
What Your 4-H'ers Will Do

- Map out a plan for the tour
- Make decisions about what skill level of rocket to purchase
- Gain experience budgeting their money
- Interview the hobby shop owner or manager

Prepare for the Meeting

Time required: Allow one hour for the tour.
Supplies needed: Hobby shop, list of questions for each member to answer.
Contacts to be made: The manager of the hobby shop should be contacted ahead of time and invited to talk briefly with the members about the model rockets available and what he or she likes best about his or her job.

If you need more than one vehicle to transport members, be sure to arrange for additional drivers.



Involve the Members

Prior to going

Meet with members and decide together what information they want to find out during the visit. To make the experience more like a scavenger hunt, give 4-H'ers a card or piece of paper to write questions and answers they discover. Ideas for questions about the model rockets include cost, skill levels, types, most exciting model, supplies needed, most appropriate engine for their favorite model and types of recovery systems available. When they talk with the manager, members may ask the following: What is the most popular rocket? What are the best types of glue, cutting tools, paints and sealers? Why does he or she enjoy operating a hobby shop?

These activities help develop communication skills.

While visiting

Encourage members to find answers to their questions. This activity may be done in pairs to add to the fun and excitement. Allow time to discuss each question and to visit with the manager. Also ask general questions.

Ask Questions

Q. *Why did you select the rocket that you did?*

Q. *What attracted you to the rocket?*

Q. *What are some rockets that you would like to be able to build someday?*

Q. *What did you learn about running a hobby shop?*

Q. *What other types of models are available?*

Q. *Where else can you purchase model rockets besides a hobby shop?*

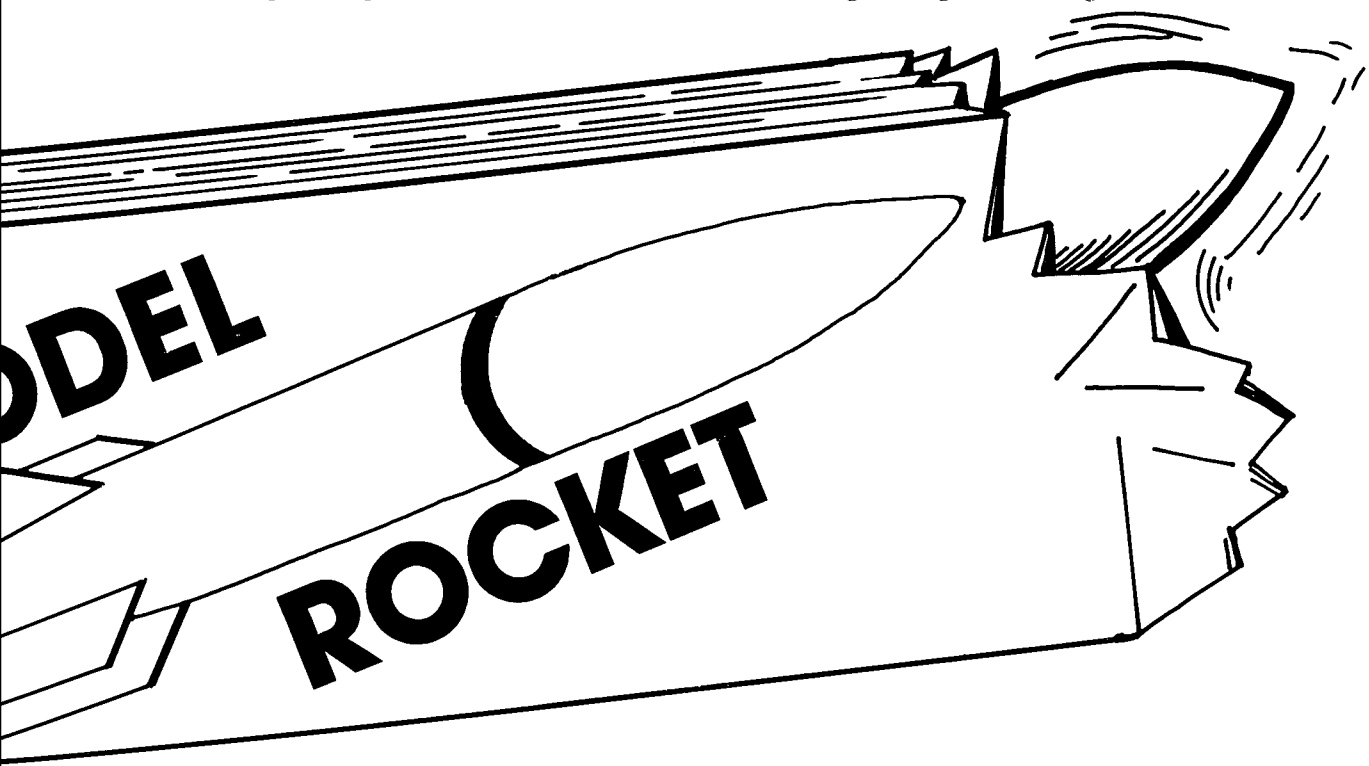
Q. *What kind of training is needed to run or work in a hobby shop?*

Q. *How many different items are sold in a hobby shop?*

Q. *What is the price range for rockets in your skill level?*

Supporting Activities

Selecting a Model Rocket
Identifying Parts of a Model Rocket
Identifying Parts of a Rocket Engine
Building a Model Rocket
Sanding, Sealing and Painting a Rocket



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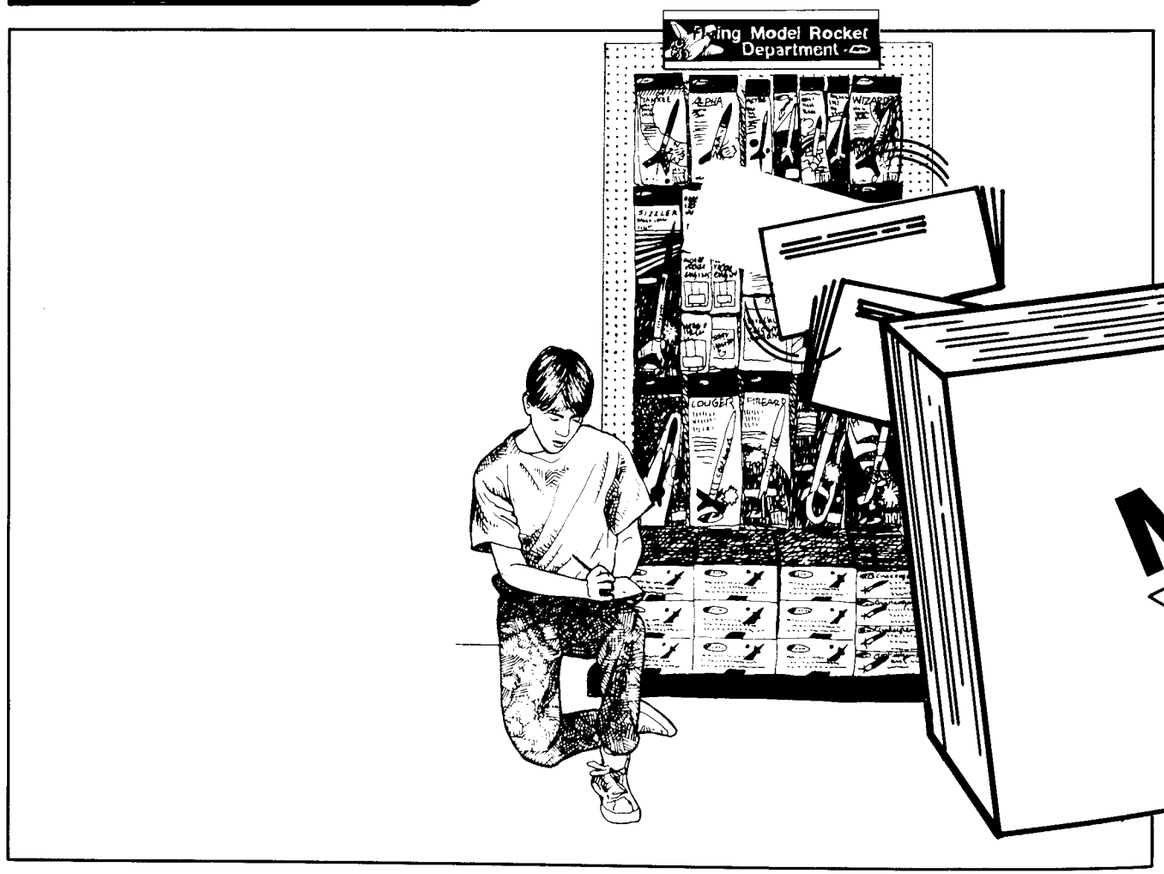

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Supporting Activities

Selecting a Model Rocket
Identifying Parts of a Model Rocket
Identifying Parts of a Rocket Engine
Building a Model Rocket
Sanding, Sealing and Painting a Rocket

FIVE
Building a Model Rocket

Most of the members have been looking forward to this meeting. Everyone can get involved as either a builder or helper. The excitement level will be high and everyone will have a real sense of accomplishment as rockets are built.

What Your 4-H'ers Will Do

- Inventory the parts in the kit
- Build a model rocket
- Develop the life skills of taking risks, reading and following directions

Prepare for the Meeting

Time required: 2 hours
Supplies needed: Tablespace, paper to cover tables, model rocket kits, white glue, pencils, scissors, ruler, fine sand paper (2 × 4" strips).

Involve the Members

As with all 4-H experiences, maximum time should be spent allowing the members to learn by doing before being told or shown how. By supporting their efforts and building on their experiences, 4-H'ers develop positive self-esteem and self-confidence.

Inventory Parts

Have each team of two or three members inventory the rocket parts in their kits by checking them off the inventory list. This activity helps them become familiar with rocketry terminology.

Build the Rockets

Each kit includes directions. The support and encouragement of a junior leader or adult is helpful to younger members and often also helps adults while building their first rockets. Complete the engine mount first.

Once each team is busy building its rockets, you will want to move from team to team giving encouragement. Teach by asking questions about how to cut out the parts, apply glue, or put on the fins. Several questions included in this guide will be useful for discussion as the teams working

The goal is to get the rocket completely assembled at this meeting. This does not include painting. Painting will be done at a later meeting.

Ask Questions

Q. *On which end of the rocket do the fins belong?*

A. At the tail where the engine mount goes.

Q. *Why is it helpful to stand the rocket on its nose when you glue the fins on?*

A. So the fins stay in place. If you lay the rocket down before the glue dries, the fins may move out of alignment.

Q. *Why do the fins need to be evenly spaced?*

A. So the rocket will fly straight without wobbling.

Q. *Why do you use white glue?*

A. It dries quickly and is water soluble.

Q. *What is the purpose of the metal clip on the engine mount?*

A. It keeps the engine from going up the body tube at launch and from being blown out the rear at the time of ejection charge.

Q. *Where do you find directions for assembling the parachute?*

A. On the edge of the parachute.

Q. *Why is there a recovery system?*

A. To bring the rocket back to the ground safely and unbroken without hurting someone.

Q. *Why are the fins sanded smooth?*

A. To reduce drag.

Q. *Why is the shock cord placed about one inch from the end of the body tube?*

A. To allow room for the nose cone.

Q. *What is the purpose of the shock cord?*

A. It absorbs shock when the ejection charge goes off so that the parachute remains attached to the rocket's body tube.

Q. *Why is it important to test-fit the engine mount into the body tube before applying glue?*

A. If glue is applied first and the engine mount fits poorly into the body tube and cannot be pushed all the way in, the mount will not be in place when the glue sets.

Q. *After the rocket is assembled, what are the next steps?*

A. Sanding, sealing, painting and putting on decals.

Supporting Activities

Sanding, Sealing and Painting a Rocket
Testing the Rocket for Stability
Launching a Rocket
Preparing the Launch Site

Field Trips—Field trips may be taken to military bases or other rocket organizations. Members may tour manufacturing plants, teaching stations or other interesting facilities.

Design Contest—Members determine the best designs in various categories.

Scale Events—The rockets are judged by how well the members were able to keep their models within scale.

SIX
Sanding, Sealing and Painting

Finishing a rocket is like putting frosting on a cake. This is the final step in completing the project. Members will use their own creativity and originality, giving them an increased sense of pride and accomplishment. A well-finished rocket will make a good exhibit if they choose to enter it in the county fair.

What Your Members Will Do

- Sand, seal and paint a rocket
- Discover the two methods of sealing balsa
- Discover how to use a spray paint can
- Apply decals
- Develop life skills of creativity, originality and pride of workmanship

Prepare for the Meeting

Time required: Two 1-hour sessions. One session for sanding and sealing and a second session for painting, with possibly a third session for applying decals.
Supplies needed: Two colors of enamel spray paint, sanding sealer, white glue, very fine sandpaper, newspaper to cover table, masking tape, two-foot-long dowels to hold rocket while spraying, paper towels, members-assembled rockets.
Reference: 4-H Project Manual.

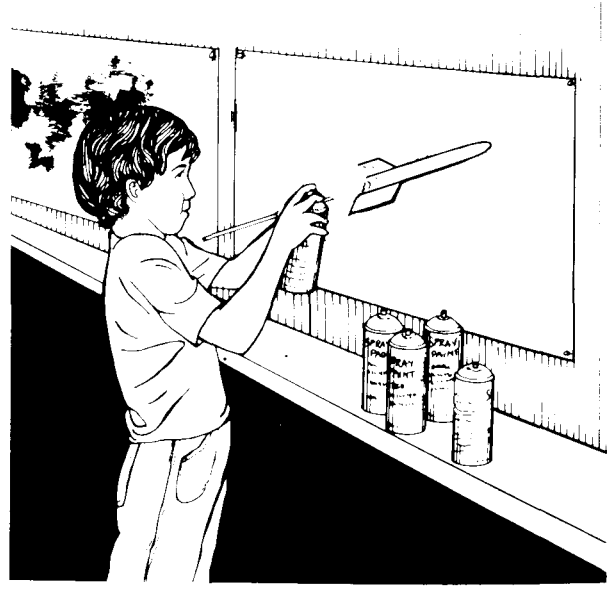
Involve the Members

After everyone has all the supplies needed, discuss briefly the steps required and what the features of the finished product should be. Encourage all members to do their best. Praise their efforts throughout the meeting. Suggested steps and key questions to ask are included in the next section.

Ask Questions

Q. *What are the five important steps to sanding, sealing and painting a rocket?*

A. 1. Check the sanding to see that the balsa is smooth and that any plastic ridges on the nose cone have been removed.
2. Apply sealer on the balsa.
3. Let sealer dry thoroughly. Sanding sealer usually dries in about 15 minutes, whereas glue used for sealer may take longer to dry. While the sealer is drying, the nose cone may be removed and spray painted. Members need to decide on their rockets' colors. Usually, the nose cone is a different color than the body tube and sometimes a different color is added to the fins.
4. When sealer is dry, use very fine sand paper again, and sand the balsa until smooth. Apply another coat of sanding sealer. Usually only one coat of sealer is necessary. When applying glue for sealer, thin the glue slightly with water and use a finger to apply a smooth coat over the balsa surface.
5. When sealer is dry, sand it smooth. Another coat of sealer may be used if a very smooth surface is desired. If sealer is thoroughly dry and the rocket is sanded smooth, paint may be applied. This step may need to be repeated again.



Sanding

Q. *Why is careful sanding important?*

A. To have a smooth surface.

Q. *Why should you sand with the grain?*

A. Sanding with the grain helps avoid scratches which may otherwise show through the paint.

Q. *Why is very fine sandpaper, such as 400 grit, recommended?*

A. To obtain a very smooth surface.

Sealing

Q. *What is the purpose of a sealer?*

A. To fill in the pores of the balsa, making a smooth surface and preventing paint from being soaked into the balsa.

Q. *How many coats of sanding sealer are recommended?*

A. At least two or three.

Q. *Is sealing absolutely necessary?*

A. No, the rocket will fly without sealing, but members may prefer a smooth, finished surface.

Q. *If white glue is used for sealing and it is too thick, how can it be thinned?*

A. Add a few drops of water so that the glue applies easily and smoothly across the surface.

Q. *What is the advantage of using white glue instead of sanding sealer?*

A. White glue is much less expensive.

Q. *Why do we sand between coats?*

A. The surface is usually rough, and sanding makes it smooth. The sealer usually has a little roughness to it when it dries.

Painting

Q. *How many coats of paint should be applied?*

A. Probably three or four, depending on the paint color.

Q. *Why is it better to apply several light coats of paint rather than one heavy coat?*

A. To prevent runs in the paint. Usually, a smoother surface develops with several coats of paint rather than with one heavy coat.

Q. *What happens if the spray can is pointed directly at the rocket when you start spraying?*

A. A paint run may develop. Start spraying off to the side of the rocket and pass the spray over the rocket and beyond it. Then reverse directions, making sure the can is not pointed at the rocket.

Q. *Approximately how many inches should the spray can be held away from the rocket?*

A. Approximately 10 inches. If it is too close, it will cause runs, and if it is too far away, the paint may begin to dry and leave a rough surface.

Q. *How can you hold the rocket without getting paint all over your fingers?*

A. Place a dowel up the body tube, which allows the rocket to be held away from your hand.

Supporting Activities

Displaying Your Rocket
Exhibiting Your Rocket
Launching a Rocket
Testing a Rocket for Stability

SEVEN
Exhibiting a Model Rocket

The 4-H'ers enjoy launching rockets they built and also look forward to showing them to others. One of many places available to exhibit their rockets is the county fair in the 4-H rocketry class.

A good experience talking with the judge encourages the member to strive to make the best even better next time. Feelings of accomplishment and self-worth are part of this experience. This activity helps your members prepare for the educational experience by role playing it beforehand.

What Your 4-H'ers Will Do

- Understand the criteria used to judge
- Judge each other's exhibits
- Develop life skills of interviewing, asking questions, responding to questions and making decisions

Prepare for the Meeting

Time required: 1 hour
Supplies needed: The members' finished model rockets, one copy of the check sheet for each team of three members, pencils, homemade ribbons.

Involve the Members

This is a fun meeting for all ages, even adults. Allowing a 9- or 10-year-old to judge the exhibit of a teenager can be a very exciting experience for the younger 4-H'er. Leaders have found that this activity works well by following these steps.

1. Have members count off by three's.
2. Designate number ones as judges, number twos as exhibitors and number threes as clerks.
3. Before having them get in their groups of three to role play a county fair judging experience, provide each judqe with a copy of the model rocketry evaluation sheet and give the clerk a sheet of paper to record comments. If copies can not be made, simply list the categories and points where each judge can see them.
4. Present the members with a situation such as the following. Each of you are either a judge, exhibitor or clerk. Pretend that you are at the county fair and it is time for the judging. The judge checks the rocket and ask the exhibitor questions. The clerk writes the comments. After judging, the judge determines what ribbon to award and gives reasons for the ribbon choice.
5. Give the teams eight to 10 minutes to judge, with a one-minute warning so the awards can be given.
6. After the first judging experience, have members change roles and repeat the experience.
7. Give everyone a chance to play all three roles if possible.
8. Follow with a discussion of what they learned, how they felt in each role, and what they plan to do to improve their rocket (if anything).

4-H Model Rocketry Judging Sheet

	Good	Could Improve	Comments
GENERAL APPEARANCE—20 Neatness, attractive in color and decoration			
WORKMANSHIP—55 Body tube (5) smooth, free of dents or nicks			
Fins (10) evenly spaced and aligned with the body tube; edges rounded if balsa			
Engine Mount (10) Metal holder, if used, flexes back to position. Engine block in place so engine cannot move forward. Must be mounted so engine does not move when ejection charge goes off but not so tight that it is difficult to remove			
Launch lug in place (5) Recovery system operative (15) Shock cord in place, firmly and smoothly attached, either tube method, or inside mount. Nose cone ejects freely. Parachute or streamer attached (if used).			
Finish (10) All surfaces smooth. Balsa sanded and sealed to give a smooth paint job. Paint evenly applied with no runs. Decals on straight.			
KNOWLEDGE OF MEMBER—25			

TOTAL SCORE

Beginner and Intermediate questions:

What was the most difficult to put together?
What would you do differently if you were to do it over?
Why should every rocket have a recovery system?
Why is wadding necessary?
Name a few safety rules. Why are the rules important?
Why should the fins be straight?
What does the "3" stand for in an A8-3 engine?

Advanced—Questions above plus these:

How would you test for stability?

If a rocket is unstable, you may add weight to make it stable. Where would the weight be placed—at the tail or at the nose? (Answer: At the nose to move the center of gravity forward.)

What is another means of stabilizing a rocket? (Answer: Add larger fins which move the center of pressure toward the tail. A rocket will be stable if the center of pressure is behind the center of gravity.)

Explain the principle of thrust.

What causes drag?

EIGHT
Discovering the Air Around You

Real airplanes and rockets and model airplanes and rockets fly in the air around us. To understand the effect that air has on airplanes and model rockets, we must first understand the properties of air itself. Members will discover that air affected many parts of their lives without them realizing it and that they have unconsciously used the properties of air for their own purposes while using frizbees, paper airplanes, straws, kites, etc.

What Your 4-H'ers Will Do

- Demonstrate that air occupies space, has weight, exerts pressure moves, can support objects
- Develop life skills of inquiry, experimentation and problem solving

Prepare for the Meeting

For the activities described, you need these items.

1. Soda pop bottle, small funnel, drinking straw, modeling clay, cup of water
2. Uniform stick such as a dowel rod, string about 4 feet long, two identical balloons
3. Drinking straw, glass partially filled with water
4. Paper 6 inches square, pin, pencil with eraser
5. Handkerchief, string, doll or similar object
6. Sheets of paper

Involve the Members

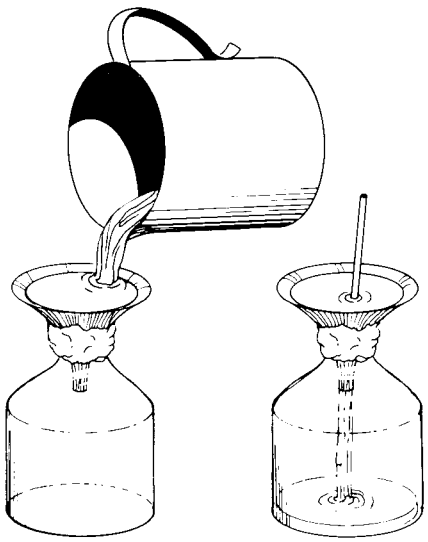
Your challenge as the project leader is to help your members learn about properties of the air around us. By helping them learn for themselves with "hands-on" activities, 4-H'ers better understand air itself. As you help them develop their knowledge of the project skills, you also help them develop important life skills.

Here are six activities for your members to do. You simply give them directions to follow. Let them explain what they have done. At this point, questions are helpful as the major concepts are discussed.

Activity One—Air occupies space

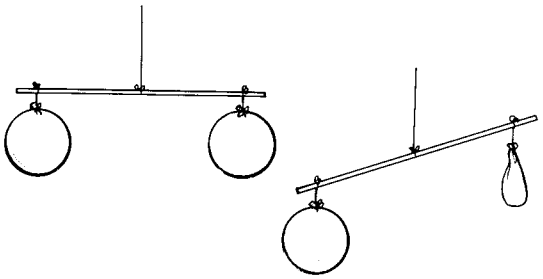
Place the funnel into the mouth of the bottle, and seal the area around it with the modeling clay. Now, pour water into the funnel and notice that the water does not enter the bottle because the bottle is filled with air. Insert the straw through the funnel and into the bottle and suck out some of the air. Notice that now water will go into the bottle.

Comments: Air acts as an incompressible fluid. Later you will show that it can even support weight and can produce lift. For now, help the member understand that air is present around us and in thebottle.



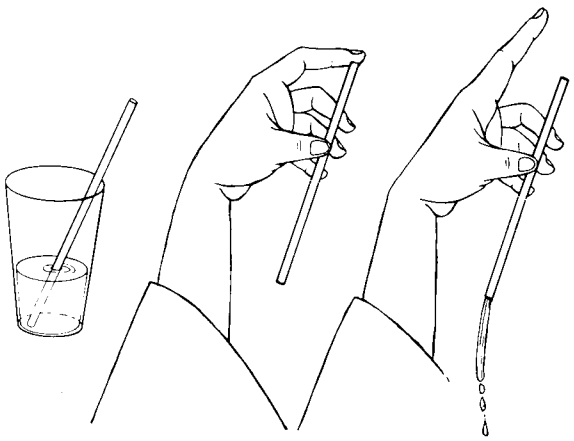
Activity Two—Air has weight

Help 4-H'ers experience the property that air has weight. Blow up two balloons so they are the same size. Now, tie one balloon to each end of the dowel rod and balance the rod. Attach a string to the balance point so the stick hangs freely. Like a scale, the balance point should be in the middle if the two balloons are the same size. If the air is released from one balloon, the other balloon (with air in it) should weigh more and move downward from the balance point.



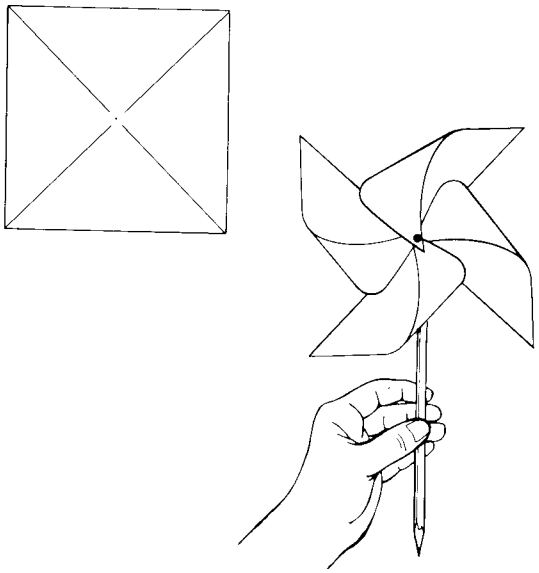
Activity Three—Air exerts pressure

Here is a simple activity to learn how air presses on a beverage and pushes it up the straw. Put a straw in a beverage glass. Hold a finger over the partially liquid-filled straw. Notice that air presses on the beverage and keeps it in the straw until the finger is removed.



Activity Four—Air moves

Cut sheets of paper ahead of time to facilitate this experiment. Make a simple pinwheel by curling alternate points and pinning them through the eraser on a pencil. This may take a couple of times to make sure the curls are right. Now, blow on it, run with it, move it vigorously through the air. It should become obvious that air moves and causes the pinwheel to turn. There is a subtle point here. Moving the pinwheel through stagnant (non-moving) air is the same as allowing moving air to pass over a stationary pinwheel.



Activity Five—Air supports

Make a parachute with the handkerchief and string. Attach weight, perhaps a toy doll, to the string and toss it up, allowing it to fall freely. If you can reach different heights, see if members can notice that the parachute comes down with a constant speed, called "terminal velocity." Experiment with different weights or different-sized parachutes.

Summarize the Activities

Let members list the properties of air that they learned about. See if they can develop other experiments that demonstrate these same properties. Have the youngsters make and fly paper airplanes. Use this activity to help them recognize the various properties of air as the gliders fly through the air around them.

List the experiences members have had that demonstrate the properties of air. (Some examples might include balloons, kites, popping paper bags, whistles of different types, etc.)

Ask members to identify which air property their examples demonstrates.

A suggested reference is *Demonstration Aid for Aviation Education,* Federal Aviation Administration, Washington, DC 20590.

NINE
Identifying Engine Parts

Model rocket engines are dependable, safety-proven propellant devices that provide the needed power for model rockets. They provide thrust needed for lift-off, enormous acceleraton until burn-out, a smoke trail to allow the rocket to be readily tracked on its flight path, a timed delay prior to initiating the ejection sequence, and the ejection charge to activate the recovery device. Identifying engine parts is a first step toward understanding how the rocket actually functions in flight.

What Your 4-H'ers Will Do

- Identify the parts of a rocket engine
- Describe the functions of a rocket engine
- Explain the letter and numbers in the engine's code
- Develop life skills of inquiry, decision making and creative expression.

Prepare for the Meeting

Time required: 30 to 45 minutes
Supplies needed: Several different rocket engines.

A rocket kit will be useful not only for this meeting but for several project experiences. The kit is an educational, see-through plastic model with parachute, engine mount, etc.

Involve the Members

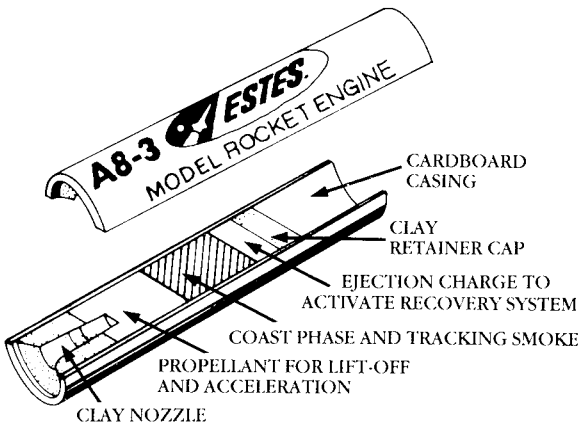
Your challenge as a project leader is to help members learn on their own the various parts of a rocket engine and how an engine works before being told or shown. The following five-step experiential learning approach allows members to develop their life skills while they learn about rocket engines.

1. Focus the members on the topic.
2. Involve members in an activity.
3. Support members during the activity.
4. Provide feedback primarily through questions.
5. Generalize how members may use the new skills in related and non-related circumstances.

Have members match parts and corresponding functions with a picture of or a model cut-away engine. Often, listing parts on individual cards and functions on another set of cards helps younger members commit themselves more easily to answers.

For more experienced members, form teams of two and have each team draw and label the parts of a model rocket engine. Have the teams compare their drawings and discuss any differences as well as the functions of each part.

The third suggested activity involves identifying what the letter and each number of the identification code represents. Give each team a code (e.g., A8-3) or a rocket engine, and ask them to identify what each part of the code means.



With each activity you want to support the teams by encouraging questions and asking questions such as those listed.

Ask Questions

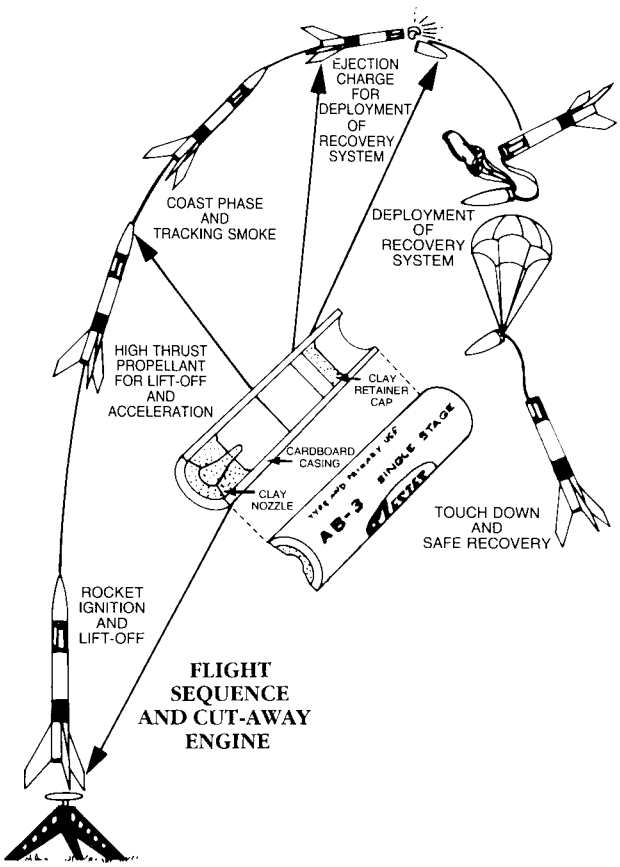
Q. *What are the major parts of an engine and their functions?*

A. Ejection charge—activates recovery system and emits tracking smoke during coast phase. Propellant—for lift-off and acceleration. Cardboard casing, clay retainer cap and clay nozzle—parts necessary for the safe construction and function of the engine.

Q. *What does each letter and number of the engine identification code, such as A8-3, mean and what engine function does it refer to?*

A. "A" refers to the total impulse or power produced by the engine. This functions during the lift-off and acceleration phase of flight. "8" refers to the engine's average thrust or push, also important during the lift-off and acceleration phase of flight. "3" states the number of seconds between the thrusting and the ejection stages. The delay occurs during the coast/tracking smoke phase of flight.

MODEL ROCKET ENGINE CONSTRUCTION AND PERFORMANCE FUNCTIONS



FLIGHT SEQUENCE AND CUT-AWAY ENGINE

Supporting Activities

Touring a Hobby Shop
Selecting a Rocket Engine
Selecting a Model Rocket

TEN
Discovering How Rocket Engines Work

A model rocket engine is the heart of the rocket. It provides the energy for the rocket to leave the launch pad, accelerate upwards, emit a smoke charge so the vehicle can be readily tracked, and finally permits the recovery sequence to be initiated after a controlled delay. Understanding the science principles involved in rocket propulsion helps 4-H'ers to more thoroughly appreciate their project area and to be safer rocketeers.

What Your 4-H'ers Will Do

- Review the names of the parts of an rocket engine
- Review the meaning of the numbers and letters of the engine's coding
- Discover the principles of rocket engine operation
- Develop life skills of working together, making decisions, solving problems and feeling good about themselves.

Prepare for the Meeting

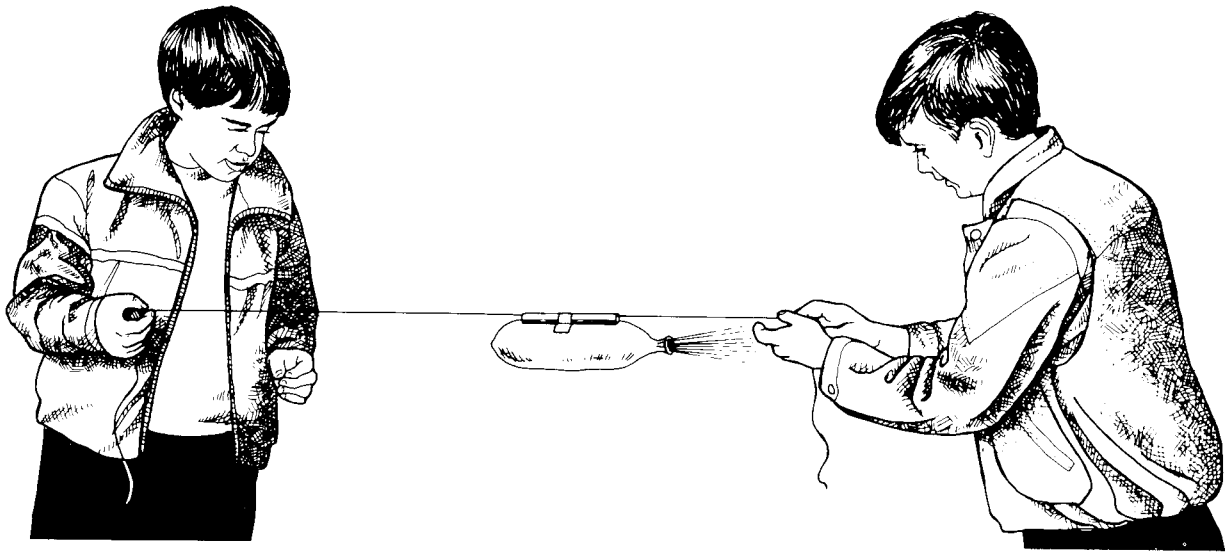
For each group of two or three 4-H'ers, have a balloon, a soda-pop straw, tape, and a length of string longer than the room being used.

Involve the Members

Your challenge as a project leader is to help 4-H'ers learn how rocket engines work. You want them to discover this themselves.

Here are some challenging activities.

1. Find out how many members have flown rockets before. Some probably have actually launched real model rockets with their siblings or friends. Actually, everyone has flown rockets before. A balloon is a rocket! It is not well guided, but it flies when released according to the same action-reaction principle as a full-sized rocket engine. As air rushes out the nozzle, the air inside pushes equally on the remaining interior surfaces of the balloon. The forces on the inside walls of the balloon are equal. The only unbalanced force is on the balloon's inside surface opposite the nozzle. This unbalanced force propels the balloon in the direction opposite the nozzle. Of course, the balloon is not perfectly symmetrical and easily distorts, plus the nozzle is flexible so the flight of this "rocket" is somewhat erratic.



2. Challenge the small groups to make a rocket that flies straight using the balloon, string, straw and tape. Give them time to solve the problem themselves. It will be interesting to see the various solutions to the problem. For your information, the solution is shown above.

Work hard to NOT be an "up-front" teacher. Let members learn for themselves so they can develop their own decision-making skills and self-confidence.

3. Try a special trick. Take a straight pin and challenge 4-H'ers to stick it into an inflated balloon. They may think it will violently explode. That is fun in itself. Actually, you usually can gently stick a pin into the balloon at the tip opposite the hole part, where the rubber is thickest. It penetrates the surface if inserted gently. Leave the pin in the balloon and air won't escape.

4. Have 4-H'ers relate these experiences to rocket engines that are used in the model rocket kits.

Ask Questions

Q. *Before you release the nozzle of the balloon and allow the air to escape, describe what the air does inside the balloon.*

A. It pushes equally on all interior surfaces. If it did not push equally in every direction, it would be moving in the direction it pushed hardest.

Q. *When you allow air to escape from the nozzle, what happens inside?*

A. The part of the balloon opposite the nozzle experiences an unbalanced force. The air inside pushes on that part of the balloon but because air escapes out of the nozzle opposite, there is no balance of pushing. The balloon is pushed in the direction opposite the nozzle.

Summarize the Activity

Review the names of the engine parts and the engine code. Suggest that 4-H'ers find other ways to demonstrate how the engine works.

ELEVEN
Testing for Stability

Testing a rocket for stability is a fun, learn-by-doing activity for a 4-H project meeting. Your members will enjoy the challenge provided and will learn the importance of flying a stable rocket. An unstable rocket can be dangerous.

What Your 4-H'ers Will Do

- Find the center of gravity of a rocket
- Test a model rocket for stability
- Do an experiment on how a change in the center of gravity affects stability
- Develop the life skills of working together, making decisions, solving problems and gaining self-assurance

Prepare for the Meeting

Supplies needed: two to three simple model rockets such as Alphas or Big Berthas, a ball of string, masking tape, a piece of clay or something suitable for adding weight, and a brief set of instructions for each member on how to test a rocket for stability. Ask each member to bring a model rocket.

Involve the Members

Your challenge as the project leader is to help your members discover for themselves why and how to test a rocket for stability. One way of being a helper instead of an "up-front" teacher is to use a learn-by discovering experiential approach outlined in the "Welcome."

Test for Rocket Stability

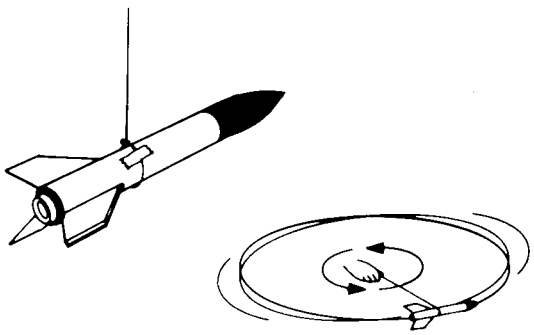
See if 4-H'ers can figure out how to test a rocket for stabiiity before being told. Give each team a six- to 10-foot-long piece of string with a loop in the end, tape and a rocket. Give each team the following situation and task.

Situation: You have built a rocket, but you are not certain it will fly straight. You want to know that it is stable and won't go all over the sky or hurt someone.

Your task: Using the materials provided, determine if your rocket is stable and safe to fly. If after a short time the teams have no idea what to do, give them hints through your questions. Here is one way to test for stability.

Make a loop in the end of a string six to 10 feet long. Slip the rocket body with the engine in place through the loop, balancing the rocket horizontally. The point at which the rocket is balanced is called the center of gravity. Tape the string to the rocket at this point.

Now swing the rocket in a circle over your head. If the rocket is stable it will point forward. You might have to throw the rocket into position to get it to fly straight. An unstable rocket can be made stable by adding a weight to the base of the nose cone. Do not add weight to the tail of the rocket.



BALANCE ROCKET WITH STRING
NOTE: BE SURE TO INSERT ROCKET ENGINE

Ask Questions

Q. *Should the engine and recovery system be in place when the test for stability is tried?*

A. Yes, this will be the weight of the rocket when it flies.

Q. *An unstable rocket may be made stable by adding weight. Where should the weight be added?*

A. Usually on the nose under the nose cone.

Q. *Why should the weight be added to the nose?*

A. To move the center of gravity forward.

Q. *What is meant by the center of gravity?*

A. The point where the rocket balances. An unstable rocket will rotate around the center of gravity.

Q. *What happens if weight is added to the tail?*

A. The center of gravity moves toward the tail, and the rocket becomes less stable. Because there will be more air pressure on the rocket surface ahead of the center of gravity, the rocket will keep tumbling. Adding weight on the tail does not move the center of gravity to the rear. The center of gravity must be ahead of the center of pressure.

Q. *What is the general rule that governs rocket stability?*

A. The center of pressure must be behind the center of gravity.

Q. *What is the center of pressure?*

A. The point at which aerodynamic forces on a model rocket seem to be balanced.

Q. *How could the center of pressure be moved toward the tail?*

A. By adding larger fins, by moving the fins further back, or by adding tabs to the current fins.

Q. *What are other causes that might make a rocket unstable?*

A. Crooked or warped fins, a misaligned engine, crooked nose cone.

Q. *What are the four basic aerodynamic forces?*

A. The forces acting upon a rocket caused by the action of the air through which the rocket is moving. They are thrust, drag, life and weight.

Summarize the Activity

Suggest that 4-H'ers work up a short skit or demonstration that shows what factors affect model rocket stability.

TWELVE
Selecting a Launch Site

Model rocketry is fun and an extraordinarily exciting activity. At the same time it can be a dangerous activity if performed improperly. Selecting a proper launch site insures the maximum degree of safety for a successful launch.

What Your 4-H'ers Will Do

- Evaluate various locations for a launch site
- Practice decision-making skills in choosing a launch site
- Review the model rocketry safety code
- Develop the life skills of working together as a team and understanding directions

Prepare for the Meeting

Time Required: Approximately 1 hour
Supplies needed: Maps of the local area or selected sites, pencils and paper to list various sites and characteristics of each site in relation to the safety code, copies of the model rocketry safety code.

Plan

Select three or four possible launching sites so that members can then make comparisons and involve themselves in the decision process of choosing the best site. If you have junior leaders or older members, this is a good activity for them. Have them sketch each site, especially if the club members will not be actually visiting each site.

Involve the Members

With the three or four sites selected and sketches made, describe each site to the members. Often these places are familar ones. Then ask teams of two to use the model rocketry

safety code to determine advantages and disadvantages of each site for a given sized rocket (e.g., for A type engine). The members may want to make a list. Have each team discuss one of the sites. Encourage questions. Follow up by discovering if the group can agree on the best site. As a way of building on what they now know, ask members the questions included in this activity.

Ask Questions

Q. *What determines the size of the launching site?*

A. The height that the rocket will reach. A 200-foot-altitude rocket probably requires a field about the size of a football field, but for a 2000 foot altitude, you would need an area 10 times as big. (See diagram.)

Q. *What is the maximum wind velocity when launching a rocket?*

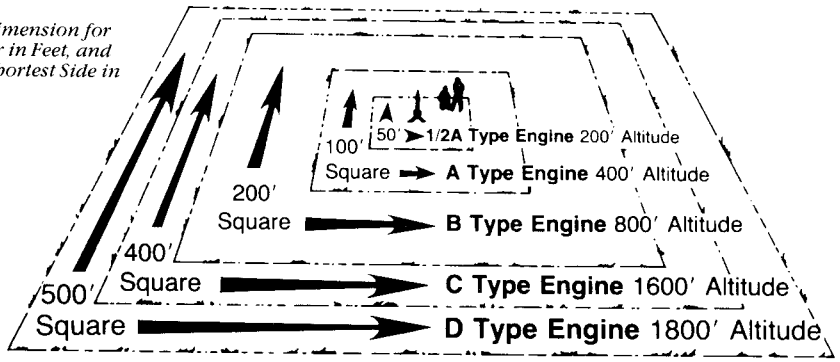
A. For safety reasons, 20 miles an hour would be a reasonable maximum limit.

Q. *How do you find out what the wind velocity is at a particular time?*

A. You may follow the weather forecast. Frequently, to determine the speed and direction the wind is blowing, people toss a piece of grass into the air and watch how it falls to the ground. If the grass is carried briskly away, wait for another day. Know that at higher altitudes wind speed may increase significantly.

RECOMMENDED LAUNCH AREA:

Minimum Launch Site Dimension for Circular Area is Diameter in Feet, and for Rectangular Area is Shortest Side in Feet.



Choose a large field away from power lines, tall trees, and low-flying aircarft. The larger the launch area, the better your chance of recovering your rocket. Football fields, parks, and playgrounds are great. This diagram shows the smallest recommended launch areas. **MAKE SURE THE LAUNCH AREA IS FREE OF OBSTRUCTIONS, DRY WEEDS, BROWN GRASS, OR HIGHLY FLAMMABLE MATERIALS.**

Q. *What are the problems of launching in a high wind?*

A. Rockets accelerate rapidly. Even in high winds they generally go nearly in a vertical direction or in the direction they are launched. However, during recovery a high wind can cause that rocket to go a great distance from the launch site. Also, under certain circumstances there can be problems with rocket stability.

Q. *What if your rocket landed in a power line?*

A. Because of the danger of electrocution, under no circumstances should you attempt to retrieve the rocket from a power line.

Q. *What kind of hazards do trees present?*

A. Trees, unlike power lines, can't electrocute you. However, there is always the danger of injury from falling while attempting to climb trees.

Supporting Activities

As a combined summary and preparation for the members' rocket launch, have each 4-H'er become very familar with the complete model rocket safety code. There are many fun ways to accomplish what could otherwise be an exercise in memorization. The following are examples to turn learning into a good time.

Codes on back: Tape one of the safety codes on the back of each member, leader, junior leader and parent. Participants must not know which code it is. When all have codes on their backs, they must go around and ask questions of those who can see and read what is on their backs. With enough questions, they will all discover what codes are taped to their backs. When they know their codes, they can tape their codes on the front of their shirts and go around helping others until everyone is finished.

Charades: This is played just like the regular game of charades only safety codes are the items the members have to act or sound out. It adds to the fun if the group is separated into teams, and a time limit is set for each charade.

THIRTEEN
Having Fun Demonstrating

Demonstrations have always been an important part of the 4-H program. Many 4-H alumni give credit to their ability to organize a talk, speak before groups, and effectively present ideas to their experiences giving demonstrations as a 4-H'er. Making the first experience both fun and educational is often the key to igniting a spark of enthusiasm which continues for a lifetime. This guide outlines a very successful way to involve the entire club as well as parents in a learn-by-doing session.

Prepare for the Meeting

First you want to gather a variety of everyday items and/or project-related items. With very young 4-H'ers, everyday items that are familiar to them usually are best. Collect three or four more pieces than the number of members in your club. Have 4-H'ers use each item as a prop for them to show how to do something. Examples include a shoe, necktie, needle and thread, project-related equipment, model animals, dolls, bandages, camera, bat, etc. Put all the items in a box or sack.

Pencils, tablet paper, felt tip pens, and poster materials are the remainder of the supplies needed.

Involve the Members

Ask one of the junior leaders who is familiar with giving demonstrations to present a very short three-minute overview of the parts of a demonstration. Here is what one junior leader used as a body for a three-minute demonstration:

I. What a demonstration is

II. Parts of a demonstration and purpose of each

A. Introduction—Get your audience's attention and tell them what you are going to tell (show) them and why.

B. Body—Tell and show them (what you said you were going to tell them).

—Include the how and why to do something.

C. Conclusion—Tell them what you told and showed them.

—Show the finished product, summarize the main ideas, ask for questions, and follow up with a closing statement.

The junior leader should enthusiastically model what the members will be expected to do. A couple of posters for the title and body are usually sufficient. The members can then use posters to prepare and practice their demonstrations.

Next, with all the demonstration props still hidden, give 4-H'ers the following instructions:

"Using the information you have just been given, your task is to prepare a short three- to five-minute demonstration on a subject of your choice. To help you get started you can select one of the items from this sack (box). After you have selected what you want, you have a full 15 minutes to prepare an individual or team (of two) demonstration. The adults and junior leaders will work with you. Decide now if you want to demonstrate by yourself or with someone. (Pause)

"Poster paper, paper and other supplies are also ready for you to use for your title and major points. The first demonstration will be in 15 minutes either from a volunteer or from whomever's name is drawn from the hat. Here are the articles from which to choose."

As the leader, you may want to match up the demonstrators with adults and junior leaders just before you have members select their props. This will give immediate reinforcement. You will also be assuring that every adult and junior leader is involved. For some of these people this may also be the first time they have helped put together a demonstration.

When the preparation time is through, draw the first name from the hat. After this, allow the person who just finished to draw the next name. With a large group and limited time, you can divide the group and have 4-H'ers giving demonstrations in two or more locations. Be sure to divide the audience also.

Praise Their Efforts

The importance of giving praise cannot be overstated. By emphasizing the positive aspects of each demonstration everyone learns to quickly recognize a good one. From the first demonstration to the last, leaders often see real improvement. Be sure that each 4-H'er is asked questions about what was presented. By simply assigning two 4-H'ers each time to ask at least one question each, you have involved everyone. Often several others will then also ask questions.

Ask Questions

The following are questions and answers to help you gain additional knowledge and skills so you can help your members and their parents after this initial experience. Some leaders have found that having a short session with the helpers ahead of time gives them more confidence as they assist members.

Q. *What is a demonstration?*

A. Basically it is a method of showing and telling someone how to do something.

Q. *Is a project demonstration the only type of presentation 4-H'ers may do?*

A. No, a speech, an illustrated talk, or a youth-in-action demonstration may be given.

Q. *Where can more information be found about a topic?*

A. Project material, books, magazines, teachers, parents, extension agents, library, etc.

Q. *What are the three main parts of a demonstration?*

A. Introduction, body and conclusion.

Q. *In the introduction what may be used as an attention getter?*

A. Since the attention getter should raise interest, it might be a short story, a poem, a question, a catchy saying, or possibly a personal experience about the member's project work.

Q. *What is the purpose of a demonstration?*

A. The 4-H'er should decide whether the purpose will be to explain, convince, persuade, challenge, inform, entertain or share.

Q. *How many key points are usually included in the body?*

A. Most demonstrations contain three or four.

Q. *What should be included in the summary?*

A. Only the main things the 4-H'er wants the audience to remember.

Q. *How should questions be answered?*

A. If there is any possibility that everyone did not hear the question, the question should either be repeated or included in the first part of the response. Responses should be in complete sentences. If an answer is not known, the member should admit it and offer to find the answer or refer to someone who does know.

Q. *What is meant by the closing?*

A. The closing is simply a way to conclude the demonstration and tie it together. It must be definite and could relate back to the introduction with a poem, story, catch statement, or perhaps a challenge to the audience.

Follow-Up

Members should be encouraged to prepare and present demonstrations at other club meetinqs, community activities and county 4-H events. A variety of materials about demonstrating are available from your extension office to help these 4-H'ers (and leaders) become more skilled. The activity described is also an excellent educational program for junior leaders to share with other clubs.

FOURTEEN
Launching a Rocket

The launch's success depends in large part on proper preparation of the rocket before launching. The preparation increases the probability of success, and 4-H'ers can learn much through preparing the rocket. Model rockets can reach speeds in excess of 400 mph. If the rocket is improperly prepared for launch, dangerous situation may exist!

What Your 4-H'ers Will Do

- Prepare a rocket for launch
- Review the Model Rocketry Safety Code
- Review the phases of flight
- Be part of a rocket launch team and launch a rocket
- Develop life skills in working together, making decisions and understanding directions

Prepare for the Meeting

Time required: Approximately 1 hour
Supplies needed: A model rocket which has been painted and stability tested; selection of different sizes of engines; solar igniters; cellophane-type tape; launch pad; launch controller (source of electric power); model rocket kit instruction sheet containing special countdown instructions for launching.

If you have one or more junior leaders assisting you, they can often locate most of the supplies required.

Suggest source: *The Rocket Book,* Robert Cannon and Michael Banks, pubished by Prentice-Hall, is available from Estes Industries, Penrose, CO 81240.

Involve the Members

This activity makes an excellent learn-by-doing experience. You will find that the members are very eager to see their rocket fly and fly well. You have the challenge of insuring their safety through proper preparation while at the same time providing opportunities for them to develop their problem-solving and decision-making skills as they select the right engine, properly prepare the rocket, and work with others in forming a rocket launch team. Allow the members to demonstrate what they can do or know before being told or shown how.

After a brief discussion of what needs to be done to ready the rocket for flight, simply divide the group into launch teams, make the supplies available, and give them a situation and task such as the following.

Situation: You have a rocket that you have just completed painting and testing for stability.

Your Task: Demonstrate how to ready the rocket for launch.

If your group has several young members, you may want them to complete each step to launching a rocket outlined under "Questions"

before moving to the next one. Ask the teams to demonstrate how they accomplished each step or task. The questions included in this guide may be discussed following the demonstration and as a summary. Encourage everyone to ask each team at least one question. After each team has readied their rocket for launching, and given their demonstration and checked each of their rockets, provide each member or team one or more of the 14 launch safety codes to explain to the group. Wherever possible, have 4-H'ers use actual equipment.

By allowing launch teams to demonstrate their skills and knowledge, you will know what questions to explore prior to the actual launching. The following questions cover both preparation and the actual launch. Several can be used to encourage more short demonstrations by the members on the areas still in question. When you are satisfied all safety precautions and preparatory steps have been taken, enjoy a successful launch!

Ask Questions

Q. *What are the steps necessary to prepare a rocket for launch?*

A. 1. Pack the proper amount of flame-proof recovery wadding loosely into the body tube.
2. Fold the parachute to enable proper deployment and place in body tube.
3. Select an appropriate engine for the rocket and insert it in engine holder.
4. Install igniter for engine ignition.
5. Place the rocket on the launch pad, connect the launch controller, and make sure everyone moves a safe distance away.

Q. *What is the purpose of the wadding?*

A. To protect the plastic parachute from the heat during the ejection sequence.

Q. *How much wadding is needed?*

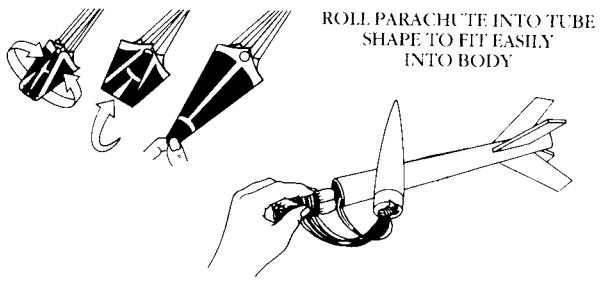
A. Usually three to four squares.

Q. *How is the wadding packed into the body tube?*

A. Pack three squares of flame-proof recovery wadding into the body tube from the top. Fill the tube for a distance of 4.0 cm (1-1/2 inches), sealing along the sides of the tube.

Q. *How do you put the parachute and accompanying shroud lines into the body tube?*

A. Hold the parachute at its center and pass the other hand down it to form a "spike" shape. Fold this spike in and roll into a tube shape. Then pack it into the tube on top of the wadding. Pack the shroud lines and shock cord in on top of the parachute and slip the nose cone into place.



Q. *What happens if the nose cone is inserted too tightly?*

A. It cannot be blown off during the ejection sequence.

Q. *What can be done if the parachute tends to stay in the folded position such as in cold weather or when left in the tube too long?*

A. Talcum powder can sometimes be used to make it work more easily. Always launch soon after the parachute is packed.

Q. *What engine should be chosen for the first flight?*

A. Usually a list is given with rocket construction instructions. Typically, one would choose the smaller engine to lift the rocket so that if a defect in construction (as a fin that may come off) became evident, the rocket will not be badly damaged.

Q. *Inserting the engine into the engine holder tube is easy, but how is the igniter placed?*

A. Be sure that the igniter is placed in firm contact with the propellant. Most problems with launch occur because of poor contact between the igniter and the propellant. Place a small piece of tape over the igniter to keep it in place. It will be burnt off during the engine burn phase and does not interfere with the rocket. Check the exact instructions that come with each igniter. Be sure to place the two wires away from the launch lug as they may interfere with the launcher during launch.

INSERT IGNITER...

AND APPLY TAPE

Questions on Launching a Rocket

Q. *What would a safe launching system consist of?*

A. A launch pad and a launch controller (source of electric power). You use a launch system that is remotely controlled and electrically operated with a switch that will return to the off position when released.

Q. *What is the proper use of a safety interlock key?*

A. The safety interlock key should be removed from the launch controller after launch and not inserted again until all members of your party are in a safe location and ready for launching again.

Q. *How far away should people be from the rocket when it is being launched?*

A. Fifteen feet is considered the minimum distance.

Q. *Why should you have a jet deflector?*

A. For ecological reasons. One has a jet deflector device on the launch pad to prevent the rocket exhaust from hitting the ground directly.

Q. *Why is a cap used on the end of a launch rod?*

A. Launch rods are slender rods, and to prevent accidental eye injury a cap is used to provide an extra margin of safety.

Q. *What is the maximum angle between the launch rod and the vertical?*

A. Thirty degrees is the maximum angle recommended. At angles greater than this the direction of the rocket flight will tend toward the ground and will not provide proper recovery of the rocket.

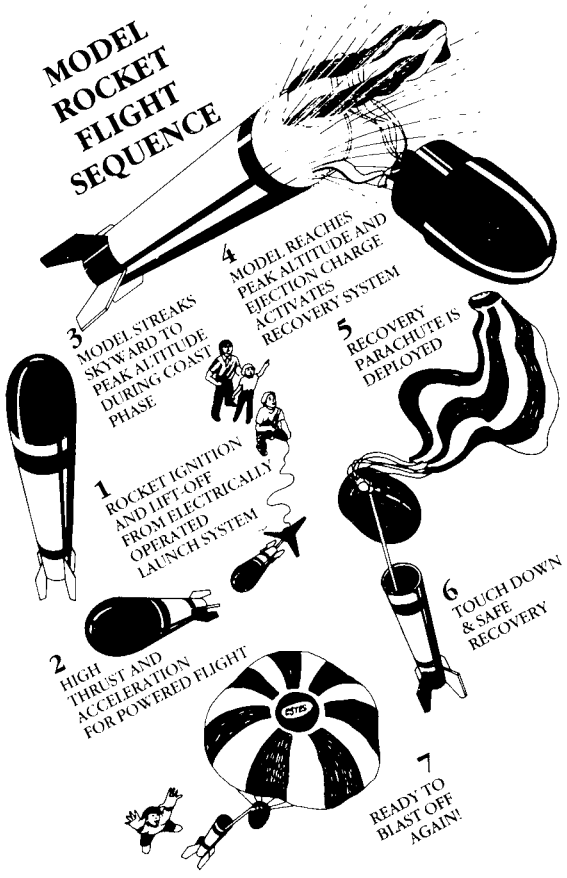
Questions to Summarize the Activity

Q. *How would you compare a model rocket to a full-sized rocket?*

Q. *What safety precautions are taken when full-sized rockets are readied for launch?*

Q. *How would you feel if you flew in a rocket-propelled vehicle?*

Q. *What are the phases of flight? (See diagram.)*



Supporting Activities

Duration Events—Members compete with each other to determine how long the rocket stays up.

Altitude Events—Members compete with each other to see whose rocket can go the highest.

Special Events—Drag races, launching two rockets simultaneously or other miscellaneous events.

Testing a Rocket for Stability

Selecting a Launch Site

4-H PROJECT CLUB CALENDAR

Date	Meeting Place	Meeting Topic & Activities	Who is Responsible	Preparation Needed
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

This Model Rocketry Leader's Guide—Beginner Level/4-H Aerospace Program was revised by Terrance F. Flower, associate professor of Physics and 4-H volunteer rocketry leader; Stanlet R. Meinen, extension specialist, retired, and volunteer rocketry leader; Thomas D. Zurcher, extension specialist, 4-H Youth Development; Georgia A. Greeley, designer and editor; C.M. Sauber and Cathy Dalglish, consulting editors; and Diane Portner and Kathy Seamon, artists.

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