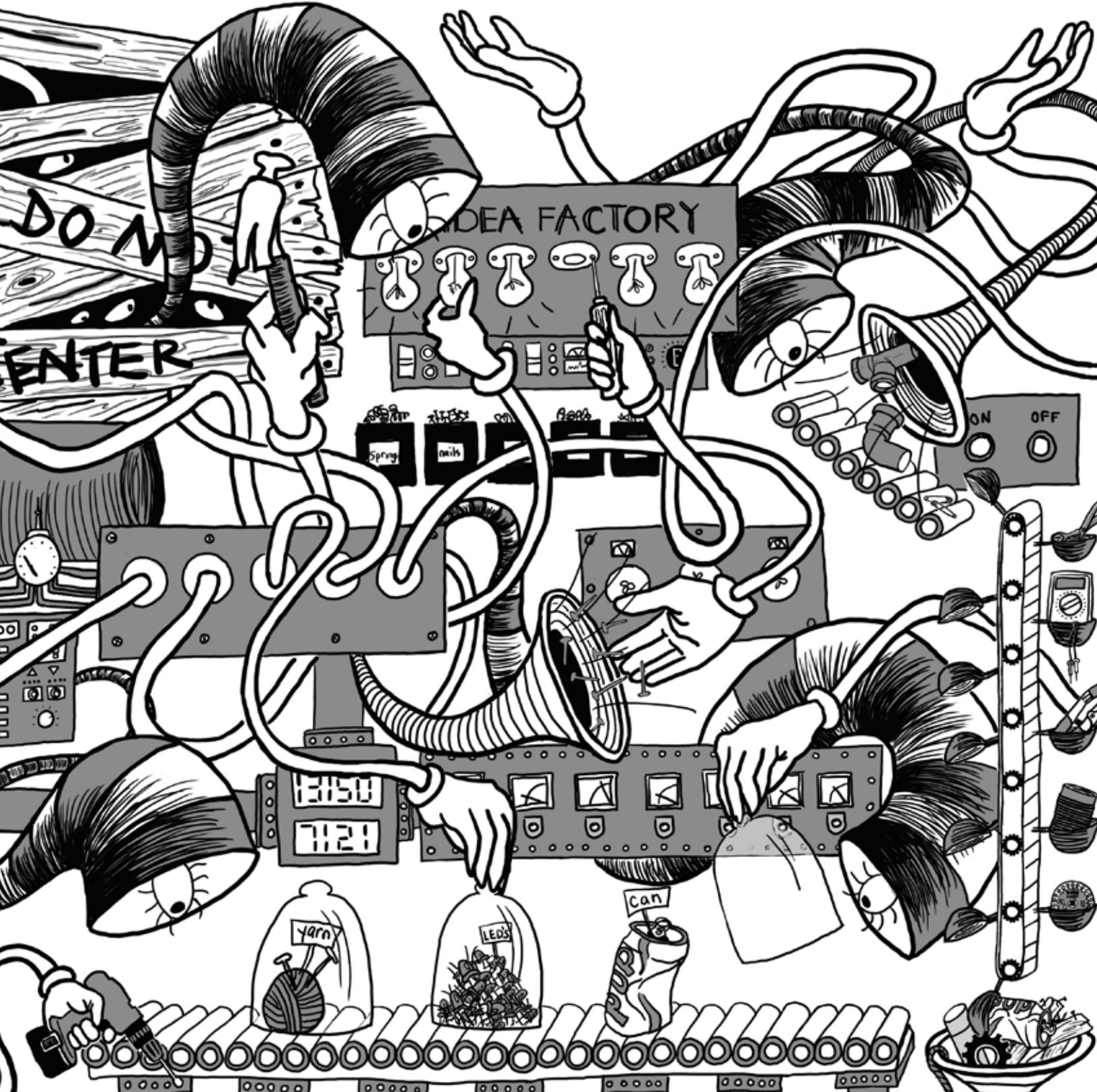




ita | YOUTH

MAKER CLUB

# PLAYBOOK



**Dear Maker & Educator,**

The Industry Training Authority Youth Team and The Magic Trout Imaginarium, invite you to use this handbook and get your students excited and inspired about making in schools.

This book brings together hands-on activities that mesh ARTS and TRADES and also meet the ADST curriculum goals for Grade Six.

We hope you find the Teacher's Guide helpful in beginning a Maker Club in your school.

ITA Youth Discover the Maker Way grants are available to help you kick start a Maker Club in your school. You can check out the simple grant application online at [youth.itabc.ca/educators/program-resources](http://youth.itabc.ca/educators/program-resources) or contact the ITA Youth Team at [youth@itabc.ca](mailto:youth@itabc.ca).

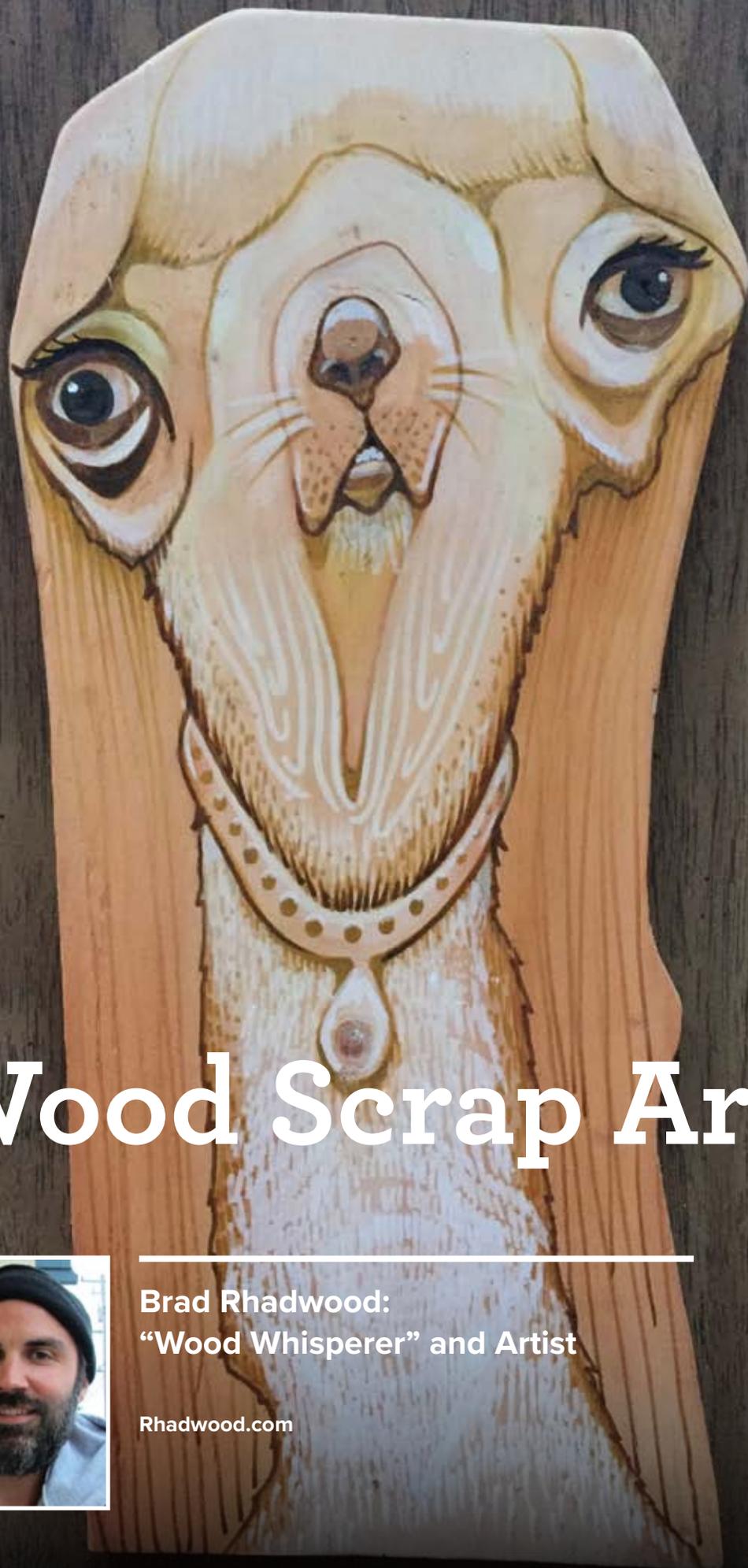
Connect with The Magic Trout Imaginarium: [www.magictroutimaginarium.com](http://www.magictroutimaginarium.com) to schedule an assembly for your schools, or to view their resource document linking ADST to Maker Projects.

We are all Makers. You've got what it takes.

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# Wood Scrap Art



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**Brad Rhadwood:**  
“Wood Whisperer” and Artist

[Rhadwood.com](http://Rhadwood.com)



## TRADE SKILLS

Basic carpentry

## SKILLS LEARNED

Clamping, sawing and sanding, wood selection, scrap re-purposing and improvisation

## TOOLS

2 woodworking clamps (ideally quick release)

Electric sander with medium and fine grit sanding discs (or sanding block with sandpaper)

Square or ruler

Crosscut saw

Coping saw

Staple gun

Wire cutters/scissors

## MATERIALS

Scraps of plywood (the more knots the better!)

Markers, pencil and eraser

Wire or similar to mount hanger on back

## WORK SURFACE

Workbench or table with overhanging lip (to clamp onto)

## SAFETY GEAR

Dust mask

Gloves

Safety glasses

## COST

\$0-5 (Free if you find offcuts)

## TERMINOLOGY

**Knots** – circular marks in the surface of wood that occur where branches used to grow.

**Profile** – the designs in the wood surface once it has been cut

**Grain** – the direction of wood fibres. Appears as lines on the surface of cut wood.

**Grit** – roughness of sandpaper. Low numbers (36-100) are coarse for removing paint/rust, medium is 100-180 and fine is 180-230 for finishing. Start coarse and work your way to finer paper.

**Plywood** – processed and compressed thin sheets of wood made from alternating layers of wood and glue.

**Offcuts** – wood leftover after a measurement is made and wood is cut to size.

**Note to Makers:** Many construction sites and home building stores will recycle or throw away their plywood offcuts. Most times you can ask and they will give them to you for free! When you are choosing your wood, take a good look at the profile of the wood and imagine what creatures may be living inside, waiting for you to bring them to life. Ex: knots make great eyes!

## PART 1

# MAKING YOUR CREATURE



## 1. Find a piece of discarded wood.

Plywood is easy to find scraps of because it is made in large 4x8 ft sheets and is often cut up into smaller pieces. Small pieces are considered unusable on construction projects.

Once you find your piece of wood, use a tape measure to measure and calculate the perimeter and area of your wood. Show your calculations and explain how you came to this conclusion.



## 2. Find a work surface

and clamp your wood to the edge. Use 2 clamps for extra stability.

## 3. Get ready to sand your wood!

Put on your gloves and safety glasses (or regular glasses will work if you already wear them). You may also want to wear a dusk mask.



- ## 4. If your wood has paint on it,
- use a sandpaper that's coarse grit (36-100). If there is no paint on it, use a medium grit (somewhere around 100-180). This orbital sander uses sanding discs with velcro on the back, so it sticks right on.

### Sanding Tip

Make sure you hold your sander tight when you turn it on and off. Your sander works by vibrating and moving in a circle, so it will try to run away from you!

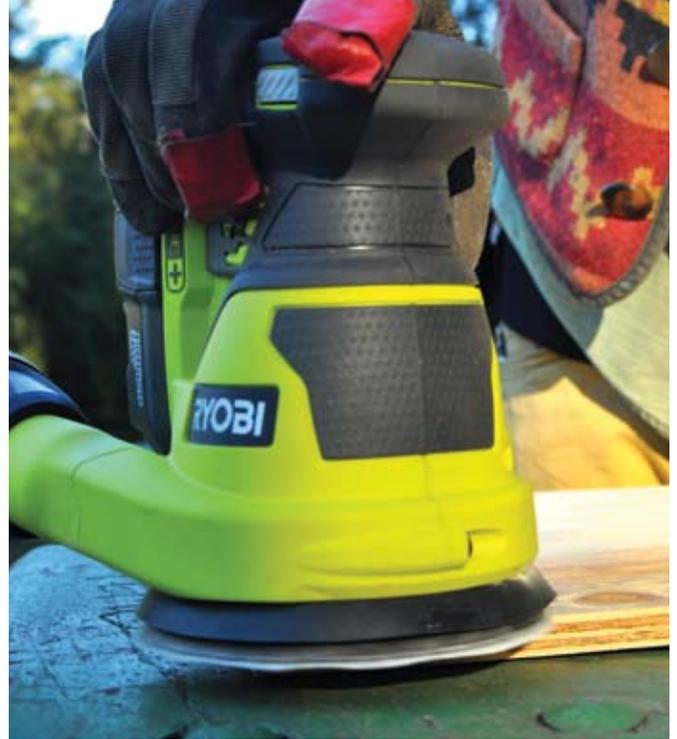


**5.** Hold your sander with your dominant hand and use your other hand to press down on the wood to prevent vibration. Move your sander in the same direction as the grain.

**6.** After you've sanded the whole surface once, turn off your sander. Now, move your clamps over slightly, otherwise the spot under the clamps will not be sanded. Take off your glove and run your hand over your wood to feel where the wood still needs to be sanded. Put your gloves back on and sand a bit more. After you've covered the entire surface, stop sanding and change your sanding disc to a finer grit and repeat this process.

**7.** Once you've done sanding, you can cut down your project to a smaller size. Unclamp your project to take a look at your wood. Rotate your wood to look at it from all sides. Turn it upside down. Decide which part of the wood you want to use and how much wood you want to cut off.

**8.** If you have a square, use your square tool to draw a cut line. Brad doesn't have a square handy, so he is improvising by using a piece of plywood as a ruler to mark where he will cut his wood. We recommend you use a square, but in a pinch there are other ways to do it!



## DID YOU KNOW



That the edges of plywood (before it's cut) are perfectly square? This is because plywood is manufactured in a factory. If a person has previously cut the wood down to size, the edge may not be straight, so look for the edge that is straight from the factory.

- 9.** Position your wood so your cut line is hanging over the edge of your workbench (you don't want to accidentally saw your workbench!). Now clamp your wood in place. Use your dominant hand to hold the crosscut saw, and your other hand to hold the wood down. Remember to tuck in your thumb! Start sawing back and forth at a 20–45 degree angle to your wood. Saw until the excess wood falls to the ground. As you can tell by Brad's expression, hand sawing wood is hard work!



- 10.** Wipe off the sawdust and get ready to draw your creature!  
You will need a pencil and eraser for this part.



- 11.** Take a good look at your wood profile. Start outlining the shapes, figures and creatures you see.



**12.** Now that you've found your creature, you can continue cutting down your wood if needed. Clamp your wood to the table, making sure the part of the wood your plan to cut off is hanging over the edge with plenty of extra room for the saw to move. Once your wood is clamped, decide if you need a coping saw (for curved or wiggly cuts) or a crosscut saw (for straight cuts). Brad's project required a coping saw for the sides and a crosscut saw for the top corners. Don't forget to put on your safety equipment if you've taken it off!



Once you have cut your project to the size you want, calculate your perimeter and area. Take into account your previous calculation and estimate how much wood you have saved from the dump.

**13.** Time to sand your creature! First clamp your wood on the workbench. Make sure your wood is hanging just a bit over the edge (so you don't sand your workbench). Use the sandpaper that is already on your sander. Turn on your sander, then move along the edges without pressing too hard. For each edge you will have to stop sanding, unclamp, rotate, then re-clamp your wood. Continue until all edges are complete.

**14.** Turn off your sander, take off your sanding disc and continue to sand the edges of your wood by hand. Take off your gloves to feel how smooth the edges are, then continue to sand if there are areas that need more work.



**15.** Start adding colour! Take out your markers and outline your creature!



**16.** Start outlining your creature, ideally with permanently markers; however, any markers will work.



## TIPS & TRICKS



To make your lines less harsh, try blending the markers by rubbing with your finger, erasing or sanding parts of your lines.



**17.** Almost done!

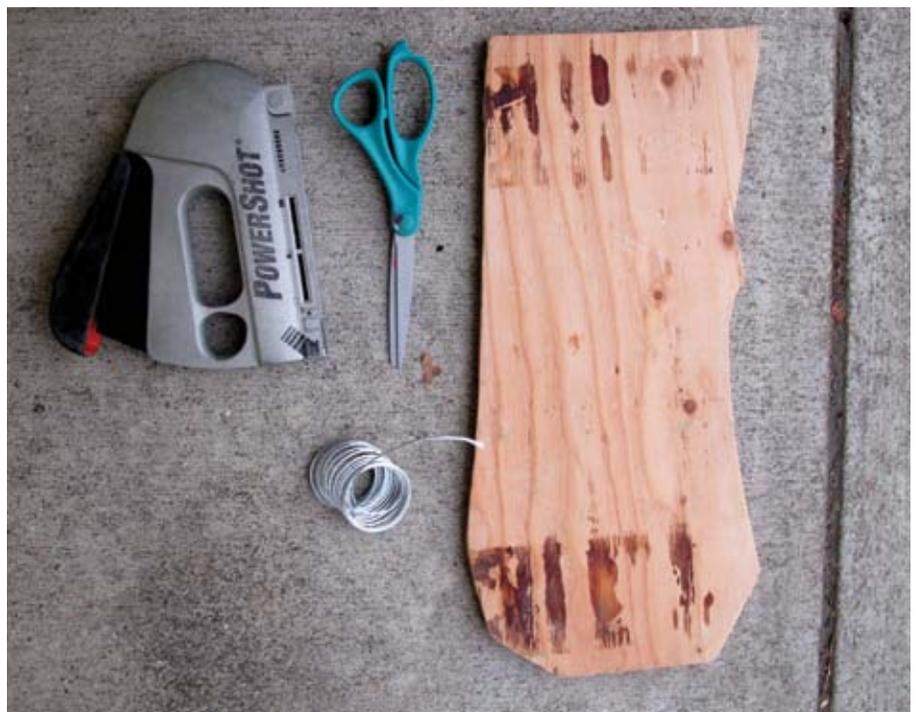
**18.** Add any final touches you might want.



## PART 2

# ADD A SIMPLE WALL HANGER

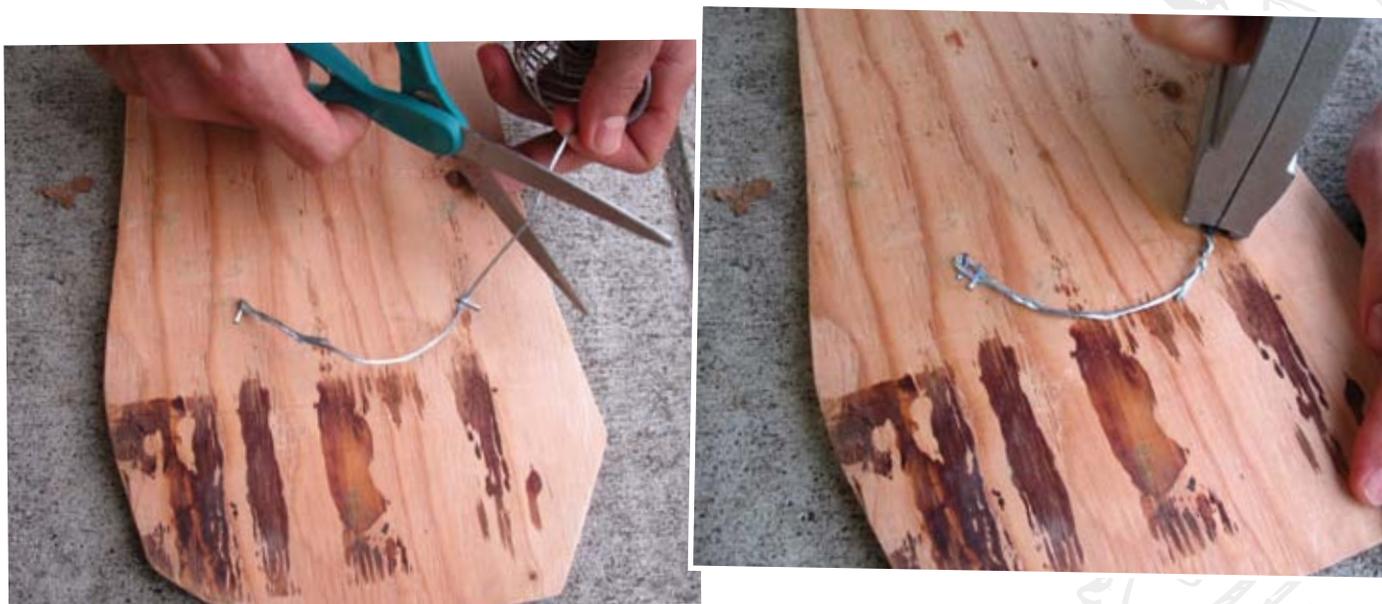
- 1.** Gather the following materials:  
Staple gun, braided wire, and scissors/wire cutters.



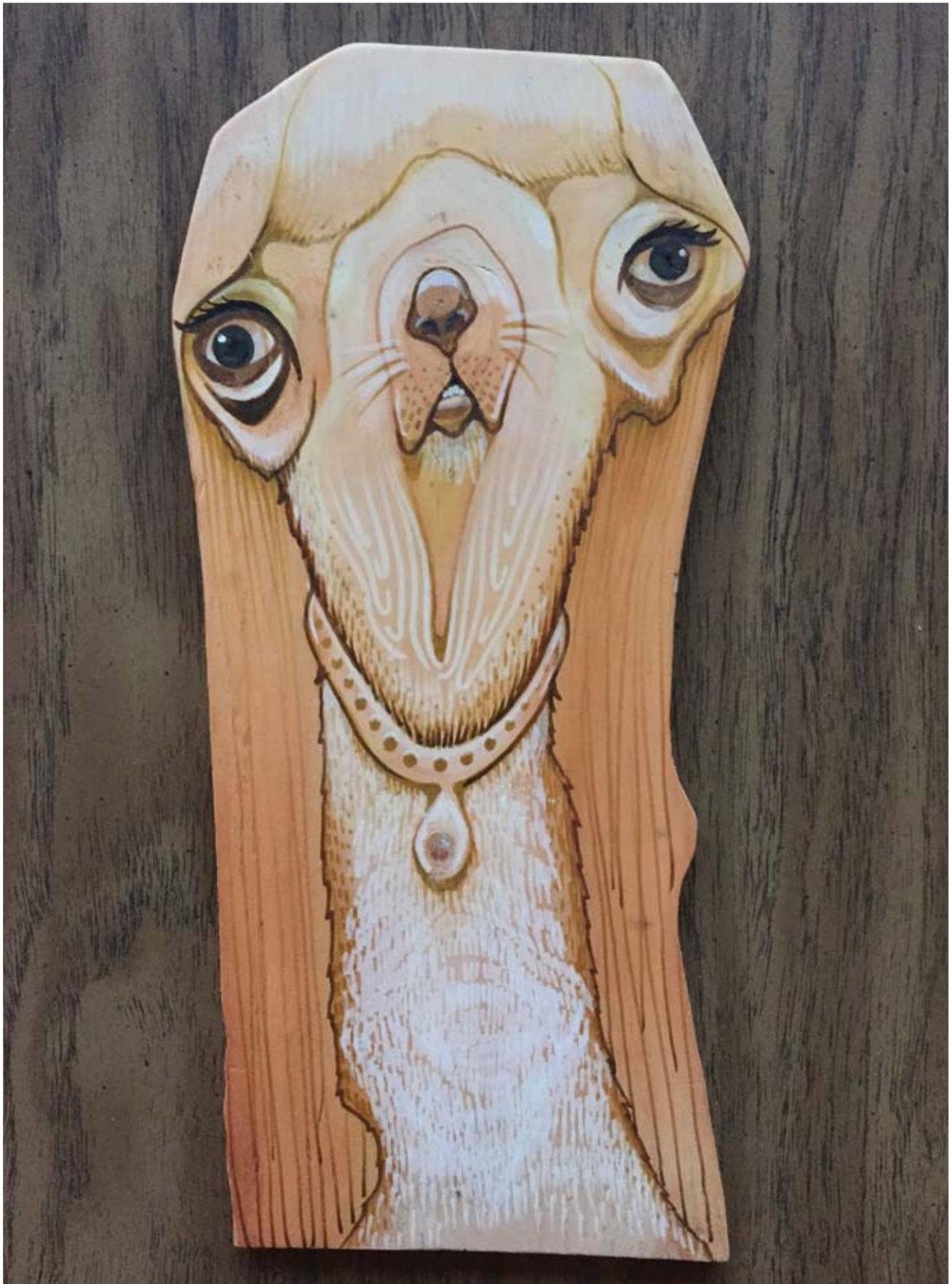
- 2.** **Unwind a bit of your wire.** Staple your wire to the back of your project, leaving 2-3 inches of wire hanging loose. Once the wire is stapled down, loop the wire underneath and twist the short piece of wire around the long piece.



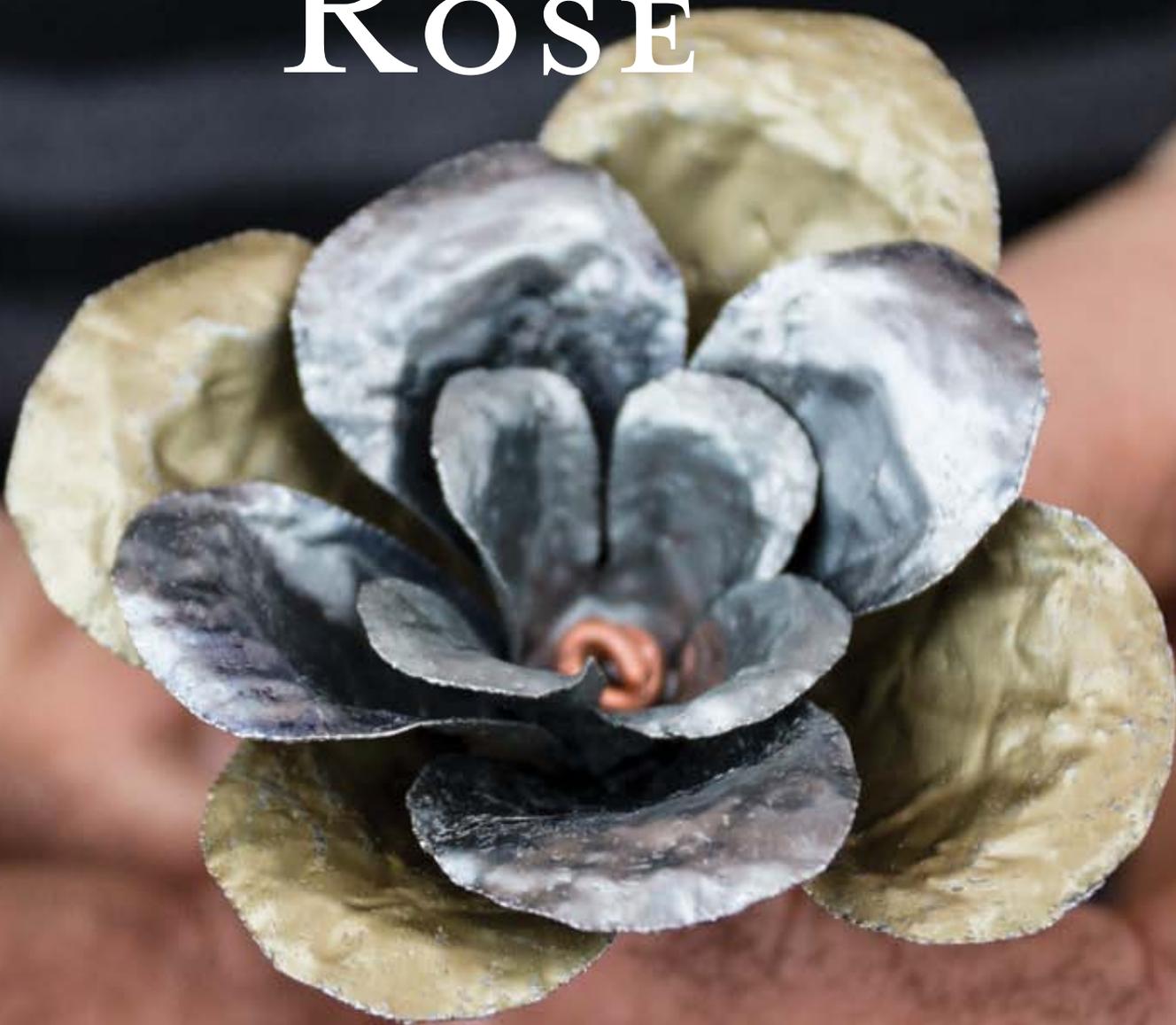
- 3.** **Now unwind a bit more wire** (about 4-7 inches) and staple somewhere around the 4 inch mark, leaving a bit of wire to twist. Cut off the remaining wire and repeat the same twisting technique as you used on the other side, then add a second staple on both sides.



4. Hang on the wall by hooking the wire onto a tack, nail or wall hanger.



# METAL ROSE



---

**Nathyn Sanche:**  
Red Seal Welder, Fabricator,  
Artist, Special Effect Assistant  
in the film industry

Makeitbe.ca



## TRADE SKILLS

Basic sheet metal working/  
some electrical

## SKILLS LEARNED

Shaping metal, stripping wire, using  
hand tools, re-purposing metal

## TOOLS

Metal shears  
Needle nose pliers  
Linesman pliers/heavy duty pliers  
Wire strippers  
Can opener  
Hammer  
Exacto knife/side cutters

## MATERIALS

Tin cans (2 minimum)  
Insulated solid wire in a bundle  
or single strand (ideally)  
Permanent marker  
Nail polish remover  
Q-tips (cotton swabs)  
Selection of nails (need one  
roughly same thickness as  
exposed inner wire)  
Optional depending on how  
you attach your rose: small nut  
(same size as wire), 2 part epoxy,  
blow torch, lighter, brazing rod,  
bottle cap, popsicle stick/straw  
(mixing tool), wire brush (to clean  
up brazing)

## WORK SURFACE

Desk with protective covering  
(cut board)

## SAFETY GEAR

Work gloves

## COST

Can = Free  
Wire = \$1 or free if you can find it  
at a electronics recycling depot

## TERMINOLOGY

**Gauge** – in electrical this is the  
measurement used to determine  
thickness of wire. The thicker the  
wire, the more current can move  
through it.

**Crimp** – to compress something  
into small folds or ridges.

**Crumple** – to press something  
into wrinkles.

**Fatigue** – the weakening of  
a material caused by repeated  
bending or loading.

**Insulation** – a material on the  
outside of a wire. It is used  
because it does not conduct  
electricity and protects from  
shock. It is often colour coded so  
electricians can tell the difference  
between wires and their purposes.

**Conductor** – an object or  
material that allows the flow of  
an electrical current.

**2 part epoxy** – a super strong  
resin based adhesive. Part 1 is the  
resin, part 2 is the hardener.

**Cure** – process of a chemical  
reaction that results in a harder,  
stronger substance.

**Exothermic reaction** –  
a chemical reaction that releases  
energy by light or heat.

**Brazing** – a way to join 2 or more  
metal items together by melting  
and flowing a filler metal into the  
joint (brazing rod).

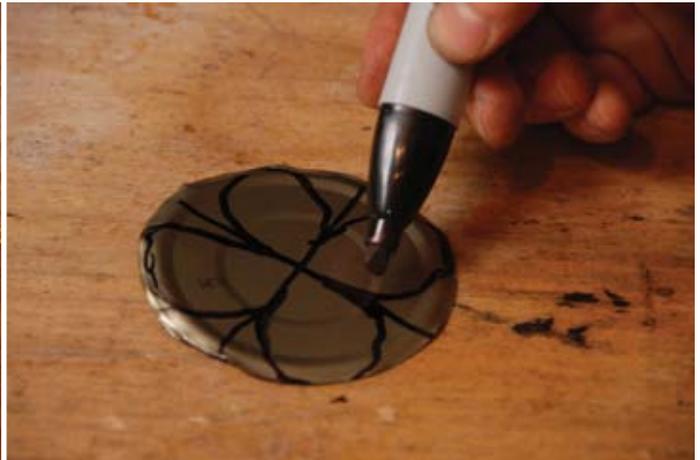
## PART 1

# MAKE THE PETALS

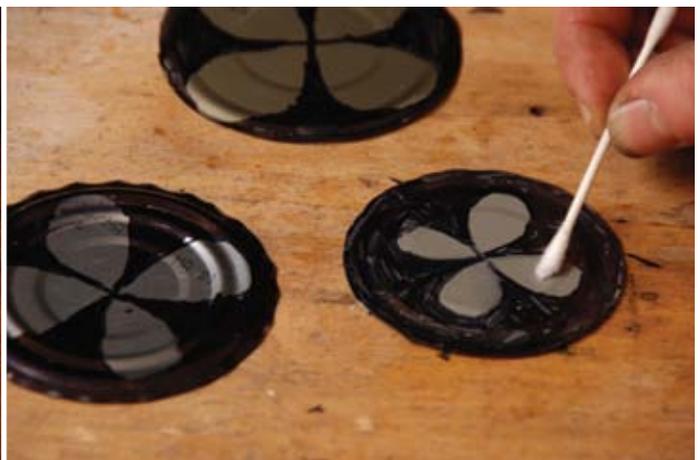
1. Use a can opener to open all your cans. Remove the tops and bottoms.



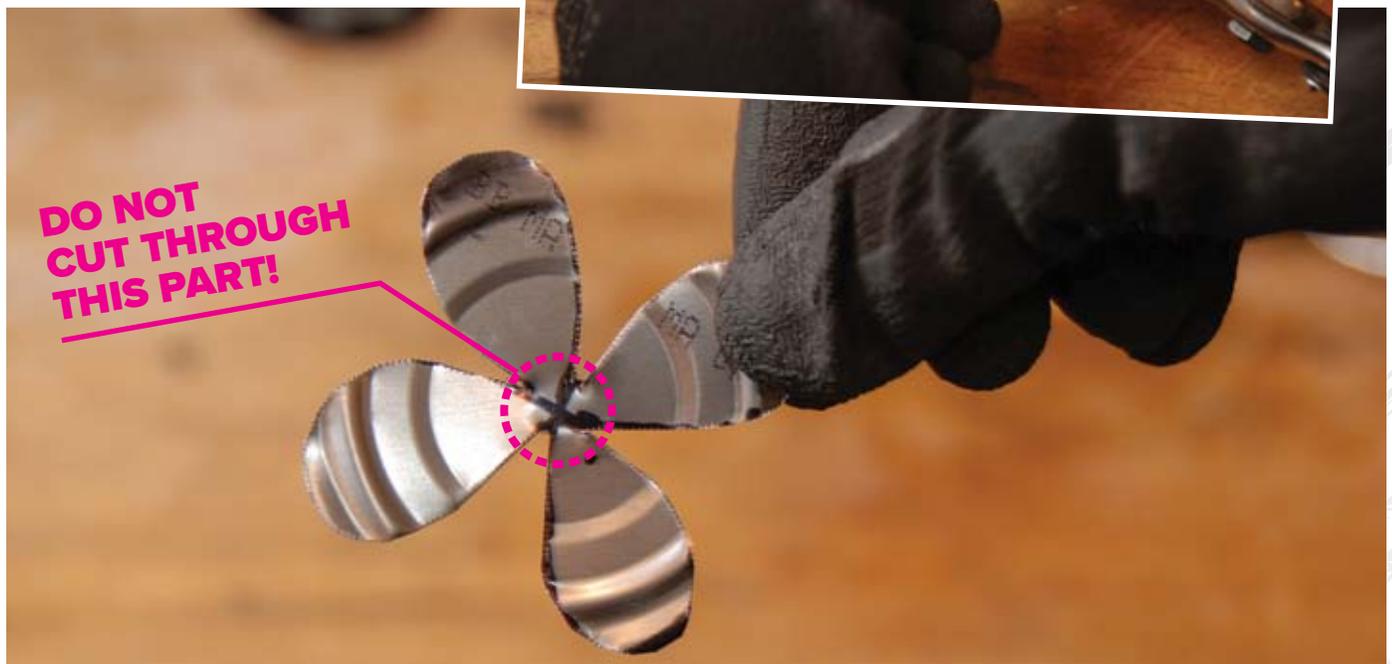
2. Use a permanent marker to divide each lid into quarters. Within each section, draw a petal shape. Since each set of petals will fit inside the next, ensure each set is drawn slightly smaller than the last.



3. With your marker, fill in the area around the petals to show where you will be cutting. If you make a mistake with the marker, you can use nail polish remover on a Q-tip to erase.



- 4.** Put on your gloves and use your metal shears to carefully cut away the drawn in sections of metal. It is important not to cut all the way through the centre of the rose where the lines intersect. Leave an area about the size of a Cheerio uncut in the centre.

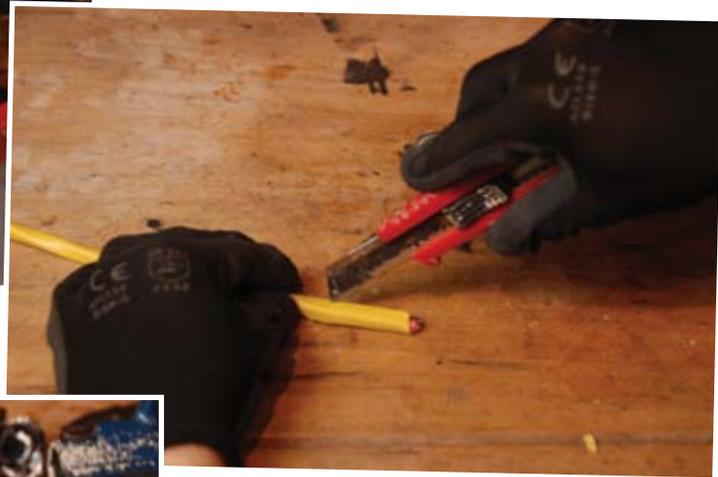


- 5.** Cut out all of your sets of petals. Afterwards, examine each set and use your metal shears to cut away any sharp bits that could snag on your skin. Aim to have rounded edges. Once all the pieces are cut, use a Q-tip dabbed with a bit of nail polish remover to take off any marker that may be left on your petals.



- 6.** If you can only find thick bundled wire, you can cut it open to get to the wires inside, which can be difficult. You can find wire free by requesting “end of roll” scraps from a hardware/electronics store.

*Note: Some wires come in single strands. If you can find a single wire, you can skip this step.*



### GET HELP WITH THIS PART

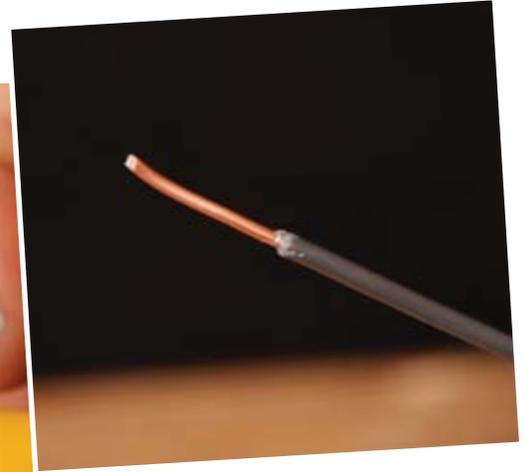
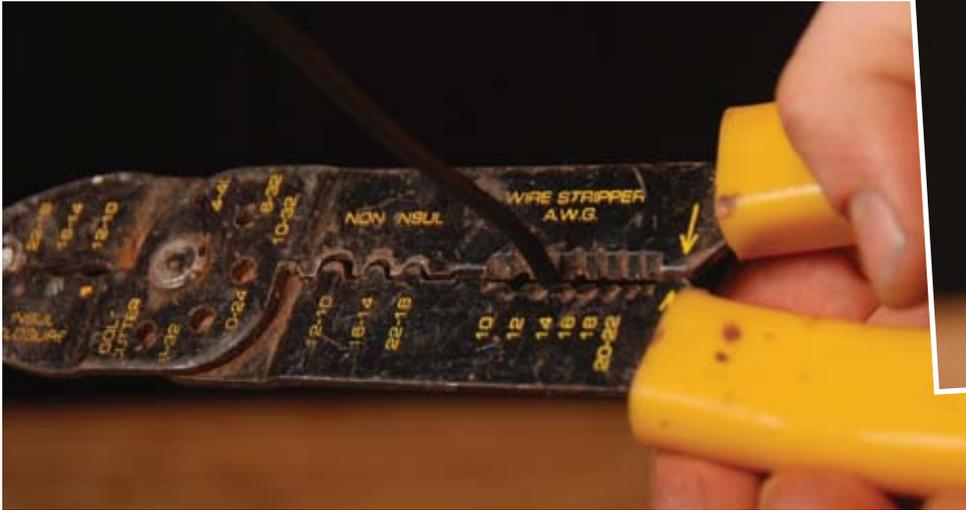
Grab your wire and your side cutters/exacto knife. Cut a piece of wire about 6-8" long. To remove the outer insulation, we cannot use normal wire strippers because the outer wire is so thick. Instead, slice the insulation tubing on the outside of the wire with an exacto knife or gently pinch it open with side cutters. Carefully peel back the tubing to expose the wires. Pull off the outer tubing. There should be 3 or 4 wires inside.

- 7.** Separate the black wire (or any colour that is not bare copper) from the bundle and straighten it.

This wire can be used as your stem (for more options look at step 20 onward).



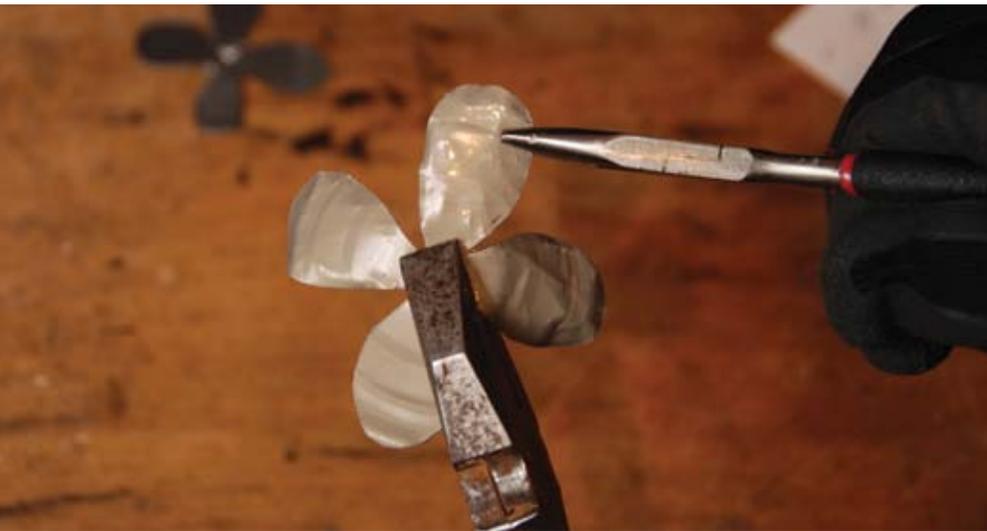
- 8.** Wire strippers look like strange scissors with a set of holes and numbers (gauges) alongside. Wire strippers are designed to cut through just the insulation of the wire, leaving the copper inside intact. Using your wire strippers, you want to remove about 1 inch or so of the insulation from the end of your wire. Choose the correct set of jaws for your wire gauge. Most standard house wiring will be 14 gauge. Squeeze the handle to bite into the wire and continue to squeeze as you pull the wire strippers away from the wire to remove the outer insulation. This may take a few tries.



- 9.** Decide which side of your can lids you want to use on the exterior of your rose and keep that side facing down and the inside facing up. Some cans have silver or white inside, while others have gold. You might have a mix of both. On the side you've chosen as your "inside," find a nail with a diameter as close to the gauge of your wire as possible. Hold up the shaft of the nail beside your stem/wire to compare size. Hammer the nail in the centre of each set of petals to create a hole.



- 10.** Now, you can start shaping your petals. To do this, first stabilize the centre of the smallest set of petals with a set of linesman pliers or other heavy duty pliers. This will reduce flexing of the narrowest section in the centre. Use a second set of pliers (ideally blunt needle nose pliers) to begin bending the petals to shape the flower. This part will take awhile.



- 11.** Once you've gone once around making your initial bend, start forming the petals into a spoon shape by crimping and crumpling petal by petal. Make sure not to bend the small connecting area. Keep this part flat.

- 12.** Once the petals are all textured and curved, they can be gently and carefully bent inward to form the shape of a flower.



- 13.** Repeat steps 10–12, starting with the next largest set of petals. Before you get to step 13, figure out how much you should bend the petals inward by test fitting the petal layers. You can do this by placing the smaller set(s) of petal inside the next largest set.



- 14.** Take out each of your petal sets. Starting with the smallest set, carefully bend down the very outside edge of each petal, creating a flare to the spoon shape one tiny bend at a time. This will give the appearance that the flower is blooming. The more time you spend on this step, the more realistic your rose will appear. The uppermost outside edge of each petal can be curved more. Towards the centre, you only want to add a very slight curve. Reassemble your rose and test often to make sure the petals fit.

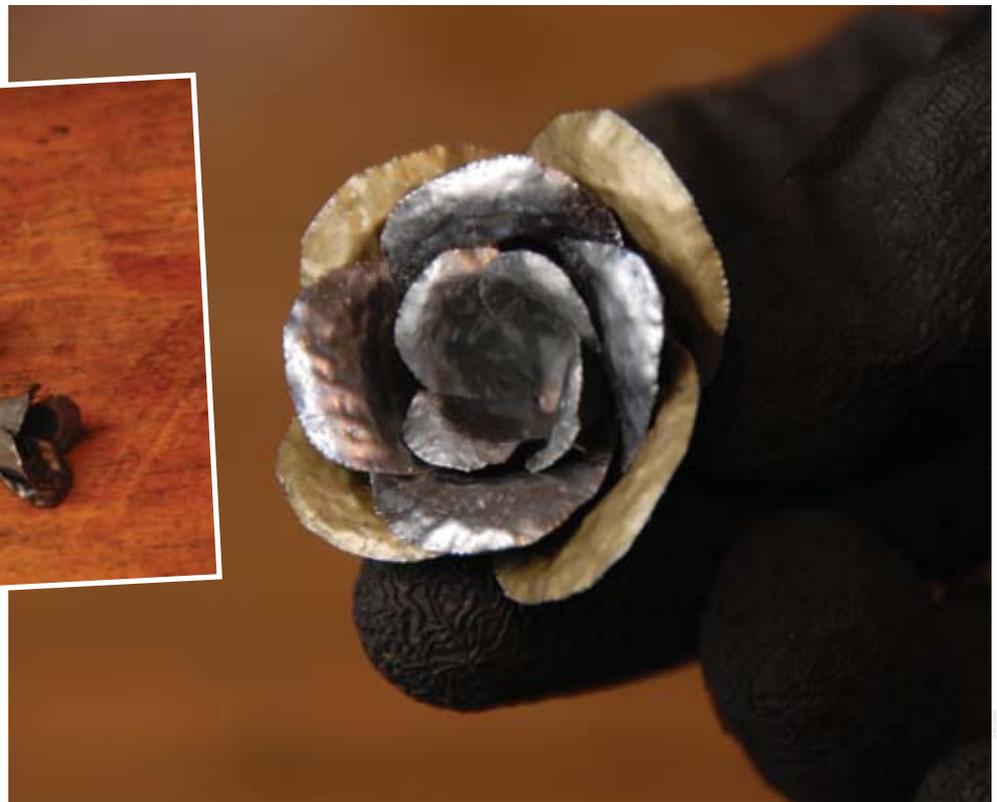


**15.** Use your hand (with gloves on) to close your petals back up and nest them, one inside the other, to see how they fit.  
Be careful how many times you bend the petals open and closed as the thin connecting sections may break from fatigue.

**16.** If you would like your flower to appear more closed, open the petals and bend a sharper curve into the side of the petal.

**17.** Keep bending all the sharp angles into smooth curves until it starts to resemble a real rose.

**18.** Remember to periodically nestle one piece into the next and check on how they look.



**19.** Once you are happy with how your rose petals look nestled in one another, you have a few options for attaching your rose to its stem. Some are better or more secure than others, but you can choose according to the material you have access to, or the skills/comfort level of the teacher or parent who is helping you.

# ATTACH THE PETALS

**OPTION A**

**MOUNT ON INSULATED WIRE (LEAST SECURE)**

**1.** Once your wire is stripped, you can push the petals of your rose onto the area of exposed wire on your stem, largest to smallest. Push your petals down snug to the point where the insulation starts.



**2.** Take your needle nose pliers and twist the wire into a ball, as tightly as possible to prevent the petals from falling off.

**3.** Done!



**OPTION B**

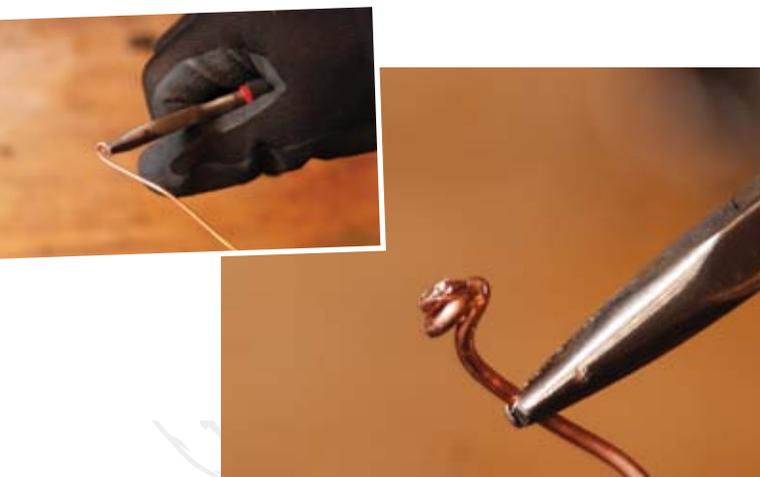
TWO PART EPOXY (MORE SECURE)

**1.** Strip the insulation off the rest of the wire.



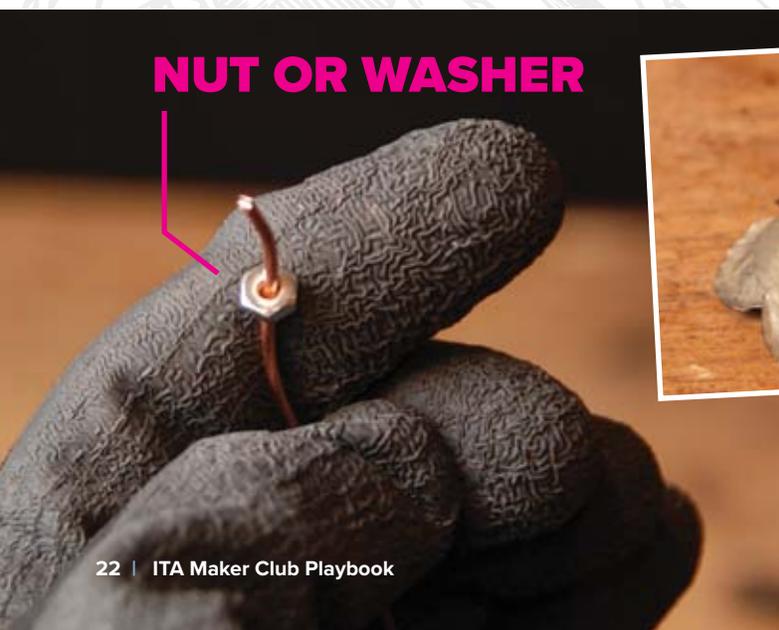
**2.** Using needle nosed pliers, pinch the end of the wire and roll it a tight curl (almost like a little ball).

**3.** Thread the petal pieces onto the unbent end, so the curled end is in the centre of the flower.



**NUT OR WASHER**

**4.** After the petal sections, thread on a very small nut or washer.



- 5.** **Wearing gloves,** following the directions on the package, mix some 2 part epoxy into a pop bottle cap using a popsicle stick or a scrap of the wire you are using for this project.

You have to work quickly; within 5 minutes the epoxy will begin to cure by heating up on its own in what's called an exothermic reaction.



- 6** **Before you apply epoxy,** make sure the petals are fit together as tightly as possible, and positioned the way you want them to be.

When you are ready, hold flower by the stem, and turn it upside down. Hold the stem with one hand and apply a small amount of the mixed epoxy to the stem and your small washer or nut with the other. It doesn't take much. A very small amount will do.

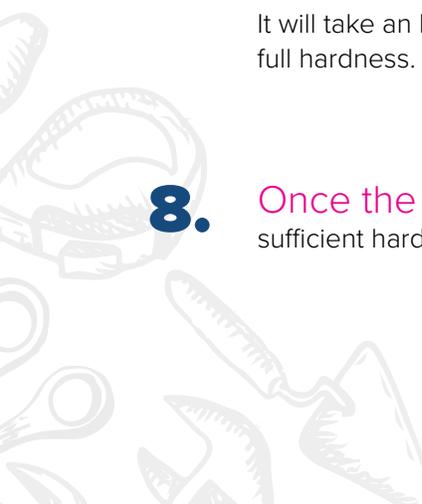


- 7.** **Bend the end** of the copper wire and hook the flower over an edge and give the epoxy some time to harden.

It will take an hour or so to reach near-full hardness.



- 8.** **Once the epoxy has reached** sufficient hardness, your flower is complete.

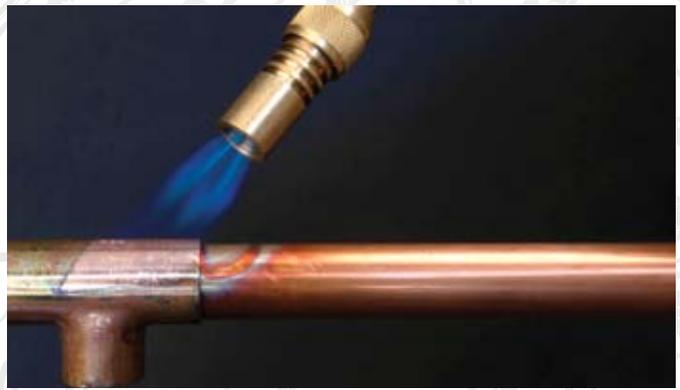


**OPTION C** BRAZING

**IMPORTANT**

You will need the help of an expert adult with this.

**Do not attempt yourself!**



Using a blow torch and brazing rod, you can attach the metal pieces to one another.

*Only do this if someone older can show you how and help you along the way.*

Here is a photo of how brazing looks once completed. This is the most secure way to attach the parts of your rose.





# AUTOMATONS

WITH MAKER HERO JUSTIN MILES

Justin is an automaton maker living in Vancouver. He is inspired by traditional Japanese automatons called “Karakuri.”

He is trained as an animator, which helps him understand and accurately re-create the movements and emotions of the characters he brings to life. Over the past 15 years Justin has made dozens of automatons in a range of mediums and styles.



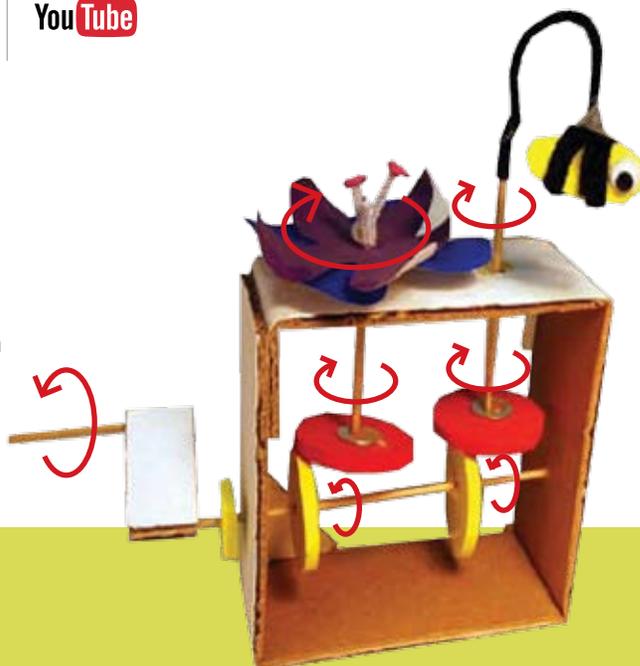
You can watch videos of Justin’s creations in action on the **Magic Trout Imaginarium** youtube channel. [tinyurl.com/magictROUT](https://tinyurl.com/magictROUT)



## HOW DOES IT WORK?

The user cranks the handle in a rotary (circular) motion which causes the cams (notchless gears) to turn. The cam transfers a rotary motion (circular) into a reciprocating motion (up and down). The shape of the cam determines the timing and action of the movement.

You can experiment with cams by downloading this free intro level project tutorial: [www.exploratorium.edu/pie/downloads/Cardboard\\_Automata.pdf](http://www.exploratorium.edu/pie/downloads/Cardboard_Automata.pdf)



Can you guess the motion from the shape of the cam?



Eccentric



Snail



Egg Shaped

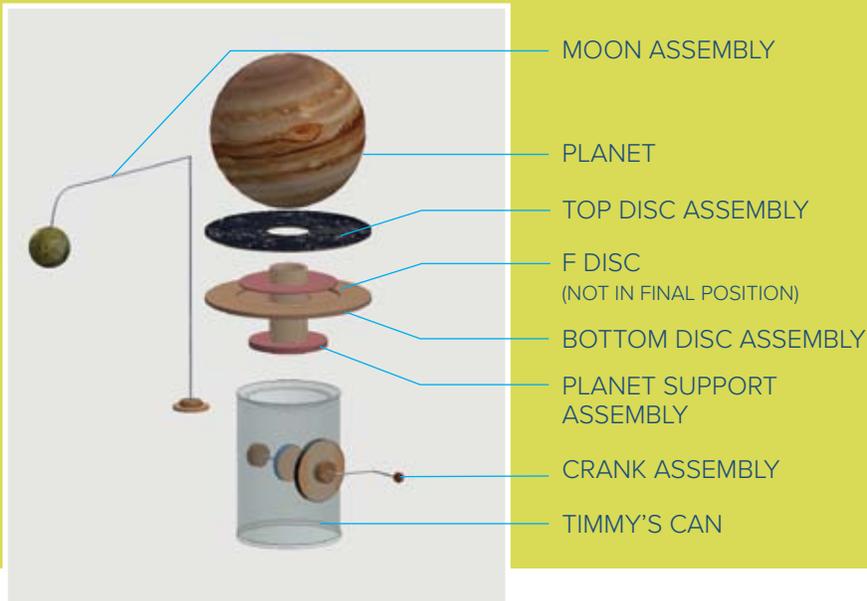


Ellipse



Round

# INNER WORKINGS



You can create an automaton out of many types of materials: cardboard, wood, metal, or wire for example.

This is a diagram of an automaton Justin created out of a coffee can, styrofoam and cardboard.

Download the tutorial in PDF for free on Justin's website:  
[justinmiles-automata.com/tutorials](http://justinmiles-automata.com/tutorials)

## HOW DO AUTOMATONS RELATE TO VEHICLES?

Engines use cranks just like automatons do. In an internal combustion engine, a “crankshaft” is used to convert power from a piston to rotational energy.

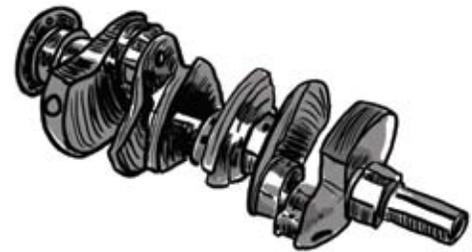
Vehicles also have cams. A “camshaft” receives the power from crankshaft, and operates the engine valves through a cam and follower mechanism, just like an automaton!

The shapes on the cams are used to convert the rotary (spinning) motion of the shaft into the reciprocating motion of the valves (up and down as they open and close). Here's a great animation of how this works:

[i.stack.imgur.com/mAbiw.gif](http://i.stack.imgur.com/mAbiw.gif)

Vehicles also use gear mechanisms similar to those in automatons. A rear differential uses 4 sets of gears to drive a pair of wheels while allowing them to rotate at different speeds from one another. This allows the vehicle to efficiently turn corners.

### CRANK SHAFT



### REAR DIFFERENTIAL



# Creepy Creature

Felt Wool Creature  
on a Wooden Plaque



---

**Zee Kesler:**  
Maker Educator & Head  
Imagineer of the Magic  
Trout Imaginarium



## TRADE SKILLS

Basic carpentry

## SKILLS LEARNED

Using hand tools, wood finishing techniques, wood re-purposing and felting techniques

## TOOLS

2 clamps (ideally quick release)  
 3 fine felting needles (per person, in case of breakage)  
 Router and router bits/hand plane/file/rasp  
 Square  
 Crosscut saw  
 Electric sander and/or sanding sponge/sanding block

## MATERIALS

1 piece of foam 2.5–3 inches thick, min 6x6" each student  
 Piece of softwood to cut down of at least 1/2 inch thickness  
 Extra piece of scrap wood  
 Sand paper (fine & medium grit for sander or loose pieces)  
 Wool roving (Corriedale Silver or similar) 15–30 grams per student (can buy in kits or bulk from [MagicTroutImaginarium.com](http://MagicTroutImaginarium.com) or your local fibre mill)

## WORK SURFACE

Workbench for carpentry  
 Desk or table is ok for felting

## SAFETY GEAR

Safety glasses, ear protection  
 Dust mask if you're bothered by dust

## COST

If scrap wood is used and wool and felting supplies are bought in bulk, this project can cost as little as \$3.50 per project

## TERMINOLOGY: WOOL

**Wool roving** – a long thick bundle of washed wool fibres that can be used to felt or spin wool.

**Needle Felting** – the process of shaping wool through repeated stabbing of a barbed needle into wool roving.

**Wet Felting** – continuous rubbing of wool fibres to one another until they mat, tangle and “felt” to one another.

**Taxidermy** – the art of stuffing dead animals and preserving them for display.

**Felting Needles** – special barbed needles that are used to stab and interweave wool fibres.

## TERMINOLOGY: WOOD

**Grain** – pattern on the surface of cut wood.

**Hardwood** – wood from a broadleaved tree. Broadleaf trees have flat leaves and produce fruits with seeds inside. Generally hard, but not always.

**Softwood** – wood from trees with enclosed seeds (such as pine cones etc). Most lumber is made from softwood.

**Plywood** – wood sheets made from alternating layers of glue and thin wood veneer compressed together. Plywood is made in large sheets.

**Crosscut saw** – a saw used to cut wood across the grain.

**Rasp** – a hand tool used to shape wood by grating. It has a rough surface and can sometimes look like a file or cheese grater.

**Hand plane** – a hand tool used to shave a thin even layer off a wood surface.

PART 1

# MAKING YOUR PLAQUE

**1.** Find some wood. I found a softwood IKEA table that was unfinished – meaning it had no varnish or paint on it. I found it in an alley behind my house for free!

**2.** Make sure your edges are square by using the square tool. (Some look like an “L” and some are shaped like a triangle, none are shaped like a square!)  
Line up the bottom edge of the wood with the bottom of your square, then push it up against each corner to check if its square or not. Notice my left corner is definitely not square!

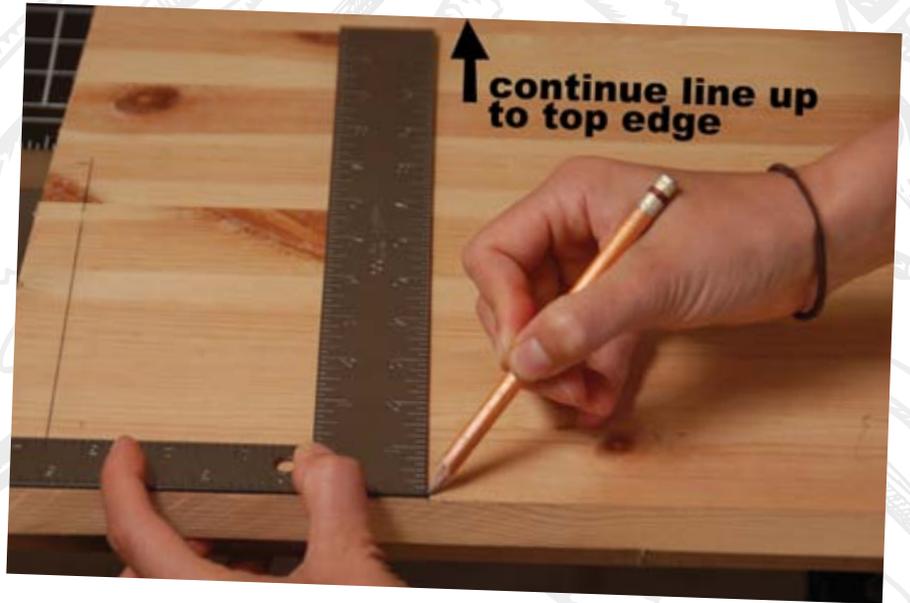
**3.** Once you find out which edge isn't square, use your square to draw a line. Check all sides by lining up the “L” shape with the corners. Make sure your pencil is straight up and down when you draw your line, otherwise your line won't be as accurate. Measure up to 8” and mark with a tick.

**4.** Line up your square using the first line you drew. Since we know this line is now square, we can use it to create the next side (top) of our plaque. Measure 5” over and mark with a tick. Use the same technique of using your previous line to measure off of until you finish tracing all 4 sides of your plaque.



**5.** Now, take a look at your plaque outline. On your inner right line, move your ruler and use your pencil to continue your line all the way to the end of the wood.

This will be the line we follow when we cut the wood into a smaller size. Since my square isn't long enough, I just moved it along to the top to finish my line. Ok, now you have the shape of your plaque.



**6.** When you are working with a big piece of wood, it's easier to work with if you cut it down smaller.

To prepare for cutting down the wood, clamp your wood to the table. Make sure the bottom of your clamp is flat against the underside of your workbench. You might have to crank open the two sides of your workbench so you can fit your clamp in between. It helps to squat down and get a better look at what you are clamping to. You might have to flip around your position on your workbench if the cranks on the workbench are in the way. Once you have tightened your clamps, try to shake and move the wood. If it moves, you haven't clamped tight enough. CLAMP FAIL! Try again.



**7.** Now make sure there is lots of space between your cut line and the edge of your workbench.

Start sawing at a 20–45 degree angle using your other hand to hold the wood steady. The less the wood moves, the easier it will be to saw.



**8.** Now you have a smaller piece of wood to work with, but we still have to cut it down further!



**9.** Re-clamp your wood, once again remembering to leave space for your saw. Continue to cut down your project until it's plaque sized.



**10.** Next, if you have an electric sander, attach a medium grit sanding paper. Clamp your project down. Put on your goggles and dust mask and start sanding your plaque following the direction of the grain. You will have to stop and move your clamps otherwise the wood under the clamps will remain unsanded.



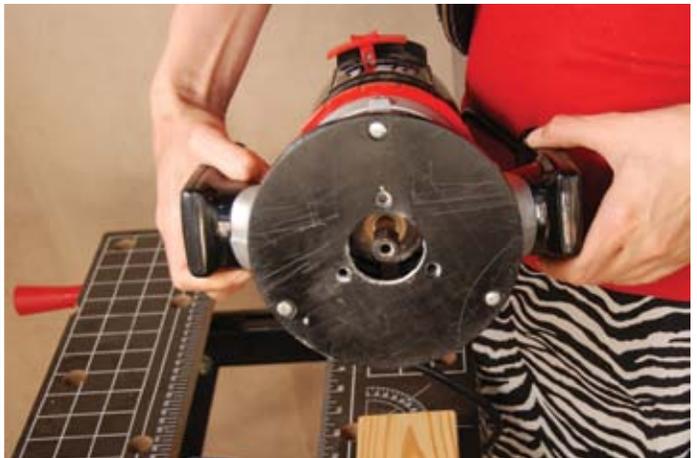
# SHAPING THE EDGES

## OPTION A ROUTER YOUR EDGES

### NOTE

There are many ways to finish the edges on your plaque. I routed the edge of my plaque, however routers are extremely dangerous! **Unless you have a teacher or adult who knows how to use one and can help you, use another method** of finishing your edges such as a plane, rasp, or you can use a sander to smooth the edges by running it along the edges on an angle.

1. Find the router bit that matches the profile you want. Make sure the router is unplugged when you lock the bit in place (check the manual). Now, adjust the depth of your router to match your wood. You want the roller on the bottom of the bit to roll on the bottom edge of your wood, not underneath.

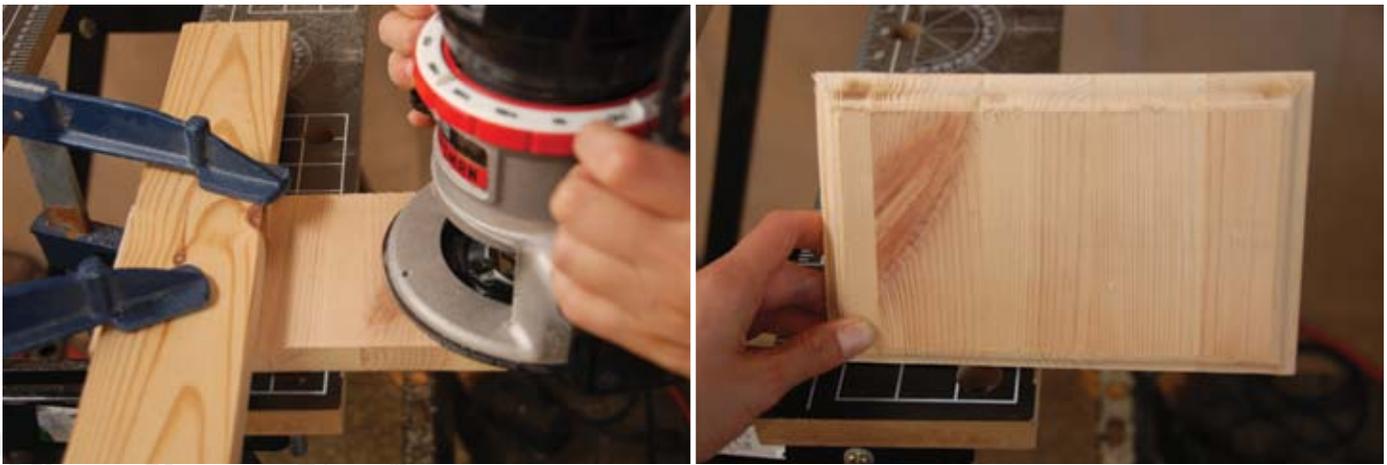


- 2.** When using a router you must make sure your project is very tightly clamped in place or it will vibrate and shoot across the room.

I noticed my clamps left an indent when they were tightened onto my wood, so I clamped my wood down with a scrap piece of wood sandwiched in between to protect my wood surface.

- 3.** Put on your safety goggles (if you haven't already) and place the router on your work surface.

Make sure the blade at the bottom is not touching the wood when you turn it on. Plug in and turn on the router; slowly and gently move the spinning blade on the bottom towards the edge of the wood. Move back and forth a couple times and be careful to ease off once you get to an edge. When you turn off the router, make sure the blade has fully stopped spinning before you put it down.



- 4.** Your edges will still be a bit rough, so you'll have to hand sand them a bit.



## OPTION B

## HAND PLANE YOUR EDGES

### NOTE

This hand plane removes a thin layer off the surface of wood. A hand plane can be used on an angle along the edge of your wood to shave the corners. You can also use a decorative plane if you want a really fancy edge similar to what a router can accomplish.

1. **Clamp your wood to your work surface**, leaving a bit of wood hanging over the edge. At the back of the plane there is a small knob you can turn to adjust the blade depth.

Start with the blade pulled back and test it by sweeping away from you across your wood. Adjust the dial, then try again, repeating this process until the blade is protruding out enough to shave a thin layer off the top of your wood.

2. **You may need to touch up** your wood by hand sanding afterwards.



## OPTION C

## RASP YOUR EDGES

Use rasp on an angle to grate away the edges.



## OPTION D

## SANDING YOUR EDGES

Use an electric sander (or hand sand) the sides of your wood to give an angled edge.



PART 3

# NEEDLE FELTING YOUR CREATURE

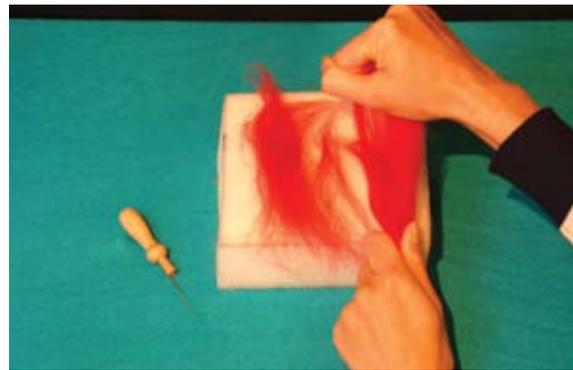


**NOTE**

You don't have to follow this part of the tutorial word for word. Once you understand the felting technique, you can change the design of your creature as well as the way it's mounted.

- 1.** Separate your felt in small strands by holding the wool roving about 4 inches from the end.

Carefully pull out small amounts of wool and layer until you have enough to form a pile about 3x-4x bigger than you want you head to be. Save some wool for later as well as some for your neck or any details you may want to add.



*If you don't have much wool of the colour you would like to make your creature you can create the shape with white wool roving then cover it over with a thin layer of colour later!*

- 2.** Gently roll your wool roving into a ball.

**DID YOU KNOW**

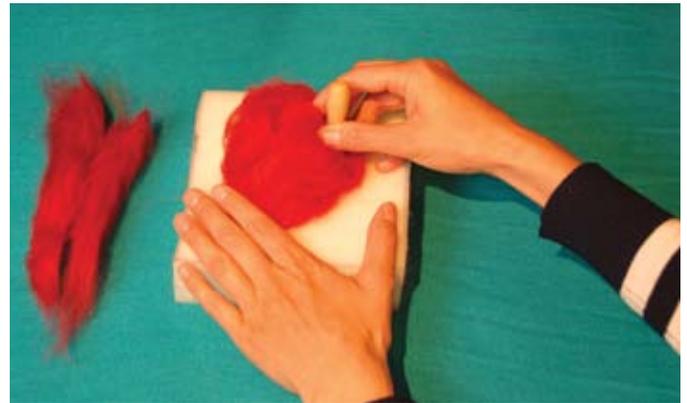


That different types of wool have different properties? Corriedale is a type of sheep found in New Zealand and Australia. Its wool is great for needle felting because it is slightly crimped which means it felts easily. A Corriedale's wool is about 5-6 inches long which makes it easy to work with to form shapes.



**3.** Place your ball of wool on top of your foam block. Stab your felting needle through your wool into the foam.

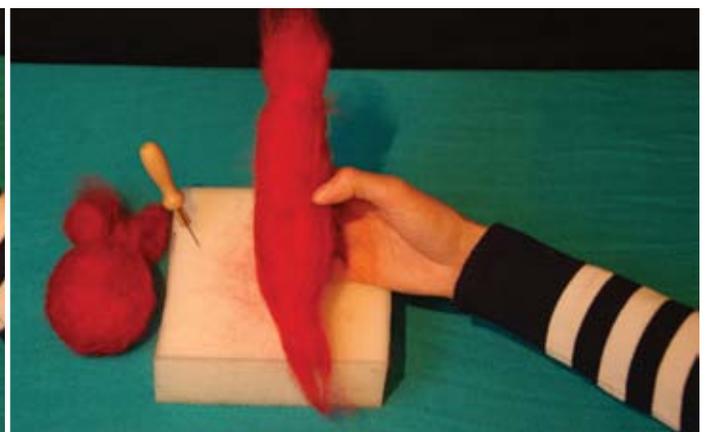
Don't stab too hard or you will go through your block into the surface below and break your needle! In order to keep the shape even and sphere-like, stab just a few times, then rotate your ball. Stab then stab again. Rotate often. You'll notice your ball will start to shrink in size and solidify the more you stab.



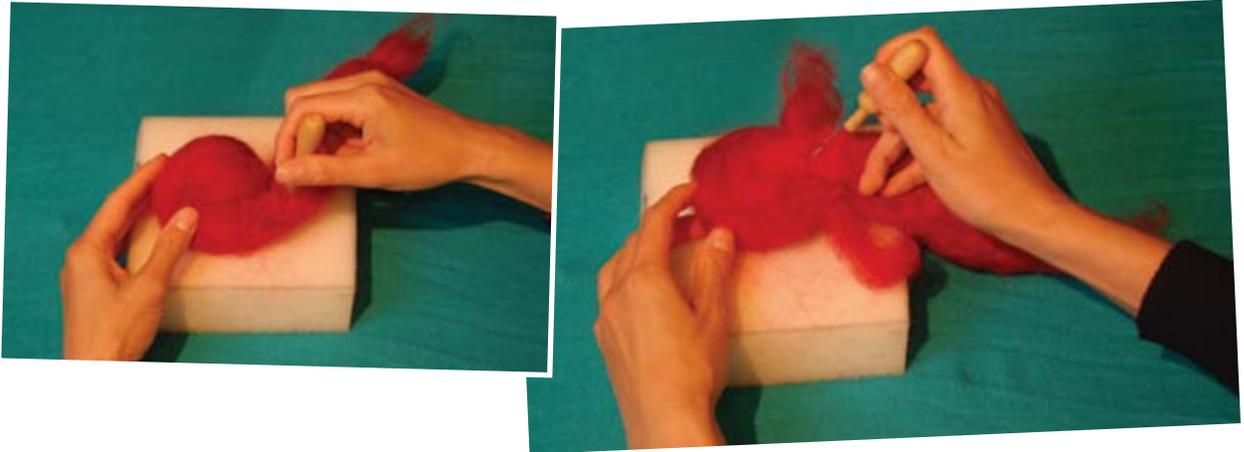
**4.** You might notice your ball becoming slightly lumpy. You can even out the surface of the head by taking a bit of wool roving and wrapping a thin layer over the shape you've made and stabbing it gently into place. (This is what I meant earlier about using white wool inside, then coloured on top if you don't have enough of your coloured wool.) Leave a bit of wool loose on one side. This is where you attach your neck or body.



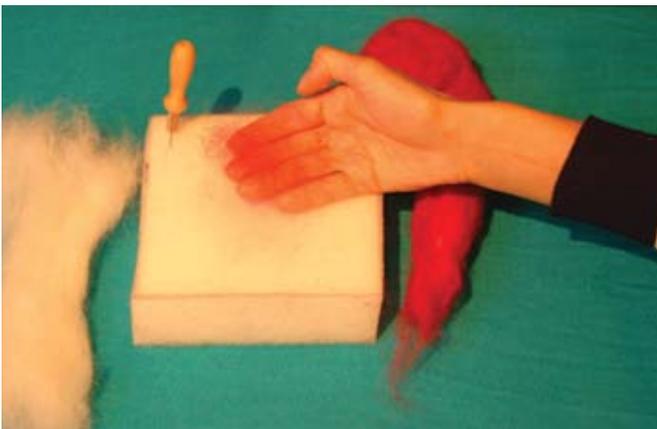
**5.** Now start felting your neck (if your creature has one). Gently pull out your wool and place it in a pile. You will need a lot since you will want to make the neck thick and dense enough to support the weight of your head. Leave some wool at the top and bottom of the neck unfelted. This will be another attachment point.



- 6.** Take your head and split the loose wool in half. Place your neck in between and felt the loose wool from the neck up and over the head.



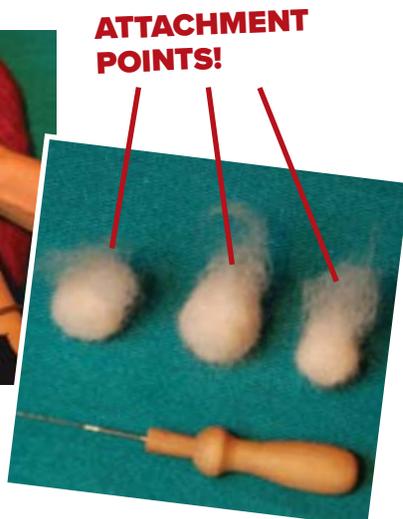
- 7.** Let's make eyes! Before switching colours, you want to make sure to clean off any wool that is stuck on your foam.



- 9.** Take a small pinch of black (or whatever colour you want to use for your pupil) and stab in into your eyeball (not your actual eyeball... your wool eyeball of course). Shape it as you stab.



- 8.** To create eyes, use the same process as when creating the head of your creature. Don't forget to cover over your eyeballs and leave a bit of loose wool on the ends for attaching!





**10.** Attach your eyes to your creature by stabbing and tucking in the loose wool in behind your eye.

Make sure the eye is securely attached by tugging it a little. If not, stab more! Be careful not to bend the needle as you do this.

**11.** I decided my character needs a horn, so I started shaping a tuft of wool; stabbing and turning (so it doesn't become flat) until my wool becomes horn shaped.

I also decided my horn needs stripes, so I added stripes!



**This is me with a horn!**

**12.** Next, secure your horn in place by using the same technique as before.

Hopefully you have the hang of it by now.



**13.** Since you have the hang of it, I won't go into too much detail about how to add the mouth.

Just choose your colour and stab stab stab... and teeth and nose... stab stab stab...



**14.** Now let's add a tie. I am making my tie in two pieces.



Don't forget to leave some loose ends to attach the tie to the body (ok, ok I'll stop reminding you).

**15.** You can't go wrong with polka dots!



**16.** Now to attach the tie to your body/neck.

This step will be a bit different. Just stab it a couple times so it stays in place. Now go cut a piece of string about 20 inches long. Find the centre of the string and place it under the tie so it's hidden.



**17.** Next, flip your tie down to cover over the piece of string and stab to secure your tie.

Make sure your string is secured well by tugging on it. If the wool comes loose this means you need to stab more! MORE!

**18.** Next, in my case, I will not be attaching my neck to a body, so I want to "tie up loose ends" so to speak.

So, flip up the bottom of your neck and fold over the loose wool and stab it until it becomes blended with the body.



PART 4

# MOUNTING YOUR CREATURE

Next, I will be mounting my creature on a plaque. The way I mount it is not the way you need to mount it; I am improvising with the materials I have. I have also decided I want to be able to take my creature off my plaque in the future. There are a million ways to do this; none are right or wrong, some just work better, look nicer or are removable. Ex: you could hot glue directly to your plaque, use spray adhesive, or velcro.

1. Hold up your creepy creature against your plaque to centre it.

Once you find where you want to mount it, hold your finger in that spot. Make sure it looks reasonably centred. Place a mark.



2. On either side of the mark, draw a dot.

You'll be drilling a small hole on either side to feed the string through.



3. Next, take out your drill and drill bits.

Examine the thickness of your string and compare it to the drill bits you have. Choose the one closest to the thickness of your string (better to have the hole a bit bigger than smaller).

4. Place your drill bit in your drill. Check your drill's manual or lookup a video online if you don't know how to do this.



- 5.** Find a piece of scrap wood to place under your plaque while you drill two holes on either side of the line.



- 6.** Pass your string through the hole. If it doesn't fit easily, try taping the ends of the string to make it pointier and easier to thread through the holes.



- 7.** Feed the string with the taped end through the front of the plaque. If this is difficult, use the felting needle to push the string through to the other side. Turn over your plaque and pull the string through.



- 8.** Push the other side of the string through the hole, and tie a tight double knot on the back side of the plaque.



- 9.** Find a wall hanger similar to this to mount your plaque to the wall.

You can also improvise, like Brad Rhadwood did in his Wood Scrap Art tutorial (using wire and a staple gun). I am improvising with the materials I have on hand, so I am going to hot glue my hanger in place. This will work fine since my project is so light. If it was heavy, glue would not be strong enough.

When you attach the hanger to your plaque, make sure the hanger is level and centred.



- 10.** Let the hot glue dry and hang your project on the wall!!!



# SOFT CIRCUITS & E-TEXTILES

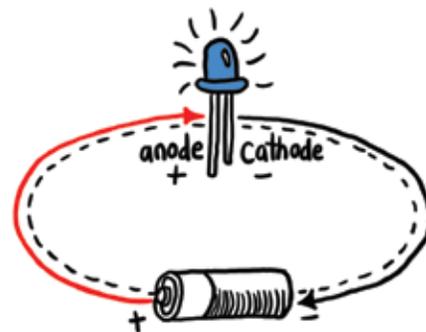
WITH MAKER HERO EMILY SMITH

Emily loves how making creates community.

As a textile artist, she enjoys all steps in the process of working with wool. Emily experiments with washing, processing and carding her own wool, spinning, natural dyeing, felting and knitting. Emily also experiments with making her own technologies to transform wool into new forms like looms and drop spindles. Emily loves sheep and alpacas and makes amazing things out of their wool; everything from more practical items like sweaters and handwarmers to felted creatures and crazy hats.

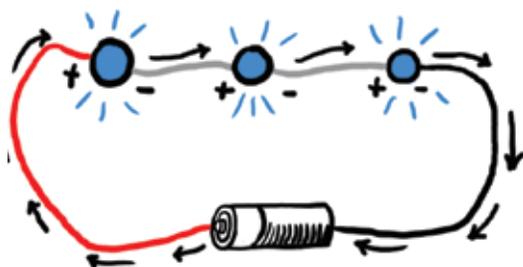
## WHAT IS A CIRCUIT?

Soft circuits are a great way to get started with either textiles or electronics. Projects can be as simple as sewing an LED into your clothes, to sensors that recognize movement, heat or the direction you're facing. The first step in understanding soft circuits is understanding what a circuit is. A really great manual with resources and soft circuits projects is available here: [alumni.media.mit.edu/~emme/guide.pdf](http://alumni.media.mit.edu/~emme/guide.pdf)

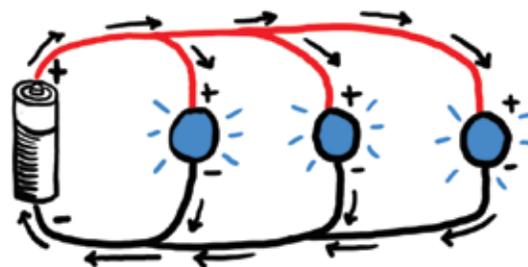


## PARALLEL AND SERIES

In a **series circuit**, the components are connected in a continuous path and the current is the same through each of the components.



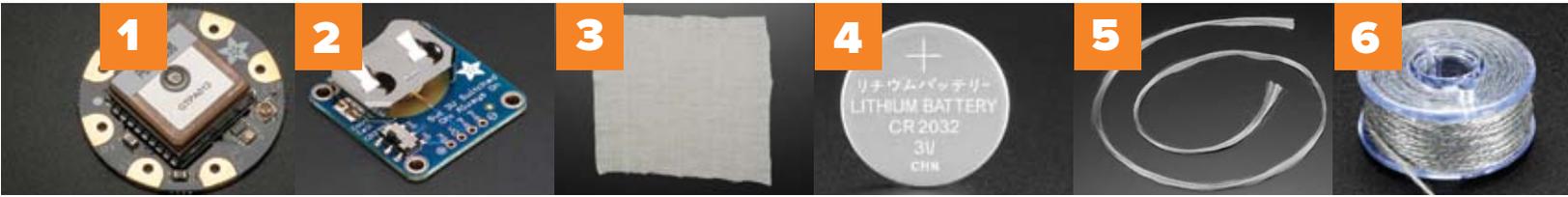
In a **parallel circuit**, all the components are connected as shown. The voltage measured across each of the components is the same. The electric current splits and flows through several different paths.



# MATERIALS TO START WITH:

There's a huge selection of components available through **Adafruit.com**.

**You might also need:** scissors, sewing needles, felting needles, regular thread, raw wool, foam block, multi-metre.



- 1.** A **Lilypad** is a sewable microcontroller that can be integrated into your textile projects. Lilypads come in programmed and pre-programmed versions and can do things like sense your direction and joint movements, blink lights, sense light variations and vibrate.
- 2.** **Coin cell holders** are battery holders for 2032 coin cell batteries. They are used to stitch your conductive thread into. This holder has an on/off.
- 3.** **Conductive fabric** has metal fibres woven into it. It can be used to integrate large amounts of electronics into clothing without the weight of wires.

- 4.** **Coin cell batteries** light up a few LEDs at once and are great for beginner projects.
- 5.** **Conductive fibre** can be knit into clothes with stretch fabric to create “textile electrodes”. The fibres can pick up information on heat and heart rate from being directly against the skin. The data can then be transmitted wirelessly to a small gadget on a mobile phone for processing.
- 6.** **Conductive thread** is made of metal fibres and can be used as a substitute for wire in your soft circuits projects.

## PROJECT IDEAS



Skirt lights up when you walk

[learn.adafruit.com/sparkle-skirt/code?view=all](https://learn.adafruit.com/sparkle-skirt/code?view=all)

Soft Controller

[learn.adafruit.com/plush-game-controller/stitch-circuit?view=all](https://learn.adafruit.com/plush-game-controller/stitch-circuit?view=all)

Conductive Gloves

[www.instructables.com/id/Making-A-Glove-Work-With-A-Touch-Screen/](https://www.instructables.com/id/Making-A-Glove-Work-With-A-Touch-Screen/)



# Skate Ramp



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**Zenga Bros:  
Carpenters, Welders,  
Artists, Skaters & Filmmakers**

From left to right: Dave, Aaron, Owen, Will, Benny, Christian. Photo credit: Gordon Nicholas



## TRADE SKILLS

Intermediate carpentry

## SKILLS LEARNED

Using power tools, driving, using a tape measure, marking measurements (chalk line), improvisation, wood scrap re-purposing and structural stability

## TOOLS

Skill saw/jig saw

(or hand saw can work too)

Drill and driver bits

Square

Measuring tape

Screws 8x3" Robertson (100 pack)

Chalk line (or regular chalk and something like straight edge of a scrap of plywood)

## MATERIALS

String (about 10 feet)

Pencil

Plywood 1 sheet  $\frac{3}{4}$ " (4X8 ft sheet)

Plywood 1 sheet  $\frac{3}{8}$ " (4x8 ft sheet)

3 2x4s, 8 ft long (this is for a 2 ft wide ramp, add more if you want a wider ramp)

Additional scrap 2x4s for your DIY ground workbench (if you don't have a work surface)

## WORK SURFACE

3 scrap 2x4s on the ground (they don't have to be full length) or workbench (if you have one)

## SAFETY GEAR

Safety glasses, ear protection

Dust mask if you're bothered by dust

## COST

\$150 or significantly less (or free!) if you can find salvaged 2x4s and plywood.

## TERMINOLOGY: CARPENTRY

**Plywood** – wood sheets made from alternating layers of processed and compressed thin wood veneer and glue.

**Lumber** – wood after it has been cut from a raw log and processed.

**Flush** – even with the edge of something.

**Offcuts** – excess pieces of wood left over after a piece of wood is cut down to a smaller size.

**Drop cut** – a cut that starts within a piece of wood rather than on the edge. Requires holding up the guard on your skillsaw.

**Profile** – in the case of this tutorial we are using profile to describe the side view (like the profile of your face). Profile in carpentry can also mean patterns or features on a wood surface.

## TERMINOLOGY: RAMP

**Deck** – flat top part of a skateboard ramp. Also used to describe the flat top part of a skateboard itself.

**Ribs** – structural framing along the curved part of the ramp.

**Skeleton** – the “bones” of the ramp, aka the structural framing

**Skin** – layer of plywood on the ramp. Goes on top of the skeleton/framing.

**Transitions** – plywood sides of the ramp that form a curved shape.

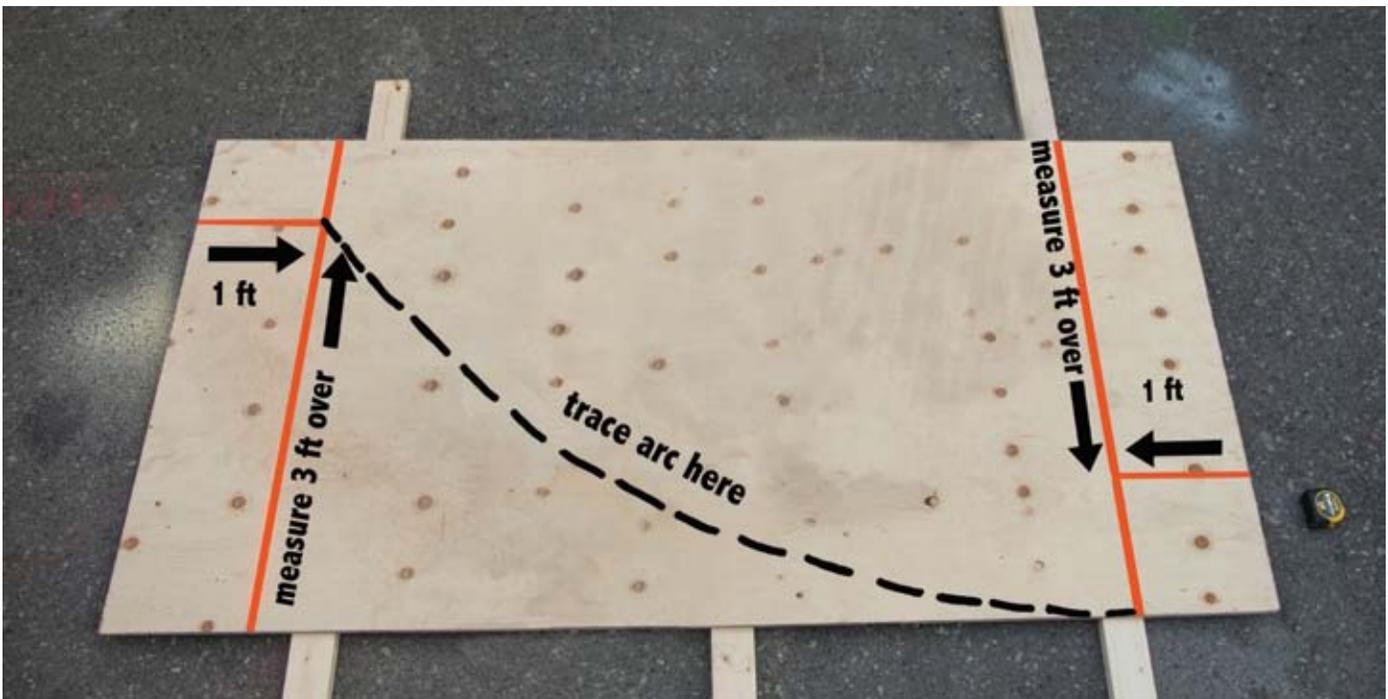
**Note to Makers:** You can make a ramp up to 8 ft wide using this basic design.

2x4s in 4 ft lengths or shorter can always be found in bins on or near construction sites (Note: don't attempt this without an adult!) Another option is lumber stores. They have wood delivered in stacks. For delivery and storage the wood has “spacers” in between to allow airflow between each layer of sellable wood. The spacers are considered unsellable. Explain your project and ask if you can recycle the spacers!

## PART 1

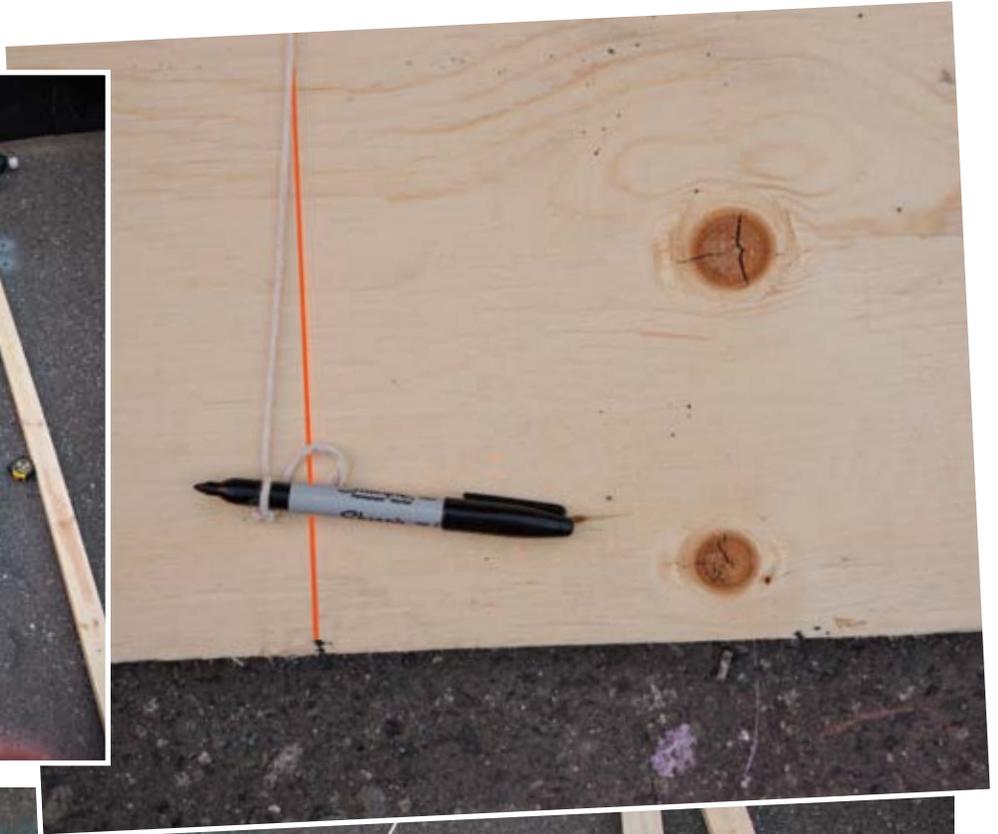
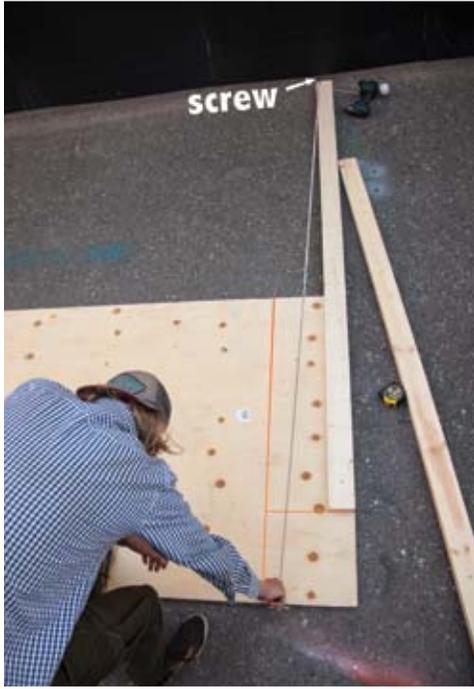
# MARKING THE TRANSITION

1. Lay your  $\frac{3}{4}$  plywood flat on the ground. Measure 1 ft over from the short edge and mark a chalk line at 90 degrees. Hook the chalk line under the edge of your plywood and pull it across your wood. Make sure your measurement at both ends of your wood is equal. With one hand, hold the chalkline holder, making sure to lay the line flat against your plywood. Now, with the other hand pinch the line and lift it up about half a foot or so, then let go, so the line snaps down on the plywood leaving a mark. Now measure 3 ft up from the long edge and snap your chalk line at the place where it intersects with your vertical line at 180 degrees. You do not need to snap the chalk line the whole way across the wood, only to the intersection. This will create a large and a small rectangle. Do the same on the other side (except opposite corner, upside down). Here is a template for reference:



2. From the 3 ft mark on the right hand side, screw a 2x4 into the plywood (see next page for photo). Place another screw on the centre of extended end of the 2x4, but don't screw it in all the way. Just screw it enough so that it attaches the 2x4 to the plywood underneath. Tie a piece of string to the screw.
3. Unravel the ball of string. Pull the string taut towards the left corner where the large and small rectangle intersect. Tie your string so that when the writing tool is upright and intersects exactly with this spot when you draw an arc. This will be your deck (top of ramp).

4. Hold your writing tool and practice moving in an arc, back and forth between the lower right hand side (bottom of your ramp) and the place where your lines intersection at the top left which will be your deck (top of your ramp). Once you're ready, draw an arc on your plywood. Now, unscrew your 2x4 and set aside.



## PART 2

# CUTTING THE TRANSITION

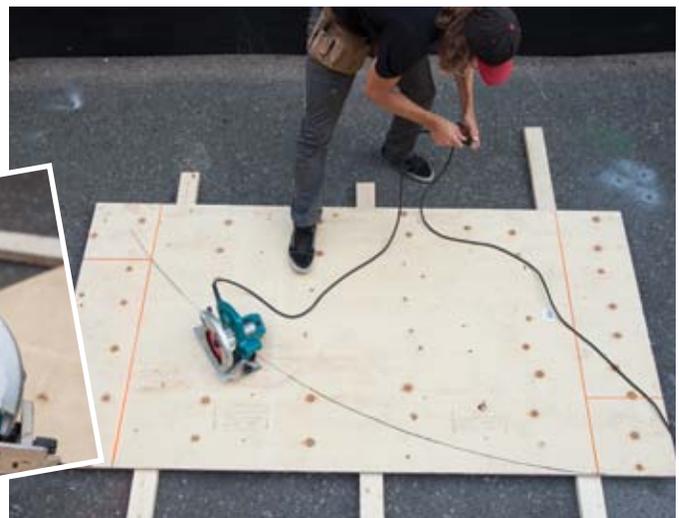
## IMPORTANT

If you have a skill saw, let a teacher or parent do these steps. A skill saw is very dangerous tool.

- 1.** Place your  $\frac{3}{8}$  ply on top of 2-3 pieces of scrap 2x4s at 90 degrees. This will lift your plywood off the ground and leave a bit of space for the blade if you're using a skill saw. If you're using a hand saw (ideally a crosscut saw) you can place your wood over the edge of a table or saw it upright, making sure to hold your wood steady as you saw with your dominant hand.
- 2.** Make sure your skill saw is off and unplugged (if it has a cord). Adjust your saw depth to just a bit deeper than the depth of your  $\frac{3}{8}$  ply. To judge the depth you can adjust the guard visually while the skill saw is placed in top of your plywood (add  $\frac{1}{4}$  depth). Calculate what is  $\frac{3}{8} + \frac{1}{4}$ ?



- 3.** Use your hand to manually hold up the guard and start cutting your transition. Start by drop cutting through the place where the platform and ramp meet on the top left and move towards the bottom right.



- 4.** Align your skill saw with your cut line and turn it on. Using your body as an axis, start cutting your transition. Move the saw slowly and carefully along the line you've drawn. If you start to deviate from your line, turn off your saw, re-adjust, then restart.



- 5.** Once you've cut your first transition, remove the first piece of plywood and use it as a template for your second transition. Trace your second transition then move the first transition out of the way. Now, using the same process, cut your second transition. You will have an oblong surf board piece of wood left over. You can use this offcut to create a "Wood Scrap Art project" listed in this manual! Set aside.



- 6.** Line up both transitions side by side to check if they are relatively close in profile. If they are slightly off, it's ok. If there's a significant difference, use the smaller transition as a template, trace the section that must be removed and cut again. Once both your transitions are cut, you are ready for your ribs!

## PART 3

## FRAMING

1. Use a square to mark your ribs. Start at the deck (top) or your ramp and head down the ramp, marking every 8 inches by draw in a line across both transitions at once. At each line, continue the mark down onto the outer sides of your transitions.



2. Measure the width of the 2 transitions. For the sake of this manual, we will make a jump ramp that is a total of 2 ft wide, but you can adjust the math and materials to make a ramp up to 8 ft wide using the process in this tutorial.
3. If you want your ramp to be a total of 2 ft across (or insert your ideal width here), how long do we cut each rib? Subtract the measurement of your 2 transitions from the total of whatever width you decide for your ramp. Whatever your answer is will be the size of each rib. Grab a 2x4 to start marking cut lines for your ribs. Make sure your square is flush and use your pencil to mark your cut line for each rib.



4. Before you cut your ribs, double check your rib measurements. If they are correct, place 2 of your scrap 2x4s underneath to lift the wood you will be cutting off of the ground. Make sure your supporting 2x4 or work surface is not going to interfere with the saw when it passes over your cut line.

## IMPORTANT

Let a teacher or parent do this part.

5. **Adjust the guard** on your skill saw to a depth just a bit deeper than your 2x4. Use your other hand to hold the wood you are cutting (tuck in your thumb!). Line up your saw with the cut line, check that your blade isn't going to contact the supporting 2x4 underneath. Benny is using his square as a guide to ensure his saw will move in a straight line as he cuts his wood. Now, turn on the skill saw and cut the wood. Repeat after every cut by shifting the wood forward.



## PART 4

# ASSEMBLING

It's helpful to have a partner for this part!

1. **Have each person lift a transition.** Grab your first rib and sandwich it between the two transitions. Make sure the transitions are both standing at 90 degrees. Check that the rib is flush with the curve of the ramp. Place the rib on the x below the line and adjust before adding one screw on either side. (You'll add a second screw after all ribs are in place.) Before you continue, check that your project is square and not tilted by lining up your square with a corner.



- 2.** Continue attaching your ribs until you reach the rib closest to the ground. When you attach the last rib, it's very important to make sure it is flush, so there isn't a "bump" when you ride onto your ramp. This may mean your last rib is closer to the previous rib you installed.



- 3.** Next, add supporting ribs to the top of the ramp: the 2 ribs that form the back frame. There should be a rib at the top backside of the ramp and a rib at the bottom backside.



**4.** Go back and add a second screw on all the ribs, on both sides of the transition and the supporting ribs, double checking that each rib is flush.

**5.** Let's attach the ramp surface or "skin." Take your 3/8 sheet of plywood and place it on your ground work surface, using scrap 2x4s you to keep your wood off the ground. Measure 2 feet from the long edge and mark with the chalk line. Now, measure 4 ft from the short edge and mark it with the chalk line. Note: This measurement will need to be adjusted if you have decided to create a wider ramp. Lift your plywood and place on your scrap 2x4s.



### IMPORTANT

Let a teacher or parent do this part.

**6.** Re-adjust the guard on your skill saw to just over  $\frac{3}{8}$  depth. Slowly and carefully, saw along the cut line on your plywood. Now cut your second line. You should now have a 2x4 foot piece of plywood. Once it's cut, decide which side of your plywood is nicer. This side will attached be face up.

**7.** **Two-person job:** have one person hold the plywood at the bottom of the ramp, adjusting to find the place where the plywood perfectly meets the ground. When you find the spot, one person will hold the plywood in place at the bottom, while the other person screws in the top of the plywood to the closet rib. Add one screw in the centre of the rib, adjust if needed.

**8.** Now, use the chalk line to mark the centre of all your ribs. This will make it easier and faster to add screws that are perfectly centred. You should be able to find the location of your ribs by looking for the marks you drew on either side of the transitions.



**9.** Add screws in all ribs, first in the centre, then one on either outside edge, then add screws in between each of the previous screws. This will help prevent warping.

**10.** Now, line up the second piece of plywood with the bottom of the first piece. Have one person step on the plywood to bend it into a curve to match the profile of the transition. On the backside of the plywood, the other person will use a marker and mark a cut line on the place where the ramp ends and the deck starts. Now remove the plywood from the upper part of the ramp.



**IMPORTANT**

Let a teacher or parent do this part.

**11.** Use your skill saw to cut along your cut line to create your top deck. Check your deck size by placing it on the top of your ramp. You may have to mark and cut off a bit of excess wood still.

**12.** Now, attach the plywood to your ramp. Once again, use your weight (or a friend's) to help bend the wood into a curve as you screw it in place. Make sure you screw your plywood down tight. You may have to put your body weight into your drill.



**13.** Once your top plate is cut to size, screw it in place in the same order as you screwed in your ribs: centre first, outside edges, then in between.



## 14. Now you're ready to ride!



**OPTIONAL**

Have a group design jam to come up with a design to attach an inner frame to add castor wheels onto the bottom of your ramp. This will make it easy to transport!

If you want your skate ramp to last longer, consider adding a second layer of  $\frac{3}{8}$  plywood and coat of paint on top for extra protection against weather. Another option is adding a layer of “Skatelite” on top of your deck and ramp surface (it is about \$150 per piece). If none of these are an option, store your ramp inside or cover it with a tarp if it's stored outside.

Interested in creating more elements for your own skate park?  
Here's a link to more skate park carpentry projects: [www.diyskate.com/ramps.html](http://www.diyskate.com/ramps.html)

# CONNECT

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