



# Blacksmith Leader Guide

Working with fire and metal is a timeless tradition that goes back to the early days when man first started making tools from iron during the iron age. Learn basic terminology, about the necessary tools, how to build a forge, and create some unique pieces. There are four divisions, based on skill level, in this project; project leader has discretion to assign division to each member.

## Disclaimer - Safety Precautions

- Project Leader must have a basic understanding of Blacksmith and some hands on experience. It would also be an asset if project leader has had prior experience in teaching blacksmith skills and techniques.
- Project members must be Intermediate or Senior 4-H members, minimum age being 12 years old.

## Project Completion Requirements

### Project Items & Record Pages

- Complete at least five (5) project topics or activities in your division
- Create at least two tangible items that will be on display at Achievement Day
- All activities/project meeting topics must be documented on the record page provided.
- Member Guide must be at the **CLUB** Achievement Day with **ALL** pages completed.

## Exhibition Requirements

### Members are strongly encouraged to participate in the 4-H Classes at PEI Fairs & Exhibitions

- Members may choose **ONE** tangible project item to send on the Exhibition Circuit.
- Group members **do not** have to send the same items.
- Chosen item must be approved by the 4-H Specialist at the Club Achievement Day

## 4-H Year Completion

### In order to complete the 4-H year members are required to:

- Complete the **PCR's (Project Completion Requirements)** as outlined above
- Complete a **Communication** Project
- Complete a **Community Service** Activity
- Complete an **Agriculture Awareness** Activity

# The Project Leader's Job

To begin, thank you for volunteering your time to be a 4-H project leader! We appreciate your time and willingness to teach today's youth a new skill and share your knowledge.

Becoming a project leader can feel overwhelming at first, but we hope that this page will make your "job" clear and offer some tips to help you be successful.

## Responsibilities

### 1. Become a screened leader

You may have already completed this step, but it is a very important one. The best place to go is to the 4-H PEI website and visit this page: <https://www.pei4h.ca/4-h-leaders>, to see if you have completed all the necessary requirements. Project meetings cannot begin until you have received a "conditional letter" from the Provincial 4-H Office.

**NOTE:** As of July 2019 a new policy has been implemented by 4-H Canada that each project group be accompanied by two screened leaders. *Insert more information about what National has to say about this policy and why they think it is important for this policy to be in place.*

### 2. Set Project Meeting Dates

The amount and length of project meetings is determined by you, the project leader. That being said, you are responsible for covering **five** activities or topics (see project activity ideas pages) with the group. You may decide that you'd like to have five meetings - covering one topic per meeting, or you may decide to spend two 5 hour sessions with your group and cover multiple topics or activities in one meeting. This will also depend on the project you are leading. For instance, if you are leading a quilting project, then the member will be focused on one large item with multiple steps and skills involved. However, a rabbit project may require multiple meetings (and even locations) to cover different activities and topics. Meetings can begin anytime after November 15th. Whatever the case, we highly recommend that Project Leaders **set dates in advance of members signing up for the project**. This method will ensure the members know what they are signing up for, or enable them to make a decision to not sign up if they cannot commit to the dates listed. We also hope that this will avoid a lot of frustration for you, because working around multiple schedules is almost impossible!

### 3. Choose Topics and Activities

You may choose to work on this step before setting dates for project meetings. Some topics and activities may be able to be covered in one project meeting, while others may need their own meeting. Regardless, we ask that you document your project meetings and topics covered on the next page so that the 4-H Specialist can refer to this information at Achievement Day if necessary.

### 4. Materials & Supplies

While you are responsible for determining what materials and supplies are needed, you **are not** responsible for covering these costs. Options to consider:

- A. 4-H Canada has a FCC 4-H Club Fund that all leaders are welcome to apply to. These grants are valued at \$500 each. Applications are accepted August through to the end of October.
- B. Asking for supplies. Depending on what project you are leading, just putting a call out for the supplies you need to friends, family, etc. may be successful
- C. Determine an estimate total for the materials and supplies needed and set a "project fee" that all members will pay to help cover the additional costs

### 5. 4-H Year Completion and Project Completion Requirements

The project leader **is not** responsible for 4-H Year Completion (these components will be completed at the Club level) though each member **must** complete these components. Project leaders should focus on the Project Completion Requirements, found on the front cover of this guide. These are the items that the 4-H Specialist will expect to see on display at the Club's Achievement Day (typically scheduled for June-July).

### 6. Club Meetings & Events

Project leaders are not expected to attend monthly club meetings, but are more than welcome to attend if they'd like to know what is going on at the Club, Provincial or National level of 4-H. Similarly, Club events and activities are open to project leaders, but it is not necessary to attend. Project leaders are encouraged to attend Achievement Day. This is an event that wraps up the Club's 4-H year and a celebration of member success.

# The Project Leader's Plan

After reviewing the Project Completion Requirements list on the front of this guide, review the Project Activity Ideas page/s. You can also pull ideas from past experiences, books, social media, online or you can plan to join a tool, attend an event or book a guest speaker. The sky is the limit! Regardless of what activities or topics you decide upon, you should choose five in total. It might be a good idea to ask the 4-H members in your project group what they envision before making a concrete plan. In some cases, the project group members may depict what activities or topics based on what project item they have in mind.

## Topics and Activities

1. \_\_\_\_\_

Supplies needed:

_____	_____
_____	_____
_____	_____

2. \_\_\_\_\_

Supplies needed:

_____	_____
_____	_____
_____	_____

3. \_\_\_\_\_

Supplies needed:

_____	_____
_____	_____
_____	_____

4. \_\_\_\_\_

Supplies needed:

_____	_____
_____	_____
_____	_____

5. \_\_\_\_\_

Supplies needed:

_____	_____
_____	_____
_____	_____

# Blacksmith

There was once a time, as little as 150 years ago, where everything made from metal was made by a blacksmith. A box of nails that we can carelessly pick up at the hardware store was once a treasured commodity, each nail made by hand. It's no wonder that during that time, as much as 20% of the adult male population would have been employed working metal.

While more and more things are made from synthetic material these days, take a quick inventory around yourself. Just about everything would have been made out of wood or metal. Imagine creating your own unique works of art to bring a little life and character to your homestead. *Retrieved from, Homestead Survival Site*

## Divisions

Due to the nature of this project it is highly recommended that members begin with the first division - beginner, and then continue to progress into higher divisions upon the discretion of the Project Leader. Divisions do not reflect member age or time in 4-H rather, the skill level as determined by the Project Leader. Division may also reflect the skill level and comfort of the Project Leader Divisions are as follows:

Division I - Beginner

Division II - Intermediate

Division III - Advanced

Division IV - Artistic

## Planning Your Project

- **Review & Select** the activities which you want to learn more about based on your division level - *possible topic choices are included on the next page!* Leaders and/or members are also invited to research and create their own project activity.
- **Discuss** with your project leader the project activity outlines as explained in the guide. The Leader Resource (*available at the 4-H PEI Office*) does include more detailed instructions for some project activities.
- **Identify** your goals & time-line for completing chosen project activities

## Helpful Resources!

<https://www.steampoweredfamily.com/education/be-a-blacksmith/>

[http://blacksmiths.mygenwebs.com/\\_glossary.php](http://blacksmiths.mygenwebs.com/_glossary.php)

[beginblacksmithing.com](http://beginblacksmithing.com)

<http://www.mooseforge.com/Techniques/textures.html>

<https://homesteadsurvivalsite.com/blacksmithing-basics-things-need-know/>

<http://www.anvilfire.com/iForge/>

If you are looking for help with one of your project activities, let your 4-H Specialist know, maybe we can help you !  
Call 368-4833 or drop by the PEI 4-H Office at 40 Enman Crescent, Charlottetown.

## Remember...

The multiple intelligence theory teaches us that people learn in at least 8 different ways. All individuals will be stronger in some ways of "intelligence" and weaker in others. It follows that the more ways we teach, the more members we will reach. Teaching projects using a broad blend of writing, reading, hands on work, artwork, self evaluation, discussion, and so on, will help increase the learning potential of all members.

Projects are designed to teach many skills. However, the 4-H member is always more important than the subject matter. Stress cooperation in the activities where possible to develop teamwork and cooperation skills. These are valuable skills that will assist them in a number of settings. Ensure the work is completed in a manner that members feel good about themselves and their efforts. This can be done by assigning appropriate tasks or roles based on member's individual abilities. Modeling and expecting supportive behaviour (i.e. no "put-downs") amongst members, or by other adults, also contributes to a positive experience.

# How it Works

Taking up blacksmithing doesn't just mean making kitchen pot hooks and decorative bottle openers. There are many things a blacksmith can make for use around the homestead that you simply can't buy these days. For example, your own wrought iron hanging grill for cooking over an open fire.

In a nutshell, when heat is applied to metal it becomes soft and can be worked in much the same way a potter works clay. The trick is choosing where to apply heat, and how to shape your piece. To make a long thin piece of metal out of a short and fat one, you can't just grab the end and stretch it. By repeated hitting around all sides, turning as you go, the metal can be worked out into a long thin piece by slowly narrowing it. The metal has to go somewhere, and you can convert width into length, or vice versa, just by knowing where to hit.

## 1. It's Hot Work

The basics of blacksmithing involve heating metal to high temperatures, around 1400 degrees, and then pounding it accurately into shape. Historically, blacksmiths often used coal fired forges to generate high heat, but coal can be messy and potentially dangerous for a backyard blacksmith.

A forge is a heat resistant box lined with firebrick that is fueled by some sort of high heat output source. These days, propane fired forges are the standard for both safety and efficiency. A small hobby forge can be built or purchased.

## 2. Accuracy is Important

While it may look like a fun way to beat out your frustrations, accurate strikes are much more important than hard hits. Blacksmithing is an art after all. Learning to accurately strike the metal and heat it in the appropriate locations takes time. An acetylene torch may not be historically accurate, but it's a great way to heat metal very precisely without having to employ a team of assistants or apprentices old school smiths would have.

## 3. You Spend a Lot of Time Holding Things

The three H's of blacksmithing are heating, holding, and hitting. You'll need to be able to hold a 1400 degree piece of metal for an extended period, so many of your tools will be various tongs and clamps. Sizing your tongs to your piece is important so you don't drop it, potentially destroying your piece or injuring yourself.

## 4. You Get to Hit Things

It is important to remember accuracy first. A good anti-vibration blacksmiths hammer will save your shoulder after a few hours work. While you're hitting metal to shape it, you'll need a platform, usually an anvil. The shape of an anvil is specifically designed to allow you to shape the metal around its various parts, whether curved, bent or straight.

## 5. Safety is Important

Working with so much heat, it's important to minimize fire and burn risk wherever possible. Many modern blacksmiths set up shop in a metal structure or converted shipping container, ideally with a concrete or gravel floor. The risk of a blacksmith's shop burning down is very real, and should not be underestimated.

For your own safety, a leather blacksmith's apron is essential for covering the front of your body, as well as long armed gloves for your hands. Look for tools labeled for use while welding, designed for high heat protection. For your eyes, safety glasses are mandatory. With the constant clank of a hammer or noise of a grinder, ear protection is a great idea.

## 6. Works are Recyclable

When you're working with wood, if you cut it too short, most times you have to start fresh with new material. Metal is moldable, and most mistakes can be repaired. This is a plus for the beginners. Start with some cheap metal and practice. With each strike, watch how your work changes. Every hit is an opportunity to learn something new.

## 7. It Takes Time

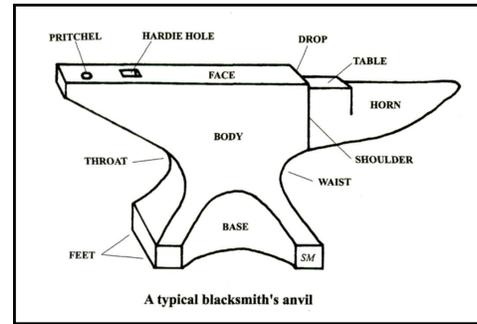
Learning the art of shaping takes time, and a lot of reading. Before you try to get a backyard forge setup, try researching. Reading everything you can ahead of time will help you know what's ahead and understand terms and instructions more easily.

# Basic Tools & Terminology



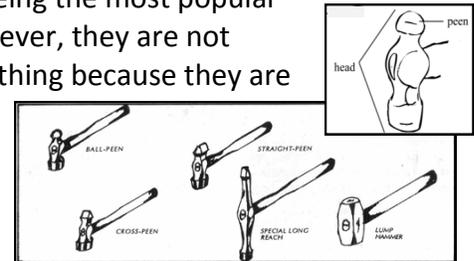
## Anvil

An anvil is a basic blacksmithing tool. Basically, it is a block with a hard, flat surface on which another object is struck. It is where you will be molding and shaping your metal work. A good anvil is critical to successful work.



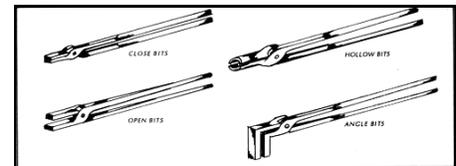
## Hammer

There are many different types, weights and shapes of hammers, claw hammers being the most popular and most widely used. However, they are not recommended for blacksmithing because they are soft and crack easily. A small ball pein or cross pein is recommended.



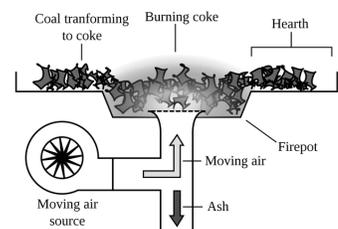
## Tongs

Tongs, vises or clamps are used for holding your work. A tong is a hinged piece of metal which holds hot metal and acts as a very strong, fireproof extension of the hand. When purchasing your first tong or vise, keep in mind that a large or medium-sized example of whichever type you decide on will be more useful than a smaller unit.



## Forge

A forge is a fire, and it is where you heat your work. You can purchase a ready-made forge or make your own. The important thing is you have a place where you can apply heat to a piece of metal.



# Division I : Terminology

**Alloy:** a solid such as steel produced by cooling a molten mixture of metals

**Annealing:** a process of re-heating work hardened steel to make it more malleable and ductile

**Compression:** when forces are applied to a material that tend to squash it

**Ductile:** materials that can be drawn into thin wires without breaking

**Formable:** easily pressed into different shapes

**Hardness:** a measure of how difficult it is to scratch or indent the surface of a material; for example, diamond is very hard and lead is quite soft

**Malleable:** materials that can be hammered into different shapes without breaking

**Metal:** naturally occurring element (iron, titanium, etc.)

**Plastic deformation:** a deformation in which the material does *not* return to its original shape; this is the opposite of an elastic deformation

**Stiffness:** a stiff material (or piece of material) is difficult to stretch

**Tensile Strength:** a measure of the strength of a material that is put under tension. It is the maximum stress it can withstand without breaking

**Weldable:** easily welded together

# Project Activity Ideas - Division I

## **Activity 1 - Terminology**

Learn the terms that are commonly used by blacksmiths. It is important that you know what your project leader is referring to when s/he speaks. It will also be helpful for you to know the proper names of

## **Activity 2 - Safety**

Before beginning any project it is important to review the safety precautions involved. This is an important activity for beginner and advanced learners!

## **Activity 3 - Tools**

Develop an understanding of blacksmith tools. What is each tool used for? When would you use it? Can you use it independently or should the leader/advanced member be nearby?



## **Activity 4 - Fire Building**

Blacksmithing would be impossible without fire! Learn how to make a fire starter and how to safely build a fire that is suitable to work with. Discuss safety practices, the proper way to put out a fire (in relation to your space) and some basic first aid practices.

## **Activity 5 - Practice & Demonstrate**

Under the direction of the project leader members will practice basic techniques to “break the ice” and “get a feel” for the metals and tools. There may be no goal in this activity, but rather an opportunity to experience.

## **Activity 6 - Visit a Blacksmith**

Besides, “Learn to Do By Doing,” the best way to learn is to see and hear. Visit a local blacksmith and see their work firsthand. Ask them questions. Do they have any advice?



## **Activity 7 - Clean & Bend Metal**

Members will learn how to shape metal into an artistic piece. This is an opportunity for members to become more comfortable with the tools and practice.

## **Activity 8 - Bend Metal into a “U” Shape**

Bend a piece of metal into a “U” shape being as consistent as possible. This will be one of the tangible items that you can display at Achievement Day. Members could also explore 90° angles and



## **Activity 9 - The Twist & Scroll**

Members will practice twisting the metal as well as creating a scroll.

## **Activity 10 - “Point” it out**

Member will learn how to hammer a piece of metal into a point.

## **Activity 11 - Coat Hanger or Towel Rack**

Using three pieces of metal and a piece of wood, you will create a coat hanger. After you are satisfied with your three hooks - be sure they are uniform, smooth and sturdy - secure them to the wood.

## **Activity 12 - Endless Ideas**

With the help of your project leader, come up with a new idea unique to your project group.



## **New Format. New activities. New ideas.**

- In its first year of the new project format, the 4-H staff welcome any feedback, questions or concerns about the Blacksmith Project. Please do not hesitate to get in touch. Further instructions are provided in the Leader Guide.
- If you have an idea or topic in mind for a project activity that relates to blacksmithing, be sure to talk to your project leader! The new project format allows you to review, discuss and select activities that interest you and your fellow 4-H project members. If you don't see something that you are interested in, suggest a new idea! Have fun with it!

# Division I - Project Sample - Hooks



## Steps to Forge a basic J hook

<http://www.instructables.com/id/Forging-a-J-hook/>  
*Picture instructions available online*

### Tools

Basic blacksmith setup you need for this.

- Forge
- Anvil
- Hammer
- Tongs
- Steel - 1/4" diam round rod (you can use other sizes for different sized hooks)



Other tools that would help but aren't necessary

- drill (or drill press) and drill bit (I use 7/32")
- Pliers



**Step 1:** Heat the steel and forge it to an almost sharp point. Hold the rod at an angle and the hammer at an angle while turning the rod every two blows or so.

**Step 2:** You can use pliers to curl the point into a small curlique, or you can do it the "blacksmith way" and start the curl off the edge of the anvil and then finish curling it over. Once you learn this method it's actually faster than the pliers

**Step 3:** Decide how big of a J you want, heat that length right past the curlique, then bend it over the anvil horn. Make sure to bend it with the curlique facing out, you don't want it on the inside.



**Step 4:** Determine how long you want it to be and hot cut it there. When using a hot cut you cut almost all the way through (around 2/3) and then break it off.

**Step 5:** You need to make a spot at the top where you can put a hole for nailing the hook. One option is to heat the top, and flatten it with 3-4 good blows, you can try to make the flattened part look nice and symmetrical, or choose to leave it random.



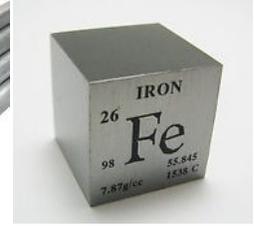
**Step 6:** Make a hole by hot punch or drill a hole.

**Step 7:** Member may choose to make a simple embellishment.

*Members may choose how they would like to mount their completed hooks .*

## Division II: Common Types of Metals

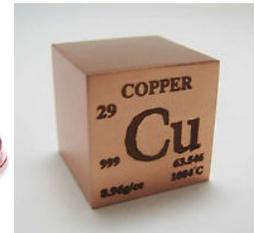
1. **Iron** is the most used metal on the planet - it is the main element in alloys called "steel" and steel alloys are basically the bread and butter of metals. Steels are usually very cheap, strong and relatively easy to work with.



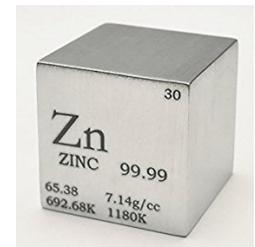
2. **Aluminum** is the next most common metal. It is light weight, corrosion resistant, and very easy to machine into just about any shape you can think of. Aluminum is more expensive than most steel alloys and usually not quite as strong.



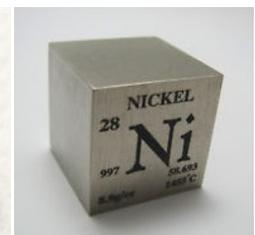
3. **Copper** comes in third. It is very heavy, but very ductile, malleable and very electrically and thermally conductive. It is corrosion resistant, but its use in construction is limited by its high price and relatively low strength.



4. **Zinc** is the fourth most common metal. It is most often used as a coating on galvanized steel. Zinc is also mixed with copper in order to make brass alloys. It has a very low melting temperature compared to most metals and is commonly used to make cast metal parts.



5. Finally, **Nickel**, comes in fifth. It is mostly commonly used as an element (along with iron and chromium) in steel alloys called "stainless steels." Nickel is very strong and very corrosion-resistant, but also quite expensive to produce. It is used in super alloys such as those used to make jet engine turbines.



## Division II: Lighting the Forge

### How to Light a Coal Fire

Assuming that you have access to a forge, here are some simple steps to teach members how to light a fire.

#### 1. Clean Up

Old ashes and cinders will restrict air flow, this makes for poor-burning .

#### 2. Build Your Fire - Paper

Start with dry, unfinished paper. Make sure you roll the paper into balls—not too tight . Cover the grate with paper, but remember to leave space for airflow. One layer is all that is necessary. The purpose of the paper is only to light the next layer on fire, but too much paper will clog the fire-bars.

#### 3. Build Your Fire - Wood

Layer small pieces of wood (kindling) alternately over the paper. This is to support the coal and ignite it as it burns. When you light your fire, you want the wood to hold after the paper burns, rather than fall apart. Choose a mixture of thick and thin kindling. Thin will burn easily and produce heat, while thick will sustain.

#### 4. Build Your Fire - Coal

Build a pile of coal on top of the wood - stick to the middle.

#### 5. Light it!

Ensure there is proper air flow. Ignite the paper from underneath and in multiple places. Get as much lit as quickly as possible.

Coal needs time. Coal produces gas and tar when heated and only when it's "dried out" do you get the red hot, or brighter, carbon fire that makes the coal so hot.

#### 6. Continued Care

Once the fire is lit, poke it gently to release ash and break up the coals that may have stuck together. Spread cinders and add more coal. Do not throw a whole bucket of coal onto the fire, always put bits at the edges or in the middle.

#### 7. Long Term Maintenance

Ensure that the fire is poked periodically. Keep adding coal as needed, but remember only bits at a time to ensure the fire does not get smothered and kill the heat.

Retrieved from, and for leader reference:

<http://www.instructables.com/id/How-to-light-a-coal-fire/>



# Project Activity Ideas - Division II

## **Activity 1 - Terminology**

Project members should review basic terms and learn some new terms that will become common to them in division II.



## **Activity 2 - Safety**

As always, before beginning any project it is important to review the safety precautions involved. This is an important activity for beginner and advanced learners!

## **Activity 3 - Identifying Types of Metal**

Now that you have a good foundation for blacksmithing, begin to explore the different types of metal available to you. What are they called? What are they most used for? Are they durable? Malleable? Strength?

## **Activity 4 - Lighting the Forge**

You've learned how to make a fire, how to be safe around fires and basic fire first aid... now, it's your turn to start lighting the fires. Put everything that you have learned into practice.

## **Activity 5 - Rivets**

Learn how to make and use rivets.



## **Activity 6 - Punch, Slit and Drift**

Three more blacksmith techniques that will come in handy for future projects.

## **Activity 7 - Basic Welding**

Blacksmithing and welding can go hand in hand. For some creations you will need to know basic welding techniques. Your project leader will determine if this is necessary for future project activities.

## **Activity 8 - Practice**

Though you may decide to practice for multiple meetings, in this division, you can use "practice" as one of your project activities. Be sure to display some of your practice work at Achievement Day.

## **Activity 9 - Candle Holder**

Are you ready for a challenge? This item may require you to use your blacksmith and welding skills. Design a candle holder that will be sturdy and safe enough to hold a lit candle.

## **Activity 10 - Trivet**

Members will research a design or create their own design in order to create a trivet.



## **Activity 11 - Household Item**

Members will choose to create a toilet paper holder or a paper towel holder. Item should be mounted for Achievement Day with a sample roll to show that the item is functional.

## **Activity 12 - Endless Ideas**

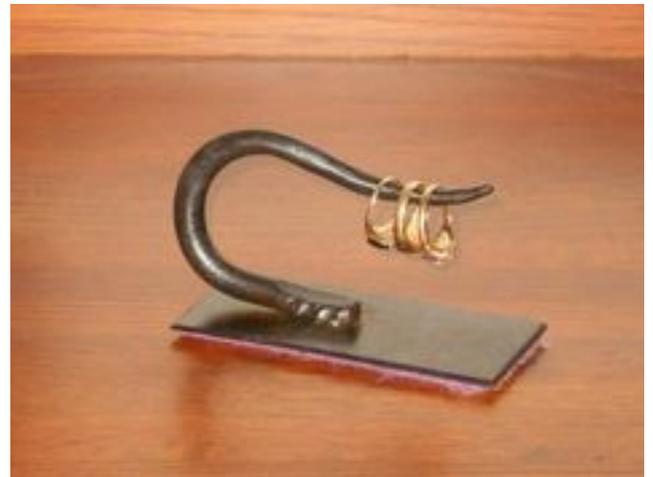
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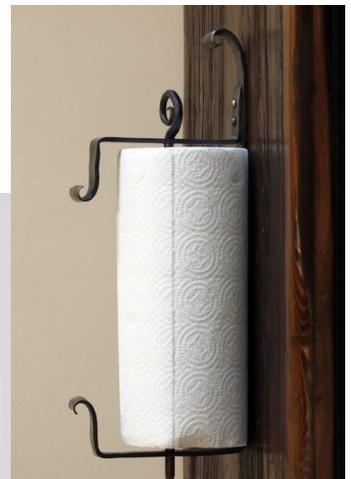
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## Project Activity Samples - Division II



### Ideas

- Candle Holder
- Trivet
- Toilet Paper Holder
- Ring/Earring Holder
- Paper Towel Holder



# Division III: A Lesson in Chemistry

**The Periodic Table of Elements...** without going too deep... the Periodic Table is organized like a big grid. Each element is placed in a specific location because of its atomic structure. The rows (also known as a period) and columns (also known as groups) are strategically made up of elements that share like properties.

Almost 75% of the elements are classified as metals.

**Periodic Table of the Elements**

1																	18
1	2											13	14	15	16	17	18
1 H 1.01 Hydrogen																	2 He 4.00 Helium
3 Li 6.94 Lithium	4 Be 9.01 Beryllium											5 B 10.81 Boron	6 C 12.11 Carbon	7 N 14.01 Nitrogen	8 O 15.99 Oxygen	9 F 18.99 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminum	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.09 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 51.99 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.41 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.79 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc [98] Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Cesium	56 Ba 137.3 Barium	57-71 La-Lu *	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 196.9 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 208.9 Bismuth	84 Po [209] Polonium	85 At [210] Astatine	86 Rn [222] Radon
87 Fr [223] Francium	88 Ra [226] Radium	89-103 Ac-Lr **	104 Rf [261] Rutherfordium	105 Db [262] Dubnium	106 Sg [266] Seaborgium	107 Bh [264] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [269] Darmstadtium	111 Rg [272] Roentgenium	112 Cn [285] Copernicium	113 Uut [284] Ununtrium	114 Fl [289] Flerovium	115 Uup [288] Ununpentium	116 Lv [293] Livermorium	117 Uus [294] Ununseptium	118 Uuo [294] Ununoctium
		* 57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [145] Promethium	62 Sm 150.4 Samarium	63 Eu 151.9 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.1 Ytterbium	71 Lu 174.9 Lutetium	
		** 89 Ac [227] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237] Neptunium	94 Pu [244] Plutonium	95 Am [243] Americium	96 Cm [247] Curium	97 Bk [247] Berkelium	98 Cf [251] Californium	99 Es [252] Einsteinium	100 Fm [257] Fermium	101 Md [258] Mendelevium	102 No [259] Nobelium	103 Lr [262] Lawrencium	

Atomic Number → 1

Symbol → H

Relative Atomic Mass → 1.01

Name → Hydrogen

**Color Code**

Other non-metals	Noble gases
Alkali metals	Lanthanides
Transition metals	Actinides
Other metals	Unknown chemical properties
Alkaline earth metals	
Halogens	

26

**Fe**

Iron

55.847

Name: Iron  
 Symbol: FE  
 Atomic # 26 ← The number of protons in the nucleus  
 Atomic Mass: 55.847  
 Group #8  
 Period #4

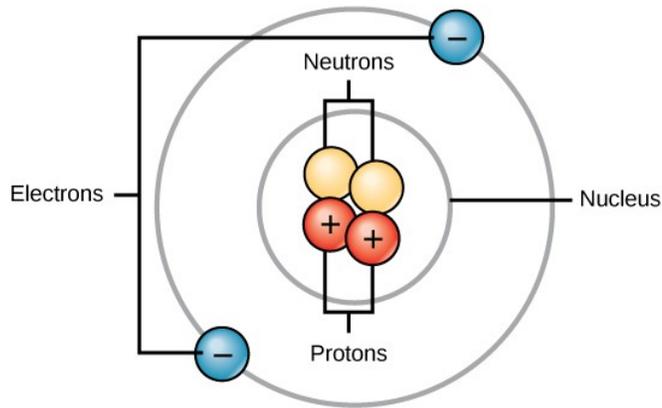
Retrieved from, and for leader reference:

[http://www.chem4kids.com/files/atom\\_intro.html](http://www.chem4kids.com/files/atom_intro.html)

<https://opentextbc.ca/biology/chapter/2-1-the-building-blocks-of-molecules/>

# Division III: A Lesson in Chemistry

These are the parts of an atom:

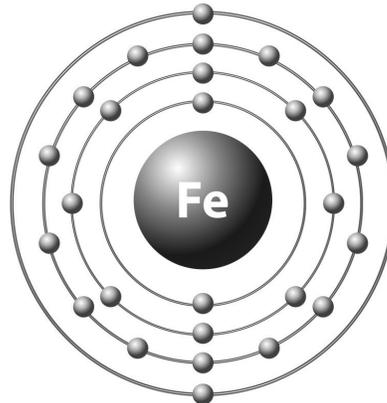


This is an **iron** atom...

26

**Iron**

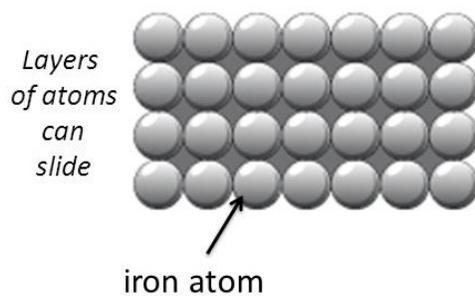
Fe



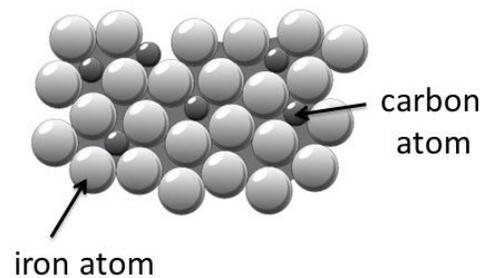
Atomic mass: 55.845

Here is how alloys would look microscopically...

**Iron**



**Steel**



Retrieved from, and for leader reference (applicable to current and following 2 pages):

[http://www.chem4kids.com/files/atom\\_intro.html](http://www.chem4kids.com/files/atom_intro.html)

<https://www.slideshare.net/tomwheats/alloy-metals>

<http://www.explainthatstuff.com/alloys.html>

<http://resources.schoolscience.co.uk/Corus/16plus/steelch2pg5.html>

# Division III: Metals & Alloying

## Common Alloying Elements

Alloying Element	Properties given to steel	Uses
Cobalt	High magnetic permeability	Magnets
Manganese	Strong and hard	Heavy duty railway crossings
Molybdenum	Maintains high strength at high temperature	High speed drill tips
Nickel and Chromium	Resists corrosion	Surgical instruments
Titanium	Increased hardness and tensile strength	High speed tool steels, permanent magnets
Tungsten	High melting temperature, tough	Cutting and drilling tools
Vanadium	Strong, hard	Tools

## Alloy Carbon Steels

Steel is made up of iron and carbon. The percentage of carbon has a dramatic effect on the properties of the material and therefore on the uses for which it is suitable:

Type of Steel	% of Carbon	Properties	Uses
Low carbon (mild steel)	0.07-0.25	Easily cold worked	Car bodies, bullets, nuts & bolts, chains, hinges, knives and armour
Medium carbon	0.25-0.50	Wear resistant	Rails, heavy machinery, such as couplings, crank shafts, axels, gears & forgings
High carbon (tool steel)	0.85-1.2	Strong and wear resistant	Cutting tools (power saw blades an, railway lines, spring and heavy strength wires
Cast iron	2.5-3.8	Easy to cast, but brittle	Pistons and cylinders

## Alloy Metal Examples

The addition of small amounts of other metals to make alloy steels changes the properties of the material even further and means that a steel can be manufactured that has exactly the right properties for its purpose.

Alloy Metal	Primary Elements	Properties	Uses
Brass	Zinc & Copper	Malleable (depending on zinc content), good conductor of electricity, soft (doesn't spark easily), acoustic properties, low melting point and low friction	Hinges, pins, screws, ammunition cartridges, lamps, electrical sockets, horns and bells
Bronze	Tina and Copper	Hard	Decorative statues and musical instruments
Duralumin	Aluminum & Copper	Strong, hard, lightweight, relatively soft, ductile, can be rolled and ductile	Aircraft parts - for its lightweight, airships, spirit levels
Solder	Lead and Tin	Low melting point	For joining metals, electronics
Stainless Steel	Steel & Chromium	Strong, corrosion resistant, hard, protective coating uses oxygen to rebuild protective layer, excellent fatigue and impact resistance	Kitchen worktops, cutlery, pans, chains, wire & swiss army knives

# Division III: Metals & Alloying

**Wrought Iron** is the traditional metal that blacksmiths work with. Wrought iron has a lower carbon content with iron silicate or slag added to it. It has a higher melting point and the iron silicate gives it a doughy or plastic like texture when it is exposed to extreme heat. The characteristic of not melting but becoming malleable when heated makes it the ideal metal of choice for blacksmiths to use. It can be shaped by hammer, press, twisting or bending. It is corrosion resistant with a rough finish, allowing it to be painted or coated.

**Cast Iron** has a higher carbon content, which means it is harder, therefore more brittle. It has a low melting point and can easily be pored into moulds and casts.

**Steel** has come to replace wrought iron as it is no longer used for economic reasons. Steel also has a low carbon content which is malleable and can be heated to change its shape.

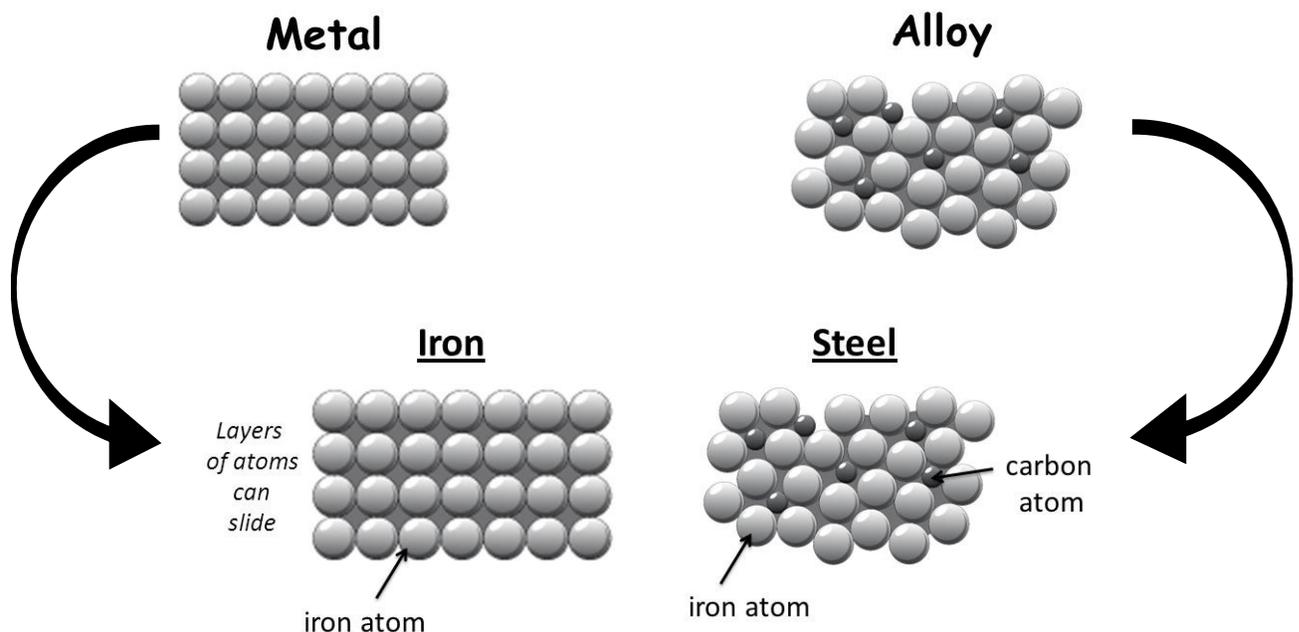
**An Alloy or Alloying** is when additional elements are added to the molten metal so that the resulting solid is harder and has other desirable properties. Pure metals are rarely used in manufacturing because they are too soft. An exception to this is manufacturing car bodies, which are made from new steels that are nearly pure iron.

## Adding larger ions

In the alloy, some of ions that are added may be larger than the original ions that make up the metal lattice. They disrupt the regular arrangement of ions and make it more *difficult* for the layers to slide over each other. This makes the alloy harder and less malleable and ductile than the pure metal (in which the layers easily slip over each other).

## Adding smaller ions

Smaller sized atoms can also have a significant effect on the alloy structure. In steel, for example, atoms of non-metals such as carbon and nitrogen can fit into holes between the iron atoms. This also distorts the metal lattice and makes it more difficult for the layers to move over each other.



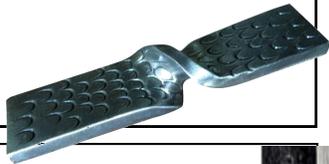
# Project Activity Ideas - Division III

## **Activity 1 - Terminology**

Review what you know and dive deeper. Are there any other terms that you may need to know as you explore harder project ideas?

## **Activity 2 - Safety**

It never hurts to review! Be sure to include fire safety practices and first aid as well.



## **Activity 3 - Textures**

Time to learn how to change the texture of metal! Members may start learning how to make textures with a hammer. Be sure to make samples for Achievement Day!

## **Activity 4 - Punches and Stamps**

Learn how to make a punch or a stamp. The beginning of your own blacksmith tool collection! Be sure to test out the pump or stamp - it should be in working condition.

## **Activity 5 - Do the Twist**

Members will research different twisting techniques and create a sample spread for Achievement Day.

## **Activity 6 - Forge**

Did you know that a forge can be made from a soup or coffee can?! With the help of your project leader, and maybe even your whole project group, build a forge from beginning to end!

## **Activity 7 - Jewelry**

With the comeback of the forge, there are many things metal that have also become popular. Design your own piece of jewelry - bracelet, pendant, etc. and work with your project leader to create it.

## **Activity 8 - Utensils or BBQ Set**

Members will create a set of utensils - think camping! 4-H Specialist will be looking for a fork, spoon and knife OR a spatula, large fork and a set of four skewers. Please be sure that knife **is not** sharpened for

## **Activity 9 - Playing Around**

Choose one of your favourite games and make a unique version! Chess, checkers, horseshoes or yahtzee? Member is allowed to use other materials, ie. Wood, for this activity to create the board.

## **Activity 10 - Hook & Eye**

Member will create a hook and eye lock that could be used to secure a door.



## **Activity 11 - Pick a Metal**

Each member can pick a metal or alloy and research it. Where is it found, what metals make up the alloy, what is it used for? Be creative when presenting back to your group.

## **Activity 12 - Exploring Metals**

Though it is understood that materials may be limited to members, should the opportunity arise - try working with a different type of metal. Use a project idea from the Division I or II level as a starting point.

## **New Format. New activities. New ideas.**

- In its first year of the new project format, the 4-H staff welcome any feedback, questions or concerns about the Blacksmith Project. Please do not hesitate to get in touch. Further instructions are provided in the Leader Guide.
- If you have an idea or topic in mind for a project activity that relates to blacksmithing, be sure to talk to your project leader! The new project format allows you to review, discuss and select activities that interest you and your fellow 4-H project members. If you don't see something that you are interested in, suggest a new idea! Have fun with it!

# Project Activity Ideas - Division III



round bar - single twist



square bar - single twist



square bar - reverse twist



round bar - reverse twist



square bar - long split twist



# Project Activity Ideas - IV Artistic

## **Activity 1 - Wall Art**

Member will create a piece of hand forged wall art.

## **Activity 2 - Outdoor**

Member will create a bird feeder - a design of their choice that can be hung outdoors.

## **Activity 3 - Furniture**

Member will create a piece of furniture that is largely made up of hand forged metal. Other materials can also be used to complete the design.

## **Activity 4 - Decoration**

Choose a decoration to create out of metal - flowers, ornament, etc. The possibilities are endless!

## **Activity 5 - Tools**

Member will create their own set of tools that include 2-3 pieces.

## **Activity 6 - Endless Possibilities**

Members and leaders are invited to come up with their own activity that will allow members to showcase a variety of skills and techniques that reflect the advanced level.

## **New Format. New activities. New ideas.**

- At this level of the project it is understood that members will have their own ideas and projects in mind. The ones listed above are merely suggestions. Members must follow achievement day requirements.
- In its first year of the new project format, the 4-H staff welcome any feedback, questions or concerns about the Blacksmith Project. Please do not hesitate to get in touch. Further instructions are provided in the Leader Guide.
- If you have an idea or topic in mind for a project activity that relates to blacksmithing, be sure to talk to your project leader! The new project format allows you to review, discuss and select activities that interest you and your fellow 4-H project members. If you don't see something that you are interested in, suggest a new idea!



## 4-H Judging

Judging is an important skill that you will use in 4-H and beyond. As a 4-H member, judging will help you develop important assessment skills, and with practice, you will learn to carefully **observe, evaluate, make decisions, communicate with confidence.**

### Is Judging a requirement for THIS project?

Judging is not a requirement for **ALL** 4-H PEI projects, but you are encouraged participate in the practice whenever possible.

- When Judging is a requirement, it will be listed in the PCR's (Project Completion Requirements) on the front page of this member booklet. Members will need to fill out the score card below showing that the activity has been completed. The judging activity will be arranged by your project leader!
- When Judging is not a requirement, members and leaders may use the information and scorecard below for practice and learning. The skills learned from 4-H judging are used in everyday life situations, so it is always a useful skill to build!

### Score Card for Judging

I place this class of: \_\_\_\_\_ in the order of \_\_\_\_\_  
(Description - specify type of animals or items) (1st) (2nd) (3rd) (4th)

I place \_\_\_\_\_ over \_\_\_\_\_ because:

Reasons: \_\_\_\_\_  
\_\_\_\_\_

I place \_\_\_\_\_ over \_\_\_\_\_ because:

Reasons: \_\_\_\_\_  
\_\_\_\_\_

I place \_\_\_\_\_ over \_\_\_\_\_ because:

Reasons: \_\_\_\_\_  
\_\_\_\_\_

I place \_\_\_\_\_ at the bottom of this class because:

Reasons: \_\_\_\_\_  
\_\_\_\_\_

For these reasons, I place this class of: \_\_\_\_\_ in the order of \_\_\_\_\_  
(1st) (2nd) (3rd) (4th)

### 4-H MEMBER OPPORTUNITY - Provincial 4-H Judging Competition (Annual Event)

This event is open to all members, ages 9-21, and offers a great opportunity to learn more about judging in a competitive atmosphere (Three age categories & cash prizes awarded to top members for their judging abilities). Senior members (17-21) also compete for the chance to join the **Maritime 4-H Judging Team** to compete at **Agribition** (Regina, SK) in November.



- **4-H Canada Learns** is a resource tool providing information on 4-H projects from different provinces. Check out [www.4-h-learns.org/resources](http://www.4-h-learns.org/resources) - keyword "judging" for resource documents that will help with developing and building your judging skills!
- **4-H PEI** is able to provide information to members and leaders on both livestock and non-livestock judging practices. Check with your 4-H Specialist for more information **AND** be sure to check out the 4-H PEI Judging Resource page at [www.pei4h.ca/4-h-judging-resources](http://www.pei4h.ca/4-h-judging-resources)

# Member Reflection

As a 4-H member, you are encouraged to “Learn to Do by Doing” through hands-on activities. Keeping a record of your 4-H activities with this **Member Reflection** will provide helpful insight for you, your leader and the 4-H Specialist as to skills you have learned and projects you have completed throughout the 4-H year!



**Skill Based Project:** You are encouraged to work on skill development and completion of project requirements (with guidance from the project leader) throughout the 4-H year. Not every activity will have a tangible item (for display), but you are asked to share the activities and learnings in which you participate below...

**Project Activity:** \_\_\_\_\_

What I did: \_\_\_\_\_

What I learned: \_\_\_\_\_

What I liked: \_\_\_\_\_

**Project Activity:** \_\_\_\_\_

What I did: \_\_\_\_\_

What I learned: \_\_\_\_\_

What I liked: \_\_\_\_\_

**Project Activity:** \_\_\_\_\_

What I did: \_\_\_\_\_

What I learned: \_\_\_\_\_

What I liked: \_\_\_\_\_

**Project Activity:** \_\_\_\_\_

What I did: \_\_\_\_\_

What I learned: \_\_\_\_\_

What I liked: \_\_\_\_\_

**Project Activity:** \_\_\_\_\_

What I did: \_\_\_\_\_

What I learned: \_\_\_\_\_

What I liked: \_\_\_\_\_

*(feel free to use more space if necessary!)*

**LEADER COMMENTS (optional):** Leader observations can be helpful to you in future years with this and other 4-H projects. Be sure to ask your project leader if they would like to reflect on your 4-H year.

I am most impressed by... \_\_\_\_\_

I believe that you have learned... \_\_\_\_\_

In the future I encourage you to... \_\_\_\_\_

## 4-H Year Completion Checklist

In addition to completing a Skill Based 4-H project, members are also required to participate in Communications, at least **ONE** Ag. Awareness Activity and **ONE** Community Service Activity in order to complete the 4-H year.

Use the space provided to reflect on what you have learned through participation in these activities.

If this information has already been completed in another booklet, please indicate where it can be found:

### My Communications Activity

- Speech                     
  Demonstration (Single)                     
  Demonstration (Team)                     
  Alternate Communications: \_\_\_\_\_

What I learned: \_\_\_\_\_

What I can work on: \_\_\_\_\_

### Agriculture Awareness Activity

What did you do to complete this activity this year? (Either on your own or with your 4-H Club)

What area of Agriculture would you like to explore in the future?

### Community Service Activity

What did you do to complete this activity this year? (Either on your own or with your 4-H Club)

What will you do in the future to give back to your community?

## 4-H PEI - Staff Comments (Optional)

Completion Requirements		<u>Completion Notes</u>
Skill Based Project		
Communications		
Ag. Awareness Activity		
Community Service Activity		