Welcome 4-H Leaders!

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 importance of weather knowledge as they become CoCoRaHS weather reporters. The Leader Guide is written with the expectation that the project leader(s) will have a working knowledge about the project topics and how they work. If not, you may need to do some pre-work / research on the activities, or recruit assistance for certain sections.

There are activities listed and instructions provided in the Leader Guide. You may substitute activities depending on member interest and availability of supplies. 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 Manual so they will be able to think about the topic and activity and decide how they will approach it. The Leader 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 skills building outcomes for members in this project are on the chart on the following page.
What Skills Will The Member Learn?

Each section or Skill Builder (or 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 Skill Builder OR a similar activity that focuses on the same skills, as you and your leader 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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<td>38</td>
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<td>• Understand how rising air affects clouds and precipitation</td>
<td></td>
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<tr>
<td>Members will be able to...</td>
<td>Activities</td>
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<td></td>
<td>• Understand what causes lightning</td>
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<td></td>
<td>• Explain why lightning strikes</td>
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<td></td>
<td>• Describe how to stay safe during a thunderstorm</td>
<td>50</td>
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</tr>
</tbody>
</table>

When you successfully complete your builders, you will showcase what you have learned.

<table>
<thead>
<tr>
<th>Showcase &amp; Portfolio</th>
<th>• Explain success in using the skills listed above</th>
<th>• Showcase Challenge</th>
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</thead>
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<td>• My Portfolio</td>
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</tbody>
</table>

This project manual was adapted from the CoCoRaHS 4-H Lesson Plans in conjunction with CoCoRaHS Canada.
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 is information to help them decide how they will best “showcase” their learning to family and friends.

Record keeping is an important part of every 4-H project. “My Portfolio Page” is used to keep track of members’ 4-H experiences. As each member learns skills this is recorded on the portfolio page. When the Portfolio Page has been completed and confirmed by the leader, then 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 occur throughout the project as you observe the progress and learning of each member. Record what you see and hear. Your feedback should be positive and specific (not just “well done”). Share feedback with members often so they can act on your suggestions. How you choose to observe and record is up to you. Remember that members may improve over the project year and that records should be updated to reflect when they showed 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, these learning goals for members are important: Following instructions - Working with others - Using supplies safely - Using the key words - Improving with practice - Respecting timelines.

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 manual outlining the basics. All members will be expected to complete the Explore level before moving into the Discover level. It introduces the basic skills and terms needed by members for other 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 specific techniques and gain related skills.

Master - project options encourage members to specialize. The Leader’s role is to look for opportunities for their members to have more in depth experiences.
4-H LEADER TIPS FOR SUCCESS!

♦ Pages 2 and 3 in each leader guide summarize what the member must do to complete the project.

♦ Depending on time available, group size, and member abilities, you may wish to break the Skill Builders into more than one project meeting.

♦ The internet has lots of interesting websites and educational activities. We do not endorse any website or 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 adapt activities to safely match your members’ abilities. Ensure members have a good understanding of safe practices when using tools, that they use the right safety equipment when necessary, and that good 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 teaching and learning methods. Teaching projects using a broad blend will help increase the learning potential of all members.

♦ Projects are designed to teach many skills, but the 4-H member is always more important than the subject matter. Stress cooperation in the activities to develop teamwork and cooperation skills. These are valuable life skills. Ensure the work is completed in a manner that members feel good about themselves and their efforts. This can be done by assigning tasks based on member’s individual abilities. Modelling and expecting supportive behaviour (i.e. no “put-downs”) in the group 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 on to 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 final results. 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 highlight of their 4-H year.

Have fun and thanks for your belief in young people!
Welcome to the CoCoRaHS Network!

CoCoRaHS = Community Collaborative Rain, Hail & Snow

CoCoRaHS is a non-profit, grass-roots volunteers network working together to measure precipitation across the nation.

- CoCoRaHS is a citizen science project with contributions from almost 1000 volunteers throughout Canada.

- CoCoRaHS began in the United States and has expanded to include Canada, Puerto Rico, and the U.S. Virgin Islands.

- The partnership between CoCoRaHS Manitoba and 4-H Manitoba equips 4-H members will a free rain gauge. Contact the Manitoba Coordinator at Manitoba@cocorahs.org to order your free rain gauge. You will need a CoCoRaHS 10 cm rain gauge for the upcoming Skill Builders. Please use a metric rain gauge to match the activities in the member manual.

- Data from CoCoRaHS stations has been used by Environment Canada, the US National Weather Service forecast offices, and NASA. It is also used by farmers, planners, airports, and mosquito control.

- Participation in the collection process takes only five minutes each day. Everyone in your family can do it. Your observations will lead to a greater understanding of the weather. Sign up online at http://www.cocorahs.org/CanadianApplication.aspx to be a volunteer precipitation reporter today.

- CoCoRaHS requires that you have an enthusiasm for watching and reporting weather conditions, a desire to learn more about how weather can effect and impact our lives, a willingness to take measurements between 6 a.m. and 10 a.m. when available, and a CoCoRaHS-approved rain gauge. Rain gauges are provided at no cost to 4-H members by contacting the Manitoba Coordinator at Manitoba@cocorahs.org.
When it rains, your rain gauge measures the amount of precipitation that falls through the area of the top of the rain gauge. When you read the gauge, you measure the depth of water that has fallen through the area and accumulated in the bottom, that is the depth of the water.

The funnel and the inner tube make it possible to measure rainfall to an accuracy of 0.2 mm. The funnel of the CoCoRaHS rain gauge squeezes the water into the area of the inner tube, which is 1/10th of the area of the outer cylinder. By reducing the area that the water falls into, the depth can be stretched by the same factor of ten. The total volume of water that fell through the top of the gauge and the total volume in the inner tube are the same. This stretching allows us to read the depth of water to an accuracy of 0.2 mm.

The metric rain gauge has increments marked every 0.2 mm. Each millimeter is marked by a longer dashed line. The numbers on the rain gauge mark every second full millimeter of precipitation.

Points to remember when reading your rain gauge

| 1 | Your most common observation will be zero. It is important to please report all zeros. |
| 2 | When only a drop or two wet the gauge record a “T” for Trace |
| 3 | The inner tube holds 25.4 mm. |
| 4 | Getting the decimal point correct is ESSENTIAL. There are big differences between 0.04 and 0.40 and 4.00 |
| 5 | Measure rainfall of less than 25.4 mm from the inner tube. Measured amounts from the inner tube will be between a few tenths up to 25.4 mm. |
| 6 | When more than an inch of rain falls the precipitation will overflow into the outer cylinder. The whole gauge has a capacity to hold 279.4 mm. |
| 7 | To measure greater than 25.4 mm  
   - Pour out the first 25.4 mm from the inner tube and write it down.  
   - Now pour the remaining water into the funnel and measure using the inner tube.  
   - Continue until all of the water has been measured. Make sure you keep track of your amounts along the way.  
   - Then, add up all of your measurements, for example: 25.4 mm + 24.8 mm + 8.8 mm = 59.0 mm  
   - Report the Total = 59.0 mm |
Skill Builder 1: Temperature

Skills Checklist
- Define temperature
- Identify what causes substances to change states

Dream It!

Background for Leaders

Temperature is an objective comparison of hot and cold. Temperature is a relative measure based on an arbitrary scale, such as the Celsius temperature scale or the Fahrenheit temperature scale. Heat is a form of energy produced by the random motion of molecules. It is possible to add energy and have a substance remain at a constant temperature. For example, adding heat to ice cubes will cause the ice to melt, but the temperatures of the ice and freshly melted water will not have changed. As a phase change occurs, the temperature does not change.

As a substance warms up with the application of heat, the temperature reading rises on a thermometer and each molecule gains more energy. The greater the energy, the more the molecules will want to spread out and the faster the molecules will move.

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>Temperature</th>
<th>A relative measure of energy. Usually measured in °C or °F.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinetic Energy</td>
<td>The energy of motion.</td>
</tr>
<tr>
<td>Molecule</td>
<td>A group of atoms; small units that make up a compound.</td>
</tr>
<tr>
<td>Solid</td>
<td>A substance with tightly packed molecules.</td>
</tr>
<tr>
<td>Liquid</td>
<td>A pourable substance with less tightly packed molecules.</td>
</tr>
<tr>
<td>Gas</td>
<td>A substance with loosely packed molecules that fill their container.</td>
</tr>
</tbody>
</table>

Age Considerations
- 10+

Thinking Ahead
- What will you discuss with members? Gather observations and think of examples that will help support your decision.
Preparation for Success

- Linking back to the Skills Checklist, help members identify how they will know they have been successful in learning from this Skill Builder. Discuss what success in these activities might look like, sound like, or feel like.

Activating Strategies

To get members thinking about this topic, discuss weather events; ask them the following questions:
- How hot or cold is it outside today?
- What is your favourite outdoor temperature?

As members identify with the temperature, they can write about other weather traits and activities they enjoy based on the temperature outdoors. Members might consider precipitation, cloud cover, wind, or the season with which each temperature is associated.

Review the responses with the group once the members are done. How similar were their descriptions of the weather? How similar were the activities they mentioned?

Do It!

Solid, Liquid, Gas

**Time Required:** 15 minutes

**Supplies:** large, open space

**Safety Considerations:** Ensure that there is enough space for members to move around comfortably and safely.

**Directions:**
All matter can move from one state to another.

1. To create a solid, have participants stand as close to each other as they can without touching each other. Explain that they are behaving like the low-energy molecules in a cold solid substance. (ex. ice, wood) Note: if there are only 1 or 2 members in your group, they can still attempt to move like a molecule.

2. Have members increase their level of kinetic energy by walking and moving around. As their kinetic energy level increases, they should also spread out and take up more space. This is the liquid state (ex. water). The point at which their energy changed from solid to liquid was the melting/freezing point.

3. Have members increase their level of kinetic energy by carefully running around. Like moving molecules, they are now spread out. This is the high-energy gas phase (ex. water vapour). The point at which their energy changed from liquid to gas was the boiling point.

4. Discuss the changes of state that occurred during this activity. Notice that members occupy a much greater area when they are in a gaseous phase compared to a solid phase.

5. Play a game. Members will change phases as you call out “Solid”, “Liquid”, or “Gas”.

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9
Changing States

Time Required: 1 hour

Information:
Science has shown that water will freeze at 0 °C and ice will melt at 0 °C. We also know that water boils at 100 °C. These scientific facts are based on observations at sea level (0 m elevation). In Manitoba, our land and homes are above sea level. The highest point in Manitoba, Baldy Mountain, is more than 800 m above sea level. At higher altitudes, the boiling point of water decreases. Less pressure means that as heat is applied to water, the gas molecules that form are able to be released from the liquid solution with less resistance. Although the difference in boiling points between sea level and your home may be very small, at the top of Mount Everest, water boils at 71 °C. The freezing point of water is not affected by elevation as air pressure does not affect this process.

Supplies:
- Water
- Pot
- Stovetop/Heat Source
- Ice Cube Tray
- Thermometer (manual or digital)

Safety Considerations: Remind members of the importance of safety when using a heat source. Use caution when measuring the temperature of the boiling water. Steam can burn your skin.

Directions:
1. Put water in a pot on High on the stovetop.
2. When the water starts to boil, measure the temperature of the water. Check that the thermometer is not touching the bottom or sides of the pot. Be sure to read the thermometer at eye level if it is not a digital thermometer.
3. Then put water in an ice cube tray in the freezer.
4. Check it periodically and record the temperature at which it first freezes.

Dig it!

After learning and experimenting with the effects of temperature on physical state, discuss the energy levels of hot and cold molecules. Reflect on the physical changes they experienced in the experiment. Also, discuss what they think the perfect outdoor temperature is.
What’s next?
The next Skill Builder will help members measure rainfall and snowfall values. There is also information on becoming involved in the CoCoRaHS network.
Skill Builder 1: Temperature

Misty Says....

In this project you will learn about many forms of weather. Temperature is something you will need to know about. Temperature tells how hot or cold it is outside each day. Both temperature and how we dress ourselves each day change with the seasons.

Dream it!

Temperature is the measure of the average kinetic energy of the molecules in a substance. Kinetic energy is the energy of motion (everything is made of tiny, moving particles called molecules). The more kinetic energy a molecule has, the faster it moves. Hot molecules move faster than cold molecules. As molecules warm up, substances change physical state. Solids, such as ice, will melt into liquid water. Liquids, such as water, will turn into a gas as steam (water vapour) if the water is warmed to a high enough temperature.

Meteorologists (weather forecasters) measure the temperatures in cities and towns across Canada. They predict the outdoor temperatures in your city or town for each day over the next week. In Canada, temperatures are measured in degrees Celsius (°C). In the United States temperatures are measured in degrees Fahrenheit (°F). Across Canada, temperatures have a range as large as 108 °C between summer and winter.

Too Cold, Too Hot
Write down what the weather would be like at each of the following temperatures. Name an activity you would participate in at each temperature.

-25 °C ___________
-10 °C ___________
0 °C ___________
20 °C ___________
35 °C ___________

Changing States
At what temperature does water boil? ___________ Freeze? ___________

Do it!

Solid, Liquid, Gas
Your leader will explain how your group can demonstrate changing states using your bodies. Following this activity, label the highest and lowest kinetic energy states.

Changing States
Review your responses to Changing States in the Dream it section.
We are going to perform a test to confirm the boiling point and freezing point of water.

1. Put water in a pot and heat on High on the stovetop.
2. When the water starts to boil, measure the temperature of the water.
3. Then put water in an ice cube tray in the freezer.
4. Check it periodically and record the temperature at which it first freezes.

The water boiled at _______.
The water froze at _______.

Dig it!
Do hot molecules or cold molecules have more kinetic energy?

What physical changes occurred when you boiled and froze water?

What do YOU think the perfect outdoor temperature is? Why?

What’s next?
The next Skill Builder will teach you how to measure and record rainfall and snowfall amounts. You will need your CoCoRaHS rain gauge for this activity.
Skill Builder 2: Precipitation Measurements

Skills Checklist

- Understand the different types of precipitation
- Demonstrate how rain is measured using a rain gauge
- Explain why it is important to know how much rain has fallen

Dream It!

Background for Leaders

CoCoRaHS is an acronym for Community Collaborative Rain, Hail & Snow Network. CoCoRaHS is a non-profit, grass-roots volunteer network working together to measure precipitation across the nation. This citizen-science project consists of almost 1000 volunteers throughout Canada.

CoCoRaHS began in the United States and has grown to be the largest provider of daily precipitation observations in the United States. It has expanded to include Canada, Puerto Rico, and the U.S. Virgin Islands.

CoCoRaHS also has a goal of education and outreach. Their partnership with 4-H Manitoba equips 4-H members with a free rain gauge. With community involvement, we can stay a step ahead of severe weather events (like flooding) lessening their damaging effects and helping save lives.

Sign up online at http://www.cocorahs.org/Canada.aspx to be a volunteer precipitation reporter today! A citizen science initiative like this is a great way to get young people all across the province learning and engaging in their environment and becoming conscious about issues like watershed management and conservation. It’s easy, fun, and rewarding.

Participation in the collection process takes only five minutes a day and is a great way to learn about the natural resource that falls from the sky. Your observations will lead to a much better understanding of the weather. Canadians are famous for talking about the weather. This project will help you share your weather knowledge.

Data from CoCoRaHS has been used by Environment Canada, the US National Weather Service forecast offices, and NASA. It is also used to help farmers, planners, airports, and even mosquito control. Climate scientists look for long term patterns in weather data.

This Skill Builder looks at measuring and recording precipitation values for rain and snow.

If you have not already done so, please order a free rain gauge by contact the Manitoba Coordinator at Manitoba@cocorahs.org.
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>Important Words</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
<td>Using a numbered tool to quantify the amount of something.</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Any product of atmospheric water vapour that falls to the earth because of gravity.</td>
</tr>
<tr>
<td>Rain Gauge</td>
<td>A device for measuring the amount of precipitation (rain) that falls</td>
</tr>
</tbody>
</table>

Age Considerations

- 10+

Thinking Ahead

- What will you discuss with members? Gather observations and think of examples that will help support your decision.

Preparing for Success

- Linking back to the Skills Checklist, help members identify how they will know they have been successful in learning from this Skill Builder. Discuss what success in these activities might look like, sound like, or feel like.

Activating Strategies

To get members thinking about this topic, discuss recent or memorable weather events; ask them the following questions:

- What weather event is memorable to you? Why?
- Why are we interested in recording how much precipitation has fallen?

As members identify types of precipitation, they can write about each form and its characteristics in the boxes in their manuals. Forms of precipitation include: rain, snow, sleet, hail, freezing rain, etc. Be sure to consider the physical state (solid, liquid, gas) and size of the precipitation. Finer details about precipitation can be found by visiting the Environment Canada glossary of weather terms at [http://climate.weather.gc.ca/glossary_e.html](http://climate.weather.gc.ca/glossary_e.html).

Review the results once the members are done. How many types of precipitation did they know about? In what season(s) can we measure these forms of precipitation?
Do It!

Fun with Rainfall Measurement

This activity requires a 0.2 mm accuracy rain gauge. Obtain a rain gauge that is capable of measuring precipitation to the nearest 0.2 millimeter. These can be ordered from CoCoRaHS by visiting http://www.cocorahs.org/Canada.aspx.

Explain that 25 mm of rain is 25 mm of water. It is a cube that is 25 mm long, 25 mm wide, and 25 mm tall. Ask members how much rain would there be if there is 25 mm of rain (depth) over an area of 10 mm long by 10 mm wide? (10 x 10 x 25 = 2500 cubic millimeters)

Did you know that 25 mm of rainfall produces 25 litres of water per square meter or nearly 101,000 L of water per acre? Now that's a lot of rain!

Rain gauge measurements from volunteers are compared to readings from satellite and radar data to make a more complete, complex puzzle of weather analysis.

Time Required: 30 minutes and/or daily all year

Supplies:

- CoCoRaHS rain gauge secured on a pole/post, placed in an open area
- Several small water balloons or a water gun
- Ruler showing inches
Directions:
1. Secure the CoCoRaHS rain gauge (standard 10 cm (4”) plastic gauge) to a pole or post in an open area where it can be easily accessed for measurements.
2. Take turns throwing water balloons at the rain gauge. Be careful not to damage the rain gauge.
   Variation: Using a water gun, see how much water you can have fall in the rain gauge.
3. For each balloon (or water gun squirt), record the amount of water in the rain gauge. Make sure to measure from the bottom of the meniscus, the lowest point of the curve on the surface of the column of water.
   • Measure the amount of water in the rain gauge by reading the values on the rain gauge.
   • Measure the amount of water in the rain gauge by using a ruler (in millimeters).
4. Keep a rain gauge outside at your house and record the next rainfall. Keep track for the entire season and record your observations on the CoCoRaHS website. You can also view the data that other sites across the continent have collected because rain doesn’t fall the same on all.

How much rain do you think the rain gauge can hold? See if you are correct.
• The CoCoRaHS (standard 10 cm (4”) plastic) rain gauge is designed to hold a total of 279.4 mm of rainfall. The inner tube will hold 25.4 mm and the outer tube will hold an additional 254 mm of overflow.
• The rain gauge is designed with the collecting portion at the top, funneling down to the inner tube inside the gauge. We can easily record measurements in 0.2 mm increments.
• Measuring with the inner tube is much more accurate than using a ruler to measure water in the outer tube.
• Fill the rain gauge (inner tube and overflow to outer tube) as full as possible.
• Record the first 25.4 mm from the inner tube and pour it out.
• Next, pour another 25.4 mm from the outer tube into the inner tube. Add this amount to the previous measurement.
• Pour the water in 25.4 mm increments from the outer tube.
• The final measurement should be 279.4 mm.

Measuring Snowfall

Prior to performing this activity, obtain a rain gauge that is capable of measuring precipitation to the nearest 0.2 of a millimeter. These can be ordered from CoCoRaHS by visiting http://www.cocorahs.org/Canada.aspx.

Snow is more difficult to measure because it has a tendency to melt, compact, or blow around. It may be difficult to determine the best place to take a measurement due to drifts and blowing snow. We may not know whether any snow melted before we measured it. Measuring the depth of the snow will not tell us exactly how much moisture fell. The amount of liquid water in the snow is never the same. Sometimes snow is light and fluffy; other times it is so heavy we can barely lift it with a shovel. The Snow Water Equivalent (SWE) is the amount of water in the snow. Simple depth measurements of snow can be taken with a ruler, but in order to measure the water content, the snow must be melted before the Snow Water Equivalent can be determined. If there is no snow available to be measured, you may skip this activity.
**Time Required:** 1 hour and/or daily all year

**Supplies:**
- CoCoRaHS rain gauge
- Ruler showing inches
- Large spatula

**Directions:**
1. Find an area of snow to sample. Don’t take your samples in areas sheltered from the wind or in snow drifts where snow has accumulated. You may need to collect from multiple locations and average them to obtain an accurate reading.
2. First, measure and record the depth of the snow at each site with a ruler.
3. Next, use the outer tube of the rain gauge. Turn it upside-down and push it into the snow. Use a spatula to hold the snow in the gauge as you carefully collect a core sample.
4. Bring your sample inside to melt.
5. Use the funnel and the inner tube to measure and record the Snow Water Equivalent (SWE). This is the amount of water that resulted when the snow melted.

**Dig it!**

Discuss reasons why the 25 mm on the rain gauge is much bigger than 25 mm on a ruler. Reasons should reflect the idea that the inner tube of the rain gauge is narrower and longer than 25 mm. The total volume of the inner tube is 25 mm$^3$. The shape of the inner tube makes it easier to take accurate readings.

Discuss what could happen that would create a “bad reading” and how this can be prevented. Review why precipitation values are important to farmers.

**What’s next?**

In the next Skill Builder we will discuss cloud formation. An experiment will create our own clouds.
In the Member Manual

Skill Builder 2: Precipitation Measurements

Misty Says....
Rain helps our plants, grass, and crops grow. On planet Earth, all life depends on water. Too much or too little moisture can affect how many plants and animals are able to survive.
For this Skill Builder you will need the rain gauge that you ordered from CoCoRaHS.

SKILLS CHECKLIST
- Understand the different types of precipitation
- Demonstrate how rain is measured using a rain gauge
- Explain how snowfall is measured

Important words
Watch for these important words throughout this Skill Builder:
Measurement, Precipitation, Rain Gauge

Dream it!
What are some forms of precipitation? Describe some similarities and differences between these forms?

<table>
<thead>
<tr>
<th>Form of Precipitation</th>
<th>Similarities &amp; Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

You will need your CoCoRaHS rain gauge for these activities!

Label the parts of the rain gauge using the following terms: funnel, outer tube, measuring tube, mounting bracket. Draw lines on the rain gauge to show that it will measure one inch of precipitation.

Do it!

Fun with Rainfall Measurements: Every Drop Counts
Directions:
1. Secure the CoCoRaHS rain gauge (standard 10 cm (4") plastic gauge) to a pole or post in an open area where it can be easily accessed for measurements.
2. Take turns throwing water balloons at the rain gauge. Be careful not to damage the rain gauge.
   Variation: Using a water gun, see how much water you can squirt into the rain gauge.
3. For each balloon (or water gun squirt), record the amount of water in the rain gauge. Make sure to measure from the bottom of the mensuration, the lowest point of the curve on the surface of the column of water.
   - Measure the amount of water in the rain gauge by reading the values on the rain gauge.
   - Measure the amount of water in the rain gauge by using a ruler (in millimeters).
4. Keep a rain gauge outside at your house and record the next rainfall. Keep track for the entire season and record your observations on the CoCoRaHS website. “You can also view the data that other sites across the continent have collected because “rain doesn’t fall the same on all.”

<table>
<thead>
<tr>
<th>Trial</th>
<th>Rain Gauge Value</th>
<th>Ruler Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How much water do you think the rain gauge can hold? ________
See if you are correct by completely filling the rain gauge. ________
Measuring Snowfall

Directions:
1. Find an area of snow to sample. Don’t take your samples in areas sheltered from the wind or in snow drifts where snow has accumulated. You may need to collect from multiple locations and average them to obtain an accurate reading.
2. First, measure and record the depth of the snow at each site with a ruler.
3. Use the outer tube of the rain gauge. Turn it upside-down and push it into the snow to collect a core sample.
4. Bring your sample inside to melt.
5. Use the funnel and inner tube to measure and record the Snow Water Equivalent (SWE).

<table>
<thead>
<tr>
<th>Trial</th>
<th>Depth</th>
<th>SWE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td></td>
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<tr>
<td>5</td>
<td></td>
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</tr>
</tbody>
</table>

The Canadian record for the least precipitation in one year is held by Arctic Bay, NWT. It received only 12.7 mm (0.5") of precipitation in all of 1949.

The Canadian record for the most precipitation in one year is held by Henderson Lake, B.C., in 1997, the community received 9479 mm (373") of precipitation.

Dig it!

Why is the 25 mm marking on the rain gauge much bigger than 25 mm on a ruler?

What could happen that would create a "bad reading"? How can this be prevented?

Why is recording precipitation amounts important to farmers?

What’s next?

In the next Skill Builder you will learn about cloud formation and you will make your own cloud.
Skill Builder 3: Cloud Formation

Skills Checklist

- Understand the different ingredients in the formation of a cloud
- Describe water vapour
- Explain how clouds are created

Dream It!

Background for Leaders

Cloud formation requires three main ingredients: water vapour, cool air, and cloud seeds. Water vapour is the gaseous form of water. Water evaporates as the heat of the sun warms a body of water. Water vapour rises up into the atmosphere to become a cloud. As the water vapour rises, it reaches cooler air that is at a lower pressure in the atmosphere.

Clouds seeds are any particulate matter in the air such as smoke or dust. These particles are large enough to serve as a structure for water vapour to condense upon as it cools to a liquid state. The liquid droplets form a cloud.

As more and more droplets of water form into a cloud, they start bumping into each other. Some droplets will stick together forming a large raindrop. When the drops become heavy enough, they fall out of the cloud. The cloud bounces and shakes, releasing droplets in the form of rain, hail, or snow depending on the season.

When rain falls on land it can run off into a stream or a river which eventually flows to the ocean. Some of the rain will fall on land where it will infiltrate into the ground to be used by humans, animals, and plants. This will happen over and over again. The entire process is known as the water cycle.

Low pressure is usually associated with high winds, warm air, and atmospheric lifting. Lows normally produce clouds, precipitation, and other bad weather such as tropical storms and cyclones. A high pressure system is an area where the atmospheric pressure is greater than that of the surrounding area. High pressure is usually associated with clear skies and calm winds.

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>Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Vapour</td>
<td>The gaseous form of water.</td>
</tr>
<tr>
<td>Air Pressure</td>
<td>The force exerted by air dependent upon how tightly packed air particles are in one area compared to another area.</td>
</tr>
<tr>
<td>Cloud Seeds</td>
<td>Particles in the atmosphere that water condenses on to form a cloud.</td>
</tr>
<tr>
<td>Evaporation</td>
<td>Changing from a liquid to a gas.</td>
</tr>
<tr>
<td>Condensation</td>
<td>Changing from a gas to a liquid.</td>
</tr>
</tbody>
</table>
Age Considerations

- 10+

Thinking Ahead

- What will you discuss with members? Gather observations and think of examples that will help support your decision.

Preparing for Success

- Linking back to the Skills Checklist, help members identify how they will know they have been successful in learning from this Skill Builder. Discuss what success in these activities might look like, sound like, or feel like.

Activating Strategies

To get members thinking about this topic, discuss the weather; ask them the following questions:

- What makes a cloud?
- What do the clouds look like today?

As members identify with clouds they can draw and write about the formation of clouds.

Review the results once the members are done. How similar were their descriptions of the clouds?

Label the missing parts of the water cycle: ANSWERS

http://www.srh.noaa.gov/srh/jetstream/atmos/hydro.htm
Do It!

Cloud in a Jar

Time Required: 15 minutes

Supplies:
- Jar with lid
- Warm water (should be steaming a little but not boiling)
- Ice
- Match

Safety Considerations: Use caution when lighting the match.

Directions:
1. Pour warm water in the bottom of the jar
2. Flip the lid of the jar upside down and fill with ice. Place the lid on top of the jar so ice is sitting on top of the lid and outside the jar.
3. Carefully light a match and throw it into the jar. Quickly replace the lid.
4. Watch the cloud form. Notice the movement of the particles.
5. Remove the lid and let your cloud free.
As the cloud is leaving the jar, you can touch it to see what it feels like.

Cloud in a Bottle

Time Required: 15 minutes

Supplies:
- Two-liter clear plastic pop bottle
- Warm water (should be steaming a little but not boiling)
- Match

Safety Considerations: Use caution when lighting the match.

Directions:
1. Fill a clear plastic 2L pop bottle one-third full of very warm water. Place the cap on the bottle. As the warm water evaporates it adds water to the air inside the bottle. This is the first ingredient to make a cloud.
2. Squeeze and release the bottle and observe what happens. Why? Squeezing the bottle represents the warming or pressure that occurs in the atmosphere. The release represents the cooling that occurs in the atmosphere. If the inside of the bottle becomes covered with condensation or water droplets, just shake the bottle to get rid of them.
3. Remove the cap from the bottle.
4. Carefully light a match and drop it into the bottle. Quickly replace the cap to trap the smoke inside. Smoke is the second ingredient in making a cloud. Smoke is one type of particle that allows water to condense; however, there are many others such as dust or sea salt particles.
5. Slowly squeeze the bottle hard and release it to change the air pressure. What happens? A cloud appears when you release and disappears when you squeeze. The third ingredient in making a cloud is a drop in air pressure. A drop in air pressure comes from air rising and pressure decreasing as you go up in altitude.

Complete this activity by having members look up a weather report using the TV, radio, newspaper, or internet. Does it include an air pressure report?
Dig it!

Review what water vapour condenses on in the sky and how water evaporates. Discuss the importance of smoke in cloud formation.

What’s next?

A more in-depth look at clouds follows in the next Skill Builder. We will learn the names of the different classes of clouds.

Leader’s Notes
In the Member Manual

Skill Builder 3: Cloud Formation

Misty Says....
Clouds can float high in the sky or on the surface of the Earth. Let's learn about how clouds form in the sky and how they stay up in the air.

SKILLS CHECKLIST
- Understand the different ingredients in the formation of a cloud
- Explain water vapour
- Describe how clouds are created

Important words
Watch for these important words throughout this Skill Builder:
Water Vapour, Air Pressure, Cloud Seeds, Evaporation, Condensation

Dream it!
High in the sky, air cools and clouds form. The atmosphere requires three main ingredients to produce a cloud: water vapour, cooler air, and cloud seeds. Cloud seeds are small particles in the air such as dust or smoke. As the sun's heat warms a body of water, moisture evaporates from the Earth, rises into the sky, and condenses on cloud seeds. As more particles and water stick together, a cloud forms.

Recipe for Clouds:
Look outside. Are there many clouds in the sky?
Draw a cloud below. Inside the cloud, list all of the materials that were required for its formation. Below the cloud, draw and name a form of precipitation that would likely fall from your cloud.

Do it!
Cloud in a Jar
Directions:
1. Pour warm water into the bottom of the jar
2. Flip the lid of the jar upside down and fill it with ice. Place the lid (upside down) on top of the jar.
3. Carefully light a match and throw it into the jar. Quickly replace the lid.
4. Watch the cloud form. Notice the movement of the particles.
5. Remove the lid and let your cloud free.
6. As the cloud is leaving the jar, you can touch it to see what it feels like.

Cloud Colour: __________________
How did the cloud feel? __________________
Cloud in a Bottle

Directions:
1. Fill a clear plastic 2L pop bottle one-third full of very warm water. Place the cap on the bottle.
2. Squeeze and release the bottle and observe what happens. Why?
3. Remove the cap from the bottle.
4. Carefully light a match and drop it into the bottle. Quickly replace the cap to trap the smoke inside.
5. Slowly squeeze the bottle hard and release to change the air pressure. What happens?

<table>
<thead>
<tr>
<th>Trial</th>
<th>What Happens?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without Smoke</td>
<td></td>
</tr>
<tr>
<td>With Smoke</td>
<td></td>
</tr>
</tbody>
</table>

Find a weather forecast on TV, radio, newspaper, or the internet. Does it include an air pressure report?
What type of weather should you expect tomorrow?

Cloudd can form more than 18,000 m above the Earth!

Fog is a cloud on the Earth's surface.

Dig it!

What causes water to evaporate?

What does water vapour condense on in the sky?

How did smoke from the match help your cloud form?

What's next?

In the next Skill Builder you will discover the different types of clouds. You will observe the shapes and forms of clouds in the sky.
Skill Builder 4: Cloud Types

Skills Checklist

- Identify at least three different cloud types
- Explain the weather associated with different cloud types

Dream It!

Background for Leaders

Clouds appear in many shapes and sizes and at a variety of altitudes. Each characteristic of a cloud is important in determining the associated weather pattern. The altitude of a cloud can be categorized into three levels.

Low level clouds lie within the nearest 2,000 m of the atmosphere. Most low-level clouds are composed of water droplets and most precipitation comes from low-level clouds. If the atmospheric temperatures are cold enough, these clouds may contain ice particles and snow. Some examples include stratus, cumulus, cumulonimbus, and fog. **Stratus** clouds are sheet like and occur on overcast days. These clouds can be white or gray and may block the sun and produce rainfall. **Cumulus** clouds are puffy in appearance and appear during fair weather. **Cumulonimbus** clouds vary in size and produce precipitation. They appear in warm, humid weather and can grow to great heights to produce thunderstorms.

Mid-level clouds are found between 2,000 to 6,000 m. At lower altitudes they are composed primarily of water droplets. Some examples of middle level clouds include altostratus, altocumulus, and nimbostratus. The prefix alto- indicates that the clouds are found at a moderate altitude. Altostratus clouds are uniform and give the sky a grayish, “frosted glass” appearance. Altocumulus clouds may appear as ripples or waves at higher altitudes in comparison to their low-level fluffy cumulus form. Nimbostratus clouds are thick, uniform and gray and often produce rain or snow without lightning or thunder.

High level clouds form above 6,000 m. The temperature at very high altitudes is so cold that these clouds are primarily composed of ice crystals. These clouds are usually thin and white in appearance. Some examples include cirrus, cirrostratus, and cirrocumulus. The prefix cirro- suggests that the clouds are found at a high altitude. **Cirrus** clouds are thin and wispy like curls of hair. Cirrus clouds often precede a front and indicate a change in the weather. Cirrostratus clouds are high stratus clouds that can create halos around the sun or moon as their ice crystals refract light. **Cirrocumulus** clouds have a wavy, patchy pattern.

Clouds can be formed by vertical development. Often, the resulting cloud type is the cumulonimbus cloud or “thunderhead”. Vertical development occurs by thermal convection (heating of the air) or frontal lifting. These clouds grow to heights in excess of 12,000 m. Very tall clouds such as cumulonimbus clouds will produce heavy rain, thunderstorms, and other severe weather events.
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>Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stratus</td>
<td>Low level sheet like clouds found on overcast, rainy days.</td>
</tr>
<tr>
<td>Cumulus</td>
<td>Low level puffy clouds that appear during fair weather.</td>
</tr>
<tr>
<td>Cumulonimbus</td>
<td>Tall clouds associated with thunderstorms. Found spanning all three levels of altitudes.</td>
</tr>
<tr>
<td>Cirrus</td>
<td>Thin, wispy high level clouds.</td>
</tr>
</tbody>
</table>

Age Considerations

- 10+

Thinking Ahead

- What will you discuss with members? Gather observations and think of examples that will help support your decision.

Preparing for Success

- Linking back to the Skills Checklist, help members identify how they will know they have been successful in learning from this Skill Builder. Discuss what success in these activities might look like, sound like, or feel like.

Activating Strategies

To get members thinking about this topic, discuss the weather; ask them the following questions:

- What do the clouds look like today?
- What is the weather like today?

Have members describe an ideal forecast for one of the following activities: 4-H Beef Club Achievement and Picnic, harvesting a field of ripe wheat, or downhill skiing. Be sure that members include the necessary features of a weather report. Remind members that communication skills are important in the field of meteorology.
As members become familiar with the clouds and the weather they can complete the word search.

Word Search Answers

Do It!

Cloud Spotter

Members will observe and photograph the clouds. The clouds and weather characteristics will be recorded. Photos will be compiled into a “Cloud Library” and will be labeled based on the time, date, type of cloud(s), and weather conditions.

Time Required: 60 minutes

Supplies:
- Copies of the cloud spotter found on the following pages
- Brass fastener
- Digital camera
- Paper
- Pen/pencil

Directions:
1. Cut out and assemble the Cloud Spotter spinner.
2. Head outdoors to observe the clouds. What shapes do you see in the clouds?
3. Using the Cloud Spotter, identify the cloud types in the sky.
4. Take pictures of the clouds. Print these pictures and include them in your manual.
5. Record the time of day, type(s) of clouds, current weather conditions, weather conditions following the picture, and your prediction of the weather to follow.
6. Over the next month, observe, photograph, and record the clouds as you identify different cloud types.
The cloud spotter can also be viewed and printed in colour at http://www.srh.noaa.gov/srh/jetstream/downloads/cloudwheel_10.pdf.
Cirrus
Appears as detached clouds in the form of white, delicate filaments, or white, or mostly white patches or narrow bands. These clouds have a hair-like appearance, or a silky sheet, or both.

Cirrostratus
Thin, wispy, or fibrous clouds that cover a large portion of the sky. These clouds are composed of ice crystals and may appear as a thin veil or as a white haze over the sky.

Stratus
Flat, grayish-white clouds that form a continuous layer across the sky. These clouds bring overcast weather and light rain or drizzle.

Cumulonimbus
Large, dark clouds that form towering thunderclouds. These clouds are associated with heavy rain, thunderstorms, and sometimes even tornadoes.

Altostratus
Sheet-like, gray clouds that cover the sky, often associated with stable atmospheric conditions.

Nimbostratus
Dark gray to black clouds that produce continuous rain or drizzle. These clouds are often associated with overcast, cloudy skies.

Stratocumulus
Small, white clouds that form in layers over the land or sea. These clouds can produce light drizzle or rain.

Cumulus
Small, white clouds that form in groups, often indicating fair weather. These clouds can grow into larger cumulonimbus clouds with the right conditions.

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Sheet-like, gray clouds that cover the sky, often associated with stable atmospheric conditions.

Nimbostratus
Dark gray to black clouds that produce continuous rain or drizzle. These clouds are often associated with overcast, cloudy skies.

Stratocumulus
Small, white clouds that form in layers over the land or sea. These clouds can produce light drizzle or rain.

Cumulus
Small, white clouds that form in groups, often indicating fair weather. These clouds can grow into larger cumulonimbus clouds with the right conditions.
Remember, when you are classifying the cloud pictures, none of them are going to look exactly like the clouds on the cloud chart. Some pictures may overlap and be two different types. It is sometimes a judgment call, so use your best judgment.

Encourage participants to watch and photograph other weather phenomena such as fog, rainbows, auroras, halos, sun dogs, etc.

**Dig it!**

Review what type of clouds were observed most often. Analyze their observations of the clouds and their weather predictions. Discuss meteorology as a career. Be sure members include a picture of cool clouds.

**What’s next?**
The science of updrafts will demonstrate how wind in a weather system affects rain and hail.
In the Member Manual

Skill Builder 4: Cloud Types

Misty Says....
Many meteorologists say that clouds are the greatest free show on Earth, and for good reason. They are among nature’s most beautiful creations, but can be among nature’s deadliest enemies to the farmer, rancher and society in general depending on what the cloud is bringing us.

SKILLS CHECKLIST
- Identify at least three different cloud types
- Explain the weather associated with different cloud types

Important words
Watch for these important words throughout this Skill Builder:
- Stratus
- Cumulus
- Cirrus
- Cumulonimbus

Dream it!
Clouds come in many different shapes and sizes. Clouds are classified based on their shape and height.

Stratus clouds are huge, gray, low-level clouds. These clouds often block the sun and will produce rainfall.

Cumulus clouds are puffy, fluffy, low-level clouds. They can appear alone or in clusters and don’t usually produce precipitation.

Cumulonimbus clouds can form from cumulus clouds. Cumulonimbus clouds are heaping rainstorm clouds associated with thunderstorms. They are often several kilometers wide and extend to great heights in the atmosphere.

Cirrus clouds are thin, wispy, high-level clouds and may signal a change in the weather.

Meteorologist for a Day
Describe an ideal forecast for one of the following activities: 4-H Beef Club Achievement and Picnic, harvesting a field of ripe wheat, or downhill skiing. Include at least five weather features such as temperature, precipitation (probability and amount), wind (speed and direction), visibility, cloud cover, air pressure, humidity, and humidex or windchill values (if applicable). Once you have prepared your forecast, share it with other members with the same enthusiasm as a televised meteorologist.

Cloud Word Search
Find the hidden words:
- Condensation
- Evaporation
- Precipitation
- Storm
- Air pressure
- Water vapour
- Cloud seeds
- Fog
- Stratus
- Cumulus
- Cirrus
- Cumulonimbus
- Forecast
- Atmosphere
- Shape
- Direction

Do it!
Cloud Spotter
Directions:
1. Cut out and assemble the Cloud Spotter spinner included in the Leader Guide.
2. Head outdoors to observe the clouds. What shapes do you see in the clouds?
3. Using the Cloud Spotter, identify the cloud types in the sky.
4. Take pictures of the clouds.
5. Record the time of day, type(s) of clouds, current weather conditions, weather conditions following the picture, and your prediction of the weather that will follow.
6. Over the next month, observe, photograph, and record the clouds as you identify different cloud types.

Visit http://weather.gc.ca/satellite/index_e.html to see the Environment Canada satellite image showing which parts of North America have cloudy skies today!
In the Member Manual

**Dig it!**

What type of clouds were observed most often?

Is it possible to predict the next day’s weather by observing the clouds in the sky today?

Do you think you would like a career in meteorology? Why or why not?

Include a picture of a cloud that is a cool shape.

---

**What’s next?**

Next, we will discover what happens to warm and cold air masses when they meet. We will learn about the force that keeps rain and hail in the clouds.
Skill Builder 5: Updrafts and Rising Air

Skills Checklist
- Describe the ability of wind to suspend rain and hail in the clouds
- Identify which type of clouds have the strongest updrafts
- Understand how rising air affects clouds and precipitation

Dream It!

Background for Leaders

Air exerts pressure in all directions at all times. The less tightly the air particles are packed, the lower the air pressure. Matter will move from an area of high pressure to an area of low pressure. Daniel Bernoulli, a Swiss scientist in the 1700’s discovered that as the velocity of a fluid increases, its pressure decreases. As a tube narrows, such as an hour glass or a venturi tube, the fluid passing through the tube speeds up as it reaches the narrowest point. At that point it exerts less pressure. Still air exerts more pressure than moving air. As air masses move faster, they also exert less pressure.

An updraft is a small, upward current of air within a cloud. Vertical movement of the air occurs because of localized regions of warm or cold air. Rain and hail will be suspended by the updraft inside a thunderstorm until the weight of the hail and the water can no longer be supported. Usually, as the updraft in a thunderstorm grows stronger, the storm becomes more intense and the size of rain or hail that is produced becomes much larger.

The jet stream is a fast-flowing, narrow stream of air moving through the atmosphere and circling the Earth. It is formed as a result of the Earth’s rotation on its axis and the differences in atmospheric temperatures. Weather patterns travel across continents along the jet stream. Local weather patterns depend on the position of the jet stream. In North America, if the jet stream is south of your home, cold air from the north will sweep down over you. If the jet stream is north of your home, warm air from the south with move into your area.

Thermal buoyancy explains why warmer clouds and air masses rise above cooler air masses. A mass of warm air will typically be less dense than the surrounding region and will continue rising until it reaches air that is warmer or less dense than itself.

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.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Pressure</td>
<td>An area where the air particles are less tightly packed in comparison to another area.</td>
</tr>
<tr>
<td>Bernoulli Principle</td>
<td>The slower the air moves, the greater the air pressure.</td>
</tr>
<tr>
<td>Updrafts</td>
<td>Upward movement of air in a cloud due to warm and cold regions.</td>
</tr>
<tr>
<td>Jet Stream</td>
<td>A fast-flowing current of atmospheric air encircling the Earth.</td>
</tr>
<tr>
<td>Thermal Buoyancy</td>
<td>The rising movement of warm air until it reaches air that is warmer or less dense than itself.</td>
</tr>
</tbody>
</table>
Age Considerations

- 10+

Thinking Ahead

- What will you discuss with members? Gather observations and think of examples that will help support your decision.

Preparing for Success

- Linking back to the Skills Checklist, help members identify how they will know they have been successful in learning from this Skill Builder. Discuss what success in these activities might look like, sound like, or feel like.

Activating Strategies

To get members thinking about this topic, discuss the weather; ask them the following questions:

- Why do clouds stay in the sky?
- What is the current forecast?

Have members record the five day forecast for their home. Be sure to include the an illustration of the weather, high and low temperatures, probability of precipitation, wind speed and direction, and any other important features.

Do It!

What’s With the Updrafts?

Time Required: 15 minutes

Supplies:

- Hand-held hair dryer
- Two or more ping pong balls

Directions:

1. Point the nozzle of the hair dryer up and turn the power on Low.
2. Place a ping pong ball in the stream of air. The ball will be suspended by the air.
3. Slowly tilt the hair dryer until the ball falls.
4. Repeat, adding a second ping pong ball. Depending upon the power of the hair dryer, both ping pong balls will be suspended.
5. As you become more comfortable with the procedure, you can turn the hair dryer up to High power.
The ping pong ball remains in the stream of air due to lower pressure around the surface of the ball. The air flows faster around the ping pong ball and there is lower pressure on either side of the ball. There is also lower pressure outside the air stream created by the hair dryer. As a result, when the ping pong ball reaches the edge of the air stream, it bounces from side-to-side and is pushed back into the region of low pressure. Occasionally, the balls will swap their order as they bounce around in the air stream.

Although there is no giant hair dryer in the sky, there are weather conditions that cause air to rise. Many of our clouds are thin and flat, meaning that only gentle updrafts are present. During spring and summer, we can sometimes watch cumulus clouds form and then rapidly explode upwards to form cumulonimbus clouds. These clouds have the greatest updrafts and are the type of cloud that forms hail and large raindrops. The height of the cloud can also be measured by the darkness of the cloud when viewed from earth. The darker the cloud, the thicker the cloud and the greater the likelihood of updrafts overhead.

Hailstones are formed from the rising and falling of the hailstone within the updrafts and downdrafts of a cloud. First, a water droplet is picked up by the updraft and is carried to an altitude where the temperature is well below the freezing point. As the frozen droplet begins to fall, it may begin to thaw. The half-frozen drop may be picked up by another updraft and will be refrozen. With each cycle, the frozen droplet adds another layer of ice. Finally, it falls to the ground as hail. Usually hail is less than 5 cm in diameter; about the size of a golf ball or smaller. In Canada, the record for the heaviest hailstone is held by a 290g hailstone that fell on August 27, 1973 in Cedoux, SK.

**Rising Air**

**Time Required:** 30 minutes

**Supplies:**
- One rectangular clear plastic container, approximately 5”x12”
- Ice cubes made with blue food colouring and water (make these before the meeting)
- Warm water with red food colouring
- Room temperature water
- Pencils
- Paper
- Map of the world (included on the following page)

Prior to completing this activity, discuss the differences in temperature in different regions of the Earth. Observe the positions of the continents and the oceans. Cold air masses stretch from the North and South poles. The sun warms the land and the oceans most intensely at the Equator. Notice that all of the oceans of the world are connected into ‘one ocean’.

**Directions:**
1. Fill the plastic container 2/3 full of room temperature water.
2. Let the water sit for 30 seconds or until it is completely still.
3. Place a blue ice cube at each end of the plastic container. These ice cubes represent the cold North and South poles of the Earth.
4. Add two drops of warm water with red food colouring to the center of the plastic container. This represents the warmth of the sun at the Equator.
5. Observe what happens.
Over the next few minutes, observe the movement of water in the container. Water is flowing from one position to another while heat is being transferred. The cold, blue water sinks, while the warmer, red water rises. The red water stays higher in the container than the blue water.

As liquids or gases are heated, they expand and become less dense. A hotter substance will float in a cooler substance. Hot water rises and floats in colder water. When liquids and gases are cooled, they contract and become more dense. A substance that is more dense will sink; cold water sinks in warmer water. Hot air rises and cold air descends for exactly the same reason.

A thunderstorm is caused by unstable air. A body of warm air is forced to rise by an approaching cold front. A strong, persistent updraft of moist air is formed. The approaching cold front helps build the updraft into a cumulus cloud. When the warm air rises and meets the cold air of the atmosphere, it condenses and forms a cloud. Heat helps fuel the thunderstorm. Heat from the sun warms the earth and causes evaporation. The more water vapour in the air, the bigger the cloud and the stronger the storm. As cold air and warm air meet, the air becomes stacked in layers and the clouds grow high as thunderheads. Cumulonimbus clouds can rise more than 12,000 m into the sky.

Dig it!

Discuss the 5-Day Forecast outlined in the “Dream It!” section. Identify a weather pattern that will involve rising air and/or updrafts. Review how the Bernoulli Principle explains the suspension of the ping pong balls. Discuss why cumulonimbus clouds have the strongest updrafts. Review how the Rising Air experiment relates to the weather.

What’s next?

Making a tornado will introduce you to the importance of safety from our weather.

Leader's Notes
Skill Builder 5: Updrafts and Rising Air

Misty Says....

Have you ever wondered what keeps the clouds in the sky? Some clouds are so very high. Storm clouds look like they are being pushed higher and higher into the sky.

SKILLS CHECKLIST

- Describe the ability of wind to suspend rain and hail in the clouds
- Identify which type of clouds have the strongest updrafts
- Understand how rising air affects clouds and precipitation

Important words:
Watch for these important words throughout this Skill Builder:
Low pressure, Bernoulli Principle, Updraft, Jet Stream, Thermal Buoyancy

Dream it!

Wind can suspend rain and hail in the clouds. Air pushes in all directions at all times. The less tightly the air particles are packed, the lower the air pressure. Bernoulli’s Principle states that the slower the air moves, the greater the air pressure. Still air exerts more pressure than moving air. The jet stream is a fast-flowing, narrow stream of air moving through the atmosphere and circling the Earth. As matter becomes warmer, it has a tendency to float above colder matter. Thermal buoyancy explains why warmer clouds and air masses rise above cooler air masses.

5 Day Forecast

Research and record the forecast for the next five days in your area. Include the an illustration of the weather. Record the high and low temperatures, probability of precipitation, wind speed and direction, and any other important features of the forecast.

<table>
<thead>
<tr>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
<th>Day 5</th>
</tr>
</thead>
</table>

Do it!

What’s With the Updrafts?

Directions:
1. Point the nozzle of a hair dryer upwards and turn the power on Low.
2. Place a ping pong ball in the stream of air. The ball will be suspended by the air.
3. Slowly tilt the hair dryer until the ball falls.
4. Repeat, adding a second ping pong ball. Depending upon the power of the hair dryer, both ping pong balls will be suspended.
5. As you become more comfortable with the procedure you can turn the hair dryer up to High power.

What happened to the ping pong ball?

Raindrops eventually fall to the ground because

Rising Air

Directions:
1. Fill a plastic container 2/3 full of room temperature water.
2. Let the water sit for 30 seconds or until it is completely still.
3. Place a blue ice cube at each end of the plastic container. These ice cubes represent the cold North and South poles of the Earth.
4. Add two drops of warm water with red food colouring to the center of the plastic container. This represents the warmth of the sun at the Equator.
5. Observe what happens.

The red goes

The blue goes

Dig it!

Look at your 5 Day Forecast. Can you see how rising air and updrafts will impact your weather?

How does the Bernoulli Principle explain the suspension of the ping pong balls?

What type of clouds have the strongest updrafts?

How do the movements of the red and blue colours relate to the weather?

What’s next?

In the next Skill Builder we will research tornadoes. We will discover how tornadoes form and the effects they can have on Earth.
Skill Builder 6: Tornadoes

Skills Checklist

- Explain what a tornado is
- Understand the dangers of tornadoes
- Describe a tornado precautionary plan

Dream It!

Background for Leaders

A tornado is a vortex (a spiral motion of liquid or gas that sucks everything near it toward its center). You see vortices in drains of tubs and sinks all the time. Small dust devils in the deserts and fire whirls from wildfires are also vortices. Scientists have even observed dust devils on Mars and have spotted solar tornadoes whipping out from the sun.

Of all the destructive powers of the world, none match the ferocity of tornadoes. Tornadoes descend like daggers from the clouds. Tornadoes are also one of the most awesome sights in the natural world. As twisting columns of air, they can measure kilometers across and can reach wind speeds up to 500 km/h.

A tornado forms very similarly to a vortex in our bathtub. As airflow pushes low-pressure air up to higher altitudes, the air heats up and is pushed upward by the air behind it. The air pressure inside a tornado is as much as 10% lower than that of the surrounding air. This causes the surrounding air to rush in even faster.

Tornadoes don’t just pop into existence; they develop out of thunderstorms with steady, upward flow of warm, low-pressure air. A thunderstorm may draw air up from the ground, creating unstable combinations of rising and falling air and resulting in a violent, rotating storm. A tornado reaches down out of a thundercloud as a huge, swirling rope of air. Wind speeds often reach 300 to 400 km/h. If the storm touches the ground, a tornado is born. Tornadoes can cause devastating damage, tearing apart homes and throwing debris.

The tornado’s path follows in the direction of its parent thundercloud. Smaller tornadoes may last for only minutes and travel only a kilometer. Larger storms can cause many miles of continuous damage.

The intensity of a tornado is based on the Fujita Scale (F-scale). Categories range from F0 (minimal damage to shingles and roofs) to F5 (substantial damage, homes leveled) depending upon the damage it inflicts. Tornado damage and the F-scale category are determined by meteorologists and engineers.
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>Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tornado</td>
<td>A spinning cloud that extends the ground, often during a thunderstorm.</td>
</tr>
<tr>
<td>Vortex</td>
<td>A spiral motion of fluid that sucks everything near it toward its center.</td>
</tr>
<tr>
<td>Meteorologist</td>
<td>A weather forecaster.</td>
</tr>
</tbody>
</table>

Age Considerations

- 10+

Thinking Ahead

- What will you discuss with members? Gather observations and think of examples that will help support your decision.

Preparing for Success

- Linking back to the Skills Checklist, help members identify how they will know they have been successful in learning from this Skill Builder. Discuss what success in these activities might look like, sound like, or feel like.

Activating Strategies

To get members thinking about this topic, discuss the weather; ask them the following questions:
- Have you ever seen a tornado?
- Why do tornadoes form?

Have members research and write about a Canadian tornado.

Do It!

How Do You Make a Tornado?

Time Required: 20 minutes

Supplies:
- Plastic 2L bottle with lid
- Water
- Salt
- Teaspoon
- Liquid detergent
- Food colouring
- Small plastic objects such as tiny houses from a popular board game.
Directions:
1. Fill a bottle with water to 2 cm from the top.
2. Add a teaspoon of salt.
3. Put the lid on the bottle and shake it until the salt is dissolved.
4. Add a drop of liquid detergent.
5. Add a drop of food colouring.
6. Cover the bottle tightly and move the bottle in a swirling motion.
7. You may wish to place small objects such as tiny houses or cars from a board game to see the destruction of a tornado.

The water in the bottle represents the swirling currents of air in a real storm. A tornado is formed as a thunderstorm draws air up from the ground. This creates an unstable combination of rising and falling air and results in a violent rotating storm. A rotating funnel cloud descends from the storm. If the cloud touches the ground, it becomes a tornado that can cause extensive and devastating damage.

Safety Plan

Tornadoes can be very dangerous. On average there are a total of 80 confirmed and unconfirmed tornadoes in Canada each year. An average of 15 tornadoes touch down in Ontario, Alberta, Saskatchewan, and Manitoba every year. Canada ranks as the country in the world with the second most tornadoes per year, after the US. The most common types of tornadoes are F0 to F2. These storms usually result in minor damage to shingles and fences and may uproot trees and down power lines.

The deadliest tornado in Canadian history was recorded on June 30, 1912 in Regina, SK. The tornado, nicknamed the Regina Cyclone, claimed 28 lives. As humans, we need to take cover when any storm is approaching, especially a storm with the potential to develop tornadoes.

When severe weather is approaching, it is important that you listen to radio or television newscasts. Stay alert to changing weather conditions. Signs of danger include dark greenish sky, large hail, low-lying rotating cloud, and a loud roar, similar to a freight train. Seek shelter immediately; most injuries associated with high winds are from flying debris.

During a tornado, go to a small interior room on the lowest floor possible. Put as many walls as possible between you and the outside. Position yourself under a sturdy table and use your arms to protect your head and neck. If shelter is not available, take cover in a stationary vehicle. Put on a seat belt and cover your head. Or lie in an area lower than the level of the roadway and cover your head with your arms and a blanket or a cushion if possible.

Once the storm has passed, continue monitoring the radio or television for emergency information. Use caution when entering any damaged structure. Do not touch downed power lines or objects in contact with power lines.

Discuss the importance of having a plan to stay safe when severe weather approaches.

Dig it!

Review how a tornado forms. Discuss why tornadoes are dangerous and why having a plan for safety is very important.
What’s next?

In the next Skill Builder, we will discuss other forms of severe weather - thunder and lightning.
In the Member Manual

Skill Builder 6: Tornadoes

Misty Says....
Tornadoes are one of the most awesome sights in the natural world. As twisting columns of air, they can measure kilometers across and can reach winds speeds up to 500 km/h.

Dream it!
A tornado is a vortex (a spiral motion of liquid or gas that sucks everything near it toward its center). A thunderstorm may draw air up from the ground, creating unstable combinations of rising and falling air and resulting in a violent rotating storm. If the storm touches the ground, a tornado is born. Tornadoes can cause devastating damage.

The winds of some tornadoes can reach 500 km/h. The intensity of a tornado is based on the Fujita Scale (F-scale). Categories range from F0 (minimal damage to shingles and roofs) to F5 (substantial damage, homes leveled).

Tornado Trouble
Research and write about a recent Canadian tornado. Be sure to include the date, location, F-scale rating, damage, and community impacts caused by the tornado.

Do it!

How Do You Make a Tornado?

Directions:
1. Fill a bottle with water to 2 cm from the top.
2. Add a teaspoon of salt.
3. Put the lid on the bottle and shake it until the salt is dissolved.
4. Add a drop of liquid detergent.
5. Add a drop of food colouring.
6. Cover the bottle tightly and move the bottle in a swirling motion.
7. You may wish to place small objects such as tiny houses or cars from a board game to see the destruction of a tornado.

What does the water in the bottle represent? ________________

Safety Plan
Tornadoes can be very dangerous. As humans, we need to take cover when any storm is approaching, especially if the storm has the potential to develop tornadoes. Part of a meteorologist’s job is to observe cloud forms and the direction of motion of a storm. A meteorologist must predict and warn us of tornadoes for our safety.

Write down your plan to stay safe from tornadoes. How will you know that a tornado is coming? What will you do? Where will you go? How will you know that the storm has passed? How can your community alert everyone that a tornado is approaching?

Dig it!

How does a tornado form?

Why are tornadoes dangerous?

Why is a safety plan important?

What’s next?
In the next Skill Builder we will learn why we see lightning and hear thunder during summer storms.

To view severe weather in Manitoba, visit Manitoba Tornado Watch on Facebook at www.facebook.com/ManitobaTornado. Experience storm chasing from the safety of your home by following stormchasers such as @reedtimmer Twist.
Skill Builder 7: Lightning and Thunder

Skills Checklist

- Understand what causes lightning
- Explain why lightning strikes
- Describe how to stay safe during a thunderstorm

Dream It!

Background for Leaders

Lightning is an electric current (a flow of charges). Within a thundercloud, many small bits of ice collide as they move around in the air. These collisions create an electrical charge. Eventually the whole cloud fills up with charges. Ice in the cloud is critical in the lightning process. Storms that fail to produce quantities of ice may also fail to produce lightning. In the rising and sinking motions within a storm there are a lot of collisions between the particles. This causes a separation of electrical charges. The positive charges, or protons, form at the top of the cloud and the negative charges, or electrons, form at the bottom of the cloud. Since opposites attract, that causes a positive charge to build up on the ground beneath the cloud. The ground’s positive electrical charge concentrates around anything that sticks up, such as mountains, people, and single trees. The charge coming from these points eventually connects with a charge reaching down from the thundercloud and lightning strikes.

As storms develop, clouds become highly charged with electricity. When the voltage in the cloud becomes high enough for the electricity to leap across the air from one place to another, lightning flashes. Lightning has been seen in volcanic eruptions, extremely intense forest fires, surface nuclear detonation, heavy snow storms, and large hurricanes. Lightning is most often seen in thunderstorms.

Lightning can strike within a cloud, from one cloud to another, from a cloud to the ground, or from the ground to a cloud. Lightning moves from a cloud to the ground when a negatively charged area in the storm sends out a charge toward the ground called a stepped leader. It is invisible to the human eye and moves in steps in less than a second toward the ground. When it gets close to the ground, it is attracted by the positively charged objects and a channel develops. We see the electrical transfer of energy in this channel as lightning. There can be several return strokes of electricity within the established channel that we see as flickering lightning.

Thunder is the result of the vibration of air particles as the electric current of lightning passes through the sky. The heat from the lightning pushes the particles apart quickly, creating more vibrations. Light travels faster than sound; we see lightning before we hear thunder. Often, we hear thunder as a loud, long rumble as it echoes off objects around us. When the thunder sounds like the crack of a whip, the lightning strike was very close to us and we are hearing the direct sound of the lightning.

Safety from thunderstorms is important. All thunderstorms produce lightning and are very dangerous. If you hear the sound of thunder, you are in danger of being struck by lightning. Remember, when thunder roars, go indoors. In the United States, lightning kills an average of 66 people per year and injures at least 300 people per year. It is important to pay attention to the weather; especially when watches or warnings are issued or severe weather is visibly approaching.
Safety from thunderstorms is important. All thunderstorms produce lightning and are very dangerous. If you hear the sound of thunder, you are in danger of being struck by lightning. Remember, when thunder roars, go indoors. In the United States, lightning kills an average of 66 people per year and injures at least 300 people per year. It is important to pay attention to the weather; especially when watches or warnings are issued or severe weather is visibly approaching.

If you are outdoors, keep an eye on the sky. Darkening skies, flashes of lightning, or increasing winds indicate a dangerous storm may be approaching. Don’t wait for rain to begin falling; lightning often comes first. If you hear thunder, go to a safe place immediately. The best place to go is a sturdy building or car. Make sure the windows in the car are shut. Avoid sheds, picnic shelters, baseball dugouts, and bleachers. If there is no shelter nearby, stay away from trees and crouch down in an open area. Stay twice as far away from a tree as the tree is tall. Put your feet together and place your hands over your head and ears. If you are with a group of people, stay about 15 feet away from each other. Stay out of water and avoid metal as both are electrical conductors. If you are playing an outdoor activity, wait until at least 30 minutes have passed since the last observed lightning strike or thunder.

If you are indoors. Stay away from windows and doors and stay off porches. Avoid water as it is an electrical conductor. Don’t take a shower, wash your hands, or do dishes or laundry. Do not us a corded telephone as lightning may strike exterior phone lines.

If someone is struck by lightning, call for help and call 9-1-1. The injured person does not carry an electrical charge, so it is okay to touch them.

WHEN THUNDER ROARS, GO INDOORS!

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>Electrical Charge</th>
<th>An overall positive or negative force resulting from collisions of particles.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightning</td>
<td>A bright flash of electricity.</td>
</tr>
</tbody>
</table>

Age Considerations

• 10+

Thinking Ahead

• What will you discuss with members? Gather observations and think of examples that will help support your decision.
Preparing for Success

- Linking back to the Skills Checklist, help members identify how they will know they have been successful in learning from this Skill Builder. Discuss what success in these activities might look like, sound like, or feel like.

Activating Strategies

To get members thinking about this topic, discuss the weather; ask them the following questions:
- Do you enjoy listening to and watching thunderstorms?
- Why do we see lightning?

Thunderstorm Mix Up

Unscramble these weather words.

<table>
<thead>
<tr>
<th>RNTUDHE</th>
<th>THUNDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHIINGGTN</td>
<td>LIGHTNING</td>
</tr>
<tr>
<td>OHT</td>
<td>HOT</td>
</tr>
<tr>
<td>STEEHLR</td>
<td>SHELTER</td>
</tr>
<tr>
<td>LAHI</td>
<td>HAIL</td>
</tr>
<tr>
<td>TSFAYE</td>
<td>SAFETY</td>
</tr>
<tr>
<td>YITEERLICCT</td>
<td>ELECTRICITY</td>
</tr>
<tr>
<td>CTTRATA</td>
<td>ATTRACT</td>
</tr>
</tbody>
</table>

Do It!

What is Lightning?

Time Required: 10 minutes

Supplies:
- Fluorescent Light Bulb
- Balloon
- Dark Room

Directions:
1. Blow up and tie a balloon.
2. Turn all of the lights off in the room (The darker the better!).
3. Have another member hold a fluorescent light bulb.
4. Rub the balloon on your hair for several seconds.
5. Quickly hold the statically charged balloon near the end of the light bulb.

As the balloon was rubbed on the member’s head, an electrical charge built up on the balloon. When the balloon was touched to the end of the fluorescent light bulb, the electrical charge jumped from the balloon to the bulb. The electricity caused the light bulb to illuminate. This is similar to thunderstorms as the charges jump from the clouds to the earth and produce visible light.
Lightning in Your Mouth

Time Required: 10 minutes

Supplies:
• Wintergreen LifeSaver®
• Mirror
• Dark Room

Directions:
1. Stand in front of a mirror in a really dark room.
2. Wait a few minutes until your eyes become accustomed to the darkness.
3. Place a mint lifesaver in your mouth.
4. While keeping your mouth open, break the candy with your teeth and watch for sparks.

The sparks are a visible transfer of energy in your mouth. When you break the lifesaver apart, you are breaking apart sugars inside the candy. The sugars release little electrical charges in the air. These charges attract the oppositely charged nitrogen in the air. When they meet, they react as a visible spark.

Thunderstorm

Directions:
1. As a group, stand in a circle in a dark room.
2. Begin the rainstorm by rubbing your hands together. Starting on your left, other members gradually join in, one at a time, around the circle. The gentle swishing creates the sound of soft rain.
3. Now snap your fingers. As each play around the circle switches, one after the other, from rubbing hands to snapping fingers, can they hear the rain get heavier? When everyone joins in, the torrent builds.
4. Finally, turn the rain into a storm by slapping your thighs and stamping your feet in turn all around the circle.
5. Be creative. Find things to make the crash of thunder and the flashes of lightning.
6. To calm the storm, reverse the actions, slapping thighs, snapping fingers, rubbing hands until the last sound is that of just two hands rubbing and the rainstorm is over.

Dig it!

Review what positive and negative charges are. Relate this concept to the experiments in this skill builder. Discuss the importance of safety during thunderstorms.

What's next?

Congratulations! You have completed all of the Skill Builders in Discovering CoCoRaHS. Members will now begin to work on the Showcase Challenge. Have a great Achievement. The members could not have done it without you.
In the Member Manual

Skill Builder 7: Lightning and Thunder

Misty Says....
Each spark of lightning can extend over five miles in length, soar to temperatures of approximately 30,000°C, and contain 100 million electrical volts. For your own safety, remember “When thunder roars, go indoors.”

SKILLS CHECKLIST
- Understand what causes lightning
- Explain why lightning strikes
- Describe how to stay safe during a thunderstorm

Dream it!

Lightning is an electric current just like electricity flowing to a light bulb. There are positive and negative electrical charges within a cloud. The positive charges are at the top of the cloud and the negative charges are at the bottom of the cloud. Since opposites attract, that causes positive charges to build up on the ground beneath the cloud. The negatively charged area in the cloud will send out a charge toward the ground called a stepped leader. This makes the first pathway to the ground and the charges flow in a zigzag behind it. You see the electricity moving in this channel as lightning.

Thunder is the result of the movement of air particles as the electric current of lightning passes through the sky. The heat from the lightning pushes the particles apart quickly, creating more movement. Light travels faster than sound; we see lightning before we hear thunder.

At any given moment there are 1800 thunderstorms in progress somewhere on the Earth. This amounts to 16 million storms each year.

Lightning detection systems in the United States monitor an average of 25 million flashes of lightning from cloud to ground every year.

Lightning can strike within a cloud, from one cloud to another, from a cloud to the ground, or from the ground to a cloud.

Do it!

What is Lightning?
Directions:
1. Blow up and tie a balloon.
2. Turn all of the lights off in the room (The darker the better!).
3. Have another member hold a fluorescent light bulb.
4. Rub the balloon on your hair for several seconds.
5. Quickly hold the statically charged balloon near the end of the light bulb.

What happened when you held the balloon close to the light bulb?

Lightning in Your Mouth
Directions:
1. Stand in front of a mirror in a really dark room.
2. Wait a few minutes until your eyes become accustomed to the darkness.
3. Place a mint lifesaver in your mouth.
4. While keeping your mouth open, break the candy with your teeth and watch for sparks.

What did you see when you broke candy? Why?

Thunderstorm Mix Up
Unscramble these weather words.

<table>
<thead>
<tr>
<th>RNTUDHE</th>
<th>LHIINGGTN</th>
</tr>
</thead>
<tbody>
<tr>
<td>OHT</td>
<td>STEEHLR</td>
</tr>
<tr>
<td>LAHI</td>
<td>TSFAYE</td>
</tr>
<tr>
<td>YITEERLICCT</td>
<td>CTRATA</td>
</tr>
</tbody>
</table>
In the Member Manual

Thunderstorm

Directions:
1. As a group, stand in a dark room.
2. Work together to create a room full of rain, thunder, and lightning.
3. Begin the rainstorm by rubbing your hands together. Other members should gradually join in creating the storm.
4. Add finger snapping, thigh slapping, and feet stomping.
5. Be creative. Find items to make the crash of thunder and the flashes of lightning.
6. Think about how the storm will gradually come to an end.

Dig it!

What are positive and negative charges?

Explain why the lightning was visible in your experiments. Use the terms “Positive Charge” and “Negative Charge”.

How can you stay safe during a thunderstorm?

You can track severe weather using forecasts and radar imagery from [www.theweathernetwork.com](http://www.theweathernetwork.com).

What’s next?

Now that you have finished all the Skill Builders in this project, it is time to think about and plan for the Showcase Challenge. The Portfolio Page is where you can make sure your CoCoRaHS Project Skills Chart is complete. There will also be space for you to write down some thoughts and reflections on the project (what you liked and didn’t like, etc.).
In the Member Manual

Showcase Challenge
Bringing it all together!

Now that you have finished this project, it is time to think about how you will share your experiences and knowledge with others. You may put your new skills to work by helping at a community event or at your club Achievement or teaching others about your topic. The goal of the Showcase Challenge is to help highlight your new skills and help you understand how you can use them. It can also be an opportunity to receive feedback from others on your project. So go back through your manual and find some highlights of your learning (what you are proud of) and think about how you will “showcase” it.

Dream It!

Here are some Showcase Challenge Suggestions:

- Demonstrate something you made or learned about
- Act out a play
- Create a game
- Use your new skills to help with the Club Achievement plans
- Make a poster or display
- Make a video or slideshow
- Compose a song
- Or come up with your own idea. It is up to you and your leader!

My Showcase Challenge Plan

My showcase idea: _____________________________

What materials and resources do I need? ____________________________________________

Who do I need to help me? _______________________________________________________

When do I need to have things done by? ____________________________

The best results are almost always obtained when members are allowed to present their information in the style of their choice.

Showcase Challenge

Have members use their Member Manual to help them in organizing what they have learned to use in this activity. The form of the showcase can vary according to the wishes of the leaders and members’ 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.
In the Member Manual

Do It!
Insert or attach your finished product or a photo of you sharing your skills in your Showcase Challenge.

Dig It!
Now that you have showcased your project skills:
- How did your Showcase Challenge go?
- What would you do differently next time?
- How will you use your new skills in the future? (in different situations?)
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 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.
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, Bonspleis, Conferences, Judging, Camps, Trips, Awards, Representation to Area or Provincial Councils, etc.)

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, 4-H club head leaders, friends of 4-H)

I am most impressed by...

I believe that you have learned...

In the future I encourage you to...

Signature: ____________________________
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 Development
1129 Queens Avenue
Brandon, MB R7A 1L9

Email: 4h@gov.mb.ca

Phone: 204-726-6613
Fax: 204-726-6260

This manual is for educational use only and is not intended as professional advice.

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 larger 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 Development (MAFRD)