



Blacksmithing

Objective: Students will learn the process of forging steel using the heat of a coal forge, a hammer, a vice, tongs, hardy tool, clamp and steel brush. Students will learn how to safely and effectively use a coal forge and anvil. They will learn how to care for and treat the tools and equipment so that results are clean and tools and equipment can withstand repeated use. Students will make decisions about length and design of their hook based upon its intended use. Students will take home at least one steel hook with a twist and/or steel bracelet with a twist.

Vocabulary

- **Forging:** Forming of metal with dies, presses or hammers at high temperature (2100°F).
- **Forge:** a brick or stone-lined furnace where the smith or smithy heats the workpiece to a malleable or annealing temperature before transferring it to the anvil to work with a hammer.
- **Critical temperature:** The temperature at which a change in crystal structure, phase or properties occurs. This can be any temperature, but is most often 1400-1500°F. This is the point where the steel is a little hotter than non-magnetic.
- **Annealing:** heating metal to remove stresses or hardening, usually to a temperature just below the metal's melting point
- **Anvil:** A heavy metal working piece on which metal objects are hammered or forged.
- **Quenching:** The rapid super-cooling of steel for the purpose of hardening. Quenching requires a medium that matches the needs of the specific chemistry of the steel. Quenching mediums can include brine, water, oils, air, molten salts, and others.
- **Tempering:** The process to make metal "tougher" by heating and quenching it through a variety of steps.
- **Blacksmith:** a person who creates objects from metal (typically iron or steel) by forging the metal using heat, hammers and specialized tools. The name comes from the Teutonic word "smeithan" meaning to forge.
- **Flux:** substance used to keep oxygen from the surface of heated or molten metal in order to prevent its oxidation. Historically, charcoal and borax compounds were used. Today argon and helium are used to keep oxygen away from the metal.
- **Hardening:** process of making a metal harder through beating it, quenching and tempering.
- **Iron:** metal, a basic chemical element existing in the earth in ores as iron oxides. It is extracted from the iron ore at high temperatures in a smelter and is hardened with the addition of carbon. Modern extraction uses blast furnaces. Iron has magnetic properties (is ferromagnetic) and can be magnetized or attracted to a magnetized object.
- **Smith:** a person who works in the metallurgy industry with such metals as iron using a forge, anvil and hammer.
- **Ferrous:** a metal that contains iron.



An Overview of Blacksmithing History

ORIGINS & IRON AGE

Blacksmithing origins first trace back to 1500 BC when the Hittites discovered the process of forging and tempering iron ore. When the Hittites were scattered in 1200 BC so was their knowledge and understanding of basic iron work. Launching into the Iron Age, a process to produce wrought iron was developed through reducing natural iron ore with heat. This new substance could be used to make simple tools that proved much tougher and sharper than stone.

ANCIENT BLACKSMITHING

Even with developments in heating iron with the use of charcoal, ancient blacksmithing was quite unpredictable due to lack of understanding the basic properties of iron. With inconsistencies in heating the iron and thus carbonization of the iron, early craftsmen found they produced works that varied in quality. Most ancient iron work was either too soft to hold a sharp edge or it became extremely hard but brittle. However, the blacksmith would occasionally and unintentionally produce weapons and tools of steel. These weapons proved harder and tougher than others and because of their unique nature, they were thought to have magical or spiritual powers. Such weapons were named, handed down from generations, and carried an air of mysticism around them.

MEDIEVAL PERIOD

During the Medieval Period, blacksmithing was considered part of the set of seven mechanical arts and was a staple of every town. With advances in heating techniques and a greater understanding of iron properties, the village blacksmith was skilled in making various tools, household objects, weapons and armour. Along with their useful skill, blacksmiths were often highly regarded in their community and would serve in other roles of leadership within the village. However, in some villages, they were viewed as workers of witchcraft and evil because of the nature of their work. No matter how they were viewed, the blacksmith was essential for everyday life.

INDUSTRIAL ERA

Equipped with advancing technology, medieval blacksmithing techniques carried through the mid-nineteenth century until experiencing a cultural shift with the introduction of the Industrial Era. As machinery and mass production increased, the demand for blacksmithing products declined leaving blacksmiths primarily occupied in farrier work. Because of the lack of work, many blacksmiths transitioned into the initial generation of automobile mechanics.

20th CENTURY

Early in the 20th century, prior to the Great Depression of the 1930s, there was a golden age for blacksmiths who made architectural ironwork. Many of the work during this time is preserved and admired today. However, the Great Depression started the art on its road of near extinction. Without a need for blacksmiths because of industrialization, blacksmithing was seen as an obsolete trade through much of the 20th century.

MODERN RESURGENCE

In 1970, a resurgence of interest in blacksmithing occurred, and the art has steadily captured the interest of many since then. Blacksmithing has redeveloped into a unique community of artists who are specialized in their skill as they use and advance upon traditions and techniques that have existed for thousands of years.

Source: Oldfield Forge, United Kingdom

Supplies - 1 per student unless noted

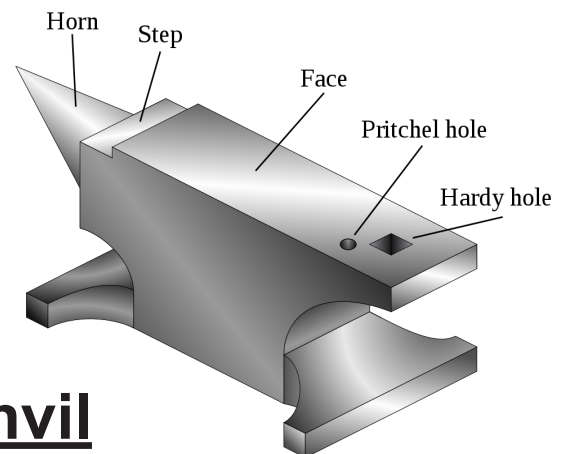
- 1 coal forge with prelighted coal per two students
- newsprint/newspaper to light forges/coal
- striker or matches to light forges/coal
- 1 300 lb anvil mounted on a wooden stump per two students
- 2 pieces, 18-inch long, 3/8-inch square stock steel
- 2-3 lb hammer
- offset tongs
- clamp for every two students
- vice for every two students
- Hardy tool per two students
- steel brush per two students
- Johnson's paste wax (1 jar for the class)
- quenching barrel with water - 3 per class
- 4-ft x 8-ft steel work table - 1 per class

Lesson outline

- Teachers will receive lesson plan from ACC a minimum of 1 week prior to attendance enabling teachers to introduce basic terminology to students so that students can concentrate on the creation process when they attend.
- Upon arrival at ACC, students will learn to identify the basic tools and equipment necessary to complete their project.
- Students will learn blacksmithing safety before creating objects and apply those safety measures as they create their hooks.
- Students will learn the proper hammer control and swing to maximize the effectiveness of each hammer blow and minimize the potential for injury or strain.
- Students will learn and apply the following steps to create a hook
- Heat an 18" piece of steel in the coal forge until it appears hot at the tip. Students will learn to identify the color of appropriate temperature steel - that is soft enough to hammer.
- Students will hold the steel with tongs. They will learn NOT to directly touch steel EVER when they are "forging" steel.
- Students will learn where to hammer steel on the anvil and will taper the end of the steel, reheating as necessary - when the steel is too hard to hammer.
- Students will learn to reheat the steel and learn to curl the tapered end of the steel into a tight scroll so that the point won't be sharp. Students will then heat and curl the end of the hook into the desired size - depending upon the intended use for the hook. Students will determine the size and depth of the curved portion that they need.
- Students will learn to quench or cool the hot end of the steel in a water bath.
- Students will use tongs to hold the steel at the hooked end. They will reheat the opposite end of the steel.
- Students will determine the desired length of their hook. They will learn to hold the steel on a hardy where they intend to cut the steel. Students will hammer the steel into the steel on the hardy tool, reheating as necessary and flipping the steel to the opposite side until it is cut at the desired area.
- Students will then heat the end of the steel opposite the hook and hammer it flat to create a place for a screw or nail. They will quench the steel again.
- Students will learn to heat the steel toward the center until it is hot enough to hammer.
- Students will learn to secure the steel in a vice, below the heated portion, clamp the end of the steel above the hot section and twist the steel to create a decorative element.
- Students will align the hook and the flattened area for hanging to ensure that the hook is useful.
- Students will quench the steel again to cool it.
- Students will use wire brushes to clean the hook and Johnson's paste wax to prevent rusting.

Blacksmithing Safety

1. NEVER touch a piece of steel in the studio unless you KNOW it is cool.
2. Use tongs or other tools to pick up steel unless your instructor tells you otherwise.
3. Wear eye protection at all times! Goggles or a face shield that fit your face.
4. Use ear protection at all times - ear plugs or ear muffs.
4. Wear cotton or wool clothes. Synthetics melt and may melt to your skin.
5. Wear closed toe shoes or boots - cotton or leather only. Again, synthetics melt.
6. Use proper posture and body mechanics when standing at the anvil and swinging a hammer.
 - a. Let the hammer do the work.
 - b. Stand close enough to the anvil that you do not have to stretch to reach it.
7. Wearing a leather apron is optional, but will help protect your clothing.
8. Never directly touch the flames or the coal. NEVER!



Anvil

Horn: conical projection used to form rounded shapes and bending. Can also be used to "draw down" or make steel longer and thinner. The horn is made of hardened steel.

Step or cutting table: Typically softer steel, this is a flat place used for cutting so that the face of the anvil does not get scratched or dented.

Face: primary working area of the anvil, it is made from hardened steel. It is flat and smooth typically with rounded edges to prevent cutting or marring the steel that the smith is working on. The face should not be struck directly with a hammer as it may damage, dent or deform its surface.

Pritchel hole: a small round hole used for punching
Hardie (hardy) hole: a square hole into which specialized forming and cutting tools, called Hardy tools, are placed. It is also used in punching and bending.