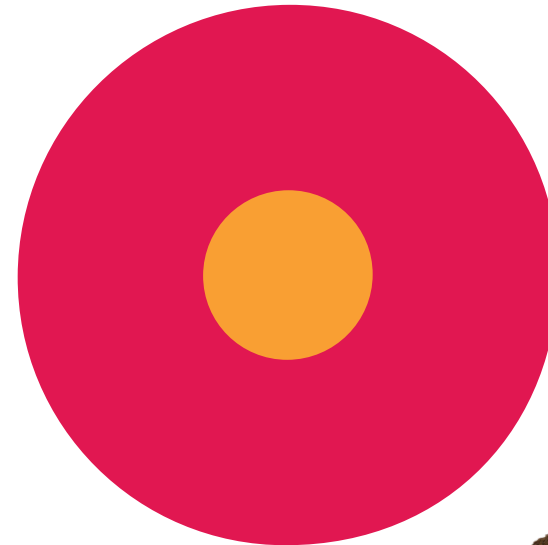


Directions

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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Tensegrity Table

GRADES 3-8

Build a structure using rubber bands and popsicle sticks that seems to defy gravity!



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Tensegrity Table

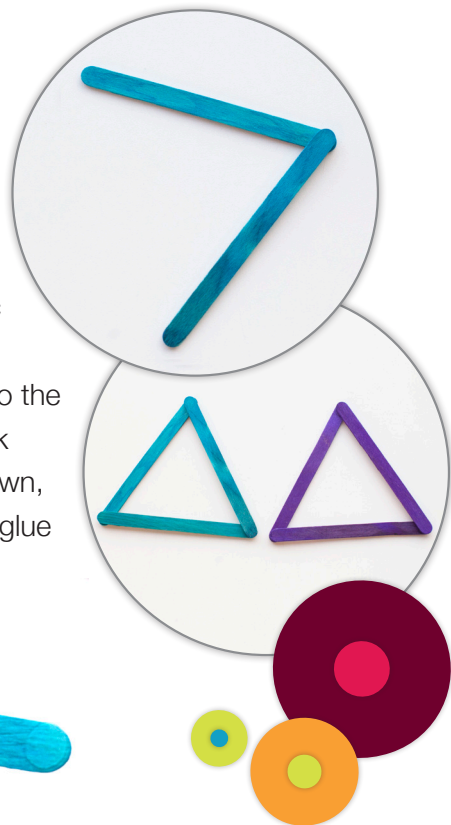


What You Need:

- Popsicle Sticks
- Binder Clips
- Glue Dots
- Big Rubber Bands
- Tiny Rubber Band
- Paper
- 3D Printed Clips
- Scissors and Pencil (not included)

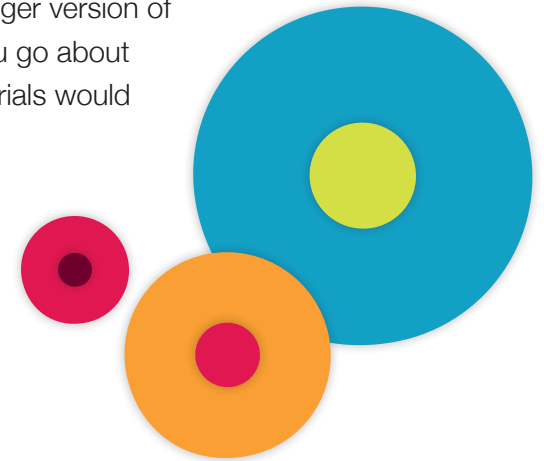
Try it

- 1. Make** two triangles with your popsicle sticks. First peel the white paper from one glue dot and stick it on the end of a popsicle stick. Then remove the clear plastic sheet from the glue dot and place another stick on top. Do the same for a third popsicle stick so you have a triangle as shown, where all three points have a glue dot between the sticks.



Here are some ideas to ponder:

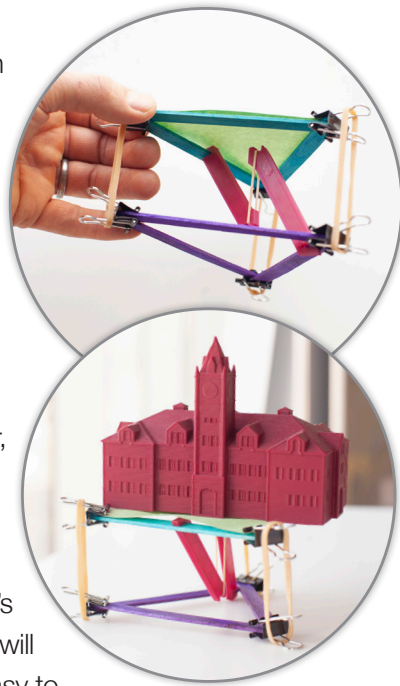
- A bicycle wheel is an example of tensegrity in everyday use - the hub is suspended in the center of the rim by the spokes pulling equally in all directions away from it towards the rim. Can you think of some other examples?
- You can use string or wire instead of the rubber bands in our model. What things might you need to consider when getting them to the right length and tension? How might you attach them?
- NASA is designing robots - like one called the Super Ball Bot - that are a tensegrity structure which varies the length of the cables to “walk” across a surface. Can you design something similar that uses this concept to move? What might be some challenges?
- If you were to build a bigger version of this table, how might you go about designing it? What materials would you use?



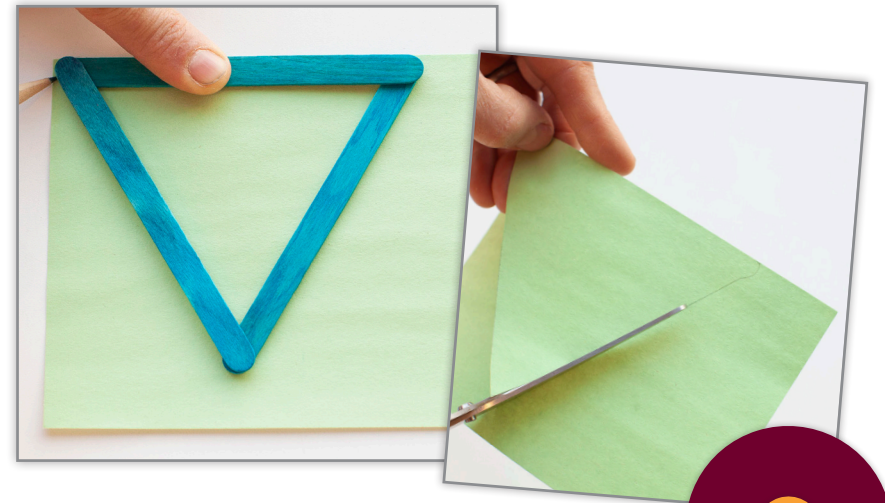
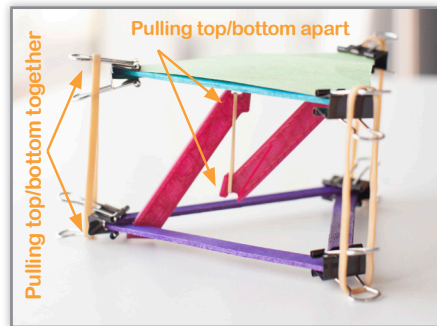
For more pictures of the finished table, videos and further explanations about other types of tensegrity structures, see our Instructable at [tinyurl.com/tensegritypop](https://www.tinyurl.com/tensegritypop) or scan this QR code:



Now it's time to see what this contraction can hold. Start with lighter items like LEGO mini-figurines or small toys, and work your way up to heavier items. If you have something a bit heavier and bigger - like our 3D-printed model of the University of Montana's Main Hall - you'll need to get the **center of gravity** right over where the rubber band in the center is. If it's off to one side or the other, it pulls the whole thing too far to that side and the tension of the rubber bands becomes off balance, eliminating its integrity. If you add too much weight or it's not balanced in the center of the table, it will fly apart - don't worry, though, it's very easy to put back together again and again!



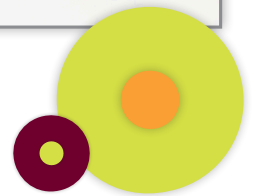
Tensegrity structures like the one we've made here work by having a bit of **tension** pulling in all the right places evenly to suspend pieces in an orientation to each other to create a structure that has **integrity**. There is an equilibrium of the tension of the three big rubber bands pulling the two platforms together (like the three legs of a stool) and the little rubber band in the center pulling them apart from each other. In our version, the three rubber bands are pulling down on the top triangle equally at all three corners. The center rubber band is pulling the top platform up to suspend it from the hook attached to the bottom platform. If any single one of these four rubber bands gets stretched too far or gets too slack, the whole thing collapses because the tension of the others pulls on the structure unevenly. They all work together to pull the structure into place in three dimensions.



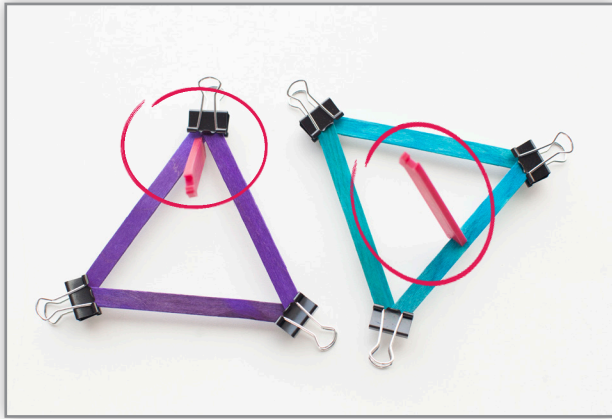
2. Trace around one of the triangles on top of the paper. Cut out this shape with your scissors. It will be the top



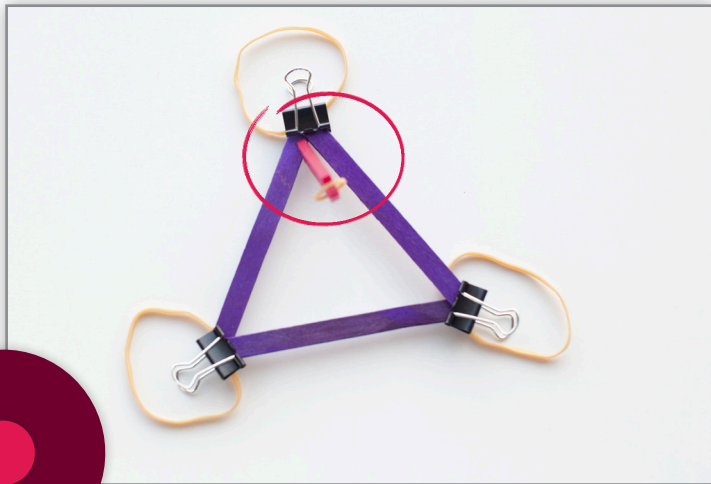
3. Clip a binder clip to each point of one of the triangles. On the other triangle, place your paper triangle over the popsicle sticks then put a clip on each point to hold it in place.



- 4. Add** the 3D printed clips as shown. One goes at the **vertex** of one of the triangles. The other goes in the middle of one of the **sides** of the other triangle. They just slide onto the popsicle stick.



- 5. Place** the three big rubber bands underneath each binder clip of one of the triangles. Then hang the tiny rubber band onto the notch of the plastic clip.



- 6. Take** the other triangle you've made and hook the plastic clip notch over the tiny rubber band and press down a bit.



- 7. Keep** a good hold on the top piece you are pressing down and hook all three big rubber bands over the binder clips on this top piece so they connect the two triangles together. This part is tricky, don't worry if it takes a couple of tries!

