Make a Picture Frame

Description
The purpose of this activity is to introduce students to the metal shop through a practical activity. This activity is an introduction to sheet metal fabrication and basic hand tools used in working with sheet metal. It also includes a design element that allows students to personalize their finished product while increasing their skill level.

Lesson Objectives
The student will be able to:
- Break out and lay out stock
- Cut sheet metal
- Form sheet metal
- Assemble sheet metal
- Finish sheet metal

Assumptions
The teacher will:
- Be a certified technology education/industrial education teacher
- Be familiar with the metal shop where this Activity Plan is being conducted
- 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
- Cut, form and join sheet metal material to create the desired project
- Safely work in the metal shop
- Demonstrate safe and appropriate use of hand tools and equipment
- Use appropriate layout tools
- Demonstrate appropriate finishing techniques

Terminology
Aviation snips: a hand tool designed to cut sheet metal into intricate designs. Can be used to cut compound curves. Red = left cutting; Green = right cutting; Yellow = universal, able to cut in any direction.
Box and pan brake: a sheet metal machine that is used to create bends, hems and boxes in sheet metal.

Breaking: bending the sheet metal along a line.

Centre punching: marking the centre of a hole.

Combination square: a ruled blade with both 45° and 90° heads. Used to lay out right angles and 45° angles.

Countersink: the process by which a chamfer is created to fit a flathead screw.

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

Emery cloth: an abrasive cloth used to remove material and smooth surfaces.

File: a hand tool designed to shape and smooth metal. Available in a variety of shapes and sizes to fit different projects. Made of hardened steel with varying textures to remove large or very minimal amounts of material.

Finishing: the process of using sanding, polishing, sandblasting or painting to create a desirable end product appearance.

Layout: the process of transferring a pattern from paper to the material using pens, scribes, centre punches, squares and scales.

Letter and number stamps: hardened steel bars with letters and numbers. Used to permanently label metal projects.

Pattern: a model or design used as a guide.

Riveting: a mechanical joining technique used to join two or more pieces of sheet metal together with a rivet.

Roper Whitney punch: a hand tool used to punch holes in sheet metal stock.

Ruler: a precision measurement tool that is a length of steel with marks at regular intervals.

Scribe: a long pointed piece of hardened steel that is used to mark layout lines on metal.

Sheet metal: a term used to describe a variety of thin rolled metal sheet stock.

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

Estimated Time

2–3 hours

Recommended Number of Students

20, based on the BC Technology Education Association Best Practices Guide
Facilities
Metal shop facility with all necessary equipment

Tools
- Aviation snips
- Bar folder
- Beverly shear
- Box and pan brake
- Centre punch
- Emery cloth
- Coarse and smooth files
- Hacksaw
- Ball peen hammer
- Letter stamps
- Rivets
- Ruler
- Scribe
- Squaring foot shear
- Vise with soft jaws/vise caps
- Whitney punch with a $\frac{3}{16}$" die (other dies may be required on an individual basis depending on student design choices)

Materials (per student)

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<table>
<thead>
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<tbody>
<tr>
<td>1 – Frame</td>
<td>5(\frac{1}{2})&quot; × 7&quot; piece 18 ga. sheet metal (steel, galvanized, perforated or aluminum)</td>
</tr>
<tr>
<td>1 – Base</td>
<td>1&quot; × 4&quot; band iron</td>
</tr>
<tr>
<td>2 – Rivets</td>
<td>¼&quot; × ½&quot; solid round head rivets</td>
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Resources

“HEADS UP! for Safety” handbook
https://www.bced.gov.bc.ca/irp/resdocs/headsup.pdf

BC Technology Education Association Best Practices Guide
http://www.bctea.org/best-practice-guide/


**Box and pan brake**
http://www.bing.com/videos/search?q=how+to+use+a+box+and+pan+brake&view=detail&mid=0B5F895025F7C74515AE0B5F895025F7C74515AE&FORM=VIRE

**Roper Whitney punch**
http://www.bing.com/videos/search?q=how+to+use+a+whiney+punch&view=detail&mid=94426538A09825CF06DD94426538A09825CF06DD&FORM=VRDGAR

**Bar folder**
http://www.bing.com/videos/search?q=how+to+use+a+bar+folder&view=detail&mid=300C3F9B87B7F4360FE7300C3F9B87B7F4360FE7&FORM=VRDGAR

**Aviation snips**
https://www.youtube.com/watch?v=5Nrc2xvLmC0
Student Activity

Frame
1. Gather sheet metal materials from teacher.

2. On both of the long sides of your sheet metal piece, use a ruler and scribe to measure in ¾" from the outside edge and scribe a long line (see diagram page 8). These will be fold lines and will create the picture holding tabs on the front of the picture frame.

3. Measure 1" up from the bottom edge and scribe a line across the front side of the picture frame.

4. Turn the frame over and measure up 1" from the bottom edge, then scribe a line across the bottom. This is the back side of the picture frame and this will become part of the base of the frame.

5. Still on the back side of the picture frame (in the 1" section at the bottom), measure and lay out the two holes for punching as per the diagram.

6. Centre punch each of the holes you have laid out.

7. Cut out corner notches with aviation snips/tin snips. (see diagram).

8. Round the edges and remove any rough spots and burrs with a smooth fine file.

9. Using the Roper Whitney punch and a ¼" die, punch the two holes on the bottom edge that were centre punched.

   Show your teacher before proceeding.

10. Using the box and pan brake or the hemming machine, fold both sides of your frame over. Do not flatten the sides. as this is where the picture will slide into.

11. With the box and pan brake: Insert the frame to your 1" fold line. The back side of your frame should be facing up. Bend to 30°.

12. Double check all edges, corners and surfaces for rough or sharp spots, and remove using smooth files or emery cloth. Set frame aside.

Base
1. Gather band iron bar stock from teacher.

2. Lay out the cut line at 4" in length and cut the band iron to length with a hacksaw/Beverly shear. Remove any burrs with a file.

3. Lay out the measurements for the holes according to the diagram, and centre punch.
4. Secure your flat iron and drill the two \( \frac{3}{8} \)" holes all the way through. **This operation should be done with confirmation from teacher that your material is secured.**

5. While your material is still secure, countersink both holes halfway through with a countersink drill bit or \( \frac{3}{16} \)" drill. Sweep away any debris with a brush.

6. Remove your base from the drill press and smooth any rough edges left around the holes.

7. Smooth any rough spots using emery cloth.

**Assembly**

1. Secure the rivet setter in the jaws of a table-mounted vise with the dimple facing up.

2. Stand the frame on the top side of the band iron. The countersunk holes should be on the bottom. Ensure the holes line up evenly.

3. Insert a \( \frac{1}{8} \)" round head rivet down through one hole in the sheet metal frame and through the band iron.

4. Flip the frame assembly over and insert the round head of the rivet into the rivet set’s dimple. With the ball side of the hammer, start to deform the bottom of the rivet into the countersunk area.

5. Once the rivet is secured enough not to fall out, insert the second rivet and hammer down to deform the rivet into the countersunk area.

6. Now firmly secure the frame to the base with the rivets. With the flat side of the hammer, flatten out the deformed mound on the bottom side of the band iron until the rivet is flush with the band iron.

7. If there is excess rivet material, file it smooth and level with the band iron base.

8. Flip frame over and make sure there are no further sharp edges or burrs.

9. Finish the picture frame with clearcoat spray.

**Extension Activity**

If AutoCAD or other design software is available, students could design a pattern using that could be laser engraved into the front edges of the picture frame for decorative purposes.
Assessment

Consider co-creating the evaluation 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 hems and folds are clean, straight and uniform
- All burrs and sharp edges are smooth
- Instructions were followed throughout the activity
- Product is painted/finished neatly
Picture Frame Body and Base Layouts

- Fold line for picture holder
- Radius edges created with aviation snips and files on all four corners
- 1/8" holes to be drilled through and then counter sunk on the bottom using a 3/16" drill bit/countersink bit
- Remove tab using aviation snips
- 1/8" holes to be punched
- Remove this tab by cutting on the line using aviation snips