4-H Environment Series
Exploring Energy and the Environment

Welcome 4-H Leaders!

Welcome to the “Energy and the Environment” project. There is lots of information, fun facts and hands on activities that cover the basic scientific principles about the elements that make up energy and how they relate to the environment. 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 this project, members will examine, by learning to do by doing, how the elements create energy and help our environment, how man’s use of them can change our climate/environment and what can members do to keep the environment healthy. 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.

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

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

Each section, 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 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></td>
<td>- Identify how fossil fuels are used and the impact on the environment</td>
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Once you successfully complete your builders, you will showcase what you have learned.

| Showcase & Portfolio | - Explain success in using the skills listed above | - Showcase Challenge |
|                     |                                                   | - My Portfolio Page |
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 encourages 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 they are 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 many 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!
Skill Builder 1: Ecosystems

Skills Checklist
- Identify sources of energy
- Define an ecosystem
- Explain how the elements of life interact within an ecosystem

Dream it!

Background for Leaders

Energy
Energy helps us do things. It gives us light, it warms our bodies and homes. It bakes cakes and keeps milk cold. It runs our TVs and our cars. It makes us grow and move and think. Energy is the power to change things. It is the ability to do work.

Energy is made from four elements: sunlight, air, water and soil. The combination of these elements affects all plants, animals and other living things on Earth. Energy becomes heat, it makes things grow and move and it runs machines. Energy doesn’t disappear. There is the same amount of energy today as there was when the world began. When we use energy, we don't use it up completely; we change it into other forms of energy. For example, when we burn wood, we change its energy into heat and light. When we drive a car, we change the energy in the gasoline into heat and motion. The energy in fossil fuels comes from the remains of plants and animals. Its energy comes from the energy in the plants and animals.

Sunlight gives us light and heat. Plants and animals use the energy from the sun to grow. Sunlight can be turned into electricity using solar panels. In agriculture, solar panels are used to power electric fences, and to run the pump that provides animals fresh water and for lights.

Hydro comes from the Greek word meaning water. Hydropower is the energy made with moving water. Moving water has a lot of energy. We use that energy to form electricity. Gravity is the force of attraction between all objects and it pulls water from high ground to low ground. The rain that falls in the mountains flows down the valleys to the oceans. The majority of the electricity in Manitoba is made using water.

Wind is moving air. We can use the energy in wind to do work. Early Egyptians used the wind to sail ships on the Nile river. People still use wind to move sailboats. In the Netherlands, people used windmills to grind wheat. The early settlers in Canada used windmills to grind grain, to pump water and to run sawmills. Today, we use wind turbines to make electricity.

Soil is very important for growing plants. All living things need energy to grow. Plants use light from the sun to grow. Plants change the energy from the Sun into sugar and stores it in their roots and leaves. This is called photosynthesis. Animals can’t change light energy into sugars. Animals, including people, eat plants and use the energy stored in them to grow. Animals can store the energy from plants in their bodies. Soil feeds everyone!
Petroleum is called a fossil fuel. It is a liquid found underground. Sometimes we call it oil. Petroleum is called a fossil fuel because it was made from the remains of tiny sea plants and animals. The energy in petroleum came from the energy in the plants and animals. That energy came from the Sun.

**Match it up!**

Where does it get its energy? Draw a line from the picture to the word.

- **Fossil Fuel - Petroleum**
- **Wind - Electricity/movement**
- **Water - Electricity**
- **Sunlight - Electricity/light heat**
- **Soil - Growing Food**

**What is an Ecosystem?**

An ecosystem includes all non-living and all living organisms such as plants and animals in a specific area. The plants and animals interact with non-living things. These non-living things include Sun, water, soil, air, weather and temperature. A swamp, a prairie, an ocean, and a forest are examples of ecosystems.

An ecosystem’s development depends on the energy that moves in and out of that system. Animals and plants within an ecosystem also depend on each other for survival. If conditions change, the animals and plants have to make changes to survive.

For example, the amount of sunlight can determine the kinds of organisms found in an area because almost all energy comes from the sun. Energy from the sun is captured in the leaves of green plants to produce food. All animals depend on this process and the food that is produced for life. How much water there is also determines what creatures, including humans, can live in an area because life cannot survive more than a few days without water. Air and soil are equally important for sustaining any life on earth.

Everything is connected to everything else. If you have a vegetable garden, the plants will attract plant eating insects. These insects attract birds, snakes, and frogs. These animals may attract predators such as foxes, raccoons, or owls. A vegetable garden is a man-made ecosystem.
In nature, everything is in constant change and is becoming something else. Materials are moved from one place to another. They are changed from one form to another. Often, what is released by one organism is taken up by another as food. For example, manure, is a great fertilizer for plants.

If the environment changes, plants and animals must move or adapt to the new environment or they will die. For example, some birds migrate to warmer temperatures in the winter, frogs and turtles adapt and insects and weak animals may not survive. If an organism can survive, grow and reproduce under certain environmental conditions, we say that it is adapted to that environment. Adaptations are the special features that increase an organism’s chance for survival and reproduction in that particular environment. When the environment changes, organisms must change with it. If they don’t they will need to move or they will die.

People have a major effect on the environment. It is important to think about how the actions of man could change the ecosystems. For example, if man cuts down the rainforest for wood to build houses or to burn for heat or to cultivate to grow food, what effect will this have on the animals living there and how does this affect the Earth? It is important to remember that everything in nature is interconnected.

**Important Words**

Help members define the following words and look for members using this vocabulary in their discussions. To increase the members’ understanding try providing a synonym members know

<table>
<thead>
<tr>
<th>Environment</th>
<th>the surroundings or conditions in which a person, animal, or plant lives or operates.</th>
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<tbody>
<tr>
<td>Energy</td>
<td>The ability to work, produce change, or move an object</td>
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<tr>
<td>Ecosystem</td>
<td>All the living things, from plants and animals to microscopic organisms, that share an environment. It is also all of the non-living things in the environment.</td>
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**Age Considerations:** Designed for ages 9 and up.

**Thinking Ahead**
What will you discuss with members? Gather observations and think about examples that will help support your discussion.

**Preparing for Success**
Ask members how they know they will be successful in this Builder by looking back to the skills checklist. Discuss what success looks like, sounds like, and feels like.

**Activating Strategies**
Activate member’s prior knowledge about energy by asking them:
- Think about the things you use everyday and where the energy would come from. For example, what powers the TV.
- Brainstorm the different types of ecosystems they can think of. For example, prairie, wetlands, desert, forest, arctic, ocean, etc.
Do it!

**Ecosystem in a Jar**

Build an ecosystem to see how the four elements (sun, water, air and soil) interact with a living plant. Discuss with members what each of the elements do in the ecosystem? Discuss what the plants and animals do? Have members record their answers in their manual.

**Time Required:** 20 - 30 minutes

**Equipment/Supplies**

- Wide mouth glass jar with a tight fitting lid
- Clean sand or gravel (aquarium sand works well)
- Activated charcoal (you can find this at a pet store)
- Soil
- Small plants (fern, philodendron, tropical)
- Decorative item such as rocks, moss etc.
- 1-2 Small animals - beetle, worm
- Water

**Instructions**

1. Clean an airtight glass container such as a mason jar. The jar needs to be very clean to avoid mold growth.
2. Add 2-5cm of clean sand or gravel to the bottom of the jar. This will create a drainage layer and water basin for the excess water in the ecosystem.
3. Add a thin layer of 1-2cm of activated charcoal on top of the sand. This layer will act as a filter to keep the ecosystem clean.
4. Add a layer of 5-10cm of good draining soil.
5. Add a decorative item such as a rock or a piece of wood.
6. Add some small plants. They should be slow growing plants that can tolerate warm, humid environments.
7. Add one or two small animals such as beetles or worms. They will provide CO2 for your plants.
8. Water the ecosystem. Give it enough water so that the sand layer is saturated. This will not be a lot of water so be careful when adding the water.
9. Put the lid on the jar.
10. Place the ecosystem near a window, but not in direct sunlight. If it is in direct sunlight the inside will get too hot and your plants will die. If there is condensation building up inside this means it has too much water. Open the lid for a day and let some of the water evaporate.
11. Have members record the role each element plays in the ecosystem in the members manual.
12. Over the next six Builders have members observe what is happening in the ecosystem. Does it need more water, more sunlight? How are the elements working together?
How the Ecosystem Works
Bottle gardens work because their sealed space creates an entirely self sufficient ecosystem. The jar helps us in identifying the impact that living things have on the environment and how the environment impacts living things. An ecosystem in a jar is a closed system like the earth with processes such as photosynthesis, transpiration and respiration occurring all the time. It is a continuous cycle with are four elements working together. If one elements is not functioning properly it effects all of the others and therefore the ecosystem.

Each element has a role to play in an ecosystem.

**Sunlight** - Provides energy to the plant so it can absorb water and carbon which the plant turns into food for the plant to grow. (Photosynthesis)

**Water** - Water will evaporate and condense against the sides of the jar. It runs down the side of the jar and runs back down into the soil. A mini water cycle is created. Water nourishes the pants.

**Soil** - As leaves die, they fall off and provide food for the animal (worm) which creates new nutrient rich soil (compost). The dead leaves also rot and produce carbon dioxide and nutrients required for plants to grow.

**Air** - Plants convert carbon dioxide into oxygen.

Go to [http://www.dailymail.co.uk/sciencetech/article-2267504/The-sealed-bottle-garden-thriving-40-years-fresh-air-water.html](http://www.dailymail.co.uk/sciencetech/article-2267504/The-sealed-bottle-garden-thriving-40-years-fresh-air-water.html) to see a jar ecosystem that has been going for over 50 years.

What is happening in the Ecosystem?
Is the plant growing? Does it need more water, more sunlight? How are the elements working

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Dig it!

How do the four elements (Sun, water, air and soil) work together to make a healthy ecosystem? What would happen if an ecosystem did not have enough water? Or not enough sunlight? Can you think of something that people do that could be bad for an ecosystem?

What’s Next?

In Skill Builder 2, members will learn about Solar Energy and why it is important. They will also discover how solar energy is used in Manitoba.
From the Members Manual

Skill Builder 1: Ecosystems

Terry says:
The four elements or things needed for life are sunlight, air, water and soil. They produce the energy needed for plants, animals and all living things on earth to survive. They work together to create ecosystems.

Skills Checklist
• Identify sources of energy
• Define an ecosystem
• Explain how the elements of life interact within an ecosystem.

Important Words
Watch for these important words throughout this Skill Builder:
Environment, Energy, Ecosystem

Dream it!
Energy is made from four elements: sunlight, air, water and soil. The combination of these elements affects all plants, animals and other living things on earth. Energy helps us do things. It gives us light. It warms our bodies and homes. It bakes cakes and keeps milk cold. It runs our TVs and our cars. It makes us grow and move and think. Energy is the power to change things. It is the ability to do work.

Energy becomes heat, it makes things grow and move and runs machines. Energy doesn’t disappear. There is the same amount of energy today as there was when the world began. When we use energy, we don’t use it up completely; we change it into other forms of energy. For example, when we burn wood, we change its energy into heat and light. When we drive a car, we change the energy in the gasoline into heat and motion. The energy in fossil fuels comes from the remains of plants and animals. It’s energy comes from the energy in the plants and animals.

Match It Up! Where does it get its energy? Draw a line from the picture to the word.

Fossil Fuel
Wind
Water
Sunlight
Soil

What is an Ecosystem?
An ecosystem includes all non-living things and all living organisms such as plants and animals in a specific area. The plants and animals interact with the non-living parts of the ecosystem. This includes sun, water, soil, air, weather and temperature. A swamp, a prairie, an ocean, and a forest are examples of ecosystems.

An ecosystem’s development depends on the energy that moves in and out of that system. Animals and plants within an ecosystem also depend on each other for survival. If conditions change, the animals and plants have to make changes to survive.

If you have a vegetable garden, the plants will attract plant eating insects. These insects attract birds, snakes and frogs. These animals may attract predators such as foxes, raccoons, or owls. A vegetable garden is a man-made ecosystem.


Terry’s Links

Do it!
Ecosystem in a Jar
Build an ecosystem to see how the four elements sun, water, air and soil interact with a living plant. Follow your leader’s instructions carefully. What do each of the elements do in the ecosystem? Record your answer.

Sunlight
Water
Air
Soil
From the Members Manual

What is Happening in the Ecosystem?

Bottle gardens work because their sealed space creates an entirely self-sufficient ecosystem. The jar helps us identify the impact that living things have on the environment and how the environment impacts living things. An ecosystem in a jar is a closed system like the Earth.

Over the next five Skill Builders observe what is happening in your ecosystem. Is the plant growing? Does it need more water, more sunlight? How are the elements working together? How does what is happening in the jar occur where you live?

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Dig it!

How do the four elements (sun, water, air and soil) work together to make a healthy ecosystem?

What would happen if an ecosystem did not have enough water? Or not enough sunlight?

Can you think of something that people do that could be bad for an ecosystem?

Terry’s Fun Fact!

David Latimer made a miniature ecosystem in a jar over 50 years ago. In that time he has watered it twice! Check it out at:

http://reclaimgrowustain.com/content/40-year-old-self-sustaining-ecosystem-jar

What’s Next?

In Skill Builder 2, you will learn about solar energy and why it is important. You will also discover how solar energy is used in Manitoba. Remember to check on your ecosystem and record what you see!
Skill Builder 2: Sunlight

Skills Checklist:
- Describe solar energy and why it is important
- Identify a renewable resource
- Explain how solar energy is used in Manitoba and how it impacts the environment

Dream it!

Background for Leaders

Everyday, the Sun sends out a huge amount of energy. It sends out more energy in one day than the world uses in a year. This energy comes from within the Sun itself.

The Earth gets most of its energy from the Sun. We call this energy solar energy. Sol means sun. Solar energy travels from the Sun to the Earth in rays. The Earth absorbs solar energy and turns it into heat. This heat warms the Earth and the air around it - the atmosphere. Without the Sun, we couldn’t live on the Earth—it would be too cold.

We use the Sun’s energy to see. Plants convert the Sun’s energy to sugars to provide food for growth and life. Radiant energy from the Sun powers the water cycle and produces wind. We use the Sun’s energy to produce heat. People, animals, and plants can live on Earth because it is just the right temperature for life.

Like most stars, the Sun is a big gas ball made up mostly of hydrogen and helium atoms. The Sun makes energy in its inner core through a process called nuclear fusion. During nuclear fusion, the high pressure and temperature in the sun’s core cause hydrogen (H) atoms to come apart. Hydrogen nuclei (the centers of the atoms) combine, or fuse to form one helium atom. During the fusion process, radiant energy (light) is produced.

It can take 150,000 years for the radiant energy in the Sun’s core to make its way to the solar surface and just a little over eight minutes to travel the 93 million miles (150 million km) to Earth. The radiant energy travels to the Earth at a speed of 186,000 miles (299,337 km) per second, the speed of light.

Only a small portion of the energy radiated by the sun into space strikes the Earth, one part in two billion. Yet this amount of energy is enormous. The sun even provides more energy in an hour than the United States uses in a year. About 30 percent of the radiant energy that reaches the Earth is reflected back into space. Another 25 percent is used to evaporate water, which is lifted into the atmosphere and produces rainfall. Radiant energy is also absorbed by plants, land and oceans.

We use solar energy in many ways. During the day, we use sunlight to see what we are doing and where we are going.

Plants use the radiant energy (light) from the Sun to grow. Plants absorb the radiant energy and turn it into glucose or simple sugars. The plants keep some of the sugars in their roots, stems, fruits and leaves. It is chemical energy. The energy stored in plants feeds every living thing on the Earth. When we eat plants, and food made from plants, we store the energy in our bodies. We use the energy to grow and move. We use it to pump our blood, think, see, hear, taste, smell and feel. We use the energy for everything we do.
The energy in the meat we eat also comes from plants. Animals eat plants to grow. They store the energy in their bodies.

We also use the energy stored in plants to make heat. We burn wood in campfires and fireplaces. Early humans used wood to cook food, scare away wild animals and keep warm.

Solar energy turns into heat when it hits objects. That is why we feel warmer in the sun than in the shade. The light from the sun turns into heat when it hits our clothes or our skin. We use the Sun's energy to cook food and dry our clothes.

Solar energy powers the water cycle. The water cycle is how water moves from Earth to the clouds. The Sun heats water on the Earth. The water evaporates—it turns into water vapor and rises into the air to form clouds. The water falls form the clouds as precipitation—rain, sleet, hail, or snow. When the precipitation falls to Earth, gravity pulls it to lower ground. There is energy in the moving water.

Solar energy makes the winds that blow over the Earth. The Sun shines down on the land and water. The land heats up faster than the water. The air over the land gets warm. The warm air rises. The cooler air over the water moves in where the warm air was. This moving air is wind.

Greenhouse Gas
People use the four elements in their day to day lives. Over time, these actions have produced too much carbon dioxide and other gases. Emissions from burning coal and fossil fuels (gasoline) in our vehicles contribute to the amount of carbon dioxide in the atmosphere. These gases become part of the Earth's atmosphere. They are making the Earth warmer than it should be. This is called Greenhouse Gas Effect. Greenhouse gases cause negative effects on all of the Earth’s ecosystems. For example, melting glaciers and stronger UV rays which cause sunburns.


Optional SunSense Activity
The Canadian Cancer Society SunSense Program has UV sensitive bracelets that teach children about the importance of sun safety. You can order the bracelets by sending an email to sunsense@mb.cancer.ca. They also have a useful resource called SunSense Grades 4-6. https://www.cancer.ca/-/media/cancer.ca/SK/prevention%20and%20screening/live%20well/SunSense-Grades-4-6-LP.pdf

Solar Energy is a Renewable Resource
Solar energy is free and clean. There is enough for everyone, and we will never run out of it. Solar energy is renewable. The sun will keep making energy for a very long time. One way to stop adding carbon dioxide into the atmosphere is to capture the sun’s energy and turn it into electricity. This can be done by using solar cells. Many solar cells together make a module. Many modules connected together make a panel. These panels generate electricity from the sun.
Light or Dark

It’s best to wear light colours on hot sunny days. Why? Have members experiment with light, heat and ice to find out!

Time Required: 15 minutes

Supplies:
• A sunny day
• 1 piece of black heavy cardstock paper
• 1 piece of white heavy cardstock paper
• 2 ice cubes

Instructions:
1. Find a sunny spot outside.
2. Place the white and black paper on a flat surface.
3. Put an ice cube on each piece of paper.
4. Watch to see which ice cube melts faster.

The ice on the black paper melts faster because light surfaces reflect more light energy and stay cooler. Dark surfaces absorb more light energy resulting in heat. More heat from the black paper made the ice melt faster.

Important Words

Help members define the following words and look for members using this vocabulary 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>Solar</th>
<th>Energy derived from the sun’s rays.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere</td>
<td>A layer of gases surrounding the Earth or other planets that is held in place by gravity.</td>
</tr>
<tr>
<td>Greenhouse Gas</td>
<td>Gases that trap heat in the atmosphere including carbon dioxide, water vapour, methane and ozone.</td>
</tr>
<tr>
<td>Renewable</td>
<td>A source of energy that is not depleted by use, such as water, wind, or solar power.</td>
</tr>
</tbody>
</table>

Age Considerations: Designed for ages 9 and up.

Thinking Ahead

1. What will you discuss with members? Gather observations and think of examples that will help support your discussion.
2. You will need to gather supplies ahead of your meeting.

Preparing for Success

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

Activate member’s prior knowledge about solar energy by asking them:

- What are the things you use everyday and where does their energy come from? For example, what powers the TV.
- How is the Sun’s energy used in your home or at school? Drying clothes on the line, growing plants, light, etc.
- Can the Sun’s energy be harmful? How?

Do it!

Build a Solar Oven

Time Required: 45-60 minutes

Supplies:
- 1 small pizza box
- Plastic wrap
- Aluminum foil
- Wooden skewer
- Marker, ruler, tape, scissors
- 1 sheet black construction paper
- Paper plate
- S’mores: Graham crackers, marshmallows, squares of milk chocolate

Instructions:
1. On the lid of the pizza box, use a marker to draw a square 2.5 cm from all sides of the box. See Diagram 1
2. Cut along the front and sides of the square you just drew. Leave the fourth side along the box’s hinge uncut.
3. Tape aluminum foil to the inside surface of the new flap you just cut with the shiny side facing you. Smooth any wrinkles. Diagram 2.
4. Tape plastic wrap over the hole you cut into the lid. Seal all 4 of the edges with tape. Diagram 2.
5. Open the entire box lid and tape black construction paper to the bottom of the inside of the box. This will help absorb the sunlight.
6. Go outside in the sunlight and place the box on a flat level surface.
7. Make a S’more and place it on the paper plate. Lift the entire lid and put inside the oven.
8. Tape one end of the skewer to the reflector lid, and attach the other end to the pizza box. Adjust so that the foil is facing the sun. Move the flap up and down and note how it reflects the sunlight. Make sure the sunlight is shining into the oven. Diagram 3.
9. Let food cook for approximately 30 minutes. Be sure to check the angle often to make sure the sunlight is getting inside the soar oven.

Make a Solar Light Jar

Time Required: 20 minutes. This project could be completed while you wait for the S’mores to cook in the solar oven.

Supplies:
- Canning Jar
- Solar garden light - from discount store to fit the lid of the jar
- Sticky foam tape
Optional: Acrylic gems to go into the bottom of the jar to reflect the light. OR Glass gems to hot glue onto the outside of the jar to reflect the light.

Instructions:
1. Remove the stake part of the light. It will slide off. You will use the solar panel and the light component.
2. Remove the lid from the jar, remove the flat part and keep the ring.
3. Test to see how the light fits into the ring of the jar. Wrap foam tape around the edge of the solar light (do as many rounds as are required for the light to fit the ring)
4. Center the solar light in the ring until the top of the solar panel is flush with the top of the lid. Make sure it is a secure fit.
5. Screw the lid onto the jar.
6. Place in the sunlight to charge the panel. When it gets dark you will have light.

Optional: To reflect the light, pour acrylic gems into the bottom of the jar or using a hot glue gun, cover the entire jar with glass gems. Take safety precautions if using a hot glue gun.

Dig it!

Why is the sun so important to the Earth?
Name 3 examples of where solar energy is used in Manitoba?
What makes the sun a renewable resource?

What’s Next?

In Skill Builder 3, you will learn about wind energy and why it is important. You will also discover how wind energy is used in Manitoba. Remember to check on member’s ecosystems and record results in the members manual.
Skill Builder 2: Sunlight

Terry says:
The sun is the source of all energy on Earth. It makes life possible. We call it solar energy. Solar energy gives us light and heat. It makes plants grow and it allows us to grow the food needed to feed the world.

Skills Checklist:
- Describe solar energy and why it is important
- Identify a renewable resource
- Explain how solar energy is used in Manitoba and how it impacts the environment

Important Words
Watch for these important words throughout the Skill Builder:
- Solar
- Renewable
- Atmosphere
- Greenhouse Gas

Everyday, the Sun sends out a huge amount of energy. It sends out more energy in one day than the world uses in a year. This energy comes from within the Sun itself.

The Earth gets most of its energy from the Sun. We call this energy solar energy. Sol means Sun. Solar energy travels from the Sun to the Earth in rays. The Earth absorbs solar energy and turns it into heat. This heat warms the Earth and the air around it—the atmosphere. Without the Sun, we couldn’t live on the Earth—it would be too cold.

We use the Sun’s energy to see. Plants convert the Sun’s energy to sugars to provide food for growth and life. Radiant energy from the Sun powers the water cycle and produces wind. We use the Sun’s energy to produce heat. People, animals, and plants can live on Earth because it is just the right temperature for life.

Light or Dark?
It’s best to wear light colours on hot, sunny days. Why? Your leader has an experiment with light, heat and ice to find out!

Dream it!
People use the four elements in their day to day lives. Over time, these actions have caused too much carbon dioxide and other gases. These gases become part of the Earth’s atmosphere. They are making the Earth warmer than it should be. This is called Greenhouse Gas. Greenhouse gas has a negative effect on all of the Earth’s ecosystems. For example, melting glaciers and stronger UV rays which cause sunburns.

Solar energy is clean energy. There is enough for everyone, and we will never run out of it. Solar energy is renewable. The Sun will keep making energy for a very long time. One way to stop adding carbon dioxide into the atmosphere is to capture the Sun’s energy and turn it into electricity. This can be done using solar panels.

Terry’s Fun Fact - Solar Energy on the Farm

Electric Fence
Yard Light
Power for Water Pump

Terry’s Links
The Canadian Cancer Society SunSense Program has UV sensitive bracelets that will teach you about sun safety. You can get one by emailing sunsense@mb.cancer.ca

Do it!

Pizza Box Solar Oven
The Sun is hot enough to cook food. You will build a simple solar oven that gets hot enough to cook s’mores. Follow your leader’s instructions to build your own pizza box solar oven and make s’mores.
From the Members Manual

Solar Jar Light

Make a light for your bedroom using the Sun and a solar panel. It is a great way to conserve energy and be kind to the planet! Follow your leader’s instructions.

Terry’s Fun Fact - Solar Energy in Manitoba

Road Sign
Roof Solar Panels
Garden Lights
Cell Phone Charger
Flashlight

Dig it!

Why is the Sun so important to the Earth?

Name 3 examples of where solar energy is used in Manitoba?

What makes the solar energy a renewable resource?

What’s Next?

In Skill Builder 3, you will learn about wind energy and why it is important. You will also discover how wind energy is used in Manitoba. Remember to check on your ecosystem and record what you see!
Skill Builder 3: Wind

Skills Checklist
- Describe wind energy
- Determine wind direction and speed
- Explain how wind is used in Manitoba and how it impacts the environment

Dream it!

Background for Leaders

Wind is air in motion. It is caused by the uneven heating of the Earth’s surface by the energy from the Sun. When the Earth’s surface absorbs the Sun’s energy, it turns the light into heat. The heat on the Earth’s surface warms the air above it.

Since the Earth’s surface is made of very different types of land and water, it absorbs the Sun’s energy at different rates. Water usually does not heat or cool as quickly as land. An ideal situation for the formation of wind is an area where land and water meet.

The air over the land usually gets warmer than the air over the water. As air warms, it expands. The warm air over the land becomes less dense than the cooler air and rises into the atmosphere. Cooler, denser air nearby flows in to take its place. This moving air is what we call wind. It is caused by the uneven heating of the Earth’s surface.

As long as the sun shines, there will be winds on the Earth. We will never run out of wind energy. It is a renewable energy source. Wind is clean energy. It produces no air or water pollution.

Knowing the wind direction and speed is important when capturing wind energy.

A weather vane is used to show the direction of the wind. A weather vane points toward the source of the wind. When the wind changes direction it often means a change in the weather. Wind direction is reported as the direction from which the wind blows, not the direction toward which the wind moves. So if the weather vane points north, the wind is blowing from north to south. The direction the wind is blowing will determine where the wind turbine is placed to capture the wind energy.
Some places have more wind than others. Areas near the water usually have a lot of wind. Flat land and mountain passes also have a lot of wind. Today we use big wind turbines to capture the wind. Sometimes, there are hundreds of wind turbines in one place. This is called a wind farm. Some wind turbines are as tall as 20 story buildings.

When the wind blows, it pushes against the blades of the wind turbines. Wind turbines slow down the speed of the wind. When the wind blows, it pushes against the blades making them spin. They power a generator and make electricity. The wind turbines don’t run all of the time. Sometimes the wind is not blowing at all and sometimes it is blowing too fast. Most wind turbines run between 65 and 90 percent of the time.

The amount of electricity produced depends on the size of the wind turbine and the speed of the wind. A small turbine may power one home. Large wind turbines can produce enough electricity to power up to 1,000 homes. Large turbines are sometimes grouped together to provide power to the electricity grid.

**Important Words**

Help members define the following words and look for members using this vocabulary 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>Windmill</th>
<th>A building with sails or vanes that turn in the wind and generate power to grind grain or pump water.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather Vane</td>
<td>A revolving pointer showing the direction of the wind, typically mounted on top of a building.</td>
</tr>
<tr>
<td>Anemometer</td>
<td>An instrument for measuring the speed of the wind.</td>
</tr>
<tr>
<td>Wind Turbine</td>
<td>A turbine having a large vaned wheel rotated by the wind to generate electricity</td>
</tr>
</tbody>
</table>

**Age Considerations:** Designed for ages 9 and up.

**Thinking Ahead:**

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

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

Activating Strategies

Activate members prior knowledge about wind energy by asking them:
- Where does the wind come from?
- Can members think of some places they have been that are windier than others, such as the beach? Why do you think these places are windier?
- When is the wind helpful - drying clothes on the line or sailing a boat.
- When is the wind harmful - tornado, blowing topsoil off of the land.

Using the Power of the Wind

Ask your members: If you could create anything using the power of the wind, what would it be? Have them list their ideas in the six boxes in the members manual.

Do it!

Make a Pinwheel

Time Required: 30 minutes

Supplies:
- Pencil, Ruler, Scissors
- 1 piece of cardstock paper per member
- 1 pin per member
- 1 small bead per member
- A stick or small dowelling or skewer 25 cm long per member, or pencil with an eraser on the end.

Instructions:
1. Draw a 17cm square on the paper.
2. Draw two pencil lines. One from each corner of the card to the opposite corner.
3. Make one small pinhole in each corner beside the line and one hole in the center where the lines cross.
4. Cut along each pencil line stopping halfway between the corner and the centre of the paper.
5. Bend over each corner so that all four corner holes are on top of the center hole. Push the pin through the holes.
6. Thread the bead onto the pin behind the pinwheel. Push the pin firmly into the stick or pencil eraser.
7. Blow on your pinwheel.

Ask the questions: Which way does the pinwheel turn when you blow on it? Does it work better if you blow from the front or from the side?
Make a Weather Vane

Time Required: 40 minutes

Supplies:
- Scissors, Black Permanent Marker, White Glue, Ruler
- Pencil with unused eraser
- Drinking straw—non bending type
- Empty plastic food container with a lid such as a yoghurt tub
- Large stick pin with plastic ball on top
- Sturdy paper such as cardstock or poster board
- Stones or sand to fill the container approximately 1/2 way
- Compass

Instructions:
1. Place the lid on the container and place it upside down on the paper. Trace around the lid. Then make another circle around the outer edge 5 cm wider than the first one.
2. Use a ruler to draw a line down the centre of the circle and then across it (left to right). Write the directions in the sections like the diagram. Or the directions could be written directly on the side of the container with the marker.
3. Cut a slit in each end of the drinking straw approx 1 cm long.
4. Using the ruler, draw a 7 cm square on the paper and cut it out.
5. Using the ruler, draw a triangle on the paper 5 cm long. Make it a wide “arrow” shape (isosceles). Cut it out.
6. Put the triangle into the slot on one end of the straw so it makes a point like an arrow. Put the square into the slot at the other end of the straw. Add a little glue and lay flat to dry
7. Fill the plastic container half full with stones or sand. Put the lid on.
8. Turn the plastic container upside down and make a hole in the bottom the size of your pencil. Leaders may want to help members do this.
9. Stick the lead side of the pencil through the hole, so that it is anchored by the stones or sand and will not move.
10. Stick the pin through the center of the straw and into the pencil eraser. If the straw won’t spin when you blow on the paper square, or if it falls over, try sticking the pin closer to the center of the straw or cut a small piece off the paper on the end that falls over.
11. Take your direction paper and your weathervane outside. Use the compass to find north and position the paper so that the word north is pointing north. Place your weathervane on the center of the paper.
12. Place the weathervane away from walls and large objects that might block the wind. The wind will push against the paper square and spin the straw until the arrow points in the direction the wind is blowing from. If the arrow is pointing west, that means the wind is a “west wind” blowing from the west to east.

Ask members why it is important to know the direction the wind is blowing.
Make an Anemometer

Time Required: 40 minutes

Supplies:
- 5 small (bathroom) paper cups
- 2 drinking straws (non-bending)
- One pencil with unused eraser
- Single-hole paper punch
- Scissors, Tape, Permanent Marker
- Push pin
Optional: multi speed fan

Instructions:
1. Take four cups and punch one hole in each, 1.5cm below the rim.
2. Take the fifth cup and punch two holes in it, directly opposite each other about 1.5 cm below the rim.
   Then punch two more holes in the cup 1 cm below the rim that are equally spaced between the first two holes.
3. In the cup with the four holes, make a hole in the center of the bottom of the cup big enough to easily fit the pencil through it. Be careful not to make the hole too big.
4. Slide one of the straws through the hole in one of the cups that has only one hole. Bend the end of the straw that is inside the cup about 1.5 cm and tape it to the inside of the cup.
5. Place the other end of the straw through two holes in the fifth cup and then through the hole in one of the one hole cups. Bend the end of the straw that is inside the cup about 1.5 cm and tape it to the inside of the cup. Make sure the openings of the two cups face opposite directions.
6. Repeat steps 4 and 5 with the remaining two cups. Make sure that the opening of each cup faces the bottom of the cup next to it. No two openings should be facing each other. Each of the four cups should be facing sideways.
7. Insert the pencil with the eraser facing up through the bottom of the fifth cup. Carefully push the pin through the two straws and into the eraser on the pencil.
8. Take the marker and draw a large X on the bottom of one of the cups.

Ask members:
- Would the anemometer spin faster or slower when a strong wind blows over it compared to a gentle breeze? Why?
- Come up with examples of other tools, appliances or things that move at a given number of revolutions per minute (RPM). For example, CD player, DVD player, computer hard drive, car engine, plane engine, wind turbine.

Dig it!

How does the wind get its energy?
What do you need to know in order to capture the wind’s energy?
What makes wind a renewable energy source and what is its impact on the environment?

What’s Next?

In Skill Builder 4, you will learn about water energy and its importance to the watershed. You will also discover how water energy is used in Manitoba. Remember to check your ecosystem and record results in the member’s manual.
From the Members Manual

Skill Builder 3: Wind

Terry says:
Wind is moving air. The energy in the wind can be used to do work. Wind is used to sail boats. Throughout history, windmills have been used to grind grain and to pump water to run sawmills. Today, we use wind to make electricity.

Skills Checklist:
- Describe wind energy
- Determine wind direction and speed
- Explain how wind is used in Manitoba and how it impacts the environment

Important Words
Watch for these important words throughout the Skill Builder:
Windmill, Weather Vane, Anemometer, Wind Turbine

Dream it!
Wind is air in motion. It is caused by the uneven heating of the Earth’s surface by the energy from the Sun. When the Earth’s surface absorbs the Sun’s energy, it turns the light into heat. This heat on the Earth’s surface warms the air above it.

How Wind is Formed
1. The Sun shines on land and water.
2. Land heats up faster than water.
3. Warm air over the land rises.
4. Cool air over the water moves in.

This moving air is what we call wind. It is caused by the uneven heating of the Earth’s surface.

As long as the Sun shines, there will be winds on the Earth. We will never run out of wind energy. It is a renewable energy source. Wind is clean energy. It doesn’t pollute the air or the water.

Some places have more wind than others.
- Near the water
- Flat land
- Mountain passes

Today we use big wind turbines to capture the wind energy. Sometimes, there are hundreds of wind turbines in one place. This is called a wind farm. Some wind turbines are as tall as 20 storey buildings.

To capture the energy of the wind you need to know what direction the wind is coming from and the speed of the wind. This is done using a weather vane and an anemometer.

Using the Power of the Wind
If you could create anything using the power of the wind, what would it be?
List some of your best ideas here.

Do it!
Make a Pinwheel
Windmills have been used to capture wind energy for many years. A pinwheel demonstrates how windmills work. They are fun too! Follow your leader’s instructions carefully.

Terry’s Fun Fact!
You can see a replica (copy) of a windmill that was originally built in 1877 at the Mennonite Heritage Village in Steinbach, Manitoba. It was used to make flour and cut wood.

Terry’s Links!
Manitoba has two wind farms. There are 73 wind turbines near St. Leon and 60 wind turbines near St. Joseph. You can find out more information at http://www.gov.mb.ca/ia/environment/wind/windfarms.html
From the Members Manual

Make a Weather Vane

A weather vane is used to show the direction the wind is blowing. If the weather vane points north, the wind is blowing from north to south.

Follow your leader’s directions carefully to build your own weather vane.

Go outside and see which way the wind is blowing.

Make an Anemometer

An anemometer is a weather instrument. It measures how fast the wind is blowing. Follow your leader’s instructions carefully to build an anemometer. Take your anemometer outside or use a fan and count the number of times it spins in one minute. The number of revolutions per minute (RPM) is the speed of the wind!

Record the number of Revolutions per Minute (RPM)

Dig it!

How does the wind get its energy?

What do you need to know in order to capture the wind’s energy?

What makes wind a renewable energy source and what is its impact on the environment?

What’s Next?

In Skill Builder A, you will learn about water energy and its importance to the watershed. You will also discover how water energy is used in Manitoba. Remember to check out your own ecosystem and record what you see!
Skill Builder 4: Water

Skills Checklist
- Explain Earth’s water supply.
- Define what a watershed is and why it is important.
- Describe how water energy is used in Manitoba.

Dream it!
Background for Leaders

Water is essential for life on Earth. It has three different states: solid, liquid and gas. The word water refers to water in the liquid state. The solid state is known as ice and the gaseous state of water is known as steam or water vapour.

The water cycle.
1. The Sun heats the water in the oceans, lakes and rivers. Some turns into water vapour. This is called evaporation.
2. The water vapour rises and forms clouds.
3. When the water vapour reaches the cold air above the Earth, it turns back into liquid water. This is called condensation.
4. The clouds let go of the water as precipitation—rain or snow that falls to the Earth.
5. The water flows back into rivers, lakes and oceans and the cycle starts again.

Between 2/3 and 3/4 of the Earth’s surface is water. The Earth’s water is in flowing rivers, ponds, lakes, oceans, northern and southern ice caps, clouds and under the ground. The oceans make up 95% of the Earth’s water. They are salt water and are not drinkable. 2% is made up of ice and 3% is drinkable fresh water. Of the freshwater available, less than 1% is above ground. It is

A watershed, is an area of land whose water drains into a common point. Within a watershed, surface and underground water are connected as water flows across the landscape and through the waterways. Any activity that affects water quality and quantity, or flow rate in one part of the watershed may affect locations downstream. Understanding how water and land connect helps us manage our activities so they do not pollute our freshwater. A healthy watershed is key to a healthy environment.

People and animals rely on surface water (streams, lakes, rivers) and groundwater (water underground) for drinking, growing food, creating energy (electricity) and manufacturing products. What people do on the land can impact the quality and quantity of our water supply. This impact affects the environment, the economy, and society.

There are two categories of water use. Instream uses leave water in place such as wildlife habitats, hydroelectric power and recreation. Withdrawal uses remove water from its natural setting such as irrigation, manufacturing and home and farm use. Sometimes water is returned to where it came from sometimes it is consumed and not returned.

Pollution on land in the watershed eventually ends up in the water. Human and animal waste, fertilizers and pesticides can put potentially harmful chemicals and pathogens in rivers and lakes. Incorrect disposal of household and industrial chemicals can lead to deadly chemicals in waterways. Sediments from construction sites can wash into streams.

Healthy watersheds and clean waterways are important to protect the rivers, streams and lakes we use for drinking water, recreation and fishing.
Hydro comes from the Greek word meaning water. Hydropower is the energy that is generated from moving water. Moving water has a lot of energy. This energy is used to make electricity. A dam is built across a river. This stops the water and makes a lake behind the dam. This lake is called a reservoir. When gates in the dam are opened, water flows down big pipes called penstocks and turns giant wheels called turbines. The turbines power the generators to make electricity. Hydropower is a renewable energy source. It is also a clean source of energy because no fuel is burned that would pollute the air.

The reservoirs are used for swimming, fishing, boating, and other sports. When dams are built, the reservoirs flood a lot of land. They change the flow of the rivers. Sometimes, fish can’t swim up the rivers and lay eggs like they could before, so dams have fish ladders, elevators, and other devices to help fish move up the river.

**Important Words**

Help members define the following words and look for members using this vocabulary 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>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaporation</td>
<td>To change from a liquid state into a gas.</td>
</tr>
<tr>
<td>Condensation</td>
<td>The process by which a gas cools and becomes a liquid.</td>
</tr>
<tr>
<td>Precipitation</td>
<td>Rain, snow, sleet or hail that falls to the ground.</td>
</tr>
<tr>
<td>Hydropower</td>
<td>Electricity produced from machines that are turned by moving water.</td>
</tr>
<tr>
<td>Watershed</td>
<td>All of the land that drains to the same location or body of water.</td>
</tr>
</tbody>
</table>

**Age Considerations:** Designed for ages 9 and up.

**Thinking Ahead:**

1. What will you discuss with members? Think of examples that will help support your discussion.
2. You will need to gather supplies ahead of your meeting.

**Preparing for Success**

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

Activate members prior knowledge about water energy by asking them:
- Think about bodies of water that you have seen. Can you drink this water?
- How do you use water around your home? How is water used on the farm?
- What would happen if your drinking water became polluted?
- What can you do so that this doesn’t happen?

Create the Water Cycle

Time Required: 30 minutes

Supplies:
- 1 medium sized resealable freezer bag per member
- Water
- kettle
- permanent black marker
Optional: Blue food colouring

Instructions:
1. Talk about the water cycle with members. Watch the You tube video COOL Water Cycle song https://www.youtube.com/watch?v=u3QwLYfgwP0 and have members draw a diagram on their resealable bag with the marker.
2. Warm up the water until steam starts to form.
3. Optional: Add blue food colouring to represent seawater.
4. Pour the water into the resealable bag and close the bag.
   CAUTION: The water will be hot. Help members pour the water.
5. Set the bag upright is a sunny location.
6. As the water evaporates, watch the vapours form a white patch on the
Earth’s Water Supply

Between 2/3 and 3/4 of the Earth’s surface is water. The Earth’s water is in flowing rivers, ponds, lakes, oceans, in the north and south ice caps, in clouds and under the ground. Of all the water on Earth only a small percentage is fresh drinkable water. To help members understand how much water on Earth is drinkable and why it is important to look after it, perform the following demonstration and ask members to fill in the blanks in their project manuals.

Time Required: 20 minutes

Supplies:
- 4 liters of water
- Pail to hold the water (ice cream pail)
- Eye dropper
- Measuring cup
- Clear bowl, Plate

Instructions:
1. Fill the pail with the 4 liters of water. Tell members that this represents all the water on Earth. Talk about where this water comes from. There are seven sources: North and South Ice caps, Oceans, Rivers, Lakes, Groundwater, Ponds and Clouds (atmosphere). Have members circle these in their manual.
2. Pour 125 mL out of the pail and into the clear bowl. This represents all of the fresh water on Earth. It is less than 3% of the total water on Earth. Fresh water is found in lakes, river, groundwater, ice and living things. The remainder of the water in the pail represents salt water that cannot be used for drinking water. Have members fill in the blanks in their manual.
3. With an eye dropper place one drop of water from the 125 mL in the bowl and drop it into the plate. This represents the freshwater that is available for use. This water is found in lakes and rivers. The rest of the 125mL of water is deep underground, in soil moisture or in the clouds (atmosphere). Have members fill the blanks in their manual.

Pretend that this pail represents all the water on Earth. Circle the seven water sources on Earth.

Ocean     kitchen tap     Rivers     Ice Caps     Lakes     Bath Tub
Groundwater     Ponds     Swimming Pool     Clouds     Water fountain

125 mL represents all of the FRESH water on Earth.

The remaining water in the pail represents SALT water that can not be used for drinking water.

One drop of water from the 125 mL cup is the amount of FRESHWATER that is available for use. This water is found in LAKES and RIVERS. The rest of the water in the 125mL cup is deep underground or in the atmosphere.
# Build a Watershed

**Time Required:** 60 minutes

## Supplies:
- Large tray—such as a large aluminum roasting pan or 4 sided cookie sheet
- 6-10 pages of newspaper
- Masking tape, Paper towel
- Large sheet of white plastic—white garbage bag
- Spray bottle, Blue food colouring (optional)
- Sponge - you will cut it
- Cocoa powder  Optional - in a shaker
- Props - Assorted toy farm animals, tractors, cars, houses, boats, building blocks etc. to represent pollution sources
- Item to elevate the pan such as a block of wood or notebook

## Instructions:
1. Crumble several pieces of newspaper into balls and rolls of different sizes and shapes. Place them in the tray and tape them in place.
2. Place one end of the pan on the wood block or notebook. Cover the entire pan and its contents with white plastic. Gently press the plastic down around the crumpled paper balls. Create a lake at the bottom of the pan for the rivers to drain into. Adjust the slope of the pan so water will run from the rivers etc. into the lake.
3. Ask members to imagine the plastic cover is the Earth’s surface. The lumps are mountains and hills and the areas in between are the valleys.
4. Use the props to represent a farm, a town and manufacturing. Cut several pieces of sponge and place on the shore of one of the rivers. The sponge represents trees, grass, vegetation. They act like a sponge and keep the pollution from reaching the water source.
5. Fill your spray bottle with water and a few drops of food colouring. Have members take turns spraying the model. Don’t spray too much! Take note of where the water pools to make ponds, where it flows into the lake.
6. Use the paper towels to absorb the water.
7. Sprinkle the model with a small amount of cocoa powder. This represents pollution created by the town, the manufacturing and the farm.
8. Spray the model with water again and watch how the cocoa powder runs into the rivers, ponds and lake. Discuss with members why this is a bad thing.
9. Notice how the sponge absorbs the pollution so it doesn’t go into the water. Discuss with members how this is a good thing.
10. Experiment with the model. Move things around and see what the changes do.
11. Have members brainstorm ways to protect watersheds. If possible, try them out in the model.
12. Show members a picture of the watersheds in Manitoba and determine what watershed they live in. Discuss the characteristics of their watershed. What do they see people doing to take care of the watershed? Refer to Manitoba’s Water Protection Handbook.

[Manitoba’s Water Protection Handbook](#) (PDF format. 2.2 MB in size. 68 pages)
Manitoba watershed information can be found at: https://www.gov.mb.ca/conservation/waterstewardship/waterstrategy/pdf/index.html#Watersheds

Map 1
Sub-basins within Drainage Area
Flowing through Manitoba

**Dig it!**

How is water energy used in Manitoba?

Is there more freshwater than salt water on the Earth? Why is this important?

What is a watershed and why is it important?

What can you do to help protect the watershed?

**What’s Next?**

In Skill Builder 5, you will learn about soil energy and it’s importance. Soil grows the world’s food. You will also learn about soil erosion. Remember to check on the member’s ecosystem and record results in the member’s manual.
From the Members Manual

Skill Builder 4: Water

Terry says:
Water is essential for life on Earth. Without water, nothing would grow. Water is also a source of energy. Moving water can be used to make electricity. Water is a renewable energy source.

Skills Checklist:
- Explain Earth’s water supply
- Define what a watershed is and why it is important
- Describe how water energy is used in Manitoba

Important Words
Watch for these important words throughout the Skill Builder: Evaporation, Condensation, Precipitation, Hydropower, Watershed

Dream it!

Water is essential for life on Earth. It has three different states: solid, liquid, and gas. The word water refers to water in the liquid state. The solid state is known as ice and the gaseous state of water is known as steam or water vapor.

The water cycle:
1. The Sun heats the water in the oceans, lakes, and rivers. Some turns into water vapor. This is called evaporation.
2. The water vapor rises and forms clouds.
3. When the water vapor reaches the cold air above the Earth’s atmosphere, it turns into liquid water. This is called condensation.
4. The clouds let go of the water as precipitation — rain or snow that falls to the Earth.
5. The water flows back into rivers, lakes, and oceans and the cycle starts again.

The water cycle will keep going forever. The water on Earth will always be there.

Create the Water Cycle

Follow your leader’s instructions to create a water cycle.

Terry’s Links!
Did you know that approximately 96% of Manitoba’s electricity is hydropowered? Check it out at http://www.gov.mb.ca/conervation/climate/mh_doing/

Hydro comes from the Greek word meaning water. Hydropower is the energy that is made from moving water. Moving water has a lot of energy. This energy is used to make electricity. Hydropower is a renewable energy source.

Earth’s Water Supply

Between 2/3 and 3/4 of the Earth’s surface is water. The Earth’s water is in flowing rivers, ponds, lakes, oceans, in the north and south ice caps, in clouds and under the ground. Of all the water on Earth, only a small percentage is fresh drinkable water. Listen to your leader’s instructions and answer these questions.

- Pretend that this pail represents all the water on Earth. Circle the seven water sources on Earth.
  - Ocean
  - Kitchen tap
  - Rivers
  - Ice Caps
  - Lakes
  - Bath Tub
  - Groundwater
  - Ponds
  - Swimming Pool
  - Clouds
  - Water Fountain

- 125 mL represents all of the ______ water on Earth.

- The remaining water in the pail represents ______ water that cannot be used for drinking water.

- One drop of water from the 125mL cup is the amount of ______ that is available for use. This water is found in ______. The rest of the water in the 125mL cup is deep underground or in the atmosphere.

Terry’s Fun Fact!
To learn more about weather and water and how it affects our lives, you can take the Discover CoCoRaHS project. You will also learn how citizen science can benefit your community.
From the Members Manual

Watershed

A watershed is an area of land whose water drains into a common point. Within a watershed, surface and underground water are connected as water flows across the landscape and through the waterways. Any activity that affects water quality and quantity, or flow rate, in one part of the watershed may affect locations downstream. Understanding how water and land connect helps us manage our activities so that they do not pollute our freshwater. To protect our water it makes sense to protect our watersheds.

Do It!

Build a Watershed

You will see how a watershed works by building your own! Follow your leader’s instructions carefully.

Terry’s Fun Fact!

To protect our watersheds Manitoba farmers develop and follow an Environmental Farm Plan for their farm. These plans include such things as:
1. Building fences to keep livestock out of rivers, streams and ditches.
2. Storing, handling and disposing of chemicals away from water sources.

Dig It!

How is water energy used in Manitoba?

Is there more freshwater than salt water on the Earth? Why is this important?

What is a watershed and why is it important?

What can you do to help protect your watershed?

What’s Next?

In Skill Builder 5, you will learn about soil energy and its importance. Soil grows the world’s food. You will also learn about soil erosion. Remember to check your ecosystem and record what you see!
Dream it!

Background for Leaders
Soil is the top layer of the Earth’s surface. It is one of the most important resources on Earth:
- It provides support and the food that plants need to grow. These plants provide food for animals and people.
- It provides habitats for animals that live in the soil and for microorganisms that account for most of the living things on Earth.
- It acts as a filter to clean water.
- It processes recycled nutrients, such as carbon, so living things can use them over and over again.

Soil is made of rocks, air, water and plant and animal remains. It forms over time. It is made as rock is broken up into small pieces. It takes 500 years to make 2.5 cm of soil.

There are four factors:
1. Parent Material - the kind of rock it is made of
2. Water drainage and the kind of land—flat, hilly, mountains
3. Climate - ice, frost, wind and water, heat
4. Organisms - plants, animals and people

Parent material is the original material from which soils develop. Its type is based on the type of bedrock and the method of deposition. There are three main types of soil - clay, sand and silt. In Manitoba, soils contain some combination of granite, limestone or shale. These rocks break down over time through weathering to form sand (from granite) or clay (from shale). Limestone can break down into sand, silt and clay sized particles.

Loams are a mixture of clay, sand and silt. Loam is the best soil for growing plants.

Dirt and soil are not the same thing. Soil contains microorganisms decaying organic matter, earthworms and other insects. Soil is a living environment. Dirt is soil that has lost the characteristics that give it the ability to support life. It is dead soil. It does not contain anything living.

The colour of soil varies depending on the type of minerals it contains. Soil high in iron is deep orange-brown to yellowish-brown. Black or dark brown soils are high in organic matter. Brightly coloured soils (red, yellow etc.) drain well and those that are often wet and soggy will have a mottled pattern of grays, reds and yellows.
Soil scientists divide the soil into layers from the surface down to the underlying bedrock. There are five layers of soil.


Because soil is a non-renewable resource it is important to take care of it. Only 1/16 of the Earth’s surface has soil that is suitable for growing crops. Of the 160 million acres (65 million hectares) in Manitoba, only 19 million acres (7.7 million hectares) have potential for agriculture. Much of this land has been settled over time and is either being lost to urbanization or soil erosion.

Erosion happens naturally. This is the loosening, transportation and relocation of soil particles from one place to another. Erosion decreases the amount of land that is available to grow food. A loss of topsoil can result in a significant loss in productivity, largely due to losses of organic matter and nutrients as well as deterioration of physical soil properties. Erosion decreases the amount of land that is available to grow food.

Wind erosion is the detachment, movement and removal of soil from the land surface by wind. It can occur naturally, without human intervention, or can be accelerated through human activities such as excessive tillage. The most susceptible period for soil erosion by wind is early spring and after fall tillage. Soil particles move by wind in one of three ways: surface creep (rolling or sliding along surface) saltation (bouncing and dislodging other particles on impact) and suspension (continuously carried in the air).

Water erosion is the detachment, movement and removal of soil from the land surface by precipitation leaving the landscape as runoff. It can occur naturally, without human intervention, or it can be accelerated through human activities such as insufficient residue cover on soils prone to runoff.

Rainfall quantity, intensity and duration influence the extent of water erosion. Intense rainstorms of more than 1 inch per hour (2.5 centimetres per hour) exceed most soils’ capacities to absorb water. This creates runoff conditions which lead to water erosion on unprotected fields. The most susceptible period for soil erosion by water is during spring snowmelt and May-June after seeding but before canopy cover.

By learning about the soil on their farms, farmers are able to manage their land so that there is less erosion and more land to grow our food. For example, rotating crops, planting shelterbelts of trees, zero till planting, and grassed waterways.

Important Words

Help members define the following words and look for members using this vocabulary 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>Clay</th>
<th>A stiff, sticky fine-grained earth, typically yellow, red, or bluish-grey in colour and often forming an impermeable layer in the soil. It is used to make bricks, pottery and ceramics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>Small loose grains of worn or disintegrated rock. Sand is found at beaches, riverbeds, seabeds and deserts.</td>
</tr>
<tr>
<td>Silt</td>
<td>Fine sand, clay or other materials carried by running water and deposited as a sediment.</td>
</tr>
<tr>
<td>Loam</td>
<td>A soil with roughly equal proportions of sand, silt and clay.</td>
</tr>
<tr>
<td>Humus</td>
<td>The organic component of soil formed by the decomposition of leaves and other plant material by soil microorganisms.</td>
</tr>
<tr>
<td>Non-renewable</td>
<td>Any natural resource from the Earth that exists in limited supply and cannot be replaced if it is used up; also, any natural resource that cannot be replenished by natural means at the same rate that it is consumed.</td>
</tr>
<tr>
<td>Soil Erosion</td>
<td>Removal of topsoil, faster than the soil forming processes can replace it, due to natural, animal and human activity.</td>
</tr>
</tbody>
</table>

Age Considerations: Designed for ages 9 and up.

Thinking Ahead:

1. What will you discuss with members? Think of examples that will help support your discussion.
2. You will need to gather supplies ahead of your meeting including samples of sand, clay, silt

Preparing for Success

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

Activating Strategies

Activate members prior knowledge about soil energy by asking:

- What is the difference between soil and dirt?
- How many different kinds of soil can they name and where are they found—for example sand is at the beach.
- Where would the soil get its energy from? Why do they think soil so important?
- What would happen if there was less soil on Earth? What can we do so that this doesn’t happen?
**Earth’s Soil Resources**

All living things depend on the soil to live! This Activity is a powerful illustration of the value of our soil and the people who work it, given the precious little amount of arable land on our Earth.

**Time:** 20 minutes

**Supplies:**
- Apple
- Knife

**Instructions:**
1. Have members turn to the diagram in their project manual on page 17.
2. Ask members how much of the Earth’s surface is used to produce all of our food.
3. Hold up the apple and ask the members to pretend that the apple is the Earth. Notice how the skin hugs and protects the surface.
4. Cut the apple in quarters. Set three of four quarters aside. They represent how much of the earth is covered with water – oceans, lakes, rivers and streams.
5. The remaining quarter represents the total LAND mass of the Earth. Cut this quarter into 4 equal pieces. One sixteenth of an apple represents the mountains, the second one sixteenth represents deserts. The third one sixteenth represents the tundra and ice caps and other non-arable portions of the Earth’s surface that is not under water.
6. The forth one sixteenth segment of the apple represents all the land suitable for growing crops. Cut this segment into two and set one of these aside. This represents the land that could produce food, but is buried under cities, highways and other structures that people have built.
7. This leaves us with a small slice representing barely one thirty-second slice of the Earth. Carefully peel this slice. This small thin piece of apple peel, barely 3% of the apple’s surface, represents the top soil on which we depend to grow our food. The whole agricultural industry is dependant upon this amount of the Earth’s surface. Soil is a important resource. We must protect it.
8. Because we all like to eat, we use food, and the agricultural industry is what grows and produces the food for us. Therefore we are all involved in agriculture to some extent and it is good to know a bit about how our food comes to us.
9. Have members look at a map of Manitoba and talk about where crops are grown and where they are not.

Like water and air, soil is very important and a limited natural resource.

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**Leaders Notes**
WATER - oceans, lakes, rivers, streams

SOIL AVAILABLE FOR AGRICULTURAL PRODUCTION

DEVELOPED BY PEOPLE

TUNDRA, ICE CAPS

DESSERT

MOUNTAINS

WATER - oceans, lakes, rivers, streams
Edible Soil

Time Required: 30 minutes

Supplies per member:
- Clear plastic cup
- 1 whole sandwich cookie
- 1 crumbled cookie—large chunks
- Prepared vanilla pudding
- Prepared chocolate pudding
- Gummy worms
- 15 mL green coconut (use one drop of green food colouring)
- Soil samples: 1 small dish of sand, 1 small dish of clay (If you do not have access to clay from the ground, use potters clay or craft clay), 1 dish of silt (talcum powder feels and looks like silt) and 1 dish of loam (combination of the 3—top soil or potting soil)

Instructions:
1. Show members the soil samples. Have members feel them and describe them. How are they different? Which one would plants grow best in?
2. Put sandwich cookie in the bottom of the cup. This represents bedrock. Parent material is formed from the bedrock after a long weathering process. Physical weathering includes things like wind or water erosion, glacial activity, freezing and thawing and biotic activity (plant roots, animals, microorganisms). Chemical weathering includes leaching, oxidation, carbonation and hydration.
3. Place crumbled cookie next. This represents parent material. It is the weathered rock and partly weathered soil from which the soil layers are formed. The size of the particles determine the texture of the soil. This is the C horizon in a soil profile.
4. The next layer is the vanilla pudding. This represents the subsoil. It is the B horizon from the soil profile. It is a lighter colour because it has less top soil and organic matter.
5. The next layer is the chocolate pudding. This represents topsoil. Topsoil has nutrients, fungi, and small animals. It is perfect for growing plants.
6. Add gummy worms and sprinkle with green coconut. This represents animals in the soil and organic matter. This layer is usually less than an inch thick. The organic matter is known as humus. It decomposes into nutrients that enrich the soil.
7. Fill in the chart in the member manual and then enjoy eating the layers of the soil!
Save Our Soil

Time Required: 45 minutes

Supplies:
- Soil - if it is winter, potting soil will work
- 3 medium sized funnels - you could cut off the bottom of a milk jug
- Handful of dead leaves, grass clippings, sticks, etc.
- Plant or sod to plant in one of the funnels
- 3 containers to place underneath the funnel—ice cream pail would work
- Water

Instructions:
This activity shows how soil erosion happens. If the land is tilled, a heavy rain can wash away the topsoil and there is less soil to grow food. When vegetation is added on top of the soil, it helps hold the soil and moisture in place. There is a reduced amount of runoff water. When there is grass or plants in the soil, the roots hold the soil in place and they use the water to grow. This helps to maintain the topsoil.

Our management and use of water has a direct impact on our soil and its quality and quantity.

1. Fill the three funnels with soil just over half way. Set one funnel aside.
2. In the second funnel, add the handful of dead leaves, grass, etc.
3. In the third funnel, transplant the plant or the sod.
4. One at a time place each funnel over top of a different pail and pour water into the funnel.
5. Observe how much soil is in each pail. (What colour is the water?)
6. Have members experiment with different amounts and types of vegetation to see which one allows for more soil to remain in the funnel.
7. Have members experiment by adding different amounts of water (rain). Try a shower, a heavy rain, a flood. What happens?

Discussion Questions:
What is soil erosion?
Why is soil erosion a bad thing? (Loss of topsoil, decrease in nutrients, changes the composition of the soil)
How can soil erosion be prevented by farmers?
How can soil erosion be prevented by towns/cities?
How can soil erosion be prevented by your 4-H club?
How can you help to decrease soil erosion?
**Dig it!**

What is the difference between soil and dirt?

What are the four kinds of soil?

Why is soil erosion a bad thing and what is being done to stop it?

**What’s Next?**

In Skill Builder 6, you will learn about fossil fuels and their environmental impact. You will also discover how fossil fuels are used in Manitoba. Remember to check the member’s ecosystem and record the results in the member’s manual.
Skill Builder 5: Soil

Terry says:
All living things - people, animals, plants, etc. depend on soil for life. From the energy in the soil we get food, clothes, and materials to build our homes. Soil is an important part of a healthy ecosystem. It is a non-renewable energy source.

Skills Checklist:
- Describe Earth's soil resources.
- Understand what soil is and how it is made.
- Define soil erosion and what can be done to prevent it.

Important Words:
Watch for these important words throughout the Skill Builder:
Clay, Sand, Silt, Loam, Humus, Non-renewable, Soil Erosion

Dream it!
Soil is the top layer of the Earth’s surface. It is one of the most important resources on Earth. It provides the support and the food that plants need to grow. Plants provide food for animals and people. Soil is made up of rocks, air, water and plant and animal remains.

Soil forms over time. It is made as the rock is broken up into small pieces by water, climate and the kind of ecosystem it is in. It takes 500 years to make 2.5 cm of soil.

There are three main types of soil - clay, sand and silt. Loams are a mixture of clay, sand and silt. Loam is the best soil for growing plants. Soil scientists divide the soil into five layers from the surface down to the underlying bedrock.

Because soil is a non-renewable resource taking care of it is important. Erosion happens naturally and it decreases the amount of land that is available to grow food. Erosion is caused by wind blowing the topsoil off of fields, water taking the soil with it as it drains and tillage by farmers. By learning about the soil on their farms, farmers are able to manage their land so that there is less erosion and more land to grow our food. For example they can rotate their crops, plant shelterbelts of trees and use zero till planting.

Terry’s Fact:
Did you know that soil and dirt are not the same thing?
Soil contains microorganisms, decaying organic matter, earthworms and other insects. Soil is a living environment.

Dirt is dead soil. It does not contain anything living. You can add organic matter to dirt to turn it into soil.

Apple Earth — Earth’s Soil Resources
Using an apple your leader will demonstrate how much of the Earth’s surface is suitable for growing plants. Fill in the diagram.

Terry's Links!
Check out the Soil Stores videos at:
Discovery of Soils https://vimeo.com/26106505
Soils Like Us. What’s in a Name https://vimeo.com/26106696
Soils Up Close and Personal https://vimeo.com/2610929
From the Members Manual

Edible Soil

Check out the three types of soil. How do they look and feel? Learn about soil layers by creating following your leader's instructions to make an edible soil dessert! Write the soil layer names in the diagram.


Explore

Do it!

Save Our Soil

Erosion is our soil's worst enemy, especially during the rainy season. Water can wash away nutrients and reduce the quality of the soil. This activity looks at how heavy rain affects the soil and will discuss what can be done about it.

Soil

Soil & Organic Matter

Soil & Vegetation

Which experiment had the least soil in the water? _________

Why? ____________________________________________

Name one way to decrease soil erosion. ____________

Terry's Fun Fact - How Farmers Protect the Soil

Zero Till - Farmers seed the crop into stubble rather than tilling the land first. This keeps the soil anchored to the land.

Shelter Belt - Farmers plant rows of trees in their fields. This stops the wind from blowing the soil out of the field and provides a habitat for birds and animals.

Grassed Waterways - Planting grass and not plowing low areas in a field where water usually runs saves the soil and protects the water.

Dig it!

What is the difference between soil and dirt?

What are the four kinds of soil?

Why is soil erosion a bad thing, and what is being done to stop it?

What's Next?

In Skill Builder 5, you will learn about fossil fuels and their environmental impact. You will also discover how fossil fuels are used in Manitoba. Remember to check your ecosystem and record what you see!
Skill Builder 6: Fossil Fuel

Dream it!

Skills Checklist
- Explain what fossil fuels are
- Describe a non-renewable resource
- Identify how fossil fuels are used and their impact on the environment.

Background for Leaders

Long before the dinosaurs, oceans covered most of the Earth. The oceans were filled with tiny sea animals and plants. As the plants and animals died, they sank to the ocean floor. Sand and sediment covered them and turned them into sedimentary rock. Hundreds of millions of years passed. The weight of the rock and the heat from the Earth turned them into oil and natural gas. Because oil and natural gas are made from the remains of plants and animals they are called fossil fuels. Their energy came from the energy in the plants and animals. That energy came from the Sun.

Coal is also a fossil fuel. Coal was formed millions to hundreds of millions of years ago, before the dinosaurs. Back then, much of the Earth was covered by huge swamps. They were filled with giant ferns and plants. As the plants died they sank to the bottom of the swamps. Over the years, thick layers of plants were covered by dirt and water. They were packed down by the weight. After a long time, the heat and pressure changed the plants into coal. Coal is called a fossil fuel because it was made from plants that were once alive. The energy in coal came from the Sun.

Today we drill through the layers of sedimentary rock to reach the rock formations that contain oil and gas. After the oil is pumped to the surface, it is sent to refineries. At the refineries, it is separated into different types of products and made into fuels. Most of the oil is made into gasoline. The oil is moved from one place to another through pipelines and by ships and trucks. We use oil to power our cars, trucks, and planes. Our factories use oil to make plastics, paints, medicines and soaps. We even burn oil to make electricity. We use more oil than any other energy source.

Natural gas is found underground in pockets of rock. Companies drill wells into the ground to reach the gas so that it can flow to the surface. Some wells are one mile (1.6 km) or more deep. The natural gas is piped from the wells to machines that clean it and remove any water. An odour like rotten eggs is added to the gas so that leaks can be detected. Most natural gas is moved from one place to another by a pipeline. Natural gas can be burned to make heat. Many homes have a natural gas furnace and many stoves and water heaters use natural gas. Power plants burn natural gas to make electricity. It is also an ingredient in paint, glues, fertilizers, plastic and medicine. Natural gas is the cleanest burning fossil fuel.
Most coal is buried under the ground. Mines are built to bring the coal to the surface. If the coal is deep in the ground, tunnels called mine shafts are dug down to the coal. Machines dig the coal and carry it to the surface. This is called deep mining.

If coal is near the surface, miners dig it up using heavy equipment. First, they scrap off the soil and rock. Then they dig out the coal. This is called surface mining. Coal is moved by truck, train and ship.

After the coal is mined, some companies put soil and rock back in place. Trees and grass are planted. The land can be used again. This is called reclamation.

Coal is burned for heat and electricity.

**Fossil Fuel and the Environment**

Everyone uses oil everyday. However, it can damage our environment. All fossil fuels produce carbon dioxide when burned. Carbon dioxide is a greenhouse gas that is believed to contribute to climate change. Oil can pollute soil and water, harming the animals that live nearby. Oil companies work hard to drill and ship oil as safely as possible. They try to clean up any oil that spills.

When coal is burned it can pollute the air. Power plants and factories work hard to keep the pollution from getting in the air. They clean the coal before they burn it. They use scrubbers to clean the smoke before it goes into the air.

Natural gas is the cleanest burning fossil fuel. It doesn’t pollute the air as much as coal or oil. That is why it is a good fuel for heating our homes and making electricity.

**Important Words**

Help members define the following words and look for members using this vocabulary in their discussions. To increase the members’ understanding try providing a synonym, the more personalized the examples the better.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>A viscous liquid derived from fossil fuels. Used as a fuel or lubricant.</td>
</tr>
<tr>
<td>Petroleum</td>
<td>A liquid mixture of hydrocarbons that is present in certain rock strata and can be extracted and refined to produce fuels including gasoline, kerosene, and diesel oil.</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>A flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.</td>
</tr>
<tr>
<td>Coal</td>
<td>A combustible black or dark brown rock consisting mainly of carbonized plant matter, found mainly in underground deposits and widely used as fuel.</td>
</tr>
<tr>
<td>Mining</td>
<td>The process of digging a hole or tunnel into the earth from which ore or minerals are extracted.</td>
</tr>
</tbody>
</table>
Age Considerations: Designed for ages 8 and up.

Thinking Ahead:

1. What will you discuss with members? Think of examples that will help support your discussion.
2. You can make the Mining Cookies with the members or make them before the meeting.

Preparing for Success

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

Activating Strategies

Activate members prior knowledge about fossil fuels by asking them:
- Where do fossil fuels come from?
- Why is gasoline called a fossil fuel?
- How are fossil fuels used around your home? On the farm? In your Community?
- What are three ways that you can use less fossil fuels?

Do it!

Fossil Fuel Uses

<table>
<thead>
<tr>
<th>Bubblegum</th>
<th>Coal</th>
<th>Crayons</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>Fertilizer</td>
<td>Gasoline</td>
<td>Paint</td>
</tr>
<tr>
<td>Ink</td>
<td>Medicine</td>
<td>Natural Gas</td>
<td>Plastic</td>
</tr>
<tr>
<td>Propane</td>
<td>Soap</td>
<td>Tires</td>
<td></td>
</tr>
</tbody>
</table>

Fossil Fuel Uses

- Bubblegum
- Coal
- Crayons
- Oil
- Diesel
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- Ink
- Medicine
- Natural Gas
- Plastic
- Propane
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- Tires
Cookie Mining

Fossil Fuel Cookies

**Time Required:** 30 minutes

**Ingredients**
- 1 cup (250 mL) all-purpose flour
- 1/4 tsp (1 mL) salt
- 1/4 cup (50 mL) granulated sugar
- 1/2 cup (125 mL) light brown sugar
- 1/2 cup (125 mL) chocolate chips
- 1/2 cup (125 mL) raisins
- 1/2 cup (125 mL) walnuts
- 1 tsp (5 mL) baking soda
- 1/2 cup (125 mL) butter
- 1 tsp (5 mL) vanilla extract
- 1 egg

**Directions**
1. Heat oven to 350°F (180°C).
2. Cream butter, sugars, egg, and vanilla together until light in texture.
3. Combine flour, baking soda, and salt. Add to creamed mixture; mix well.
4. Stir in chocolate chips, raisins, walnuts
5. Drop by spoonfuls onto baking sheet.
6. Bake in centre of preheated oven for 9 to 14 minutes or until light golden. Cool 10 minutes, then transfer to racks and cool completely.

**Yields:** 2 dozen cookies

This recipe contains nuts. If you have members with allergies please leave out the nuts and substitute something else for them.

---

**Leaders Notes**
Mining Cookies

Time required: 30 minutes

Supplies:
- Cooled Fossil Fuel Cookies
- Toothpicks
- Page 22 of members manual

Instructions:
1. Have members draw their cookie on page 22 of their manual. The first picture is what the cookie looks like before mining. It is underground. The second picture is what the ecosystem looks above the cookie looks like. Have members answer the questions.
2. Ask members to pretend they are miners and that the cookie is the land, the raisins are coal, the walnuts are oil, and the chocolate chips are natural gas.
3. Using a toothpick, ask members to gently mine (take out) the raisins, walnuts and chocolate chips from the cookie. Try to damage the cookie as little as possible.
4. Discuss with members how mining can affect the environment.
5. Have members draw their mined cookie on page 22 of their manual. Picture 3 is what the cookie looks like after it has been mined. Picture 4 is what the ecosystem looks like after the mining. Have members answer the questions.

Dig it!

Why are fossil fuels called non-renewable resources?

Taking fossil fuels from underground changes the environment. Can you list 3 ways?

How do you use fossil fuels? How could you use less fossil fuel?

What other form of energy could be used to replace fossil fuels?

What’s Next?

Congratulations you have finished the six builders in this project. Members will now begin working on the Showcase Challenge. Have a great Achievement. The members could not have done it without you!

Energy and The Environment Project References

The Sun and It’s Energy—Used with permission from The NEED Project. For more curriculum and information visit www.need.org

Elementary Energy Infobook - Used with permission from The NEED Project. For more curriculum and information visit www.need.org

Intermediate Energy Infobook on Wind - Used with permission from The NEED Project. For more curriculum and information visit www.need.org

Soil Management Guide 2008 - Manitoba Agriculture
Skill Builder 6: Fossil Fuels

Terry says:
Fossil fuels are the remains of ancient life. They were formed millions of years ago. Fossil fuels are important because of their stored energy. When they are burned they produce energy that is used by everyone everyday!

Dream it!
Fossil fuels are natural resources such as oil (including gasoline and diesel fuel) and natural gas. They are formed from the remains of ancient plant and animal life. As the plants and animals died, they sank to the ocean floor and were covered with sand and sediment. Hundreds of millions of years passed. The weight of the rock and the heat from the Earth turned them into oil and natural gas. Because oil and natural gas are made from the remains of plants and animals, they are called fossil fuels. Their energy came from the energy in the plants and animals. That energy came from the Sun.

Coal is also a fossil fuel. Before the dinosaurs lived and died, many giant plants died in swamps. Over millions of hundreds of millions of years, these plants were buried under water and dirt. Heat and pressure turned the dead plants into coal. Coal is called a fossil fuel because it is made from plants that were once alive. The energy in coal came from the Sun. Coal is burned for heat and electricity.

Today, we drill through the layers of sedimentary rock to reach the rock formations that contain oil and natural gas. Mines are built to bring coal to the surface. We use oil to power our cars, trucks, and planes. Our factories use oil to make plastics, paints, medicines and soaps. We even make electricity. We use more petroleum than any other energy source.

Natural gas is moved from one place to another by a pipeline. It can be burned for heat. Many homes have a natural gas furnace and many stoves and water heaters use natural gas. Fossil fuels, are the remains of ancient life. They do not produce energy that is used by everyone everyday!

Skills Checklist

- Explain what fossil fuels are
- Describe them as a non-renewable resource
- Identify how fossil fuels are used and their impact on the environment

Fossil Fuel Uses

<table>
<thead>
<tr>
<th>CYWC0LHSSTSTQZZA</th>
<th>EIOLIPNJAOFNYF</th>
<th>TATOVONIGHCTCO</th>
<th>LMBSYVOEALCPMLB</th>
<th>ZNOAMQYPAGSAJU</th>
<th>CHROMLJRZRRQUD0Z</th>
<th>CCJUAEPSEUQELES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROANEVJTEFWNC</td>
<td>DIESELEFZANHDIW</td>
<td>TIRESGXVNIZSLG</td>
<td>FERTILIZERCWFOL</td>
<td>MUGELBBUBKIAASN</td>
<td>FXDGGFZKYDIAIA</td>
<td>OIWQUQW1HDEQIGN</td>
</tr>
<tr>
<td>FSZBLZZBUMFQEN</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Bubblemum: Coal: Crayons
Diesel: Fertilizer: Gasoline
Ink: Medicine: Natural Gas
Oil: Paint: Plastic
Propane: Soap: Tires

Terry's Links!
Watch this video to learn about fossil fuels.
Fossil Fuels 101 https://www.youtube.com/watch?v=zaXBVyr9jG0

Fossil Fuels and the Environment

Everyone uses oil everyday. However, it can damage our environment. All fossil fuels produce carbon dioxide when burned. Carbon dioxide is a greenhouse gas that is believed to contribute to climate change. Oil can pollute soil and water, harming the animals that live in the areas. Methane is continually being developed to lessen the environmental impact of producing and using fossil fuels. Fossil fuels will continue to be the main source of energy until other sources are developed.

Natural gas is the cleanest burning fossil fuel. It doesn't pollute the air as much as coal or oil. That is why it is a good fuel for heating our homes and making electricity.
From the Members Manual

Do it!

Cookie Mining
Taking fossil fuels from the Earth is hard work and causes damage to the Earth’s resources. In this activity you will pretend that a chocolate chip cookie is the Earth and you are mining oil, coal and natural gas from it. First, follow the recipe to make Fossil Fuel Cookies. Once they have cooled follow your leader’s instructions carefully on how to mine the cookies resources!

1. Draw Your Cookie (It is underground)
2. Draw what the ecosystem looks like above the cookie (grass, trees, animals etc.)

What type of ecosystem is it?
What plants and animals live there?
How do people use the space?

3. Draw what the Cookie looks like after mining.
4. Draw what the ecosystem looks like after the mining.

How has it changed?
What lives there now?
What could be done to change how the mining effects the environment?

Terry’s Fun Fact!
As of December 2015, there were 5374 oil wells in Manitoba that are capable of producing oil.

Dig it!

Why are fossil fuels called non-renewable resources?
Taking fossil fuels from underground changes the environment. Can you list 3 ways?
How do you use fossil fuels? How could you use less fossil fuel?
What other form of energy could be used to replace fossil fuels?

What’s Next?
Congratulations you have finished the six builders in this project. You still have your Showcase Challenge and Portfolio Page to complete. If you enjoyed learning about the environment you might like to take the discover level projects in the Environment series.
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 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.
From the Members 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 the member was successful at a particular skill. Leaders will find evidence if they think about what members have produced, what discussions they have had with members, and what members are 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.

### My 4-H Portfolio Page

<table>
<thead>
<tr>
<th>Skill Builder</th>
<th>Members will be able to...</th>
<th>We know this because...</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identify sources of energy</td>
<td>Identifying the skill you will learn</td>
</tr>
<tr>
<td>2</td>
<td>Describe solar energy and why it is important</td>
<td>Identifying a renewable resource</td>
</tr>
<tr>
<td>3</td>
<td>Describe wind energy</td>
<td>Determine wind direction and speed</td>
</tr>
<tr>
<td>4</td>
<td>Explain Earth’s water supply</td>
<td>Define a watershed is and why it is important</td>
</tr>
<tr>
<td>5</td>
<td>Describe Earth’s soil resources</td>
<td>Understand what soil is and how it is made</td>
</tr>
<tr>
<td>6</td>
<td>Explain what fossil fuels are</td>
<td>Describe a non-renewable resource</td>
</tr>
</tbody>
</table>

**Showcase Challenge**
- Explain success in using the skills listed above

**Additional Comments/Activities:**

I am most impressed by...

I acknowledge that the member has completed the 4-H project requirements.
Above and Beyond!

In addition to project skills, 4-H also increases skills in meeting management, communications, leadership, community involvement through participation in club, area, or provincial 4-H events or activities. List below any activities you participated in this year in 4-H.

(Some examples include Executive Positions Held, Workshops, Communication, Community Service, Rally, Bonspiels, Conferences, Judging, Camps, Trips, Awards, Representation to Area or Provincial Councils, etc)

______________________________  ______________________________
______________________________  ______________________________
______________________________  ______________________________
______________________________  ______________________________

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

Member Point of Pride!

What I learned…

What I need to improve on…

What I want others to notice…

Member’s Signature: __________________________

Point of Praise! Another’s perspective on your achievements in 4-H.

(community professionals, Master Ends, 4-H club leader, 4-H Ambassador, 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
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.

To request this manual in alternate format, please contact Manitoba Agriculture.

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.

All project materials are available in alternate format upon request.

Manitoba 4-H project material is developed by
Manitoba Agriculture