Welcome 4-H Leaders!

Welcome to the “Rocketry” project. This project covers information relating to the basics of flight, from hot air balloons, to airplanes, and rockets. This guide provides you with project meeting plans (Skill Builders) that include: a skills list, background information, activity suggestions, and ways to know if your members have learned the skills identified. In short, all the information and tools necessary to make this project a rewarding one for you and your members.

In this project members will examine, by learning to do by doing, the four basic forces that affect flight to the making and launching of homebuilt rockets. The Leader’s Guide is written with the expectation that the project leader will have a working knowledge of how rockets work. If this is not the case, you may need to do some pre-work or research on the activities or recruit assistance for certain sections.

Be sure to try out activities, demonstrations or hands on work ahead of time to ensure you have an understanding of each Skill Builder - this also allows for any adjustments should an activity not work for you or if any equipment or supplies are unavailable.

The 3D’s of Learning - Each Skill Builder has three sections of learning called “Dream it!”, “Do it!” and “Dig it!” Below is a description of each.

**Dream it! Plan for Success** - this gives members a chance to help plan their activities. A skills checklist, background information, important words, and activating questions are included in the Member’s Manual so they will be able to think about the topic and activity and decide how they will approach it. The Leader’s Guide contains in depth background information on the topics, material lists, suggestions, time requirements for activities, and activating, acquiring, and applying questions to engage member’s thinking through each step of the learning process.

**Do it! Hands on learning** - this is where members are engaged in the activity planned / discussed in the Dream it! Section. Here members are doing the activities and leaders are observing, recording, and providing feedback on how well they are doing. Allow as much individual practice as required; you are assessing the progress and understanding of individual members.

**Dig it! What did you learn?** - this simply means that members and leaders need to ‘dig into their learning’. For the learning cycle to be completed, both need to reflect on how things went and how well they did. For members this involves self-assessment, giving feedback, creating meaning from their experiences, and thinking about what they would do differently next time. Once this is done they will be in a good position to apply what they have learned to the next experience.

The sequence of project meetings and specific skill building outcomes for members in this project are on the chart on the following page.
What Skills Will The Members Learn?

Each section or Skill ‘Builder’ in this project has activities that will help your project group learn to do by doing while learning new skills and having fun!

To complete this project members must:
- Complete the activities in each Builder OR a similar activity that focuses on the same skills, as you and your group may plan other activities.
- Plan and complete the Showcase Challenge.
- Complete the Portfolio Page.
- Participate in your club’s Achievement (See the inside back cover for more information about 4-H Achievements).

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Skill Builder 2
- Forces Acting on Aircraft
  - Explain the principles of thrust, drag, lift, and gravity
  - Design a wing
  - Make a Maple Seed Flyer
  - Make a Straw Flyer

Skill Builder 3
- Controlling Flight
  - Understand how ailerons and vertical and horizontal stabilizers control aircraft
  - Build a Styro glider

Skill Builder 4
- Intro to Rockets
  - Explain differences and similarities between airplanes and rockets
  - Demonstrate and explain the causes of “thrust”
  - Build rockets with air and chemical propulsion

Skill Builder 5
- Stomp Rockets
  - Explain the importance of a centre of gravity on a rocket
  - Build a Stomp Rocket
  - Help build a Stomp Rocket launcher

Skill Builder 6
- Model Rocket
  - Describe and explain the stages of rocket flight
  - Assemble and launch a model rocket
  - Follow model rocket safety guidelines

When members successfully complete the builders they will showcase what they have learned.

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4-H Project Series Skill Development Levels

Each project topic series contains three levels of skill development: explore, discover, and master.

Explore - each project series has one project outlining the fundamentals. All members will be expected to complete the Explore level project before moving into the Discover level of projects. It introduces the basic skills and terms needed by members for subsequent projects in that series.

Discover - each project series has several project options and members are encouraged to take as many as they would like. At this level members practice topic specific techniques and gain theme related skills through specialized builders.

Master - multiple project options encourage members to specialize in a topic. They may branch out and take advantage of community options such as cooking for a canteen or participating in a food drive. The Leader’s role is look for opportunities for their members to have more authentic experiences by: working with other mentors, partnering with outside agencies, participating in exchanges, entering competitions, etc. Projects at this level may include the “Partner-a-Project” whereby pre-approved courses will allow members to advance their skills while applying their learning to the 4-H program.

Showcase Challenge and My Portfolio Page

At the end of the members’ section are the “Showcase Challenge” and “My Portfolio Page”. The Showcase Challenge page gets members to think about their accomplishments and explain or demonstrate how they were successful. There are a number of suggestions along with planning information to help them decide how they will best “showcase” their learning to friends, family, community members and/or fellow 4-H members.

Record keeping is an important part of every 4-H project. “My Portfolio Page” is a graphic organizer used to keep track of members’ 4-H experiences. As each member learns skills, the evidence of learning (through participation and completion of the various activities) is recorded on the page. When the Portfolio Page has been completed and confirmed by the leader it becomes a record of the member’s completion of the project and participation in other 4-H activities beyond the project.

4-H leader assessment of members will happen throughout the project as you assess the progress and understanding of individual members. You need to observe the members doing the skill and record what you see and hear. Your feedback should be positive and descriptive (not just “well done”). Share that feedback with members frequently so they can put your suggestions into action. How you choose to observe and record is up to you. Some methods are to create checklists, videos and notes while encouraging discussions, peer observations and questions. Recognize that members may improve over the course of a builder and that records should be updated to reflect when they demonstrated their best learning. You are discussing how well members are meeting the skills checklists that are at the beginning of each of the project books, in each Builder and on the Portfolio Page.

Projects promote technical, communication, meeting management, and leadership skills, as well as community involvement and real-world experiences. In addition to the specific skills members are to learn in each builder, the following general learning goals for members are important: Following instructions - Working with others - Using supplies safely - Using the key words - Improving with practice - Respecting timelines.
Members must complete all the activities listed on the “Project Completion Requirements” page OR alternate idea for an activity that would teach the same skill or an age appropriate variation. If activity substitutions are used, be sure to have the member make note in their manuals.

Dependent on time available at each meeting, group size and abilities of group members, you may wish to break the Builders into more than one project meeting.

The internet has lots of interesting websites and educational activities. You may choose to use a search engine to explore the options available. Using key words such as “rocketry”, “aeronautics”, “Canadian Space Agency” or “NASA” can provide excellent additional background ideas. We do not endorse any website or the safety or functionality of any products they may sell. Information/products will be used at your own discretion.

Safety is a number one priority. Care has been taken to create safe, age appropriate activities throughout this manual. As leaders, it is important for you to emphasize safety rules and manage or adapt activities in a manner that will safely match your members abilities. Ensure members have a good understanding of safe working and handling practices when using tools, that they use the appropriate safety equipment when necessary, and that appropriate supervision is provided. A quality experience needs to be a safe experience.

The multiple intelligences theory teaches us that people learn in at least 8 different ways. All individuals will be stronger in some ways of “intelligences” and weaker in others. It follows that the more ways we teach, the more members we will reach. Throughout this project you will find a mix of writing, reading, hands-on work, artwork, self-evaluation, group discussion and math calculations. Teaching projects using a broad blend will help increase the learning potential of all members.

Projects are designed to teach many skills. However, the 4-H member is always more important than the subject matter. Stress cooperation in the project activities to help the members develop teamwork skills. Ensure the work is completed in a manner that members feel good about themselves and their efforts. This can be done by assigning appropriate tasks or roles based on member’s individual abilities. Modelling and expecting supportive behaviour (i.e. no “put-downs” among members or other adults) also contributes to a positive experience.

There will be opportunity for experimentation and applying skills that members have learned throughout this project. Experimenting can be frustrating, but learning through trial and error is an important life skill. Explain to members that it is alright to either go onto the next builder or do the builder again if they need the practice. Help the members work through their challenges until they are satisfied with the quality of their designs. Creating inventive 4-H members will be very rewarding.

Celebrating success is an important but sometimes overlooked part of our lives. We encourage you to use the final section to empower the members by celebrating all they have learned in a fun manner. Anything that you do to add to the spirit of fun and the sense of accomplishment of each member will likely be remembered as the high-light of their 4-H year.

Have fun and thanks for your belief in young people!
Skill Builder 1: Characteristics of Air

Skills Checklist
- Describe the properties of air
- Manipulate air pressure
- Make a hot air balloon

Dream it!

Background for Leaders

Air is a fluid just as water and syrup are fluids. Fluids are “substances that have the ability to flow and take the shape of the container into which they are poured”. There are weak forces of attraction between the molecules of a fluid which allows the individual particles within the fluid to flow around one another. This is different from solids, in which the individual particles are firmly held in place by strong bonds. Gases such as helium, neon and steam have the weakest bonds, which enables them to spread out rapidly.

Given the definition of fluids, many members mistakenly refer to sand, rice and other materials made up of very small particles as fluids. The simple way to explain the difference between these substances and fluids, is that fluids do not form a pile when poured in one spot.

The Can Crusher activity will show that air exerts enormous pressure. We are used to the pressure that it exerts on our bodies, but are amazed when we see air crush a can. The Crushing Can demonstrates that cool thick air has a higher pressure than rising warm air.

When the can is sealed off by the ice water, preventing the cooler air from entering into the can, the enormous amount of higher air pressure in the room crushes the can in trying to equalize the air pressures.

The temperature of air determines if its molecules are packed closely together or spread apart. A cold air mass has its molecules packed closely together, whereas warm air has its molecules spread further apart than cold air. This means that cold air is dense and exerts a higher pressure per metre than warm air. Because cold air is more dense than warm air it tends to sink (like when you open the door of the freezer compartment of the fridge), whereas the warm air rises. Essentially warm air rises as it is being pushed up by cold air sinking in below it. Helium balloons rise because air is much denser than helium. The balloon is pushed up rapidly because of all the dense air around it. This is much like watching the carbon dioxide bubble rise in soda pop.

This is the principle on which hot air balloons work. Lighter, warmer, less dense air rises and creates lift. But this isn’t necessarily the same for airplanes.

This project meeting is introductory in nature and is built around four Leader Demonstrations. Members will repeat the demonstrations and will have fun doing so. However, when members try the “Can Crusher” experiment, proper adult supervision must be employed.

Resources/Handouts/References
- How airplanes work, with pictures and videos: http://science.howstuffworks.com/airplane.htm
- A more detailed explanation of the Can Crusher activity, with pictures and video: http://www.stevespanglerscience.com/experiment/00000043
Important Words

Help members define the following words and listen for them using these words in their discussions. To increase the members’ understanding try providing a synonym members know or provide examples. The more personalized the examples the better.

<table>
<thead>
<tr>
<th>Air</th>
<th>Air is a physical substance which has weight and is made up of molecules which are constantly moving. Air is a mixture of different gases; oxygen, carbon dioxide and nitrogen.</th>
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</thead>
<tbody>
<tr>
<td>Fluid</td>
<td>Any substance that flows and takes the shape of the container it is poured into is a fluid.</td>
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<tr>
<td>Air pressure</td>
<td>Air pressure is the force exerted on you by the weight of tiny particles of air (air molecules).</td>
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<tr>
<td>Density</td>
<td>The state or quality of being dense; compactness; closely set or crowded condition. The mass per unit volume of a substance under specified conditions of pressure and temperature.</td>
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<tr>
<td>Gas</td>
<td>The state of matter distinguished from the solid and liquid states by relatively low density and viscosity, relatively great expansion and contraction with changes in pressure and temperature, the ability to diffuse readily, and the spontaneous tendency to become distributed uniformly throughout any container.</td>
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Age Considerations

- 10 and up

Thinking Ahead

- What will you discuss with members? Gather observations that will help support your discussion.

Preparing for Success

- Ask members how they know they will be successful in this builder. Discuss what success looks like, sounds like, and feels like.

Activating Strategies

- Activate member’s prior knowledge of air by asking them to tell you everything they know about it.

Wet or Dry?

- How does air take up space?

Time Required: 30 minutes

Equipment/Supplies

- Plastic cup
- Tissue paper
- Clear bowl of water
**Procedure**

1. Show the bowl of water to the members and ask if it is an example of a solid, liquid or gas. After obtaining responses, ask the members whether water can be both a liquid and a fluid? After listening to responses, explain to members that water is an example of a fluid by giving them the definition of a fluid as outlined in the “Background for Leaders” section of this builder.

2. Further engage the members by asking them if a gas, such as air can be a fluid. After listening for responses, explain to the members that air is a fluid. Explain that air can flow (wind), has weight (cold air sinks when the freezer door on the fridge opens), and air takes up the shape of the container that it occupies. This demonstration will reinforce that understanding.

3. Show the members the bowl of water, the tissue paper and the plastic cup. Ask the members what would happen if the tissue was put into the water? Listen for responses, and then put the tissue in the water to confirm understanding.

4. Next, ask the members what would happen if the tissue was put into the bottom of the cup, and then the cup placed open end down into the water? Listen to responses, and then proceed in wadding the tissue into the bottom of the cup. Then turning the cup upside down, push the cup opening down onto the surface of the water. Ask the members for their observations in what is happening to the tissue while you continue to push the cup to the bottom of the bowl.

5. Explain to members that this demonstration shows that air takes up the space between the surface of the water and the tissue. Explain that the water can’t compress the air to reach the tissue. Have each of the members try this activity.

   - What happened to the tissue paper? How did air become a factor?

**Do it!**

**Can Crusher**

- How can air exert pressure?

**Time Required: 1 hour**

**Equipment/Supplies**

- Hot plate (or stove element)
- Bucket of ice water
- Kitchen tongs (ones with rubber ends work best so that the can does not slip out of the grip of the tongs), or oven mitts.

**Safety Considerations**

Reasonable caution must be used in this activity. It is recommended that the Leader practise the activity at home. Beware of any inherent hazards in using hotplate/stove elements around members. Also use tongs that have hard or soft plastic grippers. This will eliminate the chance of the pop can squirting out when it is lifted from the hotplate. It is always a good idea to try this demonstration prior to showing it to members.
Instructions

1. Now that the members understand that air takes up space and has mass (weight), ask them if they think that air can exert pressure. Some members may relate that wind is an example of pressure.

2. 6 m tall (about the height of a two-story column 1 m wide). We don’t feel all that pressure because we are use to it. Explain that people who live high in the mountains live under less air pressure than people who live at sea level. Air is dense at sea level and gradually thins out as altitude increases.

3. Show the members the set up as in the diagram above. Instruct the members that they are to observe and then try to explain what happened.

4. Place a teaspoon full of water into the pop can, and place the can on the hot plate.

5. Wait until steam is rising out of the can and then using the tongs (or oven mitts), quickly turn the can over onto the surface of the ice water. After about a second there will be a loud “pop” and the can will be crushed. As you lift out the can, cold water will drain out of the can. If the can fails to be crushed, try boiling more water so more steam can be produced. It may also be that the can wasn’t turned over quickly enough or that too much ice got in the way of a proper seal between the water and the can.

6. Supervise members as they try this activity. This is very effective when members are holding onto the tongs (or the can by using the oven mitts) when the can is crushed. Use your best judgement.

7. Explain how the soda can imploded (burst inward).

- So what happened to the can? Why?

Hot Air Balloon

- How do hot air balloons work?

Time Required: 1 hour

Equipment/Supplies

- Large garbage bags (one per member), or large dry cleaner bags if available (without holes in the top where the hangar goes if possible)
- String
- Several hair dryers
- Construction paper
- Strips of paper 10 cm wide by 25 cm long
- Clear tape
- Pencils

Instructions

1. Ask the members for their suggestions as to how hot air balloons work. After listening for their responses explain that hot air rises because it is less dense than cold air. Tell the members that they will each try to make a hot air balloon.

2. Using the hair dryer, put the temperature on high, and if possible, the air on low. Have several members hold the bag open over the hair dryer. The bag will fill up with warm air. As the air gets hotter the bag will soon begin to displace the warm air with hot air. When you feel that the balloon is hot enough, let go.

3. The balloon will rise and yet the open end will allow cold air in and the balloon will collapse. Repeat the activity but this time close off the open end of the balloon and observe the difference in your results.
4. Now allow the members to try this activity. Challenge them to make a basket for their balloon to carry aloft. If some are successful with this, challenge them to try and carry aloft items of different weights.

Optional Activity

Depending on the interest of your members and their individual abilities, you may wish to encourage them to do a research project on the concepts learned in these activities. They could do some research and present their findings to the project group.

Topics could include:
- Daniel Bernoulli
- Types of Bird Wings
- Types of Aircraft and their Wings
- History of Ballooning
- Silver Dart
- Wright Brothers
- Or any others that you or the members can think of

Dig it!

To help members reflect on their learning and apply what they know ask them the following questions:

1. What did you learn about air?
2. Why is knowing about air important?
3. How would you teach someone about how temperature affects the properties of air?

What's next?

In the next builder members will expand their knowledge of air by learning how air affects aircraft in flight and how the wings of aircraft create lift. To get members thinking about the next builder, have them think about how airplanes fly: Why do they need wings? What do you think wings do?
In the Member Manual

**Skill Builder 1: Characteristics of Air**

**Gizmo says...**
Did you know that air is a fluid? Any substance that flows and takes the shape of the container it is poured from is a fluid. This includes such things as water, shampoo, and even honey! Even gases like air can be classified as fluids.

**SKILLS CHECKLIST**
- Describe the properties of air
- Manipulate air pressure
- Make a hot air balloon

**Dream it!**
Apart from being a liquid, did you also know air can exert a great deal of pressure? Enough pressure to crush a soda can! It’s true! Air is all around us and it is under pressure. The earth’s atmosphere is pressing against every part of you, but it doesn’t crush you because you have air inside you and that air balances the air on the outside!

Have you ever noticed what happens to the air when you open the door of a freezer? You will notice that the chilly air moves downward. Have you ever been in a multi-story house in the summer? Which part of the house is the hottest? It’s the top floor or attic, isn’t it? Simply put, hot air rises and cold air sinks. Hot air balloons rise because they have a heat source that heats the air inside the balloon and that hot air rises and pushes against the envelope and causes the balloon to lift.

**Wet or Dry?**
- How does air take up space?

**What you will need:** plastic cup, tissue paper, large bowl of water

When you pour yourself a glass of water the water takes the shape of the glass. Water is a Fluid and all fluids take the shape of the container they are in. What about air? Will it do the same thing?

1. Place some tissue into the bottom of the cup.
2. If you turned the cup upside down and placed it in the water, would the tissue get wet? Try it. Push the opening of the cup down onto the surface of the water. Keep pushing until you get to the bottom of the bowl.
3. Pull the cup out of the water. What happened to the tissue? Why?

**Do it!**

**Can Crusher**
- How can air apply pressure? We are so accustomed to the pressure of the air around us that we don’t even notice it. However, the air pressure is large enough to crush a soda can.
- Are you strong enough to crush a pop can with your hands? What are some other ways to crush a pop can?

**Safety First!**
The water in the can will be hot. Wear oven mitts or use tongs when handling the can. Safety goggles are strongly recommended.

**What you will need:** heat source (hot plate or stove element), bucket of ice water, empty pop can, tongs or oven mitts.

1. Put a teaspoon of water in the empty pop can.
2. Heat the water by putting the can on a hotplate or stove.
3. When you see steam coming out of the can, grab it with the oven mitts or tongs and quickly put it in the cold water.

Describe what happened to the can:

**Hot Air Balloon**
- How do hot air balloons work?

**What you will need:** large garbage bag (with no holes!), string, hair dryer, construction paper, tape, pencil

Write down what you think these 3 parts of a balloon do:

Envelope: __________________________________________
Basket: ____________________________________________
Burners: __________________________________________
In the Member Manual

Try It Out!

1. Put the hairdryer on high temperature and low air flow.
2. Hold the bag over the dryer until the bag is full of hot air. Let go of the bag.
3. Put hot air back into the bag but tie the end this time. Let the bag go.
4. Build a basket with the paper and attach it to the bag. Does your balloon fly? Try putting a weight in the basket.

Where you successful? What would you need if you were to build a balloon that could carry a person?

Gizmo’s Fast Facts

The first hot air balloon was invented by French brothers, Jacques and Joseph Mongolfier in 1783. Because of the uncertainty of flight, the first living beings to fly in one of their balloons were a sheep, a duck, and a rooster. The balloon stayed in the air for a grand total of 8 minutes before landing safely on the ground.

Dig It!

Think about this builder and the activities you did …

Review the Skills Checklist on page 3.
What skills have you developed? Do you need more practice?

Record it …

Discuss what you have learned with your leader so that the information can be recorded on your portfolio page.

Apply it …

How could you explain to others the interesting things that air can do?

Rocket Science

For a timeline of the history of flight check out this site: www.usps.nasa.gov/StudentsSite/historyofflight.html

What’s next?

You now know some of the things that air can do (take the shape of a container, put forth loss of pressure, and can lift a hot air balloon). Air can also provide resistance to moving objects. In the next builder you will learn about the forces that act on aircraft in flight. Airplanes are designed in a way that helps them use and reduce the effects of air to fly.
**Skill Builder 2: Forces Acting on Aircraft**

**Skills Checklist**

- Explain the principles of thrust, drag, lift, and gravity
- Design a wing
- Make a Maple Seed Flyer
- Make a Straw Flyer

**Dream it!**

**Background for Leaders**

There are four forces that act on an aircraft when it’s flying. Thrust is the forward force that is provided by the engine. Lift is the upward force provided by the wings. Drag is the force that opposes thrust. It is caused by the friction of the aircraft moving through the air. Gravity is the force that opposes lift.

As long as thrust is greater than drag the plane will go forward. As long as lift is greater than gravity the plane will continue to rise. So in order for a plane to lift off the ground and stay in the air it needs a large amount of thrust and lift. If drag or gravity were to become larger forces than the thrust or lift, the plane would crash!

Airplane wings produce lift because of a difference in air pressure. The difference in pressure is created by the shape of the wing. As you look at a wing (either bird or airplane) you notice that the top of the wing is rounder than the bottom which is relatively flat. As the plane goes forward on the runway, thanks to the propeller and engine, air is forced over and under the wings at the same time. Air has a longer way to go over the wing, because of its rounded shape (called cambered airfoil), than under the wing. Because air is “stretched” or thinned out over the top of the wing, it has less air pressure than the air under the bottom of the wing. This means that the high pressure of air under the wing will actually push up on the wing to get to the area of low pressure. This is what creates lift. This is an application of Bernoulli’s Principle; which states that a fast moving fluid exerts less pressure than a slow moving fluid.

The Maple Seed (Flyer) spins slowly to the ground. This is an adaptation by the Maple tree to help the seed in slowing its decent, catch an available breeze, and spreading further from its parent tree. When the wings of the Flyer are bent the opposite way the spin is changed to the other direction. This has to do with the leading edge of the fold in the paper wing. The wing is bent outwards from the seed, and as it falls is bent into a curved shape. This then produces a shape like a wing, and lift is created. The lift isn’t enough to keep the seed in the air (lack of thrust), but it does create a difference in air pressure, that turns the seed. This concept of creating different curves on an aircraft other than the wings to turn an airplane is crucial in controlling an airplane in the air.

The straw flyer activity helps members identify and investigate the variables that influence the flight of this type of aircraft as well as introducing the basic concept behind the shape of a rocket body. It is also pretty neat and is very responsive to adjustments in positioning of the wings, and force of thrust. Many paper airplanes fly simply because they are hurled through the air by brute force. Straw flyers require their designers and pilots to use care in order to achieve success.

**Resources/Handouts/References**

- Information on forces affecting flight and links to activities: http://www.grc.nasa.gov/WWW/K-12/airplane/forces.html
Age Considerations

- 8 and up

Thinking Ahead

- What will you discuss with members? Gather observations that will help support your discussion.

Preparing for Success

- Ask members how they know they will be successful in this builder. Discuss what success looks like, sounds like, and feels like.

Activating Strategies

- Activate members’ prior learning by asking them what they know about air pressure and how it might affect airplanes in flight.

Design a Wing

- How do airplane wings create lift?

Time required: 30 minutes

Equipment/Supplies

- 8 ½ X 11 sheets of paper (one per member)
- Clear tape
- Pencils

Procedure

1. Hold a piece of paper by the edges of one end. Bring it up a few centimetres from your mouth, and blow across it with a steady force. The paper should rise and flap out away from your mouth. Ask your members to explain what’s happening. After listening for clues about air pressure, explain to members what’s happening. Point out that fast moving air over the paper has less pressure than the still air below it. The still air then tries to get at the lower pressure by pushing up on the paper. This creates lift.
2. Now fold a piece of paper into a loop. Use a piece of clear tape to secure the ends together and insert a pencil into the opening. Blow across the top of the loop in the same way that you blew across the piece of paper earlier. The loop should rise.

3. Have the members experiment with their own loops. Some may want short loops with flat bottoms and very curved tops. Some may want to try very long loops.

- What difference did loop design have on lift?

**Do it!**

**Maple Seed Flyer**

- How does wing shape affect flight?

**Time required: 1 hour**

**Equipment/Supplies**

- Drinking straws
- Thin strips of paper (about 3 to 5 cm wide by different lengths, e.g. 7 cm, 10 cm, 12 cm, etc.)
- Clear tape
- Maple seed flyer pattern (at end of section)
- Paperclip (one per member)
- Maple Seeds (if available)

**Instructions**

1. If possible, have a maple seed available for this demonstration. If you have one hold it high and drop it. Watch as it spirals downward. Ask the members why it spiralled instead of just dropping like a ball? Listen for responses that might include ideas about wing shape.

2. If you don’t have a maple seed available you will want to make a Maple Seed Flyer for this activity. To make one use the pattern at the end of this section.

3. Once you have made one, attach the paperclip to the bottom, fold out the “wings” (each in a different direction) and let it drop. It should windmill down in the same way that the maple seed would drop. Ask the members why the Maple Seed Flyer spiralled instead of just dropping like a ball? Listen for ideas that include ideas about wing shape.

4. Have each of the members make their own Maple Seed Flyer. Have them experiment with wing length.

5. After several experiments have taken place, challenge the members to bend the wings of their flyers in different directions. Does the Flyer now spin differently? Challenge the members to explain why. After listening for explanations, point out the fold in the paper, as well as the wing shape that is produced when the Flyer falls. Challenge the members to make the connection between the shape of the Flyer wing and wing shape learned in the previous lesson. If they don’t make the connection, don’t worry. Just say that the Flyer has two wings, and it spirals because lift on the wings turns the Flyer around and around.

- When building a Flyer, what things do you have to consider?
Straw Flyer

Time required: 1 hour

Equipment/Supplies

- Straws (one per Flyer)
- Paper
- Clear tape

Procedure

1. Essentially, the straw flyer is a small loop of paper at the front of a straw, and a larger loop of paper at the rear of the straw. Both loops should be pointing up when you throw it. Use a bending straw if you can and by gently moving the end of the straw back and forth, up and down you can change how the flyer goes.
2. You should throw it with a smooth forward motion, much like throwing a dart. Make sure that the small loop is facing forward. The difference in sizes of the loops, as well as their closeness to each other has an effect on its flight.
3. Throw your straw flyer. Challenge members to guess what the effect would be of changing the loop size, position, etc.
4. Allow the members to make their own Straw Flyers. Challenge them to discover which straw flyer will fly the farthest straight distance (harder than it seems).
5. Have members experiment with the diameter of the loops, width of the loops, thickness of paper, length of the straw, weight of apparatus, distribution of weight, composition of the loops (substitute Styrofoam cup cross-sections for paper loops), and so on.

Use the diagram at the top of the page to help you make a straw flyer.

- Which flyer went the farthest? Why?

Dig it!

To help members reflect on their learning and apply what they know, ask them the following questions:

1. What did you like about this builder?
2. What was hard about getting your Straw Flyer to fly straight?
3. What would you do differently if you were to do this lesson again?

What’s next?

In the next builder members will learn how pilots control their aircraft. To get members thinking about the next builder have them think about how airplanes are guided. What external parts of an airplane move? How?
**Skill Builder 2: Forces Acting On Aircraft**

**Discover**

Gizmo says...

Airplanes need more than engines to fly. Without wings an airplane would just be a really big car. And without the right wing design it would be just like a big flightless bird!

**SKILLS CHECKLIST**

- Explain the principles of thrust, drag, lift, and gravity
- Design a wing
- Make a Maple Seed Flyer
- Make a Straw Flyer

**Important words**

Watch for these important words throughout this builder: **Thrust, Gravity, Drag & Lift.**

**Dream it!**

There are 4 forces that affect airplanes in flight:

1. **Thrust:** the forward force from the engine
2. **Lift:** the upward force from the wings
3. **Drag:** the force that opposes thrust (when the airplane hits the air)
4. **Gravity:** the force that opposes lift (what keeps you from flying off the face of the earth!)

For an airplane to fly, thrust has to be greater than drag and lift has to be greater than gravity.

The “Design a Wing” activity focuses on “lift” - the aerodynamic force that holds an airplane in the air. Wings produce lift because of the difference in air pressure caused by the wing’s shape (which is rounder at the top). Because it takes air longer to go over the rounded part of the wing, it gets stretched or thinned out. This air will have less pressure than the air that flows under the wing. The high pressure under the wing pushes up on the wing to get to the area of low pressure (to balance it out).

Wing shape also affects how the airplane is controlled. In the “Maple Seed Flyer” activity you will learn how changing the shape of a wing changes the direction of the flyer.

Just like airplanes, it is important for rockets to have the right design. In the “Straw Flyer” activity you will learn how rocket body shape affects flight.

**Design a Wing**

**What you will need:** 8 1/2 x 11 sheets of paper, pencil, tape

- How do airplane wings create lift?

If you take a piece of paper, hold it by one edge, then hold it close to your mouth and blow – the paper will move up and away from you. Why do you think this happens? Can you imagine air hitting against an airplane wing and doing the same thing?

**Do it!**

**Maple Seed Flyer**

- How does a wing’s shape affect flight?

The Maple Seed Flyer is based on what maple seeds from a maple tree do. The seeds spin slowly to the ground which helps slow their fall, catch a breeze, and spread away from their parent tree.

1. Trace the Maple Seed Flyer pattern (found at the end of the manual) onto the strips of paper and follow the directions for folding. Keep the flyer in place with the paperclip.
2. Drop the flyer. How does it fall?
3. Experiment with different wing lengths (use long strips of paper). Does this change anything?
4. Try bending the wings in different directions. Does it fall differently?

**Straw Flyer**

**What you will need:** Straw, paper, clear tape

- How does design affect flight performance?

A Straw Flyer is 2 loops attached to a straw (a small one in the front and a larger one on the back).

1. Cut out 2 thin strips of paper. Make one strip shorter (this will be the front loop)
2. Attach the loops to the straw with the tape.
3. With both loops pointing up, throw the flyer with a smooth forward motion (like throwing a dart)

How did it fly? What would happen if you changed the loop size and position? Try it! Which Straw Flyer design flew the farthest?

**Rocket Science!**

For more information on the dynamics of flight visit: 

[www.uest.nasa.gov/StudentSite/dynamicsofflight.html](http://www.uest.nasa.gov/StudentSite/dynamicsofflight.html)

**4-H Shoebox**

Make sure you save your flyers, gliders, and homemade rockets that you make. They can be used for your showcase challenge or displayed at achievement. Using a box to store them in helps keep them safe.
In the Member Manual

**Dig it!**

Think about this builder and the activities you completed ...

Review the Skills Checklist. What skills have you developed? Do you need more practice?

**Picture This...**

In this picture I am ____________________________

Share your experiences with friends and family

In this picture I want you to notice: ____________________________

I want to tell you about how this meeting went: ____________________________

I want to explain to you how an airplane’s wings help it fly:

What’s next?

You have learned about the different forces that act on aircraft and how design uses or counters those forces to improve flight. In the next builder you will learn how pilots use various parts of the plane to control their aircraft.

??Showcase Challenge??

Is there something you’ve made in this project you are proud of? Maybe you would like to use it in the showcase challenge at the end of this project.
Skill builder 3: Controlling Flight

Skills Checklist

- Understand how ailerons and vertical and horizontal stabilizers control aircraft
- Build a Styro glider

Dream it!

Background for Leaders

Pilots need to control the direction their aircraft fly. They also need to react to changes in wind speed and direction. Mountains are also to be avoided! But how?

There are four main controls that a pilot uses to control his or her airplane:

1. The engine controls thrust which keeps the plane up in the air.
2. The ailerons are on the trailing edges of the wings. They can make the plane roll over or do a barrel roll (or keep from doing one). It is important to know that when one aileron points up, the other one points down. This has to do with wing shape and direction of spin as hinted at in the Maple Seed Flyer activity.
3. The tail of the plane (vertical stabilizer) is like a rudder on a boat. It controls the way that a plane turns. You can call it a rudder or use the correct term, vertical stabilizer, depending on your members. This also has to do with the creation of a new curved surface (wing shape) and therefore lift in a new direction. If you can imagine an airplane resting on a large pin and turning around on it, much like a compass needle, you will better understand that the vertical stabilizer controls this type of turn. The technical word for this type of turn is called a “yaw.”
4. The little wings at the back of the plane (horizontal stabilizer) are also called the elevators. These can make the plane pitch up or down. Once again, the new curved surface creates a secondary lift in a new direction.

Pilots use combinations of these controls to change the direction, speed and altitude of the aircraft. However, knowing how the different controls affect the direction of an aircraft will take away much of the mystery of how planes fly.

This activity is more involved than the previous ones in that it begins to incorporate many of the individual concepts learned to this point. At the end of this guide there is a black-line master provided for this activity. It would be best if the leader made one first so that they can anticipate any questions that may arise.

Important Words

Help members define the following words and look for members using this vocabulary in their discussions. A few strategies you can use include;
- Teach synonyms by providing a synonym members know.
- Also, teach antonyms. Not all words have antonyms, but thinking about opposites requires the members to evaluate the critical attributes of the words in question.
- Provide non-examples. Similar to using antonyms, providing non-examples requires students to evaluate a word’s attributes. Invite students to explain why it is not an example.
Age Considerations

- 10 and up

Thinking Ahead

- What will you discuss with members? Gather observations that will help support your discussion.

Preparing for Success

- Ask members how they know they will be successful in this builder. Discuss what success looks like, sounds like, and feels like.

Activating Strategies

- Activate members’ prior learning by asking them to think about how air affects aircraft. Ask them how an airplane can use air to its advantage (e.g. lift)? Then ask them how they can make a paper airplane go in different directions? (e.g. make flaps on the wings)

Do it!

Styro Glider

Time Required: 2 hours

Equipment/Supplies

- Black-line master of Styro Glider
- Small Styrofoam meat tray (the ones without the raised bumps work best) 2 – 3 per member to allow for mishaps
- Masking tape
- Penny

Resources/Handouts/References

- How an airplane is controlled: http://www.allstar.fiu.edu/AERO/fltmidcont.htm
- Alternate/additional activity on controlling flight using a paper airplane: http://www.allstar.fiu.edu/AERO/EXPERIMENT6.htm
Safety Considerations

- Exacto knives and razor blades can be very sharp. Ensure members take due care when cutting out their plane parts.

Instructions

1. Tell members they will be making a plane out of Styrofoam. Ask them why they think this material will be used and what factors they think will determine if their plane flies well or not.

2. Provide members with the materials as listed above. Help them to tape the black-line to the Styrofoam tray and then supervise them as they cut out the Styro glider parts. It may be helpful if they use a pin to poke a series of holes along the outline of the parts. Then they can remove what is left of the black-line and follow the pattern of holes in cutting out the parts.

3. Make sure that all the edges are trimmed neatly. This will reduce drag and improve performance. Also, as members bend the control surfaces in different directions they will find that they may break off. Use masking tape to loosely hold the flaps in place. It will be easier to move the controls now and demonstrate the different flight combinations.

As the members get proficient in flying their Styro gliders, challenge them to demonstrate that they can pilot their planes in these following patterns:
- straight and level
- barrel roll clockwise
- pitch up
- yaw left
- fly upward to the left
- fly downward to the right
- Show off a trick of their own design.

Dig it!

To help members reflect on their learning and apply what they know, ask them the following questions:

1. What did you learn about controlling flight?
2. What advice would you give to someone who wanted to make a Styro Glider?
3. In what other ways could you apply the skills you gained in this lesson?

What's next?

1. In the next builder members will be introduced to rockets and learn about rocket propulsion.
2. Have members think about what they have learned about the forces that act on aircraft and how aircraft is controlled. Ask them if those things will apply to rockets. Why?
Skill Builder 3: Controlling Flight

Gizmo says...
How do pilots control their planes? Ever since the Wright brothers first flew in 1903 there have been all kinds of airplane types. Every aircraft has had to deal with the same four forces - lift, weight, thrust, and drag. They also had to face the challenges of stability and control.

SKILLS CHECKLIST
- Explain how ailerons & vertical & horizontal stabilizers control aircraft
- Build a Styro glider

Dream it!
Pilots need to control the direction their aircraft flies. They need to react to changes in wind speed, direction, and mountains! But how?

There are four main controls on an airplane:
1. Engine: the engine controls thrust which is needed to keep the plane in the air
2. Ailerons: these are on the back edges of the wings and move up and down. These make the plane roll to one side or the other (left or right)
3. Vertical stabilizer (or rudder): the tail of the plane (like a rudder on a boat) turns side to side and controls the way the plane turns
4. Horizontal stabilizers (or elevators): these are the little wings that attach to the plane’s tail and make the plane go up or down (change altitude)

Pilots use all of these controls in different combinations to get the plane where it needs to go.

Do it!
Styro Glider
- How do pilots control the direction of their aircraft?

Safety First!
Always be careful when working with knives and other sharp tools

What you will need: Styro Glider template, Styrofoam tray, masking tape, penny, knife

1. Tape the Styro Glider template (found at the end of this manual) to the Styrofoam tray
2. Carefully cut out the glider’s parts with the knife
3. Attach parts to look like the picture on the template
4. Bend the control surfaces (ailerons and stabilizers) in different directions to make the glider fly differently

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Glider Direction</th>
<th>Success? (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight &amp; level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barrel roll clockwise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pitch up</td>
<td></td>
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<tr>
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<td>Fly upward and to the left</td>
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</tr>
<tr>
<td>Fly downward and to the right</td>
<td></td>
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</tr>
</tbody>
</table>
In the Member Manual

Dig it!

Think about this builder and the activities you completed...

Review the Skills Checklist on page 9.
What skills have you developed?
Do you need more practice?

How Did it Go? Answer these questions:

What was it like to make a glider?

How well did your glider fly? Were you able to do all the flying patterns listed on page 10?

If you could make an improvement to your glider what would it be and why?

Gizmo’s Fast Facts

On December 17, 1903 the Wright brothers (Orville and Wilbur) made the first successful powered, piloted flight at Kitty Hawk, North Carolina. The Wrights were self-taught engineers and made the plane in their bicycle shop. The first flight was 120 feet in length and lasted only 12 seconds! The rest is history!

Rocket Science

Check out this informative and interactive online exhibit on the Wright Brothers from the Smithsonian National Air and Space Museum:
www.nasm.si.edu/wrightbrothers/index_full.cfm

What’s next?

Now that you know the basic rules of aircraft flight it is time to move on to rockets. In the next builder you will be introduced to rockets and learn about rocket propulsion (what makes rockets move!)
Skill builder 4: Introduction to Rockets

Skills Checklist

- Explain the differences and similarities between airplanes and rockets
- Demonstrate and explain the causes of “thrust”
- Build rockets with air and chemical propulsion

Dream it!

Background for Leaders

Airplanes can be anything from a model propelled by rubber band to a jumbo jet. Similarly, there are a wide variety of rockets, from small fireworks to the Space Shuttle. Airplanes and rockets are similar in the shape of their airframes or bodies and that they operate according to Newton’s laws of motion. Their differences are in the way they are propelled. While both need “thrust” to move, airplanes carry only fuel which utilizes the oxygen in the atmosphere to create the energy to turn a propeller or produce the thrust of a jet engine. Airplanes also use wings to produce lift within the atmosphere. Rockets don’t need wings. The Space Shuttle has wings so that it can glide like an airplane when it comes back into the atmosphere. Rockets (spacecraft) are propelled by the reaction of a fuel and an oxidizer carried on board. This reaction we see in the form of flames and smoke spurting through the tail of the rocket through a nozzle. The action that results is the rocket moving forward. This is according to Newton’s Third Law of Motion: for every action there is an equal and opposite reaction. So the energy of the burning propellant is translated into thrust. Rockets can fly in space because they carry their own oxidizers aboard.

The KWL activity (Blast Off 1) is an open and ongoing activity where members record what they know about rockets, what they want to know about rockets, and what they have learned about rockets. Members will track their understandings of key concepts as the rest of this unit progresses.

Rockets have evolved over the years, but remain pretty basic in their flight principles. In order to escape Earth’s gravity a rocket requires an enormous amount of thrust to climb past earth’s atmosphere. It also requires at least three fins to stabilize its flight.

There is only one opening for the explosion of rocket fuel to leave the rocket. As the burning energy pushes to get out of the rocket, the rocket is pushed upward.

The balloon in the second activity doesn’t have rocket fuel in it, but it does have air pressing outward on all sides. If you can imagine that this air is rocket fuel and that the balloon is the rocket body, then understanding rocket propulsion will be easy.

The Alka Rocket is just plain fun! It helps to demonstrate to members that when certain chemicals combine the results can be explosive. In part one of this activity we see the top of the film canister pop off because the Alka Seltzer tablet in water produces an enormous amount of carbon dioxide. This gas builds up and presses on all sides equally. As the pressure builds, the only surface that can let go is the top. And let go it does!
This activity is used to help members understand that chemical reactions can build up enormous pressures that can be used as a source of thrust. In the second part members make a rocket casing (see pattern and directions at end of this section) that is attached to a film canister with the top and lid at the bottom of the rocket (this is the rocket’s propulsion system). This is recommended as an outdoor activity as the rockets can reach altitudes of several metres.

Encourage your members to research the development of rocketry, or one of the many pioneers in space science. They may wish to explore one of the many programs that are currently underway by the Canadian Space Science Program, or by NASA instead.

Resources/Handouts/References

- The basic principles behind how rockets work: http://www.howstuffworks.com/rocket.htm
- Differences between airplanes and rockets: http://www.physlink.com/education/askexperts/ae529.cfm
- NASA’s comprehensive rocket resource: http://www.grc.nasa.gov/WWW/K-12/rocket/shortr.html

Important Words

Help members define the following words and look for members using this vocabulary in their discussions. One strategy to help members learn new vocabulary is to have them paraphrase the definitions. Having members to use their own words increases connection making.

<table>
<thead>
<tr>
<th><strong>Rocket</strong></th>
<th>A tube like device containing combustibles that, once ignited, propels the tube through the air.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aircraft</strong></td>
<td>Any machine supported for flight in the air. This can be through buoyancy or the dynamic action of air on its surfaces.</td>
</tr>
<tr>
<td><strong>Fuel</strong></td>
<td>Fuel is any material that is burned or altered to obtain energy and to heat or move an object.</td>
</tr>
<tr>
<td><strong>Propulsion</strong></td>
<td>The thrust that is needed for a plane to take off and fly through the air. Air propulsion is the act of moving an object through the air or by any method used for acceleration.</td>
</tr>
</tbody>
</table>

Age Considerations

- 10 and up

Thinking Ahead

- What will you discuss with members? Gather observations that will help support your discussion.

Preparing for Success

- Ask members how they know they will be successful in this builder. Discuss what success looks like, sounds like, and feels like.
Activating Strategies

- Activate members' prior knowledge by asking them what they know about rockets. Have them give examples of rockets and their uses.

KWL Chart

- What do you know about rockets?

Time required: 30 minutes

Equipment/Supplies

- KWL chart in member’s manual
- Pen/pencil

Procedure

1. Have members think about what they know and what they would like to know.
2. Using the KWL chart, help them enter into the first column the things that they already know about rockets. For example, they may write that rockets go into outer space. They should write down at least seven facts that they are sure of in this column. Use this as a review of the flight principles already learned in the project.
3. In the middle column the members should make a list of at least seven questions that they would like to research and have answered. Use this as a guide for you to assist them in successfully answering their questions.
4. The third column should remain blank. It should be filled in by the members as they find out the answers to their questions.

Do it!

Balloon Propulsion

- How can a balloon act as a rocket?

Time required:

- 1 hour

Equipment/Supplies

- Fishing line
- Straws
- Long balloons

Procedure

1. Show the members the balloon. Ask the members for their predictions on what would happen if the balloon was filled with air and then released. After listening to responses, fill the balloon with air and release it. Discuss with the members the results that they observed.
2. Now ask the members if a balloon would be able to lift a rocket into space? If not, then could a balloon show how a rocket engine works? Discuss the possibilities. Then set up the fishing line as noted below.
3. Give each member a balloon, a straw, and some fishing line. Have members pull the fishing line through the straw and tie each end of the line to something secure. Make sure that the line is taut. Also make sure the straw can move easily over the line. Inflate the balloon and help members when taping the balloon to the straw.

4. Before members release the balloon, explain that inside the balloon there is air pressing against all sides. Note that there is only one way that the air can get out of the balloon. Explain that as the air rushes to leave the balloon, the straw is thrust forward. Ask for predictions as to the possibility of the balloon travelling across the room.

5. Release the balloon.

- Can you think of other things that could act like rockets?

**Alka Rockets**

- How do chemical reactions create thrust?

**Time Required:** 1 hour

**Equipment/Supplies**

- Clear white 35 mm film canister, one per member (they pop better than the black ones with grey lids)
- Alka-Seltzer Tablet, one per member (caution members not to taste or take internally)
- Water
- Paper towel to mop up liquid
- Construction paper
- Scissors
- Tape
- Crayons or coloured markers

**Safety Considerations**

Be sure members don’t stand over the canisters. Have them slap the lid on and stand back. Safety goggles are recommended.

**Procedure**

1. Ask members to think about the balloon rocket. What made it move? Have them think of other kinds of forces (other than air).
2. Have the materials set out for the members. Each member should have before them a film canister with the lid off filled with about a third of water, and an Alka-Seltzer Tablet.
3. Explain to the members that this is going to be a race. To get ready for the race each member should put the tablet in one hand and the lid to the canister in the other hand.
4. Make sure that the lid is face up on their hand so that when the hand is turned over to place the lid on it will snap in easily (and quickly, which is the key to the surprise).
5. Explain that when they hear the word “LAUNCH,” they should slap the tablet into the canister to be sealed in immediately by the lid to the canister. Without adding a tablet, you may demonstrate the actions to your members.
6. When you see that the members are ready, begin a countdown, and when you get to the
word “LAUNCH!” - Just watch the excitement! Explain that rockets can be propelled by highly explosive chemicals that leave the rockets through their nozzles at the bottom.

7. Next have members make their own rockets using construction paper and the design template (at end of the Member Manual and the Leader Guide). Rockets then will be launched outside. A makeshift launch pad can be made using a piece of wood and a straight piece of coat hanger placed in a hole in the board (this will help guide the rocket).

- What comparisons are there with the forces that were built up in the balloon in the balloon propulsion activity?

**Dig it!**

To help members reflect on their learning and apply what they know, ask them the following questions:

1. How was this lesson different from the last one?
2. Why was this lesson important?
3. What did you learn in this lesson that you will be able to use in school?

What’s next?

In the next builder members will continue to learn about rockets, particularly the importance of centre of gravity. They will also build their own stomp rockets and help you build the launch pad. Have members think about how rockets are typically designed and why they are made the way they are.
In the Member Manual

Skill Builder 4: Introduction To Rockets

Gizmo says...
Over 800 years ago rockets were invented in China. They were basically a tube filled with gunpowder attached to an arrow or stick. Rockets have evolved over the years but remain pretty basic in their flight principles. In order to escape Earth’s gravity, a rocket requires an enormous amount of thrust to climb past the earth’s atmosphere. It also requires at least three fins to stabilize its flight.

SKILLS CHECKLIST
- Explain differences and similarities between airplanes and rockets
- Demonstrate and explain the causes of “thrust”
- Build rockets with air and chemical propulsion

Important words
Watch for these important words throughout this builder: Rocket, Propulsion, Aircraft & Fuel

Dream it!

KWL Chart (Know, Want to Know, Learned)

- What do you know about rockets?

Before you begin this lesson take a few minutes to think about some of the things you know about rockets. Then fill in the first two columns of the KWL chart below. KWL stands for “Know”, “Want to know”, and “Learned.” Simply write some things you already know about rockets in the first column. Then write down the things you want to know about rockets in the second column. The third column “Learned” is for all the things you will be learning about rockets throughout the rest of the project. As you learn new things about rockets, you fill in the column. At the end of the project you will be able to see the progress of your learning.

<table>
<thead>
<tr>
<th>Know</th>
<th>Want to Know</th>
<th>Learned</th>
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Airplanes can be anything from a model propelled by rubber band to a jumbo jet. Similarly, there are a wide variety of rockets. From small fireworks to the Space Shuttle, airplanes and rockets are similar in the shape of their airframes or bodies and they operate according to one of Newton’s laws of motion (for every action there is an equal and opposite reaction). Their differences are in the way they are propelled. While both need “thrust” to move, airplanes carry only fuel which utilizes the oxygen in the atmosphere to create the energy to turn a propeller or produce the thrust of a jet engine. Airplanes also use wings to produce lift within the atmosphere. Rockets don’t need them. The Space Shuttle has wings so that it can glide like an airplane when it comes back into the atmosphere.

Rockets (spacecraft) are propelled by the reaction of a fuel and an oxidizer (a substance that helps the combustion or burning of fuel). This reaction we see in the form of flames and smoke spurtting through the tail of the rocket. There is only one opening for the explosion of rocket fuel to leave the rocket. As the burning energy pushes to get out of the rocket, the rocket is in turn pushed upward. The action that results, called thrust, causes the rocket to move forward (Newton’s Law).

Do it?

Balloon Propulsion

- How can a balloon act like a rocket?

What happens when you blow up a balloon and let it go (without tying the end)? This is an example of thrust! Do you think a balloon would make a good rocket?

1. Pull the fishing line through the straw
2. Tie each end of the fishing line to something secure (to make the line tight). The line can go horizontally from one side of the room to the other.
3. Blow up the balloon, hold the end with your fingers, then get help to tape it to the straw (as in the diagram above)
4. Release the balloon!

- What made the balloon move?

Alka Blasters

- How do chemical reactions create thrust?

What you will need: 35mm film canister, Alka-Seltzer tablet, water, safety goggles

In the last activity, air pressure could make the balloon rocket go only so far. Do you think a chemical reaction will create greater thrusts? Let’s try it and see!

1. Fill canister half-full with water
2. Place a piece of Alka-Seltzer in the water
3. Quickly put the lid on the canister & turn it upside down on a flat surface (this is your launch pad)
4. Stand back and wait for the explosion!
5. Use the rocket design template at the end of this manual and customize your own Alka Rocket (be creative!)
6. Experiment with different levels of water and amounts of Alka-Seltzer
In the Member Manual

- What combination of water and Alka-Seltzer made the rocket fly the highest (had the most thrust)? Fill in the chart below as you find the best combination.

<table>
<thead>
<tr>
<th>Recipe For Rocket Success</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amount of Water</strong></td>
</tr>
<tr>
<td><strong>Amount of Alka-Seltzer</strong></td>
</tr>
<tr>
<td><strong>Estimated Height of Rocket</strong></td>
</tr>
</tbody>
</table>

Gizmo's Fast Facts
Sir Isaac Newton (1642 - 1727) was an English scientist who made great contributions to physics, optics, math and astronomy. He is probably best known for his Three Laws of Motion and the Universal Law of Gravitation. His third law of motion states that “for every action there is an equal and opposite reaction.” This explains how rocket engines can lift rockets high into the sky.

Dig it!

Think about this builder and the activities you did...
Review the Skills Checklist on page 12. What skills have you developed? Do you need more practice?

Record it...
Discuss what you have learned with your leader so that the information can be recorded on your portfolio page.

Apply it...
How could you explain to others the interesting things that you can do?

Rocket Science
Learn about Werner von Braun, called the “greatest rocket scientist in history”: [http://solarsystem.nasa.gov/library/Profile?ProfileID=83vonBraun]

What’s next?
Your introduction to rockets is now complete. In the next builder you will learn more about the design of rockets and how they affect flight. You will also build a stomp rocket!
Skill Builder 5: Stomp Rockets

Skills Checklist

- Explain the importance of a centre of gravity on a rocket
- Design, build, and test an air powered model rocket
- Be creative and solve problems

Dream it!

Background for Leaders

Rockets have been in use since the 1200s when ancient Chinese soldiers used rockets in warfare. Rockets have also been used to propel fireworks into the air. Rockets can be as small as a firecracker, or as large as a Saturn V (111m tall).

While escaping the Earth’s gravity the rocket must be held on course. Complex guidance systems do this, but it helps to imagine that a rocket is essentially the same in form as an arrow. The feathers of an arrows act like vertical stabilizers (rudders) that keep the arrow straight in flight. Likewise the fins of a rocket act in the same way for the rocket.

Another important point to keep in mind when designing arrows and rockets is the center of gravity. If you were to balance an arrow across your finger, the point where it balances is the center of gravity. If you were to tie a string to this point you would be able to spin the arrow around in a smooth circle. If you were to move the string even a centimetre in either direction, the arrow would tumble end over end. Notice that the center of gravity shows where the arrow is equally divided in weight, not length. If in a rocket, the center of gravity was too far forward, towards the nose cone, then the rocket would tumble out of control. If the weight was too close to the engine, then the rocket would tumble again, and crash. You will repeat this arrow demonstration. Proper adult supervision must be used.

Members will make stomp rockets and help make a launcher. Reinforce with the members the need to test for the center of gravity in their rockets. This can be done by a swing test as was done with the arrow.

Important Words

Help members define the following words and look for members using this vocabulary in their discussions. Ask for sentences that "show you know." When members construct novel sentences they confirm their understanding of a new word. Have members use as many terms per sentence to show that connections can be useful. Members can also create impromptu speeches using these terms.

| Stomp Rocket | A stomp rocket is a rocket that is powered by compressed air. Stomp rockets have a container of air that attaches to the rocket by a tube. When it is stomped on, the air rushes through the tube and into the body of the rocket, causing it to lift into the sky. |
| Centre of Gravity | The point where the rocket balances is the center of gravity. |
| Stabilizers | An airfoil that stabilizes aircraft. A vertical stabilizer controls yawing, or side-to-side motion, while a horizontal stabilizer controls pitching, or up-and-down motion. |
Age Considerations
- 8 and up

Thinking Ahead
- What will you discuss with members? Gather observations that will help support your discussion.

Preparing for Success
- Ask members how they know they will be successful in this builder. Discuss what success looks like, sounds like, and feels like.

Activating Strategies
- Activate members’ prior knowledge by asking them to recall the “Balloon Propulsion” activity. Ask them if air pressure could be used in a different way, a way that would provide enough propulsion to shoot a homemade rocket high into the air.

Do it!

Stomp Rockets

Time required: 2-3 hours

Equipment/Supplies
- Arrow
- String (1 to 2 m long)

For launcher:
- Collapsible water jug
- Plastic tubing
- 90° elbow for tubing
- Rigid pipe or tubing (slightly larger diameter than tubing)
- Platform to support launch tube

For rockets:
- File folders (used legal or letter sized)
- Tape
- Scissors
- Pens, markers etc.

Resources/Handouts/References
- Information on the workings of an air rocket: http://exploration.grc.nasa.gov/education/rocket/rktstomp.html
- A web site that shows how to make air rockets: http://www.scientomaker.org/airRocket/index.html
Safety Considerations

- While spinning the arrow make sure members are a safe distance away.
- Have a clearly defined launch area into which only the person about to launch their rocket may enter.
- Imitate a standard countdown sequence so that all members will pay attention to the launch.
- Have a waiting area set aside so that members are not targets under a possible landing area.

Stomp Rocket Instructions

1. A stomp rocket is basically a tube with fins and a nose cone. It sits on a stomp rocket launcher. A stomp rocket launcher has only four parts, all of which are readily available at any local hardware store. The items that you require to build one are: a collapsible water jug (the type used for camping), clear plastic tubing (old garden hose will do just as well or can be found in most hardware store’s plumbing departments), one 90 degree elbow to fit the tubing, a length of rigid pipe or tubing to fit the elbow. Mount your launch tube on a platform.

2. To launch the rocket, place it over the rigid tube. The tube should fit snugly, and yet be able to slide off easily. Launching the rocket is fun! Put the jug of air on a chair seat and have each member launch their rocket by hopping onto the jug.

3. Ask members “how an arrow is like a rocket?” Explain how both have fins and are long and mostly straight. They both have something that isn’t easy to see. It’s a center of gravity.

4. Show the diagram of the launch system to the members. Explain that together they will make a launch pad and that each of them will be making their own Stomp Rocket.

5. Before designing and building their rockets, ask members what they will have to do for their rocket to fly successfully.

6. Have members do a materials list and a blueprint drawing in their manuals.

7. Show that the arrow balances across your finger, and explain that this is the point of balance. Next attach the string, and being very careful to make sure that the members are out of harm’s way, spin around in a circle, making the arrow fly in a smooth path.

8. Explain that the center of gravity of the arrow should be near the middle, or it will tumble end over end. This is why members have to test their stomp rockets in the next activity before they launch them. They might have too much weight at the front, or rear of the rockets, and will have to make the proper adjustments. Tie the string to the arrow just to the left or right of the centre of gravity to show this.

9. Note: for this age group it is more important that they try this activity when making their stomp rockets. This has to do with the materials being used in this activity.

10. Have members help you build the launch pad. Test it to ensure a great blast of air exits the elbow.

11. Explain to members how to build their own stomp rocket.

12. A stomp rocket is a tube of paper (old file folders work very well) with fins (at least 3) and a nose cone. Point out that the fins should be straight and that a lighter rocket almost always makes a better rocket. The nose cone should be straight and it works well if it’s tucked into the tube. A small stretch of tape to hold the nose cone on, and smoothing out the edge between the cone and the tube will go a long way to ensuring success.

13. Once their rockets are made, members can check the centre of gravity with a string (just like the arrow) and make any necessary adjustments.

14. Blast off! Have each member take turns launching their rocket.

15. Have members record their results in their log book in the members manual.

- What did you do to ensure your rocket flew successfully?
**Dig it!**

To help members reflect on their learning and apply what they know, ask them the following questions:

1. What was the most fun about doing this lesson?
2. When else have you had fun and learned new things at the same time?
3. What would you do differently if you did this lesson again?

What’s next?

Next up the members will assemble and launch a model rocket, the most powerful rocket in this project. Have members think about what makes an activity successful and how they can apply the skills they have learned so far to make the final lesson and the Showcase Challenge a success.

**Leader’s Notes**
In the Member Manual

Skill Builder 5: Stomp Rockets

Gizmo says...
Rockets have many uses - from being used in war, to propel fireworks. Rockets can be as small as a firecracker or as big as Saturn V Rocket (111 meters tall). While escaping the Earth's gravity the rocket must be held on course. Complex guidance systems do this, but it helps to imagine that a rocket is essentially the same in form as an arrow. The feathers of an arrows act like vertical stabilizers (rudders) that keep the arrow straight in flight. Likewise the fins of a rocket act in the same way for the rocket.

SKILLS CHECKLIST
- Explain the importance of a centre of gravity on a rocket
- Build a Stomp Rocket
- Help build a Stomp Rocket launcher

Dream it!
An important point to keep in mind when designing arrows and rockets is the center of gravity. If you were to balance an arrow across your finger, the point where it balances is the center of gravity. If you were to tie a string to this point, you would be able to spin the arrow around in a smooth circle. If you were to move the string even a centimetre in either direction, the arrow would tumbling end over end. Notice that the center of gravity shows where the arrow is equally divided in weight, not length. If in a rocket the center of gravity was too far forward, towards the nose cone, then the rocket would tumble out of control. If the weight was too close to the engine, then the rocket would again tumble and crash.

Stomp Rocket Blue Print
- What do you need for stable rocket flight?

A stomp rocket consists of a tube with fins and a nose cone. How you design, build, and decorate it is totally up to you! A picture of a sample stomp rocket is provided.

To begin, make a list of the materials you will need and draw a blueprint (design) of your rocket.

Materials List

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Safety First!
Launch rockets outside. Have a launch area that only the person launching the rocket can enter. Just before launching start a countdown (10, 9, 8, 7, ...) so that everyone in the area is paying attention.

Important words
Watch for these important words throughout this builder: Stomp rocket, Centre of gravity, & Stabilizers

Do it!

What you will need: File folder, tape, scissors, pens, markers

1. Build your rocket. Ensure it has the proper centre of gravity.
2. Help build the rocket launcher with your leader and fellow members (like the diagram on the previous page and according to your blueprint).
3. Launch your rocket and record your flight data for each launch (duration of flight, distance, height, difficulties, and successes) in the table below.

<table>
<thead>
<tr>
<th>Stomp Rocket Flight Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date/Time</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Gizmo's Fast Facts
The Saturn V (5) rocket (that took the first men to the moon in 1969) was the biggest, most powerful, and most famous rocket ever built. It was 363 feet tall (over 20 stories high), weighed over 6 million pounds, and had more than 3 million parts!

Rocket Science
Go to http://history.nasa.gov/SP-4457/contents.htm to see cool pictures of the first eleven years of the Saturn V rocket.
To see a video about the Saturn V go to: http://videos.howstuffworks.com/hsw/8421-the-rocks-the-saturn-v-rocket-video.htm
In the Member Manual

Dig it!
Think About Your Learning...

Think about this builder and the activities you did...
Review the Skills Checklist on page 15. What skills have you developed? Do you need more practice?

Picture This...
In this picture I am _______________________

Share your experiences with friends and family
In this picture I want you to notice: _______________________

I want to tell you about: how this meeting went: _______________________

I want to explain to you how to design a rocket: _______________________

What's next?
After learning about the principles of flight, making all kinds of flying objects such as hot air balloons, gliders, and various rockets, you have gained a lot of skills! The next builder is the last one in this project. You will be putting together the most powerful rocket yet - a model rocket from a kit. Hopefully you have a rocket picked out and ready to assemble.
Skill Builder 6: Model Rocket Mania

Skills Checklist

- Describe and explain the stages of rocket flight
- Assemble and launch a model rocket
- Follow model rocket safety guidelines

Note to the Leader- This project meeting requires the use of model rocket kits and a launch system. Many good inexpensive kits (that are re-usable) can be purchased in hobby stores, large department/ toy stores, or online. Online reviews will give you an idea how easy kits are to build and how well they fly. Kits come in many different levels of complexity and should have a rating system on ease of assembly. For members who have no prior experience with model rockets look for rockets labelled “Skill Level 1”, etc. Only one launch system is required in order for the whole group to participate. Members can purchase individual launch systems if they would like to pursue a hobby in model rocketry.

This meeting may take a little longer or may need to be broken into two meetings or more.

Dream it!

Background for Leaders

By now the members have a good grasp of the key elements in controlling the flight of airplanes and rockets. Model rockets, when built according to the instructions provided and materials supplied are a sure bet. Home made rockets are much more of a gamble, but fun nonetheless!

At this point it is important to know a few more facts about rocket flight, more specifically, model rocket flight.

Model rockets are powered by solid chemical engines. They burn for a pre-determined number of seconds, coast, and then a small chemical charge blasts itself forward in the rocket tube ejecting the parachute. The flight of a model rocket follows three stages:
- The first stage is the lift-off. This stage ends when the rocket engine quits firing.
- The second stage is called Coasting Flight. This is the time between the end of the lift-off, and the ejection charge. The amount of time that the rocket coasts is determined by the rocket engine. The coasting phase can last for as little as three seconds, or all the way to ten or more seconds.
- The third phase is the ejection and landing phase. This stage is marked by the ejection of the nose cone and the return of the rocket to the surface.

Essentially a successful mission is characterized by a safe launch, straight and even rocket ascent, and a smooth landing in which the rocket is recovered and is undamaged.

Resources/Handouts/References

- A guide to building your first model rocket: http://library.thinkquest.org/10568/
- As an alternate or additional activity members maybe interested in making a pop bottle rocket: http://www.soe.ucsc.edu/~karplus/abe/soda-bottle-rocket.pdf
Important Words

Help members define the following words and look for members using this vocabulary in their discussions. Get members to use a dictionary (printed or online) and show them the range of information it provides.

<table>
<thead>
<tr>
<th>Important Words</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ascent</td>
<td>An act of an upward, rising movement. The act of climbing or traveling up.</td>
</tr>
<tr>
<td>Lift Off</td>
<td>The action of an aircraft in becoming airborne or of a rocket in rising from its launching site under its own power.</td>
</tr>
<tr>
<td>Coasting</td>
<td>To continue to move or advance on acquired momentum after effort has ceased.</td>
</tr>
<tr>
<td>Landing</td>
<td>The act or process of coming to land or rest, after a voyage or flight. The termination of a voyage or flight.</td>
</tr>
<tr>
<td>Chemical Engine</td>
<td>Chemical engines power model rockets. They burn for a set number of seconds, coast through the air, and then a small chemical charge blasts itself forward in the rocket tube ejecting the parachute.</td>
</tr>
<tr>
<td>Ejection</td>
<td>The act of ejecting or casting out; discharge; expulsion; evacuation. The act of driving or casting out by physical force from within.</td>
</tr>
</tbody>
</table>

Age Considerations

- 10 and up

Thinking Ahead

- What will you discuss with members? Gather observations that will help support your discussion.

Preparing for Success

- Ask members how they know they will be successful in this builder. Discuss what success looks like, sounds like, and feels like.

Activating Strategies

- Before members start to assemble their model rockets have them discuss some of the things that went well and things that didn’t go as planned in making their flyers and home-made rockets. Discuss the importance of planning to avoid problems later on.

Do it!

Rockets Away!

Time required: 2 hours (or more)

Equipment/Supplies

- As noted above, each member will require a model rocket kit. It is best if they purchase one that has extra engines and igniters. A model rocket launch system will also be required. Make sure members read all instructions and safety precautions first.

- If home made rockets are to be built, additional materials required would be: old file folders, straws, tape, white glue, scissors.
Safety Considerations

Stress the importance of reading the safety information that comes with the model rocket kits, and make sure that the members follow the basic safety precautions that were outlined at the previous project meeting. In addition, go over the copy of the Canadian Association of Rocketry’s safety guidelines that is found at the end of each Member Manual.

Suggested Variations/Age Appropriate Variations

Gauge the skill level of your members in deciding the level of rocket to be purchased and assembled.

Instructions

1. At this point, you can outline to the members that they will be assembling model rockets. Ask members how they came to choose their model rocket.
2. Go ahead and help the members with their models.
3. Test launch the rockets.
4. Plan a special launch celebration for members to share their success with their families.

Dig it!

To help members reflect on their learning and apply what they know, ask them the following questions:

1. What steps did you take to make your flight a success?
2. What have you learned about rockets?
3. Will you continue with model rocketry? Why?

What’s next?

Members have now completed all the developmental activities as set out in this project. The upcoming Showcase Challenge and Portfolio Page is a chance for continued evaluation of the members learning and a chance for the members to present their findings to their peers, family and 4-H club.

Leader’s Notes
In the Member Manual

Skill Builder 6: Model Rocket Mania

Gizmo Says...
Congratulations on getting to this point in the project! In this last builder you will assemble a model rocket kit and launch it! Use the skills you have learned so far to make this activity successful and rewarding.

SKILLS CHECKLIST
- Describe and explain the stages of rocket flight
- Assemble and launch a model rocket
- Follow model rocket safety guidelines

Important words
Watch for these important words throughout this builder:
- Lift off, Ascent, Coasting, Ejection, Landing, Chemical engine

Dream it!
As you know, homemade rockets may not always perform the way you would like them to. Model Rockets, when put together properly, are a sure bet to fly right!

Before you begin assembling your model rocket, let’s learn a few more facts about rocket flight, more specifically, model rocket flight.

Model rockets are powered by solid chemical engines. They burn for a set number of seconds, coast through the air, and then a small chemical charge blasts itself forward in the rocket tube ejecting the parachute. The flight of a model rocket follows three stages:
- The first stage is the lift-off. This stage ends when the rocket engine quits firing.
- The second stage is called Coasting Flight. This is the time between the end of the lift-off and the ejection charge. The amount of time that the rocket travels through the air is determined by the rocket engine. The coasting phase can last for as little as three seconds, or all the way to ten or more seconds.
- The third phase is the ejection and landing phase. This stage is marked by the ejection of the nose cone and the return of the rocket to the surface.

A successful mission is characterized by a safe launch, straight and even rocket ascent, and a smooth landing in which the rocket is recovered and is undamaged.

Do it!

Safety First!
Model rockets have the potential to hurt you or others around you. Be sure to follow all safety guidelines that come with your model rocket. The Canadian Association of Rocketeers’ “Model Rocket Safety Code” is found at the end of this manual for your reference. Read it with your leader and make sure you understand it.

Rockets Away!
1. With help from your leader and other members assemble your rocket. Be sure to read the instructions carefully.
2. Launch your rocket! Have friends and family on hand (make sure they bring a camera) to witness this historic launch!
3. How did it go? Fill in the flight information below

<table>
<thead>
<tr>
<th>Rockets Away!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Height (feet):</td>
</tr>
<tr>
<td>Modification changes needed (if any):</td>
</tr>
<tr>
<td>Launch was (check one):</td>
</tr>
</tbody>
</table>

Showcase Challenge?
Have you decided what you would like to use in the showcase challenge?

Rocket Science
See this video of the “Gila Monster”, one of the biggest homemade rockets ever made!
In the Member Manual

Dig it!

Think about the builder and
the activities you did...

What will you add to
the “L” column in
your KWL chart on
page 12?

How Did it Go? Answer these questions:

What was it like to assemble a model rocket?

Was your mission successful? What happened?

Will you continue with model rocketry? Why?

Have you every thought about starting your own model rocket club? As an optional ac-
tivity you could make a plan including what you need to make this club a reality (e.g.
member recruitment, publicity, safety, adult supervision, etc.). You can get information
and advice from the Canadian Association of Rocketry and the Manitoba Association of
Rocketry.

http://www.canadianrocketry.org/index.php
http://www.manitobarocketry.org/

What’s next?

Now that you have finished all the builders in this project it is time to think about and plan for
the Showcase Challenge. On the following page is your portfolio page where you can make sure
all your Rocketry Project Skills Charts is complete. There will also be space for you to write
down some thoughts and reflections on the project.
Showcase Challenge

Have members use their Member Manual to help them in organizing what they have learned. The form of the showcase can vary according to the wishes of the leaders and member’s ability. Information could be presented in many forms, some of which are: posters, pamphlets, written reports, speeches, computer presentations, displays, etc. Suggestions are listed on the Showcase Challenge page at the back of the Member Manual. The best results are almost always obtained when members are allowed to present their information in the style of their choice.

Further suggestions:

- Have members plan and give a presentation on their rockets to friends, family members, other school children (their class or a younger grade), senior citizens, etc. The presentation should include both written (planning, speech) and oral (speaking to group) components.
- Members could also teach others in the community how to build and launch a homemade rocket.
- Have members start their own model rocket club in their community. Have them make a plan, an outline as to what they need to make the club a reality (e.g. recruitment, publicity, safety, adult supervision, etc.). Members could also get information and advice from the Canadian Association of Rocketry and the Manitoba Association of Rocketry (see links below).
  - http://www.manitobarocketry.org/
Portfolio Page

Once members have completed all the builders they will have a lot of information recorded in their manuals. These are products of their learning. As a final exercise in the project, members and leaders will pull together all this learning in completing the Portfolio Page in the Member Manual. There is a skills chart that lists the skills members are expected to complete by the end of the project. Members and leaders must indicate how they know the member was successful at a particular skill. Leaders will find evidence if they think about what they have observed members doing, what discussions they have had with members, and what the members have produced. If leaders think that members need to go back and improve on any skill, this chart helps them clarify what needs to be done.

My 4-H Portfolio Page

Name: __________________ Date: __________ Year in 4-H: __________
Club: __________________ Hours Spent on 4-H: __________

Rocketry Project Skills Chart

To be completed by the leader and the member based on observations and conversations throughout the project.

<table>
<thead>
<tr>
<th>Skill Builder</th>
<th>Members will be able to…</th>
<th>We know this because…</th>
</tr>
</thead>
</table>
| 1             | • Learn what the properties of air are  
                • Manipulate air pressure to crush a pop can  
                • Make a hot air balloon | Identify activities completed and record observations and information from discussions about activities. |
| 2             | • Understand the principles of thrust, drag, lift, and gravity  
                • Design a wing  
                • Make a Maple Seed Flyer  
                • Make a Straw Flyer | |
| 3             | • Understand how ailerons and vertical and horizontal stabilizers work.  
                • Build a Styro glider | |
| 4             | • Understand how air and chemical propulsion work  
                • Make a Balloon Rocket  
                • Make an Alka Blaster | |
| 5             | • Know the importance of a centre of gravity on a rocket  
                • Build a Stomp Rocket  
                • Help build a Stomp Rocket launcher | |
| 6             | • Describe and explain the stages of rocket flight  
                • Assemble a model rocket from a kit and launch it  
                • Understand model rocket safety guidelines | |

Additional Comments/Activities:

Leader Point of Praise!

I am most impressed by…

I acknowledge that the member has completed the 4-H project requirements.

Leader’s Signature: ____________________________
In the Member Manual

Above and Beyond!
In addition to project skills, 4-H also increases skills in meeting management, communications, leadership, community involvement through participation in club, area, or provincial 4-H events or activities. List below any activities you participated in this year in 4-H. (Some examples include Executive Positions Held, Workshops, Communication, Community Service, Rally, Bonspiels, Conferences, Judging, Camps, Trips, Awards, Representation to Area or Provincial Councils, etc)

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

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________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

**Feel Free to add additional pages that include awards, certificates, new clippings, photos or other items that describe your 4-H involvement.

Member Point of Pride!
What I learned…

What I need to improve on…

What I want others to notice…

Member’s Signature: __________________________________________

Point of Praise! Another’s perspective on your achievements in 4-H.
(community professionals, MAFRI staff, 4-H club head leaders, 4-H Ambassadors, friends of 4-H)

I am most impressed by…

I believe that you have learned…

In the future I encourage you to…

Signature: __________________________________________
Maple Seed Flyer

Instructions

The Plane
- Cut on the two middle horizontal lines, and fold in.
- Fold the bottom flap up
- Cut the vertical line at the top and fold paper in opposite directions to create two flaps
- For best results, attach a paper clip to the bottom
- Drop and watch it spin
Black Line Master for Styro-Glider

1. Tape the black-line of the glider parts onto a Styrofoam tray of about the same size.
2. Use a straight pin to poke holes along the lines of the glider parts.
3. Take the paper off the tray, and using a single edged razor blade, or an Exacto Knife, cut out the parts of the plane.

Assemble the parts of the glider so that it looks like the picture at right.
Wrap and tape a tube of paper around the film canister. The lid end of the canister goes down!

Tape fins to your rocket.

Roll a cone of paper and tape it to the rocket's upper end.

Cones can be any size! Overlap this edge to form cone.
CAR Model Rocket Safety Code

1) CONSTRUCTION. I will always build my model rocket using only lightweight materials such as paper, wood, plastics or rubber without any metal airframe components. My model shall include aerodynamic surfaces or a mechanism to assure a safe, stable flight.

2) MOTORS. I will use only pre-loaded, commercially available model rocket motors or motor reloads approved by Energy Mines and Resources Canada. I will never subject these engines to excessive shock, extremes of temperature, nor will I ever attempt their reloading or alteration. I shall always employ recommended manufacturer handling and ignition procedures.

3) RECOVERY. My model rocket will always use a recovery system to return it safely to the ground so that my model rocket may be re-flown. I shall prepare the recovery system with due care to assure that it will properly deploy.

4) WEIGHT LIMITS. My model rocket will not weigh more than 1500 grams at lift-off, and the model rocket engine(s) will contain no more than 125 grams of propellant and produce no more than 160 N-s combined total-impulse.

5) FIRING SYSTEM. I will always use a remote electrical system to ignite the model rocket engine(s). My firing system will include an ignition switch that returns to "off" when released, and a safety interlock to prevent accidental ignition. I will never leave the safety interlock key in my firing system between launches.

6) LAUNCH SYSTEM. My model rocket will always be launched from a stable platform having a device to initially guide its motion. My launcher will have a jet deflector to prevent motor exhaust from directly contacting the ground. To protect myself and other from eye injury, I will position the launch rod or rail so that the upper end is above eye level, or else I will place a large guard on the upper end between launches.

7) LAUNCH SITE. I will never launch my model rockets near buildings, power lines, or within 9.1 kilometres from the centre of an airport. The area immediately around the launch system will be cleared of any flammable materials. I will always obtain the permission of the launch site owner prior to using the launch site for my model rocket activities.

8) LAUNCH CONDITIONS. I will never launch model rockets in high winds or in conditions of low visibility which may impair the observation of my model rocket in flight, or in a direction below 30 degrees from the vertical.

9) LAUNCH SAFETY. I will remain at least 5 meters away from any model about to be launched. I will always announce to persons within the launch site that I am about to launch my model rocket, and I shall give a loud countdown of at least 5 seconds duration. I shall immediately remove the safety interlock key from my firing system after the launch of my model rocket.

10) MISFIRES. In the event of an ignition misfire, I shall not immediately approach my model rocket, but remove the safety interlock key and remain back for a safe period until assured that no ignition will occur.
11) ANIMAL PAYLOADS. I will never endanger live animals by launching them in my model rocket.

12) TARGETS. I will never launch my rocket so that it will fall on, or strike, ground or air targets. Nor will I include any explosive or incendiary payload.

13) HAZARDOUS RECOVERY. I will never attempt to recover my model rocket from a power line, high place, a tree, or other dangerous location.

14) PRE FLIGHT TESTS. Whenever possible, I will always test the stability, operation and reliability of my model rocket designs prior to flight. I will launch unproven designs in complete isolation from other persons.

15) PERSONAL CONDUCT. I will always conduct myself in a responsible manner, conscious that the maintenance of safety for myself and other rests with my ability to design and construct sound working models, and to enthusiastically abide by the CAR Model Rocket Safety Code.

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4-H Achievement

4-H Achievement is... a 4-H club celebration when members have completed their projects. Achievements are planned by the club to give recognition to members and leaders for their accomplishments in their 4-H projects and club activities.

A 4-H Achievement can take many different formats: from choosing a theme, to member project displays, to members using their new skills for the event (entertainment, food, decorating, photographer, etc.), to members presenting their project to the whole group, the options are endless and open to the creativity of the members and leaders in each club!

Clubs may also plan their Achievement to promote 4-H to the community or to recognize sponsors and others who have helped the club.

Members and leaders - be sure to check your project books for the project completion requirements, so you will be ready for your club’s Achievement celebration!

If you have any questions, comments or suggestions for this or other 4-H projects contact:

Manitoba 4-H Projects
Manitoba Agriculture Food and Rural Initiatives
1129 Queens Avenue
Brandon, MB R7A 1L9

Email: 4h@gov.mb.ca
Phone: 204-726-6613
Fax: 204-726-6260

For more information about 4-H and the many 4-H opportunities available please visit

http://www.gov.mb.ca/agriculture/4-h/
What is 4-H?

4-H is an international youth organization involving more than 7 million members in 80 countries around the world.

In Canada, 4-H began in 1913 in Roland, Manitoba as a community-based organization dedicated to growth and development of rural youth. Today’s 4-H program reaches both farm and non-farm youth across Canada. The motto of “Learn to Do by Doing” is embodied in the program, as 4-H focuses on skill development as well as personal development of life skills such as communications, leadership and citizenship.

4-H Motto
“Learn To Do by Doing”

4-H Pledge
I pledge,
My HEAD to clearer thinking,
My HEART to greater loyalty,
My HANDS to greater service,
My HEALTH to better living,
For my club, my community, and my country.

4-H Quality Equation Principles

Quality People
- Promote responsibility, respect, trust, honesty, fairness, sportsmanship, citizenship, teamwork and caring.

Quality Experiences
- Provide members with personal development and skill development experiences.

Quality Projects
- Promote and value quality effort.
- Promote high quality, safe food production within industry standards.

Manitoba 4-H project material is developed by
Manitoba Agriculture, Food and Rural Initiatives (MAFRI)