**Make a Pencil Holder**

# Description

Welders are required to work with many other metalworking trades. To be successful as a welder one must have an understanding of many other metalworking skill sets and an understanding of the entire project. This activity plan will demonstrate to students how to successfully cut, lay out, assemble, and weld a wood stump pencil holder for use as a

paperweight and pencil/pen holder. These tasks will expose students to skills used by welders and metal fabricators.

# Lesson Objectives

Students will learn to:

* Work safely using metalworking tools
* Perform accurate layout
* Cut and form materials using hand tools and power tools
* Join and shape metal by welding processes
* Perform finishing techniques using hand tools and power tools

# Assumptions

Students will:

* Have knowledge of measurement systems used in metalworking
* Have knowledge of layout procedures used in metalworking
* Have an understanding of safe shop practices
* Know the safe use and procedures of hand tools, bench grinders, belt sanders, and welders

# Terminology

**MIG welding (GMAW)**: a welding method in which electric current flows through the filler metal wire to maintain the arc. An inert or semi-inert gas shields the arc from outside air. MIG is an abbreviation of “metal gas welding,” and GMAW is an abbreviation of “gas metal arc welding.”

**Porosity**: a condition in which bubbles form in the weld due to the absorption of atmospheric gases in the molten weld.

**Shielding gas**: an inert or semi-insert gas used to protect the weld area from atmospheric gases such as oxygen, nitrogen, and water vapour.



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**Stick welding (SMAW)**: a welding method that uses flux-coated electrodes within a high- amperage circuit to melt and deposit metal for surfacing and joining metal components. SMAW is an abbreviation of “shielded metal arc welding.”

**Tack weld**: a small weld(s) that holds pieces together for assembly. They can be removed more easily than a full weld if adjustments are needed.

**Weld bead**: a deposit of filler material into the weld joint.

# Estimated Time

6 hours

The time will depend on the students’ experience in the metalwork shop and the number of tools available to them.

# Recommended Number of Students

20, based on the *BC Technology Educators’ Best Practices Guide*

# Facilities

A standard secondary school metalwork shop

# Equipment/Machinery

* + MIG welder (GMAW)
  + Stick welder (SMAW)
  + Drill press
  + Bench grinder
  + Belt sander
  + Bench vice
  + Beverly shear
  + Foundry furnace
  + Welding torch
  + Wire wheel

# Tools

* + Hacksaw
  + Metal file
  + Machinist square
  + Scribe
  + Layout hammer

**Materials**

* Mild steel flat stock ⅛" × 2"
* Mild steel pipe 0.100"–0.1875" wall × 2" diameter or similar
* Mild steel round stock 3⁄16"
* Spray paint
* Sandpaper

# Resources

## Safety tests: Generic safety tests are available in the Heads Up for Safety booklet

https://[www.bced.gov.bc.ca/irp/resdocs/headsup.pdf](http://www.bced.gov.bc.ca/irp/resdocs/headsup.pdf)

## Welding video and instructions ranging from preparation to various welding positions

https://[www.millerwelds.com/resources/article-library/mig-welding-the-basics-for-mild-steel](http://www.millerwelds.com/resources/article-library/mig-welding-the-basics-for-mild-steel)

## Video explaining different types of welders: oxyacetylene, MIG, TIG, and stick

https://[www.youtube.com/watch?v=xrPeKfKW3Eo](http://www.youtube.com/watch?v=xrPeKfKW3Eo)

## Video about the career of welding

https://[www.youtube.com/watch?v=rlOEBAIkmwg](http://www.youtube.com/watch?v=rlOEBAIkmwg)

## Weld joints and types

https://en.wikipedia.org/wiki/Welding\_ joint

## BCIT Metal Fabrication trades video

https://[www.youtube.com/watch?v=IhvvUWH8Z5w](http://www.youtube.com/watch?v=IhvvUWH8Z5w)

# Teacher-led Activity



Demonstrate the following procedures to the class. Students will then replicate the processes.

**Note**: In the following activities other dimensions of metal can be used, but measurements will need to be adjusted.

## Part 1: Layout and Cutting of Stump

1. Use a ruler and a scribe to make a mark at 3" on a piece of mild steel pipe 0.100"–0.1875" wall × 2" diameter or similar.
2. Using a hacksaw or band saw, cut pipe to length.
3. Using a bench grinder, belt sander, or file, square both ends of the pipe.
4. Using a 2" hole saw on a drill press, or a hacksaw and grinder, cut a 2" circle out of mild steel flat stock ⅛" × 2".

## Part 2: Layout and Cutting of Axe

1. Using a ruler and a scribe, make a mark at 1" on a piece of mild steel flat stock ⅛" × 2" and cut it off with a hacksaw or band saw.
2. Using a hacksaw or band saw and hand tools, cut out an axe head. Axe could be different styles, such as a battle axe, splitting axe, throwing axe, or a double-edge axe.
3. Using a hacksaw, cut a 2.5" piece of 3⁄16" mild steel round stock for the axe handle.

## Part 3: Stump Fabrication

1. Tack weld the bottom of the stump onto the pipe with an open corner fillet weld.
2. If correctly placed after tacks, completely weld it on.
3. Grind the weld flush to the sides and flatten them on the bottom.
4. Weld multiple beads from the top to bottom. These welds will replicate the bark of a tree. Many overlapping welds may be required to produce the desired look.

## Part 4: Axe Fabrication

1. Tack weld both sides of the axe head to the handle.
2. File the axe head and the tack welds into a realistically shaped axe.
3. With a hacksaw and small file, cut a notch in the blade of the axe. The notch needs to fit over the stump to look like the axe is stuck in.

## Part 5: Stump and Axe Assembly

1. Place the axe notch over the top of the stump
2. Tack weld the axe to the stump in a manner that the attaching weld is not obvious.

## Part 6: Finishing

1. Using a wire wheel or wire brush, polish all surfaces, removing welding tarnish and discoloration.
2. Apply finish coat. Options for finish could include spray paint, powder coating, or oil blackening.



# Assessment

Consider co-creating the assessment criteria with your students at the beginning of the activity/ project. You may want to include the following:

* + Pipe length is correct.
  + Stump sits flat and level.
  + Axe is shaped realistically.
  + Welds do not contain porosity.
  + Finishing work was done correctly.
  + Safe work habits were displayed.

# Optional Extension Activity

Students who have experience with MIG welding steel could use a stick welder instead. A stump top could also be added to make it into a paperweight/sculpture instead of a pencil holder.