Scout Name: _____ **Unit #:** _____ **Date:** _____

Camp Attended: _____

METALWORK

Merit Badge Requirements

1) Read the safety rules for metalwork. Discuss how to be safe while working with metal. Discuss with your counselor the additional safety rules that apply to the metalwork option you choose for requirement 5.

2) Define the terms native metal, malleable, metallurgy, alloy nonferrous, and ferrous. Then do the following:

a) Name two nonferrous alloys used by pre-Iron Age metalworkers.
b) Name three ferrous alloys used by modern metalworkers.
c) Describe how to work-harden a metal.
d) Describe how to anneal a nonferrous and a ferrous metal.

3) Do the following:

a) Work-harden a piece of 26- or 28-gauge sheet brass or sheet copper. Put a 45-degree bend in the metal, then heavily peen the area along the bend line to work-harden it. Note the amount of effort that is required to overcome the yield point in this unworked piece of metal.
b) Soften the work-hardened piece from requirement 3a by annealing it, and then try to remove the 45-degree bend. Note the amount of effort that is required to overcome the yield point.
c) Make a temper color index from a flat piece of steel. Using hand tools, make and temper a center punch of medium-carbon or high-carbon steel.

4) Find out about three career opportunities in metalworking. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.

5) After completing the first four requirements, complete at least **ONE** of the options listed below:

a) Option 1 – Sheet Metal Mechanic/Tinsmith
    1) Name and describe the use of the basic sheet metalworking tools.
    2) Create a sketch of two objects to make from sheet metal. Include each component's dimensions on your sketch, which need not be to scale.
    3) Make two objects out of 24- or 26-gauge sheet metal. Use patterns either provided by your counselor or made by you and approved by your counselor. Construct these objects using a metal that is appropriate to the objects ultimate purpose, and using cutting, bending, edging, and either soldering or brazing.
        a) One object also must include at least one riveted component.
        b) If you do not make your objects from zinc-plated sheet steel or tin-plated sheet steel, preserve your work from oxidation.
b) Option 2 – Silversmith
    1) Name and describe the use of a silversmith's basic tools.
    2) Create a sketch of two objects to make from sheet silver. Include each component's dimensions on your sketch, which need not be to scale.
    3) Make two objects out of 18- or 20-gauge sheet copper. Use patterns either provided by your counselor or made by your and approved by your counselor. Both objects must include a soldered joint. If you have prior silversmithing experience, you may substitute sterling silver, nickel silver, or lead-free pewter.
        a) At least one object must include a sawed component you have made yourself.
        b) At least one object must include a sunken part you have made yourself.
        c) Clean and polish your objects.
c) Option 3 – Founder
    1) Name and describe the use of the basic parts of a two-piece mold. Name at least three different types of molds.
    2) Create a sketch of two objects to cast in metal. Include each component's dimensions on your sketch, which need not be to scale.
    3) Make two molds, one using a pattern provided by your counselor and another one you have made yourself that has been approved by your counselor. Position the pouring gate and vents yourself. Do not use copyrighted materials as patterns.
        a) Using lead-free pewter, make a casting using a mold provided by your counselor.
        b) Using lead-free pewter, make a casting using the mold that you have made.
d) Option 4 – Blacksmith
    1) Name and describe the use of a blacksmith's basic tools.
    2) Make a sketch of two objects to hot-forge. Include each component's dimensions on your sketch, which need not be to scale.
    3) Using low-carbon steel at least ¼ inch thick, perform the following exercises:
        a) Draw out by forging a taper.
        b) Use the horn of the anvil by forging a U-shaped bend.
        c) Form a decorative twist in a piece of square steel.
        d) Use the edge of the anvil to bend metal by forging an L-shaped bend.
    4) Using low-carbon steel at least ¼ inch thick, make the two objects you sketched that require hot-forging. Be sure you have your counselor's approval before you begin.
        a) Include a decorative twist on one object.
        b) Include a hammer-riveted joint in one object.
        c) Preserve your work from oxidation.

Requirement 1

Read the safety rules listed in the Metalwork merit badge pamphlet. Describe how to be safe while working with metal:

Requirement #5 asks that you choose 1 of the 4 options. Which option did you select?

Describe the additional safety rules that apply to the option you selected:

__ Discuss all of the safety rules with your counselor.

Requirement 2

Define the following terms:

Native Metal:

Malleable:

Metallurgy:

Alloy:

Nonferrous:

Ferrous:

A) Name two nonferrous alloys used by pre-Iron Age metalworkers:

1) _____ 2) _____

Name the metals that are combined to form alloy #1:

Name the metals that are combined to form alloy #2:

B) Name 3 ferrous alloys used by modern metal workers:

1) _____ 2) _____ 3) _____

C) Describe how to "work-harden" a metal: _____

D) Describe how to "anneal" a nonferrous metal: _____

Describe how to "anneal" a ferrous metal: _____

Requirement 3

A) Work-harden a piece of 26- or 28-gauge sheet brass or sheet copper. Put a 45-degree bend in the metal, then heavily peen the area along the bend line to work-harden it. Note the amount of effort that is required to overcome the yield point in this unworked piece of metal.: _____

B) Soften the work-hardened piece from requirement 3a by annealing it, then try to remove the 45-degree bend. Note the amount of effort that is required to overcome the yield point: _____

C) Make a temper color index from a flat piece of steel. Using hand tools, make and temper a center punch of medium-carbon or high-carbon steel:

Requirement 4

Find out about three career opportunities in metalworking.

1) _____ 2) _____ 3) _____

Pick one of the above careers: _____

What education do you need for this profession: _____

What training do you need for this profession: _____

What experience is required for this profession: _____

Explain why this profession might interest you: _____

Requirement 5

After completing the first four requirements, complete at least **ONE** of the options listed below.

A) Object 1: Sheet Metal Mechanic/Tinsmith

1) Name the basic sheet metalworking tools and describe the use of each below:

Tool:	**Describe the use of the tool:**

2) Create a sketch of two objects to make from sheet metal, include each component's dimensions on your sketch, which need not be to scale:

3) Make two objects out of 24- or 26-gauge sheet metal. Use patterns either provided by your counselor or made by you and approved by your counselor. Construct these objects using a metal that is appropriate to the object's ultimate purpose, and using cutting, bending, edging, and either soldering or brazing. Describe your project: _____

A) One object also must include at least one riveted component. _____

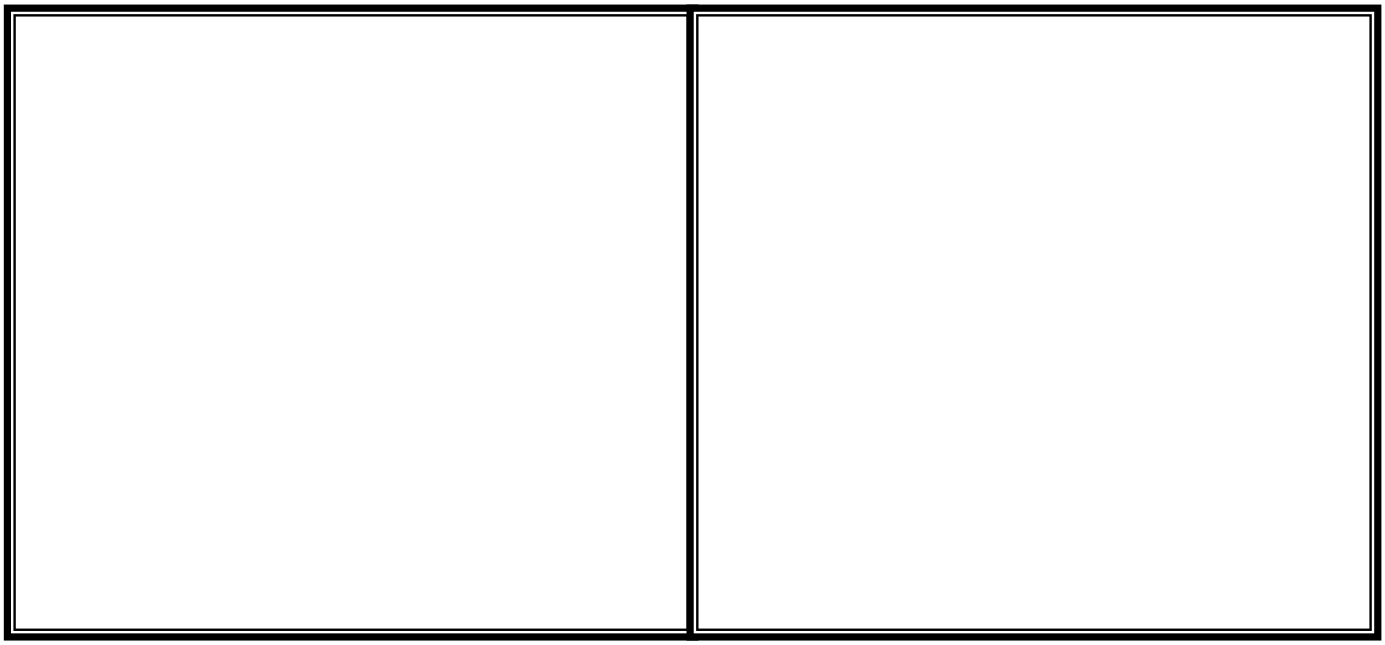
B) If you do not make your objects from zinc-plated sheet steel or tin-plated sheet steel, preserve your work from oxidation. _____

B) Object 2: Silversmith

1) Name and describe the use of a silversmith's basic tools:

Tool:	**Describe the use of the tool:**

2) Create a sketch of two objects to make from sheet silver. Include each component's dimensions on your sketch, which need not be to scale.



3) Make two objects out of 18- or 20-gauge sheet copper. Use patterns either provided by your counselor or made by you and approved by your counselor. Both objects must include a soldered joint. If you have prior silversmithing experience, you may substitute sterling silver, nickel silver, or lead-free pewter. Describe your pattern: _____

_____

_____

_____

A) At least one object must include a sawed component you have made yourself. _____ was this done?

B) At least one object must include a sunken part you have made yourself. _____ was this done?

C) Clean and polish your objects. _____ was this done?

C) Option 3 – Founder

1) Name and describe the use of the basic parts of a two-piece mold.

Mold: **Describe the mold:**

_____ _____

_____

Name at least three different types of molds:

_____ _____ _____

_____ _____ _____

_____ _____ _____

2) Create a sketch of two objects to cast in metal. Include each component's dimensions on your sketch, which need not be to scale.

3) Make two molds, one using a pattern provided by your counselor and another one you have made yourself that has been approved by your counselor.

Describe your molds: _____

Position the pouring gate and vents yourself: _____ was this done?
Do not use copyrighted materials as patterns.

A) Using lead-free pewter, make a casting using a mold provided by your counselor: _____was this done?
Describe your casting:_____

B) Using lead-free pewter, make a casting using the mold that you have made: _____was this done?
Describe your casting:_____

D) Option 4 – Blacksmith

1) Name and describe the use of a blacksmith's basic tools:

Tool:	**Describe the use of the tool:**

2) Make a sketch of two objects to hot-forge. Include each component's dimensions, but does not need to be to scale.

3) Using low-carbon steel at least ¼ inch thick, perform the following exercises:
A) Draw out by forging a taper: _____was this done?

B) Use the horn of the anvil by forging a U-shaped bend: _____was this done?

C) Form a decorative twist in a piece of square steel: _____was this done?

D) Use the edge of the anvil to bend metal by forging an L-shape bend: _____was this done?

4) Using low-carbon steel at least ¼ inch thick, make the two objects you sketched that require hot-forging. Be sure to have your counselor's approval before you begin.
Describe your two objects:

_____
_____
_____
_____

_____
_____
_____
_____

A) Include a decorative twist on one object: _____was this done?

B) Include a hammer-riveted joint in one object: _____was this done?

C) Preserve your work from oxidation: _____was this done?