Introduction to Welding

Description
Welding is an important trade and is always in demand. Welding is needed in many trade areas and in many industries. Welding is used to permanently join pieces or parts of metal. Skilled welders can weld most metals using a variety of processes. The most common material for welding is steel. Steel is commonly welded by the use of a MIG welder (GMAW), stick welder (SMAW), or TIG welder (GTAW). In this activity plan students will learn and practise MIG, one of the easiest welding methods to learn.

Lesson Objectives
Students will learn to:

• Work safely using metalworking tools
• Cut and form materials using hand tools and power tools
• Join metal with a MIG welder (GMAW)

Assumptions
Students will:

• Have an understanding of safe shop practices
• Know the safe use and procedures of hand tools, bench grinders, belt sanders, and MIG welders

Terminology

Adjusted voltage: the constant voltage output of a GMAW unit that has been adjusted to suit the required transfer mode, from short arc transfer through globular arc transfer to spray arc transfer, which requires the highest voltage.

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.”

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.

Stick welder (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. 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.

**Welder voltage**: the input voltage required for a welding transformer to operate.

**Weld joint types:**

- a. Butt joint
- b. Lap joint
- c. Corner joint
- d. Edge joint
- e. Tee joint

**Welding coat**: body protection from heat, light, and sparks.

**Welding gloves**: hand protection from heat, light, and sparks

**Welding helmet**: face, head, and eye protection from heat, light, and sparks.

**Wire speed**: the rate in feet or metres per minute at which wire is fed through the GMAW unit.

**Estimated Time**

3 hours

The time will depend on the students’ experience in the metalwork shop and the number of tools and welders 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)
- Bench grinder
- Belt sander

Personal Protective Equipment
- Welding coat
- Welding gloves
- Welding helmet

Tools
- Hacksaw
- Ruler
- File or sandpaper

Materials
- Mild steel flat stock ⅛" x 1"
- MIG welding consumables

Resources
Safety tests: Generic safety tests are available in the “HEADS UP! for Safety” handbook
https://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

Video explaining different types of welders: oxyacetylene, MIG, TIG, and stick
https://www.youtube.com/watch?v=xrPeKfKW3Eo

Video about the career of welding
https://www.youtube.com/watch?v=rlOEBAlkmwg
Weld joints and types
https://en.wikipedia.org/wiki/Welding_joint

BCIT Metal Fabrication trades video
https://www.youtube.com/watch?v=IhvvUWH8Z5w

Teacher-led Activity

Mig Welding the DIY Guide

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

Part 1: Welding Demonstration

1. Explain safe MIG welder use. Topics should include:
   
   a. Dangers of UV light produced and the PPE needed to protect the user, such as welding coats, welding gloves, and welding helmets.
   
   b. Dangers of fumes produced. Discuss the PPE needed and ventilation required to protect the user, such as ventilation fans and respirators.
   
   c. Dangers associated with heat related to the weld and the PPE needed to protect the user, such as welding coats, welding gloves, and welding helmets.
   
   d. Dangers associated with electricity used by the welder and the importance of a dry work area and dry PPE.
   
   e. Dangers associated with compressed gas cylinders related to the welder and the careful handling required.

2. Show students how to prepare the metal for welding using a grinder, sander, file, or sandpaper. Metal should be bare steel where the joint will occur and where the ground clamp will be.
3. In small groups (so welding can be seen up close) lay weld beads on a piece of steel:
   a. Show good welds and explain what they should look like.
   b. Adjust welder’s voltage up and down to show what happens to the weld.
   c. Adjust welder’s wire speed up and down to show what happens to the weld.
   d. Adjust welder’s shielding gas up and down to show what happens to the weld.
   e. Adjust the tip’s distance (wire stick-out) from the weld to show what happens to the weld.

4. In small groups (so welding can be seen up close) demonstrate different weld joints:
   a. Butt joint
   b. Lap joint
   c. Corner joint
   d. Edge joint
   e. Tee joint

**Part 2: Laying Beads**

1. To practise welding a simple bead, have students weld straight lines on top of a piece of steel.

2. Check the students’ weld quality after each bead before allowing them to continue.

3. Welds should be inspected for porosity, speed of travel, and penetration.

**Part 3: Welding Joints**

1. Have students cut ten 6” long pieces of 1” × ⅛” flat bar for the welding joint samples.

2. Each student should create a weld sample for each of the five weld joints.

3. Weld joints should be letter punched with students’ names for evaluation purposes.
Assessment

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

- All five weld joints were completed
- Each joint is free of porosity
- Each joint is oriented correctly
- Welds have good penetration
- Welds show correct speed travel
- Safe work habits were displayed

Extension Activity

Students who have completed the weld samples or have experience with MIG welding steel could practise making the same welds using other welders such as a stick welder, TIG welder, or welding torch.