**Make a Portable Hibachi**

# Description

The purpose of this activity plan is to introduce students to the metal shop through a practical activity. Students will gain valuable knowledge in using power tools and equipment as well as GMAW (MIG) welding processes. The end result of the project is a functioning, portable hibachi BBQ.

# Lesson Objectives

The student will learn:

* Safe use of tools and equipment
* Correct layout and measurement techniques
* How to select cutting tools appropriate for the project
* How to cut, form, and join metal material into a desired project
* Finishing techniques: grinding, filing, and sanding
* GMAW (MIG) welding techniques for tack welds and beads

# Assumptions

The teacher will:

* Be a certified technology education/industrial education teacher
* Be familiar with the metal shop that this activity plan is being produced in
* Have experience with all aspects of the given metal shop, including machines, tools, and processes

The student will:

* Be attentive and participatory
* Recognize that appropriate attitudes are the best insurance for safety
* Work safely in the metal shop

# Terminology

**Abrasive chop saw**: a circular metal cutting saw that uses abrasive discs to cut.

**Burr**: a sharp edge of leftover material produced after a cut has been made.

**Drill press**: a fixed-base machine that is used for drilling holes.

**Foot shear**: a foot-controlled machine used to cut sheet metal stock.



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**Hacksaw**: a fine-tooth hand saw with a blade held under tension in a frame.

**Horizontal band saw**: a saw in which the blade is a continuous band of metal that moves through the material.

**Grinder**: a hand-held power grinder.

**Layout**: the process by which measurements are transferred from drawings to material.

**Measurement**: assigning a number to represent a length or amount of something based on a standardized system of units.

**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 inert gas”, and GMAW is an abbreviation of “gas metal arc welding.”

**Stock**: the material being used; in this case metals of differing type and measurements.

# Estimated Time

5–10 hours

# Recommended Number of Students

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

# Facilities

Metal shop facility with all necessary equipment

# Personal Protective Equipment

* + Welding coat
  + Welding gloves
  + Welding helmet

# Tools

* + Whiteboard for written instruction purposes in place of handouts
  + Abrasive chop saw
  + Beverly shear
  + Centre punch
  + Drill press
  + File
  + Foot shear
  + Grinder
* Hacksaw
* Horizontal band saw
* MIG welder
* Scribe
* Tape measure
* Vertical band saw

# Materials

Note: Substitutions can be made for materials not readily available or cost prohibitive.

* Expanded metal C ¾-13R or C ¾-16F
* ¾" square bar stock – substitution could be square tube of same dimension
* 3⁄16" round bar stock
* 3⁄8" round bar stock
* 3" flat bar – ¼" thick
* 3" × 6" × ¼" thick steel channel – flat plate could be substituted to make up the bottom and walls of the hibachi
* Four 3⁄8" × 2¼" hex bolt with nuts and washers
* Two pieces of 4" × 2" × 1" thick, hard wood
* Danish oil or another similar finish
* Sandpaper

# Resources

#### “HEADS UP! for Safety” handbook

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

#### BC Technology Education Association Best Practices Guide

<http://www.bctea.org/best-practice-guide/>

*Modern Metalworking*, textbook by John R. Walker, copyright 2004. Goodheart-Wilcox Company Inc.

# Teacher-led Activity

Demonstrate the procedures in the following steps to fabricate a hibachi. Students will then fabricate their own hibachis.

## Part 1: Parts Manufacturing

* 1. Measure and lay out a 12" section on the bottom of the channel and scribe a line.
  2. Using the horizontal band saw, cut the body of the hibachi.
  3. File and grind all edges on the body. Ensure there are no burrs or sharp edges. Put to the side to begin the next part.



* 1. Lay out two 6" sections on the 3" flat bar and scribe a line. These will be the end caps for your hibachi.
  2. Cut the end caps using the abrasive chop saw or horizontal band saw.
  3. File and/or grind all edges and surfaces of the end caps until smooth and burr-free.



* 1. Measure and lay out two holes using a tape measure and scribe according to the diagram below.

3"

2"

2"

1.5"

X

X

6"

* 1. Centre-punch the middle of the layout to make sure the drill bit will go through the material in the correct location.



* 1. Clamp the flat bar to the drill press with a piece of scrap wood underneath. Before turning the drill press on, confirm that the drill bit will not pass through into the drill press table.
  2. Drill holes in both end caps using a HSS 3⁄8" drill bit.
  3. On both sides file out the holes or use a countersink bit or a de-burring tool to make sure there are no burrs or sharp edges. Set the pieces aside.



* 1. Lay out and measure two 4" pieces of ¾" square bar stock. Scribe the line for cutting. These will be the legs. You could substitute square tube for this part.
  2. Cut the bar stock using the abrasive chop saw or vertical band-saw.
  3. File all edges to remove burrs and sharp corners.



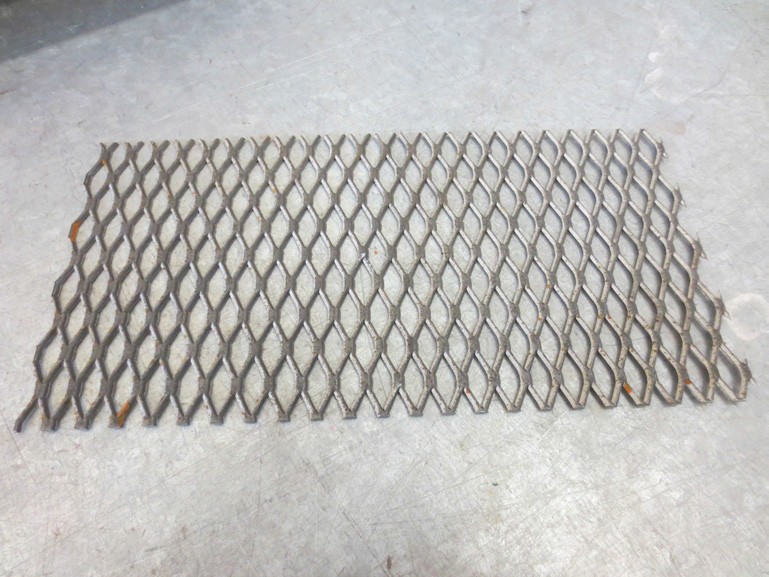
* 1. File all flat surfaces of the bar stock for the legs. This will make sure there are good contacts for welding at the assembly stage. Set the pieces aside.
  2. Measure and lay out two lengths of 3⁄8" bar stock at 11". These will become the grill ledge.
  3. Cut the lengths using the abrasive chop saw or hacksaw.
  4. File the ends to remove burrs and sharp corners. Set the pieces aside.



* 1. Measure and lay out two lengths of 3⁄16" bar stock 5¾" in length. These pieces will eventually be welded to the grill for reinforcement.
  2. Cut on the Beverly shear or use the hacksaw.
  3. File the ends to remove all sharp edges. Set the pieces aside.



* 1. Measure and lay out the expanded sheet metal to 12" × 57⁄8".
  2. Cut out on the foot shear. Handle very carefully as the edges will be very sharp. Set the grill piece aside.



## Part 2: Handle Construction: Woodshop

This is only one option for handles. Students could design their own.

1. Gather material: two pieces of 4" × 2" × 1" thick hard wood. Oak or maple would work nicely.
2. Sand and file all edges to create a small chamfer.
3. Measure and lay out two holes as per the drawing below.

### 1¼"

X X

1"

1"

2½"

4"

1. Clamp each piece onto the drill press table with a scrap piece underneath.
2. Before turning the equipment on, test the set-up to confirm the drill will not go through the table.
3. Drill two holes 3⁄8" in size in both handles in the laid-out positions.
4. Countersink each hole to fit a 3⁄8" hexagon bolt head.
5. Sand holes and remove any sharp edges.
6. Oil the handles with Danish oil or another similar finish. Set aside to dry.



**Note**: Countersink procedure has not been completed in this image.

## Part 3: Assembly of Parts

Warning! All safe working procedures should be followed when using the MIG welder. Ensure students have had adequate practice time using the welders before beginning the assembly process. All safety gear (PPE) must be worn when operating the welding equipment.

**Warning!** If substitutions are made with materials, be sure to confirm that the heat of the welds will not adversely affect the overall project. Thin materials will also be impacted when used as a BBQ once the project is complete.

1. Using the MIG welder, begin assembling the grill ledge pieces onto the inside of the body (Figure 1). The ledge should be tack welded into place at either end and in the middle. The bar should sit 1" down from the top edge of the body wall. Complete this step for both ledges.



1. Turn the body over and place the feet onto the bottom as in the photo below. Use magnetic clamps to hold the feet in place (1" from either side of the top, and 2" in on either end).



1. Weld the feet into place. Use tack welds to hold them and then add short beads to ensure they are secure. The legs should have welds on either side to safeguard against warping once the hibachi is in use.



1. Rotate the body so that the end caps can be placed inside the ends. Use a magnetic clamp on the inside of the body to hold the end cap for welding on the outside edge.



1. If the body is placed on end it will be easier to weld the end caps in position with a horizontal weld. If the body is sitting on its feet, the weld becomes vertical and may be more difficult for beginning welders. Complete a welded bead on either side and along the bottom of the body. Once finished, set the body aside to cool.



1. Lay the expanded sheet metal on the welding table and add the reinforcement bars to either end, aligned with the short ends of the grill. Tack weld in place.



1. Grind, file, and sand all edges, surfaces, and welds to remove rough spots and burrs. Ensure the project is free of any welding splatter. Once filing is complete, wipe down the project with a dry cloth to ensure no dust or debris remains.
2. Paint the outside of the body of the hibachi using high-heat engine/BBQ paint. Be careful not to overspray onto the grill. Make sure the body has two coats of paint before use. Each layer of paint will need to set/cure before the next coat can be applied.
3. Assemble the handles onto the end caps in the following order: Hex bolt > Handle> Nut > Wall of the end cap > Washer > 2nd Nut



# Assessment

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

* + Safe working procedures at all times
  + Personal and project management: good use of time, attitude, effort
  + Accurate measurements and layout
  + Appropriate tools use
  + All burrs and sharp edges are removed
  + Welds have good penetration and contact, no pitting or splatter.
  + Project fits well together, no missing pieces.