

Directions

spectrUM Discovery Area is located on the Children's Floor of the new Missoula Public Library at 455 East Main Street, in downtown Missoula.



“Stare at spectrUM’s logo for 30 seconds and then look away to a blank wall. What do you see? The colors are reversed because of something called afterimage. **Pretty cool, huh?**”



Science. Try it.



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Chocolate Welding

GRADES 4-8
Weld pieces of chocolate together to test then taste!



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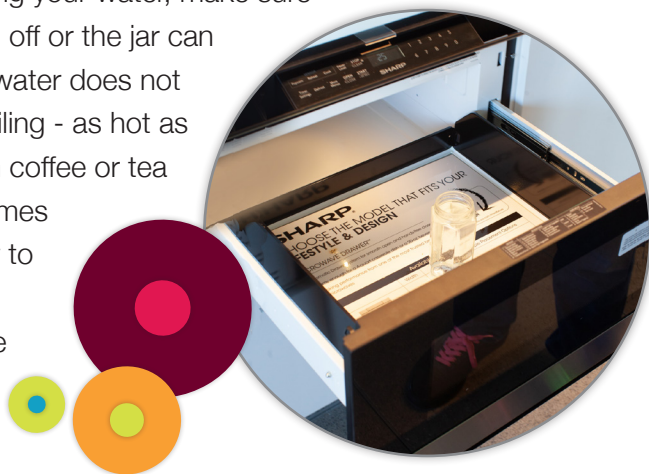
WELDING WITH Chocolate

What You Need:

- Andes Mints
- Wax paper & Napkin
- Paper plate
- 3D Printed Jig
- Glass Jar or Ceramic Coffee Mug (not included)
- Water
- Microwave/stove
- Optional: Fridge/Freezer and Heavy Things

Try it

- 1. Wash** your hands so they are clean - you'll want to eat the chocolate at the end!
- 2. Heat** water in a glass jar or ceramic coffee mug - not plastic - in the microwave or in a pot on the stove. **USE CAUTION:** This first step should be done with adult supervision. If you are microwaving your water, make sure to leave the lid off or the jar can explode. The water does not need to be boiling - as hot as a cup of warm coffee or tea is best. If it comes to a boil, allow to cool for 10-15 minutes before proceeding.



Fusion welding can be performed using gas, electricity or any other type of source that creates heat. It differs from other welding processes because it only uses the parent material and heat to create the bond between two objects. In other types of welding - such as **arc welding** - welding rods or welding wire is added to the heating process in the presence of an inert gas in order to bond the two materials together.

- Can you find something around your house or garage that is made of metal welded together?
- Are there other chocolates you can try welding with? What might happen if you tried chocolates that had crispy rice (Crunch Bars) or cookies (Twix) in them?
- Many artists use welding to create sculptures. Can you make a sculpture out of welded chocolates?



For more pictures, videos, and other ideas you can try with chocolate welding, see our Instructable at [tinyurl.com/chocowelding](https://www.tinyurl.com/chocowelding) or scan the QR code.



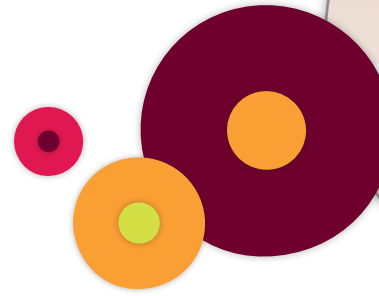
Welders and engineers can test how strong their welds are by seeing how much weight they can bear. This is called a **stress test** or **load test**. If you would like to do this, take some of the wax paper and put it on top of your welded piece, and make sure to leave it on the paper plate to avoid a mess. Add weights like heavy books on top. How much can it hold?

If you have a scale in the house, you can also measure how much weight the pieces can hold by placing your pieces on the plate, then on the scale. Put some of the wax paper on top of your piece to avoid a mess, then stack heavy things on top until the piece breaks. Keep a close eye on the scale as you add the weights. How many pounds or kilograms does it read right before the piece breaks?

While there are many different types of welding processes, the chocolate welding process uses what's called **fusion welding**, which involves a melting of the material along a small part at a time, and then bonding two surfaces together and holding the piece place it until the material has cooled enough to provide a strong bond between them. The chocolate goes through a **phase change** from solid, to liquid when it is heated, then back to solid again when it cools. Metal goes through the same process when welded but at much higher temperatures.



3. Wrap the jar with wax paper or tape it onto the jar. This isn't necessary but makes cleanup a breeze!



4. You have enough materials to create two kinds of welded pieces - an **I-beam** and a **box section**. Build both of these on the provided paper plate to keep things clean and tidy. The I-beam is called that because it looks like the capital letter "I". The box section is named that because it looks like a box when we are done.

5. To create an I-beam:

A. You just need three pieces of chocolate/mints for this. Melt the long edge of one piece as shown in the picture against the side of the hot jar.



B. Set it down on the face of another piece and hold it in place - it looks like an upside-down capital letter “T”.

C. Blow on it for just a bit until it will stand up on its own, then stick it in the freezer or fridge for a couple of minutes. You can also set it outside in the cold, or wait about 5 minutes at room temperature.

D. Once your first section is cool, take it and melt the other long edge of the piece you melted in step A. Add the third piece of chocolate so it looks like the letter “I” and allow to cool.



6. To create a box section:

A. You'll need four pieces of chocolate for this. Melt the long edge of two pieces of chocolate against the side of the jar.

B. Place these pieces at a 90° - or right - angle in the 3D-printed jig as shown on the next page. It's the small plastic piece that has two notches in it.



C. Repeat this process again with the other two pieces, and place them in the empty slot of the jig.

Place in the freezer or fridge for a couple of minutes, or wait about 5 minutes at room temperature.



D. Now we will weld the two right angle pieces together to make a square, or box. Melt the long, exposed edges of both of the pieces you made in the previous step, then place them in just one slot of the jig so that they form a box.

E. Allow to cool in the fridge or freezer for a couple of minutes again, or about 5 minutes at room temperature.

