



High School Makerspace Tools & Materials

Working Draft
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Introduction

Makerspaces are collaborative workshops where young people gain practical hands-on experience with new technologies and innovative processes to design and build projects. They provide a flexible environment where learning is made physical by applying science, technology, math, and creativity to solve problems and build things.

Every Makerspace is different, reflecting the available resources and the needs of the makers. It can be any kind of physical space from a classroom to a shed, from a storage room to a freestanding building. It can support a handful of young makers to dozens of students, focused on a particular activity such as electronics, or offering a broad range of equipment and materials.

Given this range of possibilities it's impossible to make a one-size-fits-all template for developing a Makerspace. Instead this document is an outline providing an à la carte approach to selecting equipment, tools, and materials for a new Makerspace, allowing it to best serve the needs of its makers. It covers outfitting a space from the floor up including space requirements, workbenches, storage, and maintenance materials. The tools and materials have been chosen to be easy to use and to be useful on a broad range of projects. The amounts listed are to support the work of up to 25 makers at once in a space, for a semester's worth of projects. The quantities should be adjusted to match the number of makers and length of projects for your particular space.

The equipment is divided into sections, but each section amplifies the usefulness of the others allowing hybrid projects like robotics (general tools + electronics) or wearable electronics (electronics + textiles).

For updates and more information visit the companion web site Makerspace.com.

How to read this document

This document is split into sections, each section covering a particular specialization such as electronics, textiles, 3D printing, etc. Each section includes a description, notes on safety, requirements such as space or utilities, and a list of projects and resources for making the most of the section.

Workspace

The working environment of the space creating the foundation for a safe, comfortable and clean working environment.

General Tools

Tools and materials that are common among workspaces and are useful on a wide range of projects.

Electronics

The broad application of electricity from learning about analog circuits to microcontrollers, robots, and other electromechanical creations.

Textiles

Working with flexible materials such as cloth, vinyl, leather, rope and string.

Computers

The hardware and software analogous to industry standards in planning, design and fabrication,

allowing design and creation, research and learning, and output of the completed designs to digital fabrication machines.

3D Printing

Basic additive manufacturing ability (aka 3D printing) allowing makers to create detailed, complex objects.

Laser Cutting

The requirements for a laser cutter which would provide the ability to cut and etch materials quickly and with high precision.

The bulk of each section are equipment, tools, and materials lists. These lists include the common name of each tool, general pricing information, and when necessary, a more specific description and web link to an example.

The tools and materials here have been chosen specifically for young people age 14-18 to work with in a shared environment. The tools try to avoid easily lost or broken parts that are easy to maintain. They also try to take into account that they might be used by smaller hands with less strength than an adult, while still being able to work reliably. Experience has shown that using undersized and/or dull "children's" tools is often very frustrating to budding makers as they do not perform as well as their more professional counterparts.

A note on example links and prices

The links provided are for information only and are not purchase recommendations or endorsements. Prices given are estimates.

The lists of equipment are broken down in the following categories:

Tools covers the tools for this section. The number of each tool is estimated for a group of up to 25 students to work simultaneously.

Accessories lists the support items for the tools above. This includes things like storage, safety, and maintenance materials.

Consumables lists the items that will need regular replacement such as hot glue sticks, saw blades, etc. These are estimated on a semester-long class of 25 makers and may need replenishing more or less often depending on use.

Materials & Parts lists the types of materials that can be used with the tools in the section. They are generally the most common and useful materials to keep on hand that can be broadly useful for projects. The amounts are estimated on a semester-long class of 25 makers and may need replenishing more or less often depending on use.

The elements in each section are also broken down by price/performance allowing you to choose cost and capabilities that match your space.




Basic These are the most basic equipment and materials recommended for a starting Makerspace. They are selected to keep the cost low while making sure that the tools are the most useful and the materials are easy to work with. Basic elements are indicated with **green**.

Intermediate These tools and materials that add more capability to the Makerspace, allowing makers to create more ambitious projects and work with more materials with greater precision.

In most sections the Intermediate tools and materials are added to the Basic set allowing a space to advance over time.

Intermediate elements are indicated with **blue**.

Key:

	Basic Makerspace Only
	Intermediate Makerspace Only
	Both Basic and Intermediate .

Identical Items listed twice indicate an additional amount for an Intermediate space.

Workspace

Description

This section covers the requirements to create a safe, comfortable and creative making space. Large workbenches allow makers to work comfortably while allowing them to build cooperatively. Shelves give participants a place to keep their projects when they're not in the space, and there are supplies for cleaning up when done.

Many elements of the workspace such as workbenches, shelving, and whiteboards can be made significantly cheaper than buying ready made.



Safety

The workspace needs to be organized and spacious enough to provide enough room to move freely around working makers without danger. This means at least 6 feet between workbenches. Pathways to tools, exits, and safety equipment need to be kept clear and trash and debris needs to be easily and regularly removed. Everyone should know where the first aid kits and fire extinguishers are. Drop cords can quickly become a work and tripping hazard, so outlets need to be provided around the perimeter of the room and/or dropped from the ceiling for each workbench. Similarly the use of power strips is generally discouraged with the exception of a few specific sections listed below.

The space must be well ventilated to remove the airborne dust and fumes that many activities can create.

Requirements

The space needs to be well lit and ventilated.
Access to grounded outlets all along the perimeter of the room.

Basic: 1000 square feet or more. (For 25 makers)

Intermediate: 1200 square feet or more. (For 25 makers)

Intermediate: Having a sink available is preferred but not required.

Tools & Equipment

Equipment	Description	Example	Quantity	\$ Each	\$ Total
Workbench	6' x 3' Wooden top, standing height. (Can be built.)	Example	6	\$160.00	\$960.00
Worktable	6' x 3' wooden top, sitting height (28") (Can be built)	Example	1	\$160.00	\$160.00
Tool bench	Bench for stationary tools such as a drill press and bench vise. (Can be built)	Example	1	\$210.00	\$210.00
Stool	30" round	Example	26	\$55.00	\$1430.00
Chair	Standard chair, without arms.		4	\$45.00	\$180.00
Whiteboard	4' x 8'(Can be built)	Example	2	\$80.00	\$160.00
Project storage shelves	Shelving at least 24" deep, 30+ linear feet of shelves. (Can be built)	Example		-	\$300.00
Accessories					
Dry erase markers			8	\$1.00	\$8.00
Whiteboard eraser			2	\$3.00	\$6.00
Wet/Dry vacuum	5 gallon or larger capacity. With wheels.	Example	1	\$45.00	\$45.00
Push broom	24" or wider.	Example	1	\$30.00	\$30.00
Broom	Standard lobby broom		2	\$10.00	\$20.00
Dust pan			2	\$8.00	\$16.00
Bench brush	8" to 10"	Example	6	\$2.00	\$12.00
Trash Can	30 gallon or larger. Wheeled preferred.		2	\$25.00	\$50.00
Consumables					
Trash Bags	Matching the trash can above.		1 box	\$12.00	\$12.00
Paper towels			6 rolls	\$2.00	\$12.00
Vacuum collection bags	Matching the wet/dry vacuum above.		6 bags	\$3.00	\$18.00
Vacuum filter	Matching the wet/dry vacuum above.		1 filter	\$9.00	\$9.00
				Basic Total:	\$3314.00
				Intermediate Total:	\$3638.00

General Tools

Description

These are the tools and materials to outfit a workshop where makers can create a large variety of projects. This includes non-specialized hand and power tools for cutting, fastening, shaping, marking, measuring, taking apart, and putting together a large variety of projects. The materials are similarly non-specialized and can be worked easily with the tools in this section. These tools are also the base for other sections, for example combining with Electronics students can build robots and other electromechanical projects.

These tools take from a few seconds to a few minutes to learn to use.

Safety

The tools listed are safe when used responsibly. Hand tools can give scrapes, small cuts and pinches. Hammers can crush, and also generate flying debris, so eye protection should be worn. A heat gun and handheld torch can generate fires if used without proper attention to the work and surrounding areas.

Some power tools are heavy and should be not be used by makers who don't have the strength to control the tool well.

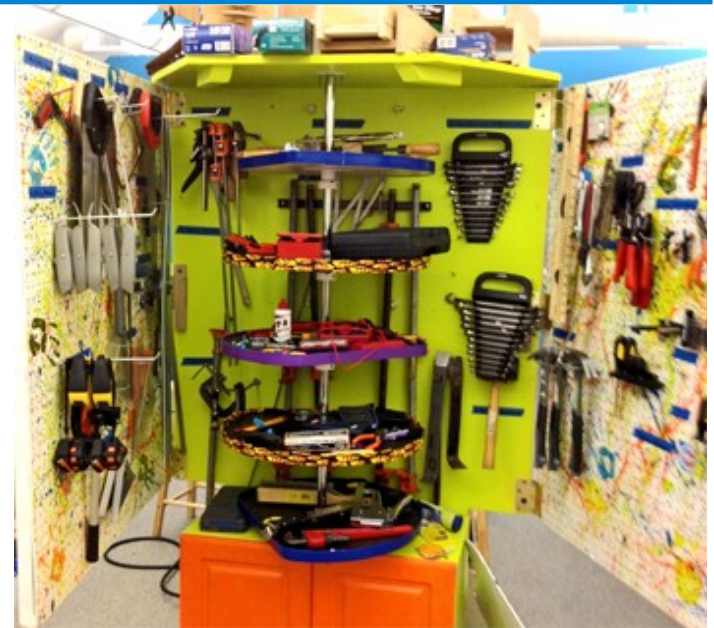
Electric saws have high power moving blades that can quickly cause traumatic injuries. However the chance of injury is small when properly maintained and used with care and attention. Safety glasses, respirators (masks) and earplugs should be worn during use.

All power tools have the ability to grab or throw anything loose in it's vicinity. Long hair must be tied up and loose clothing must be secured. Safety glasses must be worn at all times.

Respirators (masks) and safety glasses should be worn when using sanding with either a power sander or by hand.

Projects & Resources

- [Cross puzzle](#)
- [Custom roller skates](#)



- [Model rocket launch pad.](#)
- [Jam jar jet](#)
- [Rustic wood side table](#)
- [Wooden bench](#)
- [Compressed air rocket](#)

Additional projects at:
[MakeProjects.com](#)
[Instructables.com](#)

Requirements:

Work area as outlined in the **Workspace** section, above.
 Several feet of open wall area to store tools.

Tools & Equipment

Tool	Description	Example	Quantity	\$ Each	\$ Total
Cordless Drill/Driver	Rechargeable, Variable speed, 1/2" chuck	Example	4	\$120.00	\$480.00
Circular Saw	7 1/4" blade. Corded. Bevel adjustment. Storage case.	Example	1	\$100.00	\$100.00
Jig Saw	Variable speed with orbital action.	Example	1	\$50.00	\$50.00
Rotary tool	"Dremel" or similar. Corded (not cordless) Variable speed. Add a "keyless chuck" accessory if not included in your model.	Example	2	\$75.00	\$150.00
Bench top drill press	Multiple speed, 1/2" chuck. 8" or longer swing.	Example	1	\$120.00	\$120.00
Drill bit set	Multipurpose bits in sizes from 1/16" to 1/2" with case.	Example	3	\$15.00	\$45.00
Forstner bit set	Bits ranging from 1/2" to 1 1/2" or more.	Example	1	\$35.00	\$35.00
Random orbit sander	With dust collector/vacuum attachment.	Example	1	\$70.00	\$70.00
Claw hammer	16oz, smooth face.	Example	4	\$15.00	\$60.00
Mallet	18 oz rubber	Example	1	\$12.00	\$12.00
Ball peen hammer	aka "machinist's hammer". 16 oz weight.		1	\$10.00	\$10.00
Screwdriver Assortment	10 screwdrivers in various sizes, both straight and Phillips head.	Example	-	-	\$20.00
Small screwdriver assortment	10 Small screwdrivers with both straight and Phillips heads.	Example	-	-	\$20.00

	Combination wrench set (SAE)	Sizes from 1/4" to 3/4"	Example	2 sets	\$15.00	\$30.00
	Combination wrench set (Metric)	Sizes from 10mm to 24mm		1set	\$25.00	\$25.00
	Socket set (SAE)	3/8" drive. Sockets from 5/16" to 3/4"		1 set	\$24.00	\$24.00
	Adjustable wrench	"Crescent" wrench 6" and/or 8" length	Example	4	\$10.00	\$40.00
	Pipe wrench	2" jaw or 10" handle		1	\$26.00	\$26.00
	Hex wrench set (SAE)	Folding set of imperial (SAE) 5/64" to 1/4"	Example	2	\$9.00	\$18.00
	Hex wrench set (Metric)	Folding set. Sizes from 1.5mm to 8,,		1	\$9.00	\$9.00
	Star wrench set	aka "Torx" wrenches. Folding set preferred.	Example	1	\$9.00	\$9.00
	Tap and Die set (SAE)	Threads from from 4-40 to 1/2"		1 set	\$45.00	\$45.00
	Bench vise	4" or larger jaws		1	\$35.00	\$35.00
	Slip joint pliers		Example	4	\$5.00	\$20.00
	Needle nose pliers		Example	2	\$4.00	\$8.00
	Square nose pliers		Example	2	\$5.00	\$10.00
	Locking pliers		Example	2	\$6.00	\$12.00
	Utility knife	Retractable blade.	Example	7	\$3.00	\$21.00
	Pull saw	"Japanese style" 10" double sided with ripping and crosscut blade	Example	2	\$16.00	\$32.00
	Mieter box	Plastic or wood	Example	2	\$15.00	\$15.00
	Wood chisel set	Set of 4 or more. Hardened steel square blade in various widths		1	\$25.00	\$25.00
	Block plane	At least 1 1/2" width	Example	1	\$45.00	\$45.00
	Hack saw	Open frame	Example	2	\$10.00	\$20.00
	Center punch		Example	1	\$6.00	\$6.00
	Sheet metal nibbling sheers	Manual	Example	1	\$45.00	\$45.00
	Utility Scissors	Sometimes called "EMT Scissors"	Example	7	\$3.00	\$21.00
	Pry bar	Flat, 8" to 12"	Example	1	\$10.00	\$10.00
	Putty knife	3" wide, flexible steel.		2	\$4.00	\$8.00
	Tape measure	16 foot or longer	Example	2	\$8.00	\$16.00
	Yardstick	wood		6	\$1.00	\$6.00
	Carpenter's square	Steel 16" x 24"	Example	4	\$5.00	\$20.00
	Bar clamp	24" or longer bar.	Example	4	\$8.00	\$32.00

	C clamp	2 each, 4", 8" and 10"	Example	6	\$6.00	\$36.00
	90° clamp	Sometimes called a framing clamp		4	\$6.00	\$24.00
	Spring clamp	3" to 4" size		6	\$3.00	\$18.00
	Staple gun	Heavy duty, manual.	Example	2	\$18.00	\$36.00
	Hot glue gun	Full size, not "mini" or "craft" size.	Example	7	\$7.00	\$49.00
	Heat gun	300w or more power.	Example	1	\$18.00	\$18.00
	Hand torch	Butane. Electric ignition.	Example	1	\$30.00	\$30.00
	Wire brush	1" to 4" of bristles.		4	\$3.00	\$12.00
	Paint brush assortment - wide	Between 1" to 4" wide, synthetic bristle		10	\$1.00	\$10.00
	Paint brush assortment - detail	Less than 1" width.	Example	20	\$0.50	\$10.00
Accessories						
	Safety glasses	With adjustable length temples.	Example	30	\$2.00	\$60.00
	First aid kit	Appropriate for workshops.	Example	2	\$18.00	\$32.00
	Fire extinguisher	Class ABC. 5lb.		2	\$20.00	\$20.00
	Heavy duty drop cord	25 foot. High visibility (Yellow or orange)		3	\$15.00	\$45.00
	Sharpening stone	Double sided (medium and fine grit) at least 2" wide.		1	\$16.00	\$16.00
	Apron	Denim or canvas	Example	12	\$10.00	\$120.00
	Pegboard	4' x 8' sheets, with mounting hardware.	Example	2	\$22.00	\$44.00
	Pegboard	(Additional)		1	\$22.00	\$22.00
	Pegboard hook assortment	200 pieces total, various sizes and functions	Example	200 pegs	-	\$40.00
	Large rolling tool box	Steel, 4+ drawers with wheels.	Example	1	\$140.00	\$140.00
	Tool cabinet	Freestanding metal cabinet with lock and shelves.	Example	1	\$360.00	\$360.00
Consumables						
	Utility knife blades	Blades to match utility knives above.		25 blades	\$0.25	\$7.00
	Coping saw blades			20 blades	\$0.15	\$3.00
	Hack saw blades	Match hack saw above.		10 blades	\$0.35	\$4.00
	Circular saw blades	7 1/4". (1) ripping (24 teeth) (1) cross cut (40+ teeth) (1) plywood (100+ teeth)		3 blades	\$12.00	\$36.00
	Jig saw blade assortment	At least 12 blades with fine, medium and rough wood blades and fine metal blade. Shank should match jigsaw above.		1 assortment	\$25.00	\$25.00

			t			
	Rotary tools bit set	Various grinding, sanding, polishing and cutting bits to fit rotary tool above. With storage case.	Example	1 set	\$25.00	\$25.00
	Block plane blade	Matches the block plane above		1 blade	\$9.00	\$9.00
	Sandpaper assortment	9" x 11" Sheets, various grit from 80 (medium) to 240 (very fine) grit		100 sheets	-	\$20.00
	Sanding pad/sponge	Medium to fine grit	Example	1 case of 12	\$35.00	\$35.00
	Steel wool	"0" or "fine" size. package of 12 or more pads.		1 pack	\$5.00	\$5.00
	Orbital sander sanding discs	Matching the orbital sander above. Medium and fine grit.		2 boxes	\$12.00	\$24.00
	Staples	Match staple gun above.		1 box	\$5.00	\$5.00
	Hot glue sticks	10" clear		50 sticks	-	\$15.00
	White glue	4 oz bottle or bigger.		7 bottles	\$2.00	\$14.00
	Wood glue	8 oz bottle		4 bottles	\$3.00	\$12.00
	PVC cement	4 oz bottle or bigger		1 bottle	\$4.00	\$4.00
	Super glue			2 bottles	\$4.00	\$8.00
	Super glue remover	5 gram brush-on		1 bottle	\$3.00	\$3.00
	Epoxy	General purpose, quick set 2-part epoxy syringe	Example	4 syringes	\$3.00	\$12.00
	Spray adhesive	16 oz bottle. 3m Super 77 or similar multipurpose		1 bottle	\$12.00	\$12.00
	Duct tape	2" width 60 yard roll, silver.		4 rolls	\$4.00	\$16.00
	Masking tape	3/4" width 60 yard rolls		6 rolls	\$2.50	\$15.00
	Electrical tape	1/2 or 3/4" width. 20 yard or longer rolls. Black.		4 rolls	\$3.00	\$12.00
	Work gloves	Cloth with rubberized/nitrile palm coating. 5 pair each small, medium, large	Example	15 pair	\$4.00	\$60.00
	Disposable gloves	Nitrile, 100 each, small, medium, large				\$45.00
	Disposable respirators	AKA "dust mask" Rated N95 or higher.		30+ masks	\$0.75	\$23.00
	Foam ear plugs			1 pack of 50+ pair	\$10.00	\$10.00
	Pens	Ball point		50	\$0.15	\$8.00
	Pencils	#2, wood.		50	\$0.10	\$5.00

Marker assortment	Various colors	50	\$0.50	\$25.00
Acetone	32 oz / 1 liter	1 bottle	\$8.00	\$8.00
			Basic Total:	\$1804.00
			Intermediate Total:	\$3452.00

Materials & Parts

Material/Part	Description	Quantity	\$ Each	\$ Total
Plywood	1/4" thick 2' x 4' sheets. (Can be cut to size)	6	\$4.00	\$24.00
Plywood	1/2" thick 4' x 4' sheets. (Can be cut to size)	2	\$6.00	\$12.00
Lumber	1" x 2" x 4'	8	\$1.75	\$14.00
Lumber	1" x 4" x 4'	8	\$1.75	\$14.00
Lumber	2" x 4" x 4'	8	\$2.00	\$16.00
Lumber	1" x 6" x 8'	8	\$3.00	\$24.00
Lumber	2" x 6" x 8'8	6	\$4.00	\$24.00
Steel pipe	3/4" x 60" Black or galvanized.	4	\$12.00	\$48.00
U-bolt	3/4" inner diameter.	8	\$2.00	\$16.00
Steel pipe flange	3/4" inner diameter floor/wall flange. Example	4	\$6.00	\$24.00
Steel 90° fitting	3/4" Female/Female threaded. Example	6	\$6.00	\$36.00
Steel Tee fitting	3/4" Female threaded. Example	4	\$6.00	\$24.00
Steel cross fitting	3/4" Female threaded. Example	2	\$10.00	\$20.00
Sheet steel	Galvanized 26-30 gauge. 12" x 24" sheets.	4	\$10.00	\$40.00
Slotted angle steel	1 1/4" to 1 3/4" width. 4 foot lengths. Example .	4	\$6.00	\$24.00
Threaded rod	1/2" diameter 2 foot or longer lengths. Example	4	\$5.00	\$20.00
Nuts	1/2" hex. Box of 50 or more.	1 box	\$8.00	\$8.00
PCV pipe	1/2" diameter 5' length	12	\$1.50	\$18.00
PCV connector	1/2" dia 90 degree slip elbow	12	\$0.30	\$4.00
PCV connector	1/2" dia Tee slip connector	12	\$0.25	\$3.00

	PCV connector	1/2" dia 45 degree slip connector	6	\$0.50	\$3.00
	PCV connector	1/2" dia 4-way slip connector	6	\$1.00	\$6.00
	PCV connector	1/2" dia end cap	12	\$0.75	\$9.00
	Popsicle sticks	wood, box of 1000+	1 box	\$12.00	\$12.00
	Toothpicks	wood, Box of 1000+	1 box	\$6.00	\$6.00
	Basswood assortment	Assortment of various sizes. Example	-	-	\$20.00
	Dowel	1/4" diameter 36" round	6	\$0.25	\$2.00
	Dowel	1/2" diameter 36" round	6	\$0.50	\$3.00
	Dowel	1" diameter 36" round	6	\$2.00	\$12.00
	Bolts	3/8" diameter 3" length, fully threaded. Coarse (20) thread. Hex head. Box of 20 or more.	1 box	\$16.00	\$16.00
	Bolts	3/8" diameter 1 1/2" length. Coarse (20) thread. Hex head. Box of 20 or more.	1 box	\$13.00	\$13.00
	Nuts	3/8" hex. Box of 50 or more.	1 box	\$7.00	\$7.00
	Washers	3/8" inner diameter flat washers. Box of 100 or more.	1 box	\$6.00	\$6.00
	Bolts	1/4" diameter 3" length, fully threaded. Coarse (20) thread. Hex head. Box of 20 or more.	1 box	\$15.00	\$15.00
	Bolts	1/4" diameter 1 1/2" length. Coarse (20) thread. Hex head. Box of 20 or more.	1 box	\$12.00	\$12.00
	Nuts	1/4" hex. Box of 50 or more.	1 box	\$6.00	\$6.00
	Washers	1/4" inner diameter flat washers. Box of 100 or more.	1 box	\$6.00	\$6.00
	Machine screws	10-24 size, 3" or longer, fully threaded. Pan or round head. Phillips or slotted head. Box of 50 or more.	1 box	\$14.00	\$14.00
	Machine screws	10-24 size, 1 1/2" length. Pan or round head. Phillips or slotted head. Box of 50 or more.	1 box	\$12.00	\$12.00
	Nuts	10-24 size, hex.	1 box	\$14.00	\$14.00
	Washers	10-24 size. Flat washers. Box of 100 or more.	1 box	\$10.00	\$10.00
	Nails	2" galvanized	1 box	\$6.00	\$6.00
	Nails	1 1/4" brads	1 box	\$3.00	\$3.00
	Screws	3/4" flat head wood screws	1 box	\$10.00	\$10.00
	Screws	2" flat head wood screws	1 box	\$12.00	\$12.00
	Swivel casters	2" wheels with plate mount.	8	\$3.00	\$24.00
	Thumb tacks	flat metal head	1 box	\$2.00	\$2.00
	Rubber bands	Various sizes	1 package	\$5.00	\$5.00

	Craft paper	Roll 36" or 48" wide. White or "natural" color	1 roll	\$22.00	\$22.00
	Corrugated cardboard	Various sizes and shapes. Can be upcycled or scavenged.	4 pounds	\$12.00	\$12.00
	Paperboard	aka "chipboard". Various sizes and shapes. Can be upcycled or scavenged.	1 pound	\$6.00	\$6.00
	Foam board	Brand name "Foamcore". 1/4" thick 36" sheets. White.	8 sheets	\$3.00	\$24.00
	Dense polystyrene foam	2" thick. 4' x 8' sheet. (Can be cut smaller to store) Available from hardware stores and home centers. Example .	1 sheet	\$24.00	\$24.00
	Zip tie assortment	Various lengths	1 package	\$8.00	\$8.00
	String	Cotton, 16 ply 500 feet	1 roll	\$3.00	\$3.00
	Rope	Cotton 1/4" or 3/8" 50 feet	1 roll	\$6.00	\$6.00
	Cheesecloth	2 yards or more	-		\$4.00
	"Hand moldable" plastic	Brand names "Shapelock", "InstaMorph" 1 pound (500 grams) or more.	1 bag	\$25.00	\$25.00
	Paint - Acrylic	4oz tubes or larger, multiple colors	8 tubes	\$3.00	\$3.00
	Storage shelf	Open shelves, 24" deep. At least 4 shelves 5' long. (15 total feet of shelves.)	-	\$160.00	\$160.00
	Storage shelf	(Additional 10 feet of shelves)		\$100.00	\$100.00
	Storage cabinet	Metal cabinet, 36" x 24" x 72"	1	\$315.00	\$315.00
				Basic Total:	\$783.00
				Intermediate Total:	\$1391.00

Electronics

Description

This section covers the tools and materials needed to learn about electricity, electronics, integrated circuits and microelectronics. Solderless breadboards allow makers to quickly and nondestructively explore circuits while soldering allows makers to assemble circuits more permanently, either from kits or original designs. Makers can learn to read and create schematic diagrams and troubleshoot circuits. Microcontrollers allow makers to create advanced electronics and electromechanical systems including robots.

The equipment here can be quickly set up when needed and easily stored when not in use.

It takes around 10 minutes to learn to solder, an hour to become proficient at using an oscilloscope, and about 15 minutes to master the rest of the tools.

Compared to the Basic electronics set, the Intermediate set has higher quality and easier to use soldering irons, it encourages more complex projects including robotics, as well as more advanced tools for troubleshooting and problem solving.

If upgrading from the Basic Electronics setup you can use the temperature controlled soldering irons to either replace or augment the pencil irons in the Basic setup.



Safety

Electronics at this level are low power and safe, however the tip of a soldering iron heats to about 400°F, hot enough to cause burns and should be handled attentively. Under normal soldering conditions, solder containing lead posed no health risk, though makers should be encouraged to wash their hands after a long period of handling leaded solder. Lead-free solder is available but less recommended because the rosin gives off much more toxic fumes when soldering, is more corrosive to soldering tips, requires higher temperatures to solder with, and is generally harder to work with. Any kind of soldering generates fumes from the rosin core of the solder so the area should be ventilated.

Projects & Resources

Light Theremin <http://makeprojects.com/Project/Light-Theremin/989/1>

Atari Punk console <http://www.jameco.com/Jameco/PressRoom/punk.html>
 Learn To Solder Badge Kit http://www.makershed.com/Learn_to_Solder_Skill_Badge_Kit_p/mkls01.htm
 LED Nametag http://www.makershed.com/LED_Hello_My_Name_Is_Name_Tag_Kit_p/mkam1.htm
 Tron bag <http://makeprojects.com/Project/Tron-Bag-with-EL-Wire/477/1>
 Alarm bag <http://makeprojects.com/Project/Alarm-Bag/1057/1>
 Simple motor <http://makeprojects.com/Project/Simple-Motor/67/1>
 LED Night-Light Cube <http://makeprojects.com/Project/LED-Night-Light-Cube/258/1>
 Drawdio electronic pencil: http://www.makershed.com/Drawdio_Fun_Pack_p/mkad20.htm
 Arduino reference: <http://arduino.cc/>
 Arduino microcontroller projects: <http://arduino.cc/playground/>

Requirements

Grounded outlets for each power strip.
 Ventilated work area when soldering.

Intermediate: Using microcontrollers and the oscilloscope require access to computers. (See **Computer Lab** below.)

Tools & Equipment

	Tool	Description	Example	Quantity	\$ Each	\$ Total
	Pencil soldering iron	30w	Example	13	\$6.00	\$78.00
	Basic temperature controlled soldering station	With replaceable/interchangable tips.	Example	13	\$20.00	\$260.00
	Soldering stand	With sponge (Might be included with more advanced soldering irons.)	Example	13	\$5.00	\$65.00
	Helping hands		Example	13	\$6.00	\$78.00
	Digital multimeter		Example	2	\$15.00	\$30.00
	Oscilloscope	2 or more channel, 500MS/s or better.	Example	1	\$400.00	\$400.00
	Wire stripper	For 22-30 gauge wire	Example	7	\$7.00	\$49.00
	Needle nose pliers	Needle nose, smooth jaw	Example	7	\$3.00	\$49.00
	Flush diagonal cutters		Example	7	\$8.00	\$49.00
	Solder vacuum		Example	2	\$5.00	\$10.00

	Solderless breadboard	"half size" 400 point.	Example	25	\$5.00	\$125.00
	Solderless breadboard	"full size" 800+ point.	Example	8	\$8.00	\$64.00
Accessories						
	Power strip	6 outlet grounded.		6	\$5.00	\$30.00
	Storage box	Plastic, 4 gallon or larger, with lid.		1	\$19.00	\$19.00
Consumables						
	Solder	1/4 pound of 60/40 0.031" diameter rosin core. (To be divided into smaller spools.)	Example	1	\$6.00	\$6.00
	Solder wick	5 ft spool	Example	1 spool	\$3.00	\$3.00
	Tip cleaner		Example	1	\$8.00	\$8.00
					Basic Total:	\$830.00
					Intermediate Total:	\$1245.00

Materials & Parts

Material/Part	Description		Quantity	\$ Each	\$ Total
Hookup Wire	22 gauge, solid core, 25 foot rolls. multiple colors	Example	5	\$3.00	\$15.00
Heat shrink assortment	From 1/16" to 3/8" diameter.	Example	2	\$5.00	\$10.00
AA battery			20	-	\$15.00
9v Battery			10	-	\$15.00
Coin cell battery	3 volt CR2032 type.		20	-	\$12.00
9v Battery clip		Example	10	\$1.00	\$10.00
AA x 2 battery holder		Example	5	\$2.00	\$10.00
AA x 4 battery holder		Example	5	\$2.00	\$10.00
Resistor assortment	1/4" watt. Assortment of at least 250 pieces	Example	-	-	\$8.00
Capacitor assortment (Electrolytic)	Assortment of at least 50 pieces	Example	-	-	\$15.00
Capacitor assortment (ceramic)	Assortment of at least 50 pieces	Example	-	-	\$5.00
Diode assortment	Assortment of at least 50 pieces	Example	-	-	\$2.00
Transistor assortment	Assortment of at least 50 pieces	Example	-	-	\$15.00

Potentiometer assortment	Assortment of at least 10 pieces	Example	-	-	\$5.00
LED assortment	Assortment of at least 100 pieces	Example	-	-	\$10.00
Switch assortment	Assortment of at least 10 pieces	Example	-	-	\$8.00
Motor	Assortment of at least 10 small DC motors	Example	-	-	\$10.00
Photo resistor assortment	Assortment of at least 10 pieces	Example	-	-	\$3.00
555 timer	8 pin "DIP" package	Example	5	\$2.00	\$10.00
Piezo buzzer	1/2" to 1/4" enclosed piezo buzzer.	Example	5	\$3.00	\$15.00
Speaker	Small 8 ohm, 0.5 watt	Example	5	\$2.00	\$10.00
Micro servos	Small, 5v servos. Often blue and with "9g" in the product number.	Example	6	\$5.00	\$30.00
Gear reduction motors	140:1 reduction or higher (slower)	Example	6	\$6.00	\$36.00
Wheels	Hub matching gear motors above.	Example	6	\$3.00	\$18.00
Arduino Duo		Example	6	\$30.00	\$180.00
USB cable	3' with full size "A male to B male" plugs on both ends.		8	\$3.00	\$24.00
9v wall plug	5.5x2.1mm barrel connector to match Arduino above	Example	8	\$6.00	\$48.00
IR Emitter/reviver pair	aka "Line sensor"	Example	12	\$1.00	\$12.00
Temperature sensor	Analog, 3 pin.	Example	6	\$1.50	\$9.00
Tilt sensor		Example	4	\$2.00	\$8.00
Force sensitive resistor		Example	4	\$7.00	\$28.00
Flex sensor		Example	4	\$8.00	\$32.00
Motion sensor	PIR (Passive Infrared) sensor	Example	2	\$10.00	\$20.00
Humidity and temperature sensor		Example	2	\$10.00	\$20.00
Parts Storage cabinet	24 or more drawers	Example	1	\$35.00	\$35.00
				Basic Total:	\$268.00
				Intermediate Total:	\$713.00

Textiles

Description

This station covers most common tasks of working with cloth, vinyl, leather, yarn and other flexible materials. The tools and materials can be used to make, repair, and alter clothes, quilt, knit, crochet, and knot, among other skills. In addition to making clothing, the station can be used to create home decor, utility (aprons, gloves, tool belts, etc), jewelry, and used along with other tool to create furniture, fiberglass, soft circuits and other projects.

The Basic equipment can be quickly set up and put away when not needed while the Intermediate section has a dedicated worktable for larger projects. The Intermediate tools allows makers to work with a wider range of materials and adds a serger which cuts and sews at the same time easily creating professional seams as well as decoration.

Time to set up and learn the basic use of a sewing machine is half an hour.

Time to set up and learn the basic use of a serger is an hour.

Other tools require minutes to learn.



Photo: jigabugbaby on Flickr.com

Safety

Sewing is generally a safe activity with very little risk of more than a small prick from a needle. However steam irons do get hot enough to cause burns, sergers have blades that can cut a careless finger, and sewing machines and sergers both have enough power to put a needle through a finger when used carelessly.

Projects & Resources

- [Necktie glasses case](#)
- [Morse Code scarf](#)
- [Shift ruffles](#)
- [Vibrating pillow](#)
- [LED shoe clips](#)
- [Upholstery](#)
- [Rock star headphones](#)

Additional projects at:
MakeProjects.com
Instructables.com

Requirements

Basic: Two grounded outlets.

Intermediate: 6' x 3' area for sewing table.

Intermediate: Three grounded outlets.

Tools & Equipment

Tool	Description	Example	Quantity	\$ Each	\$ Total
Sewing Machine	Basic name brand, multi-stitch sewing machine	Example	1	\$100.00	\$100.00
Serger	Also called an "overlocker" or "overlock machine".	Example	1	\$230.00	\$230.00
Fabric Shears	8-10"		2	\$11.00	\$22.00
Embroidery scissors	4"	Example	1	\$12.00	\$12.00
Seam ripper		Example	1	\$4.00	\$4.00
Cloth tape measure		Example	1	\$3.00	\$3.00
Hand sewing needle assortment	At least 12 needles.		-	\$3.00	\$3.00
Heavy duty hand needle assortment	At least 6 needles for upholstery and leatherwork.			\$5.00	\$5.00
Steam iron	Includes auto-off feature.		1	\$18.00	\$18.00
Ironing board	Freestanding, collapsable.	Example	1	\$19.00	\$19.00
Crochet hook assortment	At least 8 aluminum hooks of various sizes.		-	\$15.00	\$15.00
Leather Punch		Example	1	\$20.00	\$20.00
Snap setter	With multiple sizes of bits/dies.	Example	1	\$15.00	\$15.00
Sewing awl			1	\$5.00	\$5.00
Embroidery hoops	10" and 6"		2	\$3.00	\$6.00

	Knitting needle assortment	At least 4 pair of different sizes.		-	\$12.00	\$12.00
	Pins	Box of 100 or more		-	\$2.00	\$2.00
	Safety pins	Box of 50 or more		-	\$2.00	\$2.00
	Thimble			5	\$1.00	\$5.00
Accessories						
	Sewing Table	3' x 6' worktable. Can be same as the workshop workbenches.		1	\$160.00	\$160.00
	Cutting Mat	Self healing 36" x 48"			\$65.00	\$65.00
	Sewing Machine storage case	Match the make and model of sewing machine.		1	\$23.00	\$23.00
	Sewing bobbins	Match the make and model of sewing machine.		Box of 10	\$3.00	\$3.00
	Craft storage box		Example	1	\$16.00	\$16.00
Consumables						
	Sewing machine needles	70/10 or 80/12 size, packs of 5		3 packs	\$2.00	\$6.00
	Serger needles	14/90 or 12/80, packs of 5. Matching make and model above		3 packs	\$8.00	\$24.00
	Serger blades	Matching make and model above		1 set	\$12.00	\$12.00
	Fabric marking pen			2 pens	\$5.00	\$10.00
	Fabric glue	4oz or bigger bottle. Machine washable. (not water soluble.)		1 bottle	\$4.00	\$4.00
					Basic Total:	\$332.00
					Intermediate Total:	\$821.00

Materials & Parts

Material/Part	Description	Quantity	\$ Each	\$ Total
Cloth - muslin		6 yards	\$2.00	\$16.00
Cloth - muslin	(Additional)	6 yards	\$2.00	\$16.00
Cloth - cotton	Lightweight cotton, 2 yards each of different colors/patterns	8 yards	\$4.00	\$48.00
Cloth - cotton	(Additional)	6 yards	\$4.00	\$24.00
Felt	9" x 12" craft felt sheet, various colors.	100+ sheets	-	\$12.00
Sewing Thread assortment	12 or more spools, various colors with at least 250 yards per spool.	12 spools	\$1.00	\$12.00

	Conductive thread	With stainless steel. 30+ feet. Example	1 spool	\$8.00	\$8.00
	Fusable bonding tape	aka "Stitch Witchery" 5/8" width 12 + yards	1 spool	\$6.00	\$6.00
	Upholstery Thread	large 1000+ yard spools. Mix of black and white spools.	4 spools	\$5.00	\$20.00
	Nylon webbing/strapping	1" width. 5+ yards.	-	-	\$12.00
	Elastic 1/4" wide	3+ yards	-	-	\$3.00
	Elastic 1" wide	3+ yards	-	-	\$3.00
	Button assortment	Various sizes and colors. At least 100 buttons.	-	\$5.00	\$5.00
	Hook and Loop fastener	Velcro or other brand, 3/4" wide tape, without adhesive backing	2 yards	\$6.00	\$12.00
	Snaps	Package of 10 sets ore more, small or medium size.		\$7.00	\$7.00
	Ribbon	Fabric ribbon. 1/4" to 1 1/2" width. Various colors	3 spools	\$9.00	\$27.00
	Leather cord	5 or more yards		\$12.00	\$12.00
	Yarn	Acrylic worsted, various colors.	4 skeins	\$4.00	\$16.00
	Fabric Glue	4oz. Washable.	1	\$7.00	\$7.00
	Storage bin	10-12 gallon, plastic, with lid.	1	\$12.00	\$12.00
				Basic Total:	\$140.00
				Intermediate Total:	\$278.00

Computers

Description

Computers give makers access to information as well as digital tools to design, create, and collaborate on projects. Computers are absolutely necessary for working with digital fabrication tools such as 3D printers, laser cutters and CNC machines. They are also necessary for programming robots and using other programming tools. The addition of a printer allows makers to print patterns, designs and decorations.

With internet access they offer access to reference information, project ideas, expert help, instructional videos and safety information as well as data files to modify or replicate with digital fabrication tools.

Most newer laptops are capable of handling these tasks, with the main limitation being the size of the screen. Working with complex 3D models and professional design tools require more powerful computers. Ultraportables, netbooks, and tablets are not recommended.

Compared to the Basic computer lab section, the Intermediate lab has more powerful computers capable of running more advanced software. Screens are larger to make design easier, and the Intermediate setup has a larger format printer allowing makers to print larger plans and full-size patterns.



Operating Systems

In general any operating system (Windows, OS X, Linux) is acceptable and if the space is associated with another organization with computers, such as a school or library, it's recommended that you use what the organization supports. One exception is if you are using an Epilog laser cutter, the software required to operate it is Windows only. In addition, some professional engineering tools are Windows only.

Software

There is a great selection of software that is available to makers for free, and most of them run on a number of operating systems. Some examples are [Gimp](#) for creating and manipulating images. [Inkscape](#) for creating and manipulating line drawings. [Blender](#), [Sketchup](#), [Tinkercad](#), and [123D](#) for creating and working with 3D objects. However free software is often not what the professionals use. Professional engineering and image creation software costs many times the value of the computer they run on, they are often more powerful and are easier-to-use.

Educational discounts are available from most professional software companies including [Adobe](#), [Autodesk](#) and [Corel](#).

Projects & Resources

Make Projects: DIY Project resources <http://makeprojects.com/>

Instructables: DIY Project resources <http://www.instructables.com/>

Codecademy: Self guided programming lessons. <http://www.codecademy.com/>

Arduino: Introduction to microcontrollers and robotics. <http://arduino.cc/>

Requirements

Internet access (WiFi preferred)

6 grounded outlets.

Tools & Equipment

Tool	Description	Example	Quantity	\$ Each	\$ Total
Laptop	15" or larger screen. 2GB or more RAM. 200 GB or more hard drive.	Example	6	\$500.00	\$3000.00
Laptop	17" or larger screen. 4GB or more RAM . 500 GB or more hard drive.	Example	6	\$600.00	\$3600.00
Printer	Black and white laser printer. Wireless.	Example	1	\$110.00	\$110.00
Larger format printer	Laser printer with support for 12x18 or larger print size	Example	1	\$390.00	\$390.00
Accessories					
Table	Round "activity" table capable of seating 4.	Example	2	\$165.00	\$330.00
Chair	Folding chair or wheeled office chair		6	\$22.00	\$132.00
USB thumb drives	2 GB or larger		6	\$5.00	\$30.00
Mouse	3 button with scroll wheel		6	\$4.00	\$24.00
Mousepad			6	\$2.00	\$12.00
Printer stand	Capable of storing several reams of paper.	Example	1	\$45.00	\$45.00
Consumables					
Printer toner	Cartridge to match your printer		1	\$30.00	\$30.00
Paper 8 1/2 x 11 (Letter size)	White 20# 500 sheets		1	\$10.00	\$10.00

	Paper 11x17 (Ledger size)	White 20# 500 sheets		1	\$10.00	\$10.00
	Colored paper	Various colors 500 sheets total. 8 1/2" x 11"		1	\$15.00	\$15.00
	Card stock	White 110# 250 sheets		1	\$15.00	\$15.00
					Basic Total:	\$3753.00
					Intermediate Total:	\$4643.00

3D Printing

Description

3D printing allows makers to create complex 3D shapes from plastic or other materials. Extrusion based 3D printers build objects by melting out thin layers of plastic, one on top of the other. Many different kinds and colors of plastics can be used, including ABS (the same plastic used in Lego) and PLA (a biodegradable plastic). There is even glow-in-the-dark material! 3D printing is not a particularly fast process. Speed is almost entirely based on the volume of plastic needed for the project. For example a small plastic whistle is mostly hollow will print in around 5 minutes, while larger pieces can easily take hours. The output of extrusion printers often requires a bit of cleanup by hand after printing.

While a computer is not required to print, makers will need access to one to create or download the files for printing.

The addition of other items such as [windup motors](#) makers can create things that move or have other interesting capabilities.

The Intermediate printer offers a pair of print heads (extruders) that can print in two colors at the same time, or print in more than one material at a time. When one material is water soluble much more complex shapes can be printed. One example would be printing a wheel on an axle with water soluble material separating them. When the material is dissolved the wheel can spin freely on the axle.

In lieu of a full 3D printer setup, consider sending work to service bureaus like [Shapeways](#) and [Ponoko](#). They can print with more detail or in other materials.

It takes 1-3 hours to learn to use and maintain 3D printer.

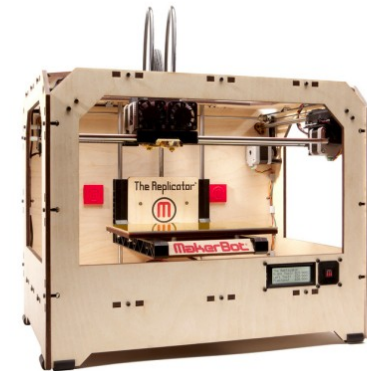


Photo: MakerBot Inc.

Safety

3D printer is generally very safe. The print extruder does heat to several hundred degrees and should not be touched. There will be a slight "hot plastic" smell when printing with ABS plastic. It's non-toxic but can be an irritant and the printer should be placed in an open area or near ventilation.

Software

There are a large number of applications that can create 3D models for printing. Popular free offerings include [Google Sketchup](#), [Blender](#), [Wings 3D](#), [tinkerCAD](#), and [Autodesk 123D](#). Commercial packages include [Rhino](#), [Autodesk Inventor](#), and [Solidworks](#). The prices varies from several hundred to thousands of dollars, though educational discounts are available.

In addition to creating original 3D models, designs can also be freely downloaded from sites like [Thingiverse.com](#).







Projects & Resources

Many 3d printable models: <http://www.thingiverse.com/>
3D Printing curriculum: <http://curriculum.makerbot.com/>

Requirements

Minimum 24" x 24" of dedicated table or desk space.
1 grounded outlet.

Tools & Equipment

Tool	Description	Example	Quantity	\$ Each	\$ Total
 Makerbot Replicator	Single extruder	Example	1	\$1749.00	\$1749.00
 Makerbot Replicator	Dual extruder	Example	1	\$1999.00	\$1999.00
Accessories					
  SD Card	1GB or larger SD card for transferring student models to the printer		25	\$2.00	\$50.00
Consumables					
  Plastic filament	1kg ABS 1.75mm. Any color.	Example	1	\$50.00	\$50.00

Plastic filament	(Additional roll/color)	Example	1	\$50.00	\$50.00
PVA (water soluble) filament	1kg PVA 1.75mm	Example	1	\$90.00	\$90.00
				Basic Total:	\$1849.00
				Intermediate Total:	\$2239.00

Laser Cutting

Description

A laser cutter allows makers to quickly and accurately cut complex shapes from flat materials such as paper, wood, acrylic, cardboard, and felt. These flat cutouts can then be assembled to create 3D structures. Laser cutters can also be used to etch designs into the surface of materials. Since it works conceptually much like a traditional printer it can be easier and faster to learn to use than a 3D printer. A computer is required to create designs and to manage the laser cutter. Training to use a laser cutter includes selecting material that can be safely and effectively cut, creating patterns on the computer, choosing the correct settings to cut effectively, as well as care, maintenance, and calibration of the laser cutter. Laser cutting and etching can be done directly by makers or can be submitted to a supervisor to cut outside of class time.



Compared to the Basic laser cutter, the Intermediate laser cutter package offers much faster cutting, the ability to cut thicker materials, and more detailed and accurate cutting and etching.

It takes up to an hour to learn the basics of laser cutter use. Learning to fully maintain a laser cutter will take several hours.

Safety

The primary risk when using a laser cutter is of fire within the cutter itself. The laser cutter should not be run unattended, as even a small fire can cause costly damage to the equipment. A CO2 or halon fire extinguisher should be accessible near the cutter. Both halon and CO2 extinguishers can be used to quench fires without causing more damage to the laser cutter.

A secondary risk is of fumes. Proper, filtered ventilation is a must. As the laser vaporizes material, gases are released. While most recommended materials do not release hazardous gases, they can still cause irritation. Cutting unapproved materials such as vinyl and PVC will release

chlorine gas which is not only toxic but corrosive and will damage the laser.

While the laser its self is invisible, a properly maintained laser cutter has a number of interlocks and safety systems to prevent the laser from escaping the cabinet and causing damage or harm. If the lid or access panel are opened during operation the laser will immediately cut out. The glass in the cabinet is designed to filter out the reflected rays of the laser so cutting can be observed without danger.

Software

There are a number of applications that can create two dimensional files for laser cutting. In general any application that can generate vector drawings can be used. The standard is [Corel Draw](#) a commercial vector drawing application that costs around \$400, though educational discounts are available. [Inkscape](#) is a free option which also allows makers to create dimensional drawings for cutting and etching. In addition software like [123D Make](#) can generate 2D files from 3D models. There are also downloadable files available on the internet, as well as tools that automatically create custom files for things such as boxes or gears.

Projects & Resources

List of materials that can be cut and/or etched in a laser cutter: http://www.epiloglaser.com/laserable_materials.htm

Many patterns that can be laser cut: <http://www.thingiverse.com/tag:lasercut>

Gear creator: http://woodgears.ca/gear_cutting/template.html

Box creator: <http://boxmaker.rahulbotics.com/>

Requirements

Space: Minimum 60" x 60"

Power: 3 grounded outlets.

Tools & Equipment

	Tool	Description	Example	Quantity	\$ Each	\$ Total
	Epilog Zing 24 Laser	30 watt laser with 24" x 12" cutting area. * May also be leased.	Example	1	\$7995.00	\$7995.00
	Epilog Mini 24 Laser	35 watt laser with 24" x 12" cutting area. * May also be leased.	Example	1	\$17,00.00	\$17,000.00
Accessories						
	Compressor	Provides air assist, which prevents flare ups and fires.	Example	1	\$80.00	\$80.00
	Air filtration system	Removes debris, toxic fumes, and odors from cutting. At least 450cfm, 3-stage filter	Example	1	\$2500.00	\$2500.00

		including HEPA filter (Optional if you have access to external ventilation.)			
	Fire extinguisher	CO2 or Halon to prevent causing more damage to the laser cutter. 5 lb.	1	\$65.00	\$65.00
	Computer	Windows XP/Vista/7 Required to send files to the cutter.	1	\$600.00	\$600.00
	Table	At least 60"x30" With shelves for material storage	1	\$190.00	\$190.00
	Chair		1	\$25.00	\$25.00
Consumables					
	Electricity	Assuming 14 hours per week of use at \$0.12kWh			\$82.00
	Electricity	Assuming 14 hours per week of use at \$0.12kWh			\$109.00
	Filter replacements	Matching the 3 different filter elements for the air filter above			\$275.00
				Basic Total:	\$11,812.00
				Intermediate Total:	\$20,844.00

Materials & Parts

Material/Part	Description	Quantity	\$ Each	\$ Total	
Card Stock	12" x 12" 100 sheets, various colors	100	-	\$15.00	
Acrylic sheet 1/8" or 3mm	12" x 24" or smaller. Transparent. Various colors	5	\$8.00	\$40.00	
Acrylic sheet 1/4" or 5mm	12" x 24" or smaller. Transparent. Various colors	5	\$12.00	\$60.00	
Corrugated Cardboard	12" x 24" 100 sheets (Can be upcycled/salvaged and cut to size)	100	-	\$5.00	
Felt	12" x 12" 50 sheets, various colors. Wool.	50	-	\$25.00	
Hardboard or MDF 1/8"	12" x 24" Can be cut to size.	20	-	\$35.00	
Hardboard or MDF 1/4"	12" x 24" Can be cut to size.	20	-	\$45.00	
Plywood 1/8"	12" x 24" Birch, sanded. Can be cut to size.	20	-	\$60.00	
Plywood 1/4"	12" x 24" Birch, sanded. Can be cut to size.	10	-	\$45.00	
				Basic Total:	\$140.00
				Intermediate Total:	\$330.00