



AZ 4-H BLACKSMITHING Program Overview



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Document Overview:

This document is intended to provide a brief overview of the blacksmithing program, instructional resources, equipment, and learning resources for beginning 4-H blacksmithing instructors. There are infinite rabbit holes that a beginning blacksmith can go down, and this project is an excellent means to support youth in finding their own spark. The information below is a general introduction to strategies for safe and educational youth experiences, the types and purposes of tooling used by smiths, locations to purchase equipment, and some good resources for learning to make your own tools and projects.

Creating a Positive Youth Development Experience

The 4-H Blacksmithing Program is an excellent pathway for creating safe learning environments for youth to grow. There are many pathways in metalwork, and youth have plenty of room to find their individual spark, and pursue their own curiosities and passions. Blacksmithing also provides an abundance of career skills for youth that are interested. Metalworking techniques involve extensive use of hand and power tools, and youth can quickly gain experience in artisan blacksmithing, fabrication, welding, farrier work, and other industries and career areas. In addition, the metalworking program requires youth to learn how to function in a shop setting where there is risk of injury. The first abilities learned are to listen, pay attention, and avoid causing others harm – essential skills for any apprentice entering the trades.

There are many opportunities to teach important life skills (both social and career) in the blacksmithing program. Youth need to cooperate, keep others safe from harm, assess situations for a safe/productive environment, and act in many other ways that help them become positive and impactful members of their community. That being said, youth are not always aware of what they are learning. Finding time to deliberately insert these types of ideas and skill building into programs and reflect on them can maximize the impact youth receive. We suggest using The Targeting Life Skills Wheel as a tool to help teach these important life skills.

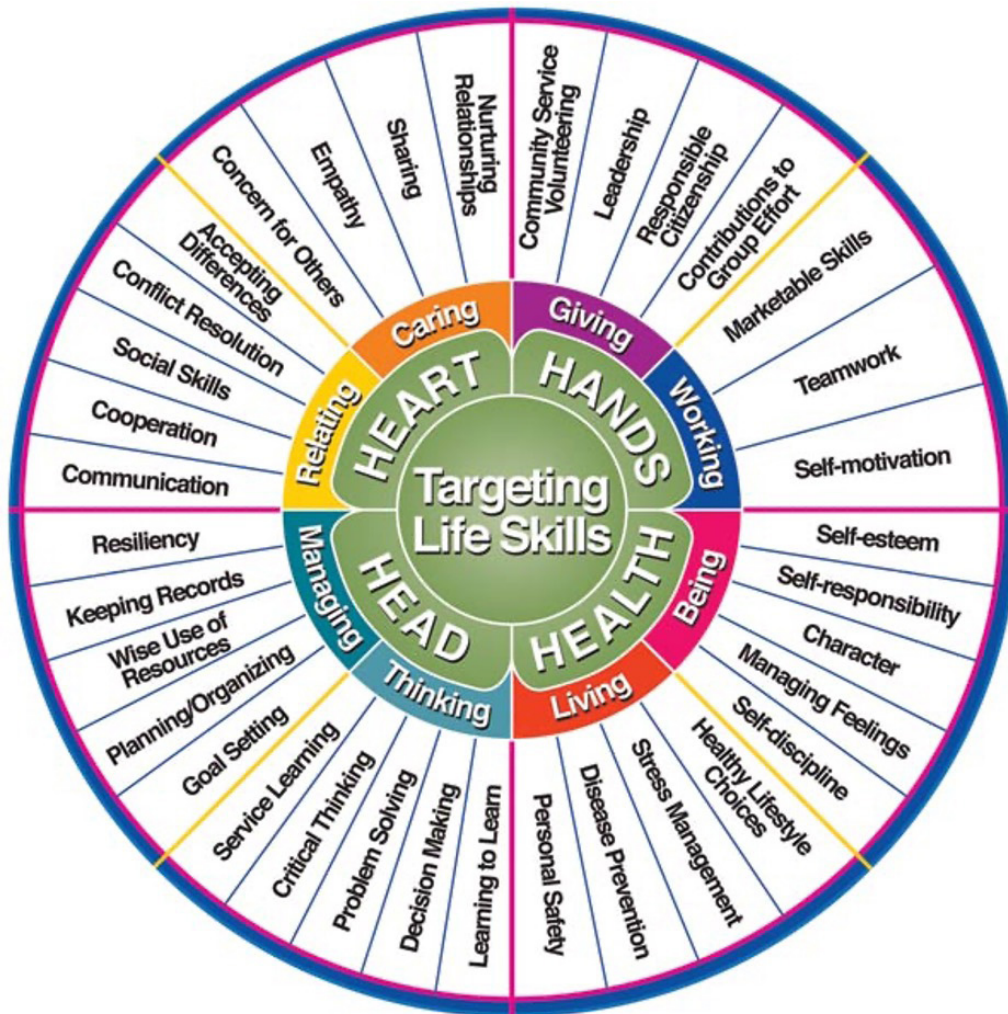


Figure 1: The Targeting Life Skills Wheel can be an excellent resource for adding depth to any 4-H program.

In 4-H we often refer to a tool called the “Targeting Life Skills Wheel,” (Figure 1). This is an excellent tool/framework to use when intentionally trying to deepen a program experience. As a 4-H instructor, using this tool can be as simple as planning a project, and then picking a few key skills to emphasize that day. A few examples of how these target skills can be integrated into blacksmithing programming are noted below:

- Business/economic skills – teaching youth financial literacy, and the tools to create and manage a business can definitely be taught in the shop! Many basic projects require consumables such as steel, abrasives, and propane. There are also great opportunities to fundraise by selling hooks, leaves, and other blacksmithing projects that are very accessible to the beginning blacksmith. This can be achieved by Integrating skills such as record keeping, planning/organizing, and wise use of resources by keeping track of expenses, material supplies, and manufacturing costs. Working with youth on pricing items appropriately and selling at markets and fairs to fundraise for the project is another way to help build youth business/economic skills.

- Community mindset – there is risk in blacksmithing! Heat, hammers, power tools – these all provide different challenges to 4-H instructors, but also unique opportunities. Risk provides a pathway to teach youth concern for others, teamwork, problem solving, and contribution to group efforts. In the shop we create danger but can also control it. Communicating and making sure to keep peers safe is an absolute requirement of the project, and a great set of life skills to emphasize and teach to youth. There are many other ways to integrate life skills into the blacksmithing program. The Targeting Life Skills Wheel is an excellent framework to keep in your back pocket as an instructor. Glance at it when you are planning a meeting and sprinkle in a few of these important concepts!

Shop Safety:

Shop safety – it is important to consider the workspace and the processes happening within it. Dangerous situations can come in many forms. Make sure that ventilation and filtration is set up to avoid dangerous situations, and carefully consider tooling locations and durability/heat resistance of surrounding materials. Forging and grinding creates sparks, flammable/conductive dust, and fumes, so carefully consider, and manage the risks of your workspace and projects. Make sure all equipment is well maintained and in safe working condition. Best practice is to stop and plan your projects carefully before starting!

Equipment Overview:

- **Personal Protective Equipment** – This is a must! Working with hot steel and hammers creates a very dangerous environment for your eyes, skin, ears, and lungs. Careful consideration should be given to the project materials and process, and how to protect ourselves from short- and long-term bodily harm.
 - Glasses – in most cases standard safety glasses should be used. If working with very high temperatures in the forge, such as forge welding/yellow heat, it is prudent to consider a protective shaded lens, such as shade 5 plasma cutter glasses. The various spectra of radiation coming from the forge can cause long term damage to eyesight, so if smithing regularly make sure you have the appropriate protective glass for your projects.
 - Gloves – For heat a pair of thick welders gloves is a great piece of starter equipment. As knowledge of forging, skill, and dexterity increases, some blacksmiths decide to go to thinner gloves, or in some situations without gloves at all. However, for youth and novice smiths, it is important to have a pair of thick, well-fitted, leather gloves. Many work gloves now have plastic guards/protectors – do not use these! Synthetics can melt and catch fire, causing serious burns and toxic fumes. For chemicals use a pair of disposable nitrile gloves. Epoxies, cleaning solvents, oils, fluxes – lots of chemicals are used in the shop, and skin exposure should be avoided.
 - Ear protection – In most cases, a well fitted pair of ear muffs or plugs from the local hardware store work great. If possible, muffs more quickly allow removal for youth and instructors to clearly communicate in noisy environments. If working with heavy machinery, such as power hammers, abrasive saws, etc. it may be



Figure 2: Using a forging press. Eye protection and gloves are used, in addition to tongs to keep hands away from the heat and press jaws.

necessary to find a pair of quality mufflers rated to a higher decibel setting that suits your purpose.

- Masks – Dust and fumes are inevitable when heating and grinding material. Be sure to have a good amount of N95 dust masks on hand. If working in the shop regularly, a respirator with replaceable filter cartridges is a wise choice. These allow the filter to be suited to the task – particle/N95 rated for dust, and carbon inserts for toxic fumes. Best practice is to buy from a reputable company making equipment intended for construction or shop use – 3M is a good reference for quality products.
- **Forge** – There are two types of forges commonly used in metalworking – propane and coal. Each has distinct pros and cons and require a different maintenance schedule to ensure safe and efficient operation. A few more details are bulleted below:
 - Propane – these forges utilize propane gas through a burner to create heat. They are easy to use, have easily resourced consumables, and are generally clean burning. The major downside of propane forges is the heating space is limited, and it can be difficult to get large or unwieldy pieces appropriately heated.
 - Coal – solid fuel forges utilize different types of coal for heat and are great for working with large pieces of steel and high temperatures. Managing the fire does take some time to learn, but a skilled blacksmithing can very specifically manage

their fire for the task at hand. Downsides of these forges include the smoke and dust – coal dust gets everywhere and is definitely something to be very careful with. In addition, quality fuel can be difficult and expensive to source.

- Torches, induction, electric, etc. etc. etc. – there are many ways to heat metal, so be sure to look around and learn what experienced blacksmiths are using. Odds are if you are working hard and it's not going very well someone has already learned how to do it better. As you progress in skill and knowledge, additional tools such as Oxyacetylene or oxy-propane torches can become useful. There are also a wide variety of electric solutions, such as induction forges and electric ovens that may be useful in furthering your metalworking journey.
- **Hammers** – In general, the first hammer any smith should have is a 2.5 pound cross peen or rounding hammer. When working with youth additional considerations should be made on how much weight is appropriate. Most importantly – forging is about precision not power. Hitting something harder can be dangerous and is very often ill advised. Early efforts should be spent hitting the work in a very accurate way, as opposed to trying to move a lot of metal. Once muscle memory is established, more power can be added for quick and efficient work. Each hammer brings different advantages so try several out and see what fits your needs. Smiths will often have a rack of hammers, each with a specific use, so be sure to go to garage sales, thrift shops, used tool shops, and eBay to get a variety!



Figure 3: Using V-bit tongs to get hot metal out of the forge.

- **Tongs** – there are many types of grabbing tools, and they are very important in keeping hot work away from our skin – even the best gloves can't protect you from glowing metal! Blacksmiths generally become very proficient at forging new tongs to fit the specific stock they are working with. A few types are listed below.
 - V-Bit – these are a 'bolt-jaw' style of tong with a pair of V shaped notches for fitted to a specific size for picking up square or round stock.
 - Wolf Jaw – these tongs generally have several different notches and hollows shaped to be a true multi-purpose tong. These are by far the most generally useful tong, and can work with a variety of stock sizes.
 - Offset – these are generally a V or bolt jaw style, with the gripping surface offset from the length of the handles (reins). Great for long pieces of stock that need to be picked up from the middle.
 - Flat Jaw – two flat surfaces sized to the size of stock being worked – excellent for working with flat stock.
 - Box Jaw – sized to securely clamp the height and width of a piece of flat stock – excellent for working with flat stock.
 - Scrolling – two rounded bits, similar in appearance to needle nosed pliers. These are used to create decorative scrolls or curves in a work piece.
 - These are just a few of the varieties' of tongs used. Best practice is to get comfortable with the process of making these tools, so that all hot work can be held securely and efficiently. Making tongs is a great beginner project, and is one of the first steps in making tools to make tools!
- **Hot-Cutting and Punching** – cutting chisels and punches are essential kit for starting blacksmiths. Chisels can be used to cut a piece of hot work down to size, or add decorative features. Punches come in infinite shapes and sizes, but for a starting kit it is essential to have a small (~1/4" face) flat punch for punching holes, and a marking punch for punching index points for drilling.
- **Vice** – holding the work in a vice allows for a hand to be freed up, and a solid grip for hammering, cutting, and punching. A stable, free standing vice is useful in just about every project – forging or finishing.
- **Powered** – this type of equipment can add a lot of versatility, and also quite a bit of danger to a shop. Angle grinders, for example, are one of the most useful and versatile tools, yet they are by far the most dangerous tool in most shops. Two tools that can open up many metalworking options are the angle grinder and a 240v welder. Each of these can help fabricate equipment, trim stock, and do countless other tasks that make metalworking efficient and productive. That being said, before using these tools be sure to research and utilize appropriate protective equipment, and invest in proper training to protect yourself and our 4-H youth members.

Equipment – Reputable Sources

A few reputable dealers of equipment are listed below. These are all excellent places to source consumables and specialized tools. Before going online, be sure to get familiar with local resources. Let them know you are working with 4-H. Shop staff often will get excited that

you are sharing these skills with youth, offer discounts, and provide helpful knowledge and resources. However, fine quality steels and blacksmithing tools are often not available outside of major cities. If you are needing specialized equipment or materials, the following businesses are a good place to start:

- Centaur Forge - <https://www.centaurforge.com/>
- Blacksmith Depot - <https://www.blacksmithsdepot.com/>
- NC Tool - <https://www.nctoolco.com/>
- Blacksmith Supply - <https://www.blacksmithsupply.com/>
- Pieh Tool - <https://piehtoolco.com/>
- Pops Knife Supply - <https://popsknife.supplies/>
- Fiery Furnace Forge - <https://www.ffforg.com/>
- New Jersey Steel Baron - <https://newjerseysteelbaron.com/>
- Holland Anvil - <https://www.hollandanvil.com/>

Steel (Briefly)

This topic is endless, but for practical purposes there are a few classes of steel, some uses, pros/cons, and sourcing advice below.

- **Mild steel** – this is the most common class of steel that blacksmiths tend to use. It cannot be heat treated (hardened or softened), which makes poor for tools, but an excellent choice for most blacksmithing projects. Mild steel is made in many different stock sizes and is relatively affordable, so stock purchases can be tailored to the task at hand. 3/8" round or square bar runs about \$15 per 20 feet and will keep a group of youth occupied with projects for several meetings.
- **High Carbon** – this class of steels tends to be easy to heat treat (make hard or soft), and they are excellent for beginning knifemakers and blacksmiths. Varieties to look for include 1084, 1085, 80CRV2, and 5160 – these types forge well and have excellent properties for toolmaking.
- **Medium Carbon** – this class of steel is slightly more difficult to heat treat, generally leaning towards water as a hardening solution, and requiring higher temperatures to soften or temper. 1045 or 4041 alloys are excellent for hammer making, and other tooling requiring impact resistance and toughness.
- **Stainless** – these steels tend to be complex in composition compared to high carbon, and often require specialized electric ovens for heat treatment. In general, beginning knifemakers and blacksmiths tend to stay away from stainless. However, as skills and equipment resources deepen, these steels are very much worth considering. Stainless excel in corrosion resistance, and many 'super' alloys have been made that have unparalleled performance for many tasks.
 - **Scrapyard steel** – If 'picking' isn't in your repertoire of skills, that will need to change. The challenge of mystery steel can be frustrating, so scrap steel is not a good choice when making a fine quality knife or similar tools. However, there are a few common scrap yard items that are very useful in the shop.



Figure 5: Grinding a knife from high carbon steel. Note the “firework” sparks - these bright exploding sparks are a good indicator of high carbon amounts in steel.

- Mild steel stock – buying new steel can get expensive, so if you are welding up a tool stand, making a table, or in general need big pieces that aren’t too long, then scrap steel can be a good choice. It’s generally much cheaper, and you can find sections of plate or oversized pieces that will serve your purposes well.
- Spring steel – leaf springs and strut springs tend to be analogous to 5160 steel. These can make decent quality knives, and are usually good enough quality for making tools and punches.
- Ball bearings – Good sized ball bearings can make excellent knife steel – the material is often analogous to 52100 steel, and can be very useful
- Axles – big truck axles tend to be steel similar to 4140 or 1045. Heat treating mystery steel can be challenging but occasionally these pieces are worth collecting.
- Other interesting finds – scrapyards always have something cool that can be incorporated into a project – keep your eyes open for railroad spikes, brake drums, anvil shaped objects, and more!

- Things to **AVOID** – scrap yards will often have solvents, petroleum products, and other chemical dangers that need to be considered. When heating scrap steel in a forge these products can off gas and cause serious harm to one’s health. Avoid paint, coated metals, unknown non-ferrous metals, **galvanized or plated steel**, and any unknown spills, materials, chemicals, etc.

First Timers Buying List

These are just examples – be sure to check local used tool stores, medical equipment suppliers (PPE), and hardware stores for better deals (and possibly better tools!).

- [Anvil](#) – NC Anvil 70 pound Knifemaker
- [Forge](#) – Devil Forge two burner with door
- [Hammers](#) – Blacksmith Depot 1.8 and 2.5 pound rounding hammers
- [Tongs](#) – Get a variety that will fit the stock you are using – V-bit and Wolf Jaw are great starters.
- [Vice](#) – 6 inch swivel vice
- [Welding Gloves](#) – Leather, heavy gauge, insulated.
- [Safety Glasses](#)
- [Dust Masks](#) – N95 disposable style.
- [Hearing Protection](#) – Ear muffs.

Learning Resources

- Tong overview - <https://workingtheflame.com/blacksmith-tongs-guide/>
- Blacksmithing tools overview - <https://workingtheflame.com/blacksmithing-tools-list/>
- Informative YouTube Channels:
 - o Torbjorn Ahman - <https://www.youtube.com/c/torbjornahman>
 - o Essential Craftsman - <https://www.youtube.com/c/essentialcraftsman>
 - o Christ Centered Iron Works - <https://www.youtube.com/c/ChristCenteredIronworks>
 - o Brian Brazeal – amazing hammer forging series <https://www.youtube.com/watch?v=UwmhuNI0Qlc&t=11s>
 - o Black Bear Forge - <https://www.youtube.com/c/BlackBearForge>
 - o Outdoors55 - <https://www.youtube.com/c/OUTDOORS55>
 - o Walter Sorrels - <https://www.youtube.com/c/WalterSorrellsBlades>
 - o Alec Steele - <https://www.youtube.com/c/AlecSteele>