UNFOLD A SOLAR ARRAY
ISS - PART 2

The ISS (International Space Station) uses photovoltaic solar arrays to generate power.

Solar arrays take up a lot of space, some of them on the ISS are 73 meters long! They can't go into space open - so they are packed up very tightly and then unfolded once up there.

ISS panels are long and thin, so they can be lined up beside each other and more are added as the station gets bigger and needs more energy.

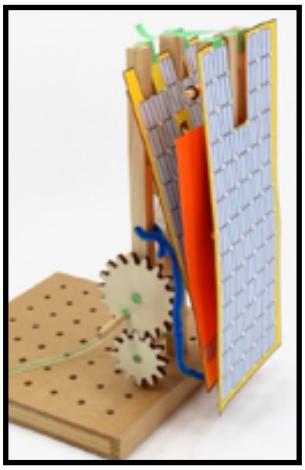
About 60% of the energy they produce directly powers the station, and 40% goes to recharging the batteries on board so when they are in shade behind the earth (or some panels shade other ones), they can use battery power. The solar panels are on gimbals (rotating joints) so they can turn to face the sun for maximum efficiency.

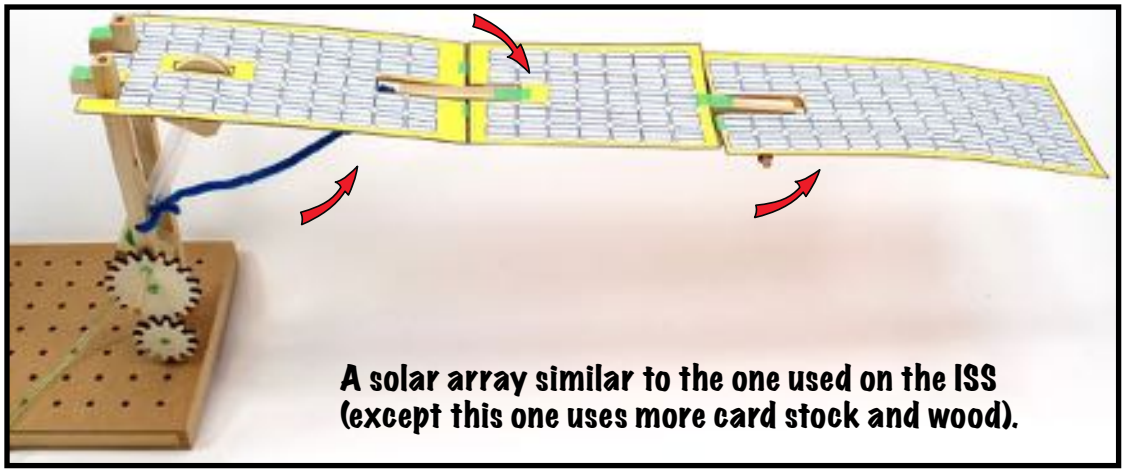
This image (left) shows three different solar array styles on the ISS- all unfolded in different ways!

This challenge is to make a mechanism that unfolds a solar array (well, card-stock array) that is small at first (so it fits in a rocket ship) - but then expands to have a very large surface area - that could be used to generate electricity.

There are a number of ways to unfold a solar array. This is the most complex we have instructions for. Once you mastered this one - try the Miura fold solar array activity - that uses an origami design!

Requirements are that it fold tightly to launch - then expand - a lot!

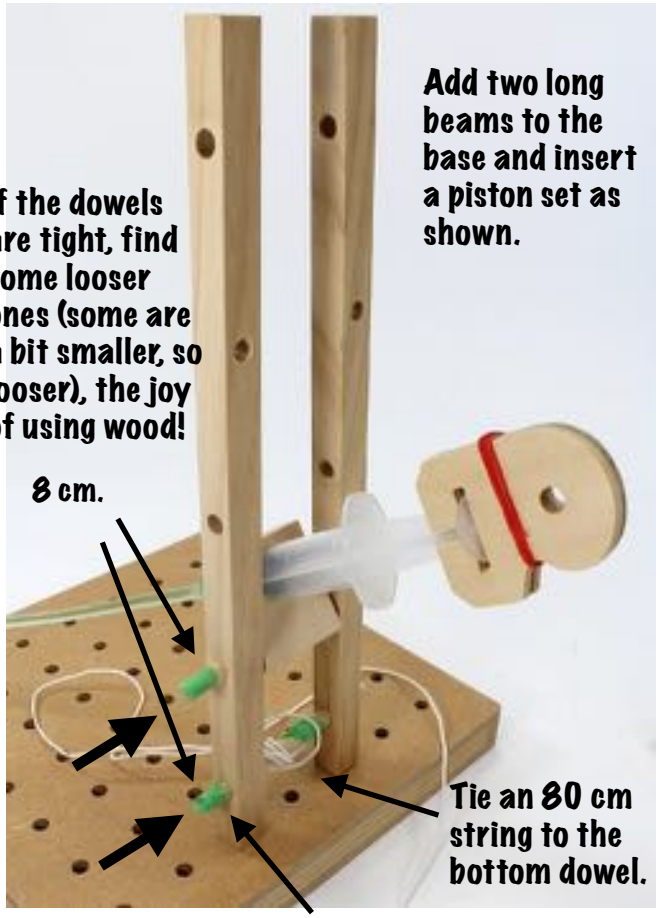




A solar array similar to the one used on the ISS (except this one uses more card stock and wood).

There is a template of a solar array at the end of this challenge.

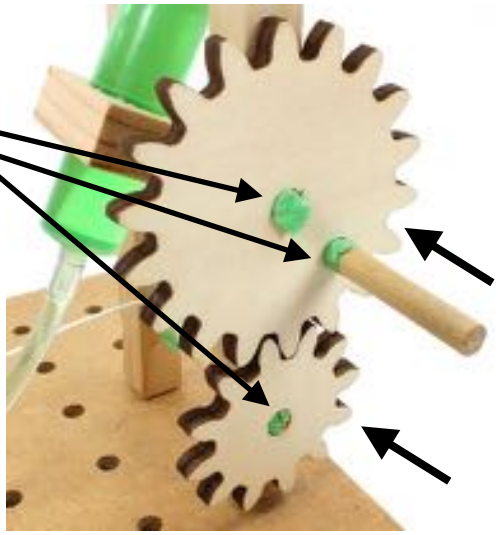
SOLAR ARRAY

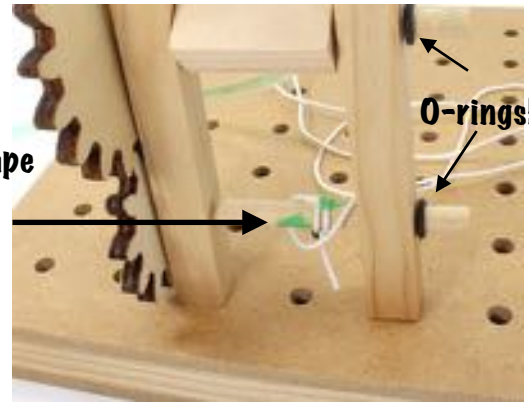


Tiny amount of tape on the end of each dowel.

Add the gears to the dowels. The tape makes a friction fit with the gears so they turn the dowels.

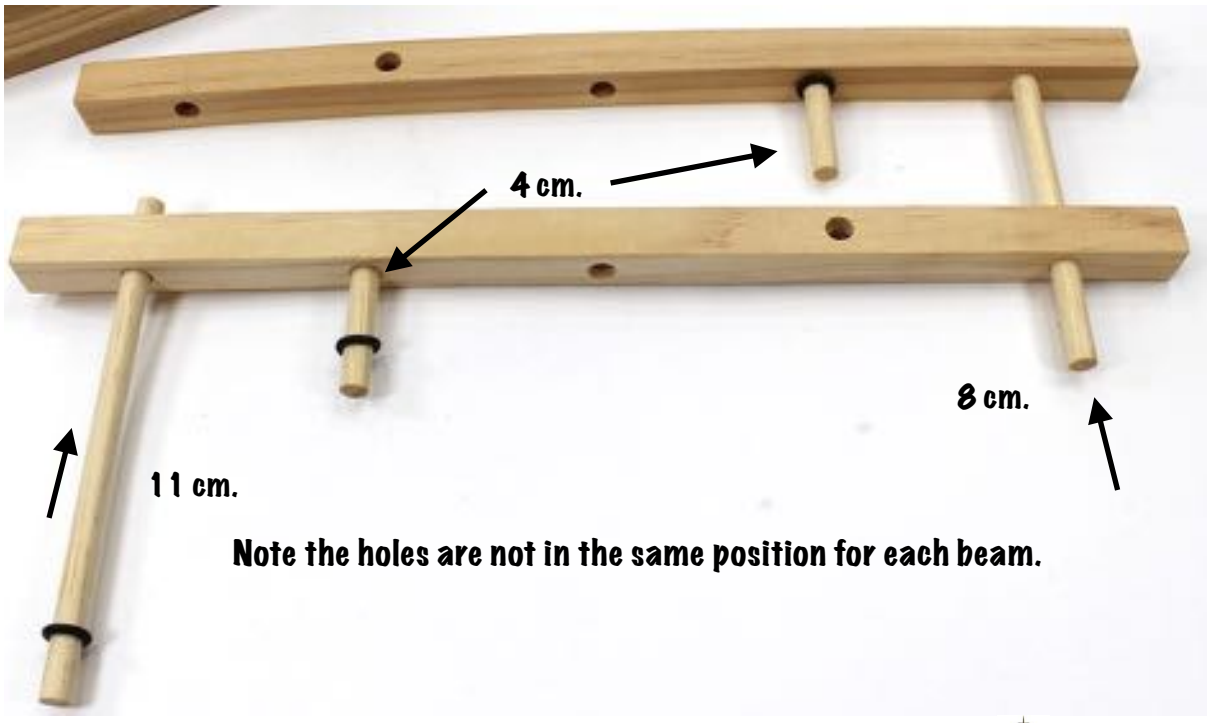
Too much, it won't fit - too little it slides
- experiment!





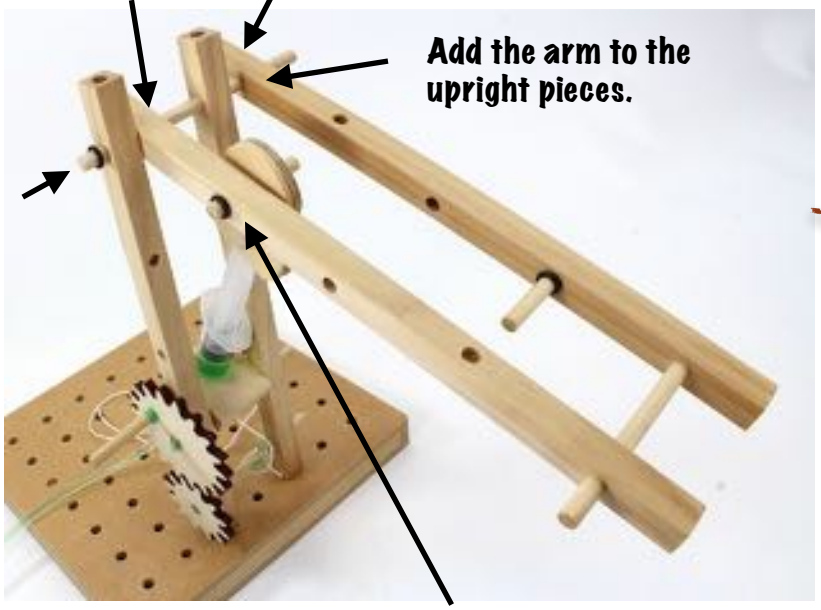
The first array.

Use two long beams and add some dowels and O-rings.

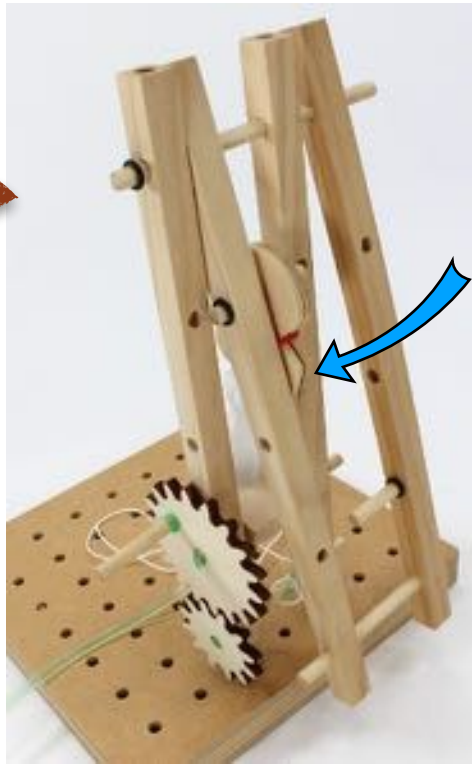


Note the holes are not in the same position for each beam.

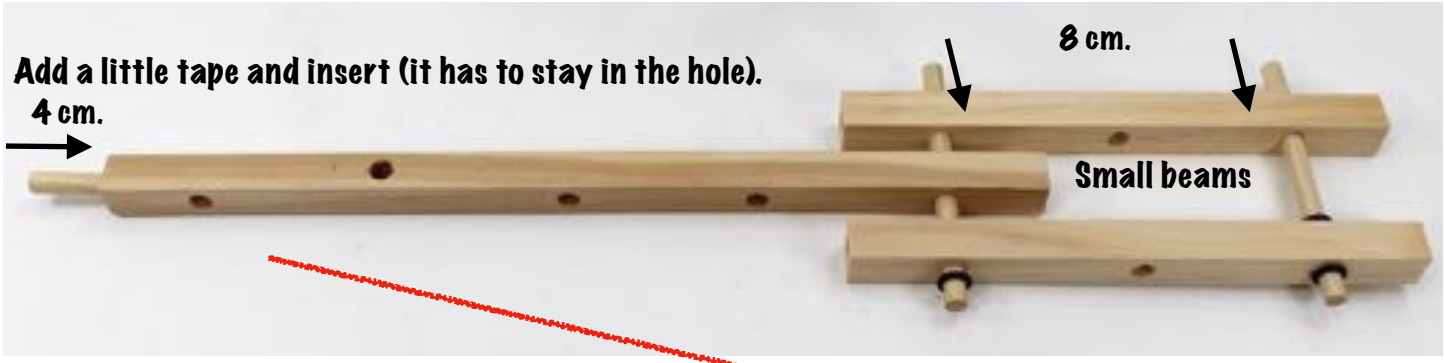
SOLAR ARRAY

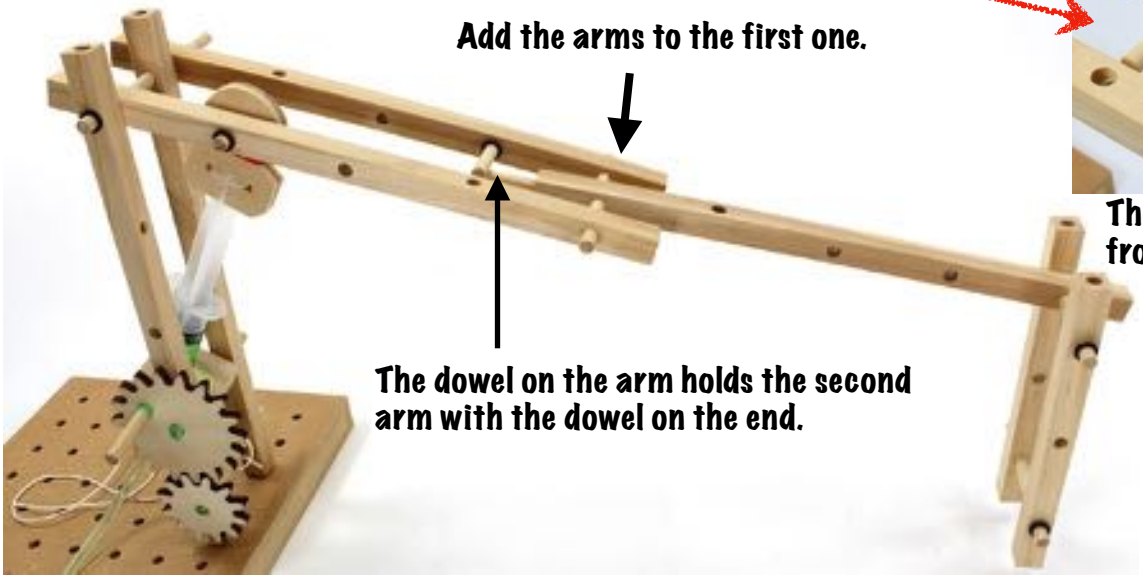


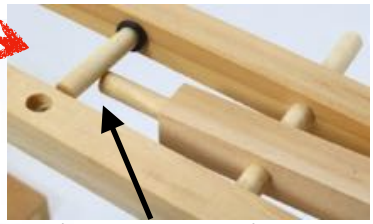
Looks good, adjust the piston in the holder so it closes tightly.



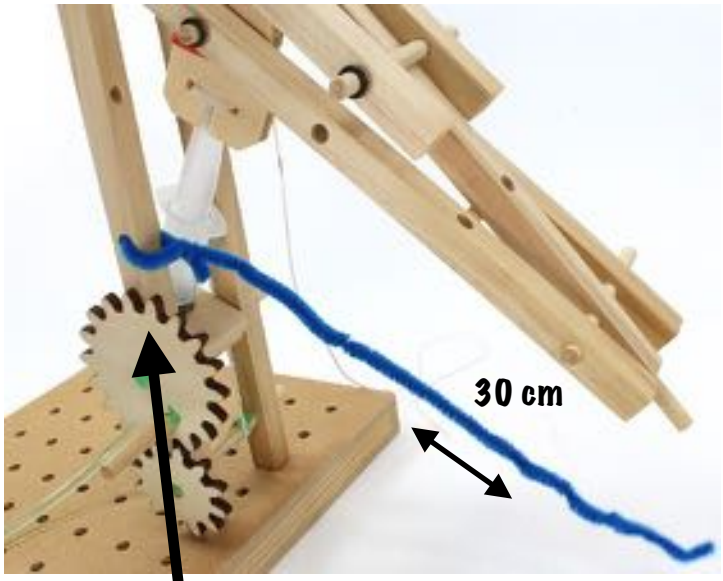
Second and third arms...



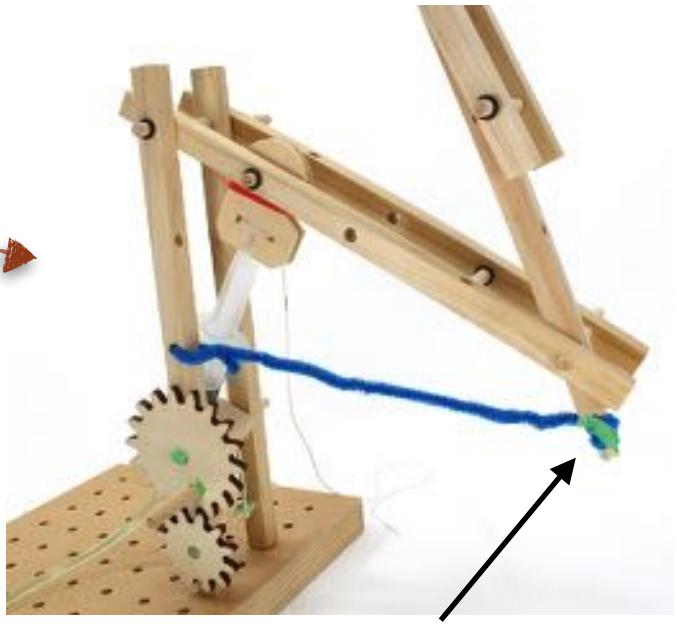




PATHFINDERS

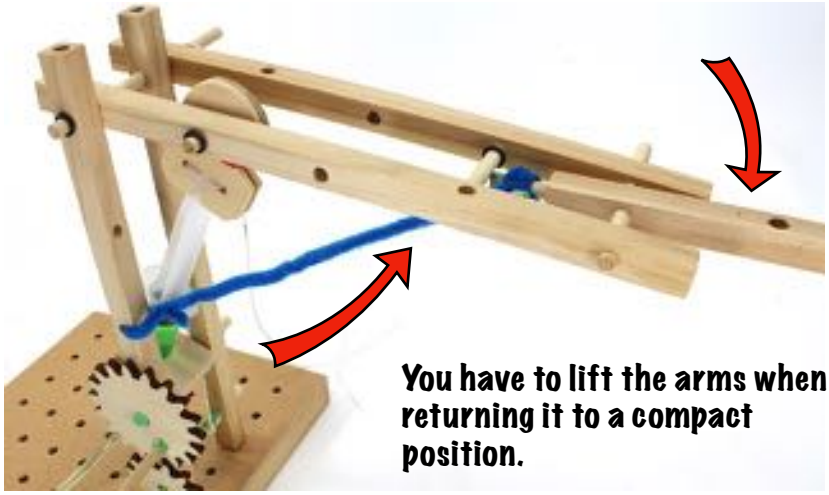


Add a 30 cm twist tie to the upright structure.

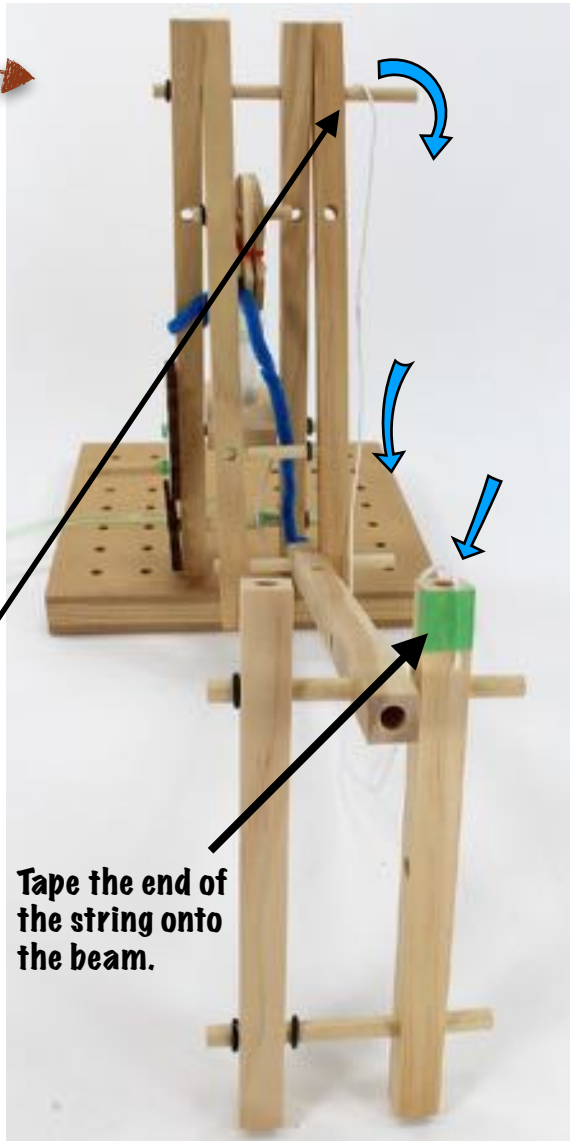


Wrap the twist tie around the dowel and add some tape to hold it on.

Looks good - open it up a few times, if the twist tie pulls off then it is too short.

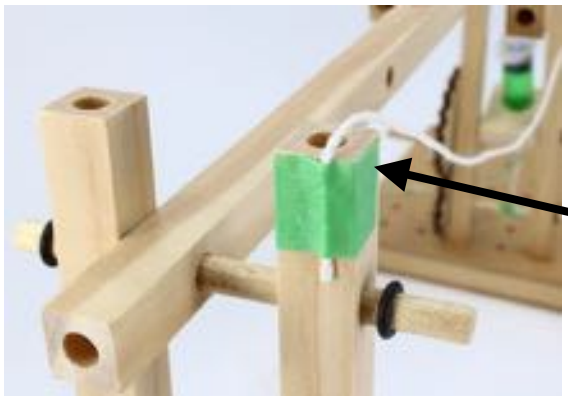


You have to lift the arms when returning it to a compact position.



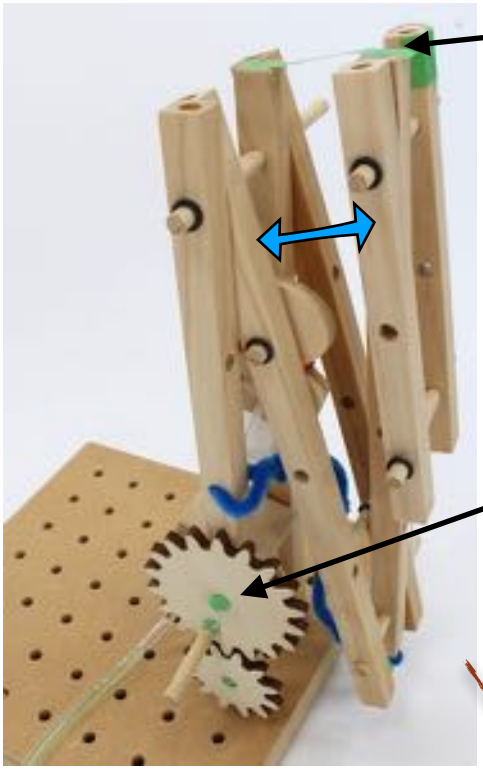
Feed the string over the long dowel and out to the final arm.

Tape the end of the string onto the beam.



Push the tape tight!

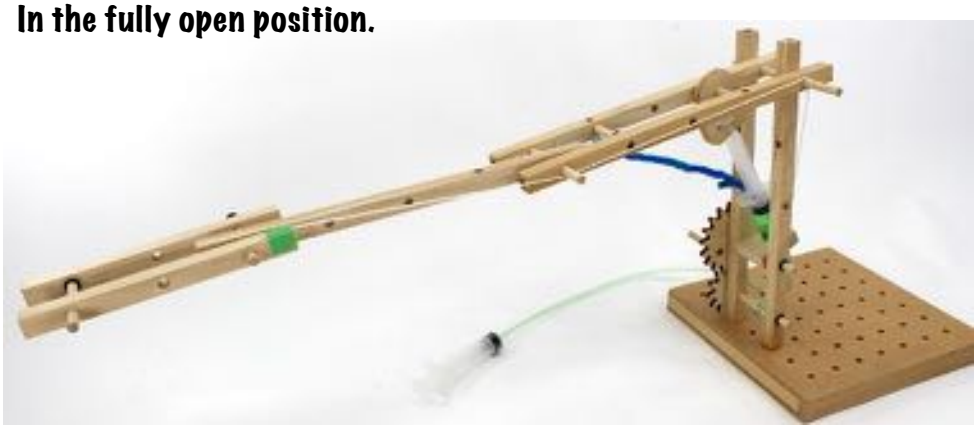
Do some testing folding it in and out.
You will have to lift it up into the folded position. The challenge is for unfolding the array - not folding it back up!



It does not stay in place when folded - you need to add a thin piece of tape to hold it in place.

You will have to unwind the winder too!

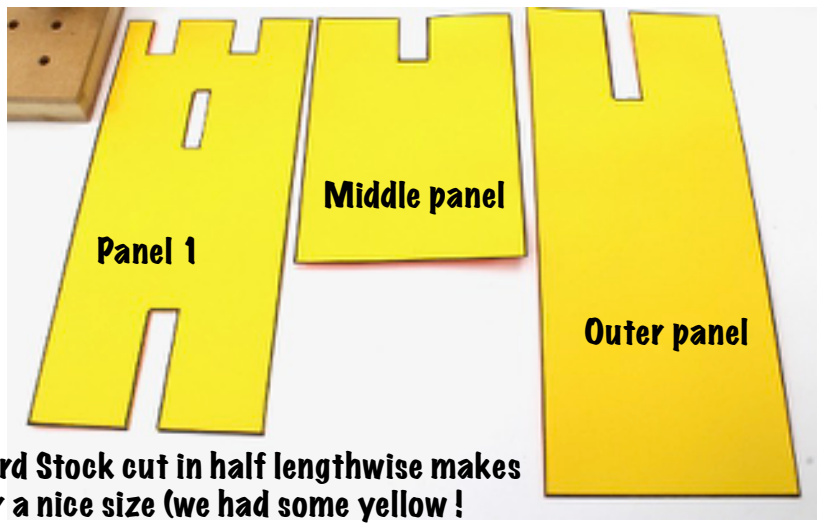
In the fully open position.



Looks great! Now for the solar panels!

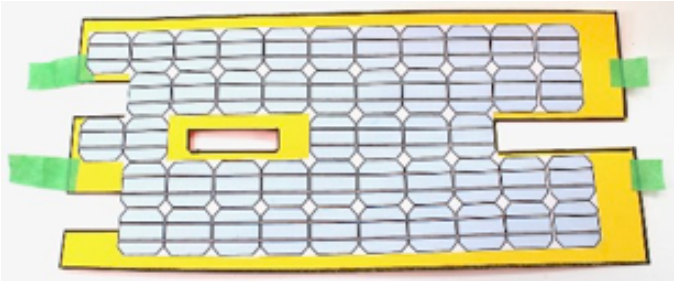
Cut two pieces of card stock in half lengthways.
You will need to cut holes and grooves for where the beams and linkage are connected. Dimensions are at the end, or you can lay the paper on the arms and work it out that way.

Print and cut the solar array image as well, they fit nicely on the pieces of card stock (but need trimming as well).

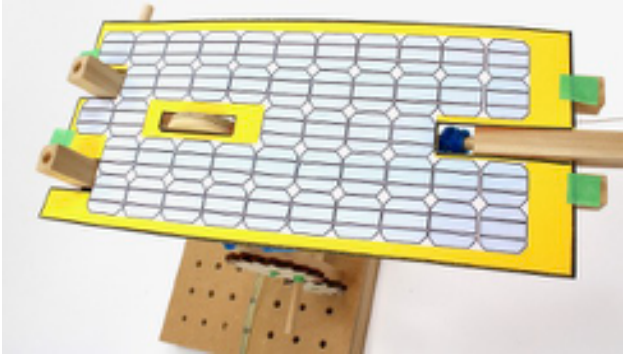


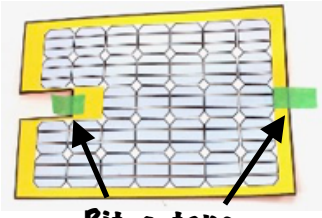
Card Stock cut in half lengthwise makes for a nice size (we had some yellow !

Cut the first arm (panel 1) and add the panels. We used some green masking tape to attach it to the first arm.



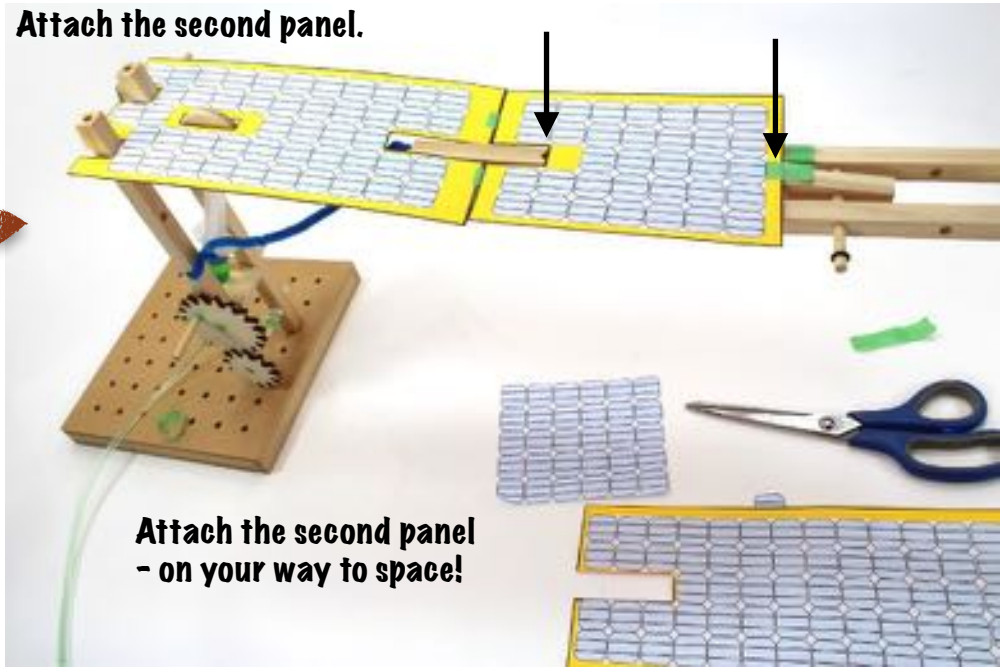
Good start!





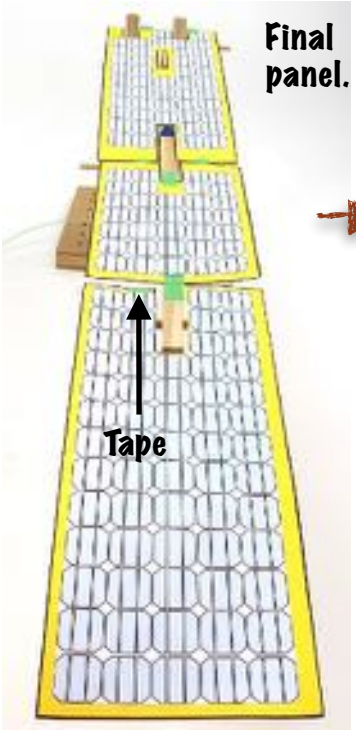
Bit-o-tape

Attach the second panel.

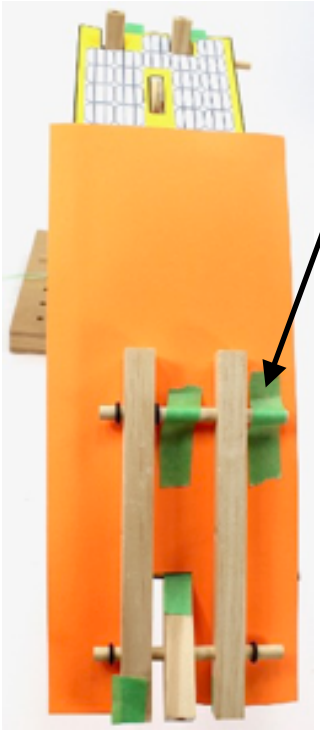


Attach the second panel - on your way to space!

Final panel.

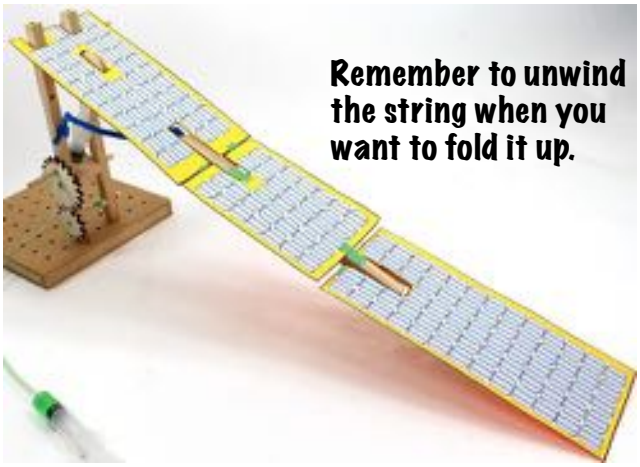


Tape



Final panel. Tape the back side so it sticks better.

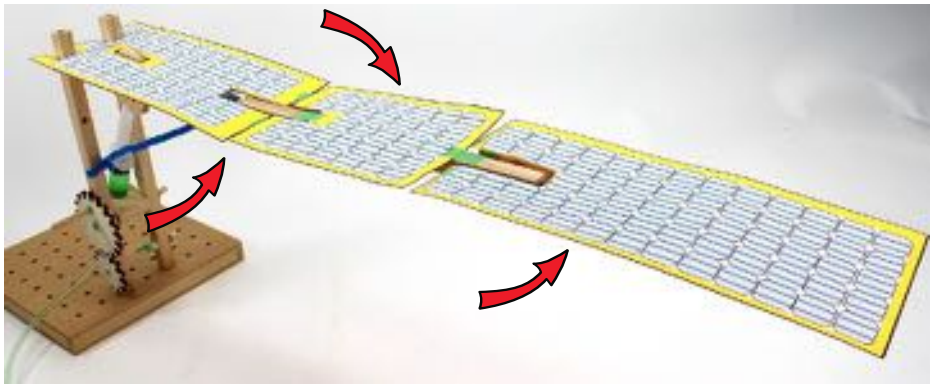
Looks great! Time to fold it up and see how it works!

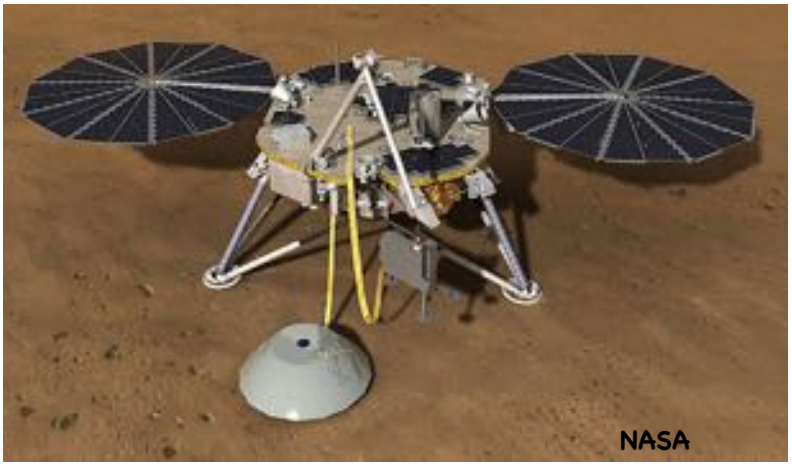


Remember to unwind the string when you want to fold it up.

You will have to use the tape to hold it, but not too tight or it won't open!

Super cool - your first step to becoming a space engineer (or is it rocket surgeon?).

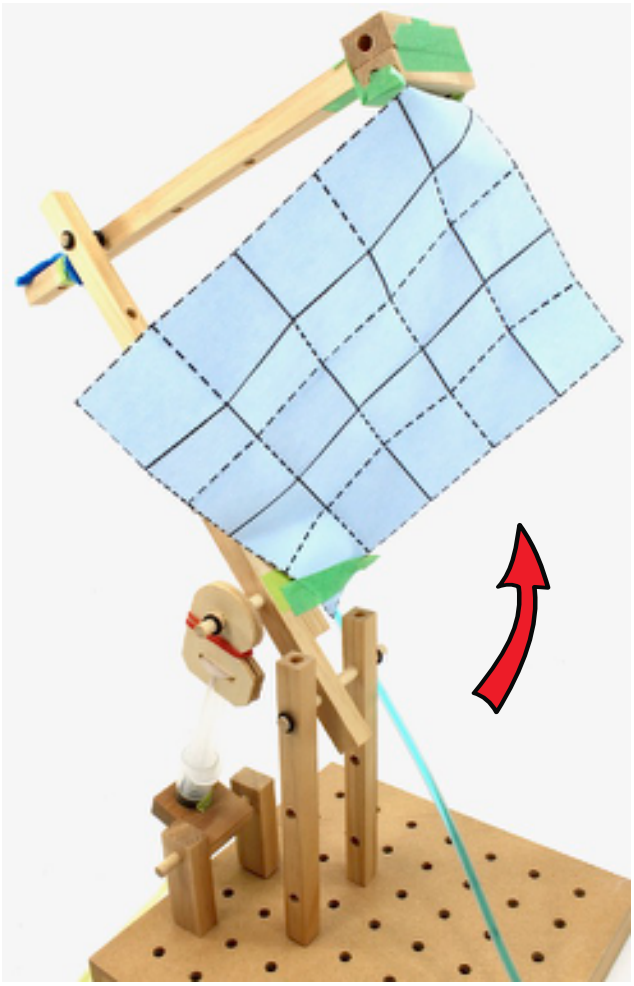


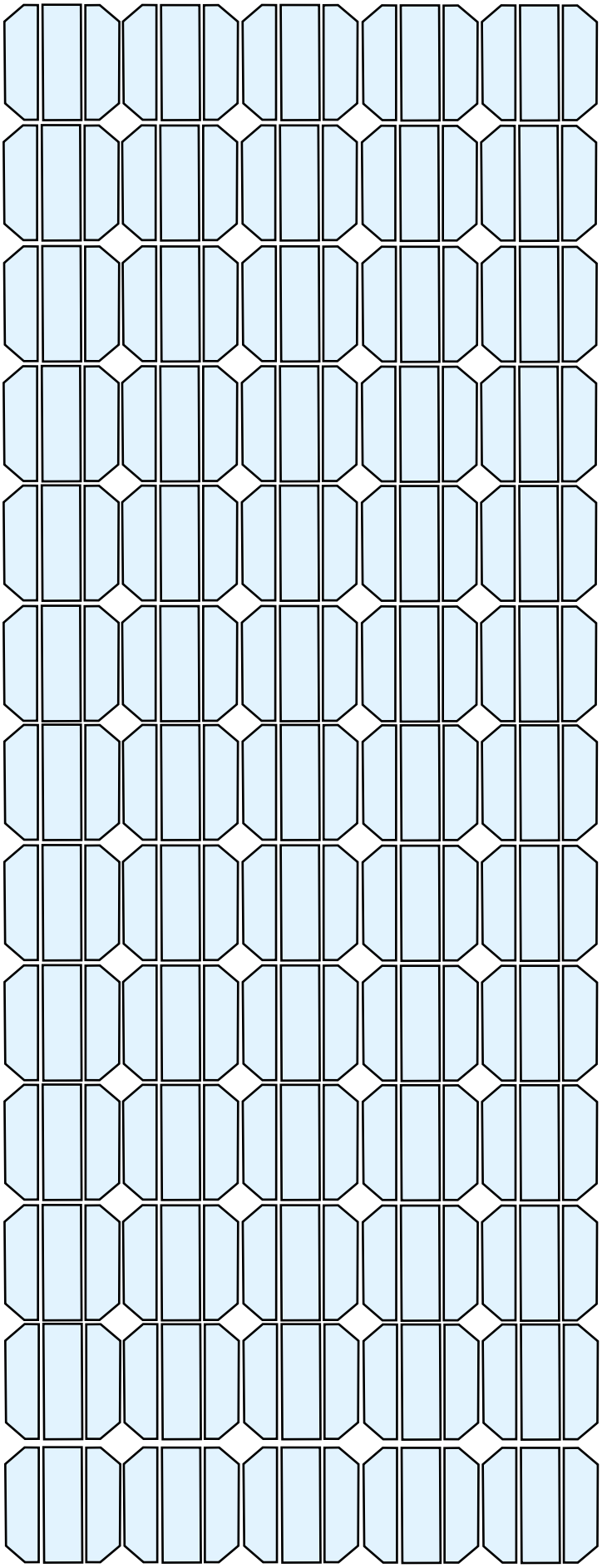
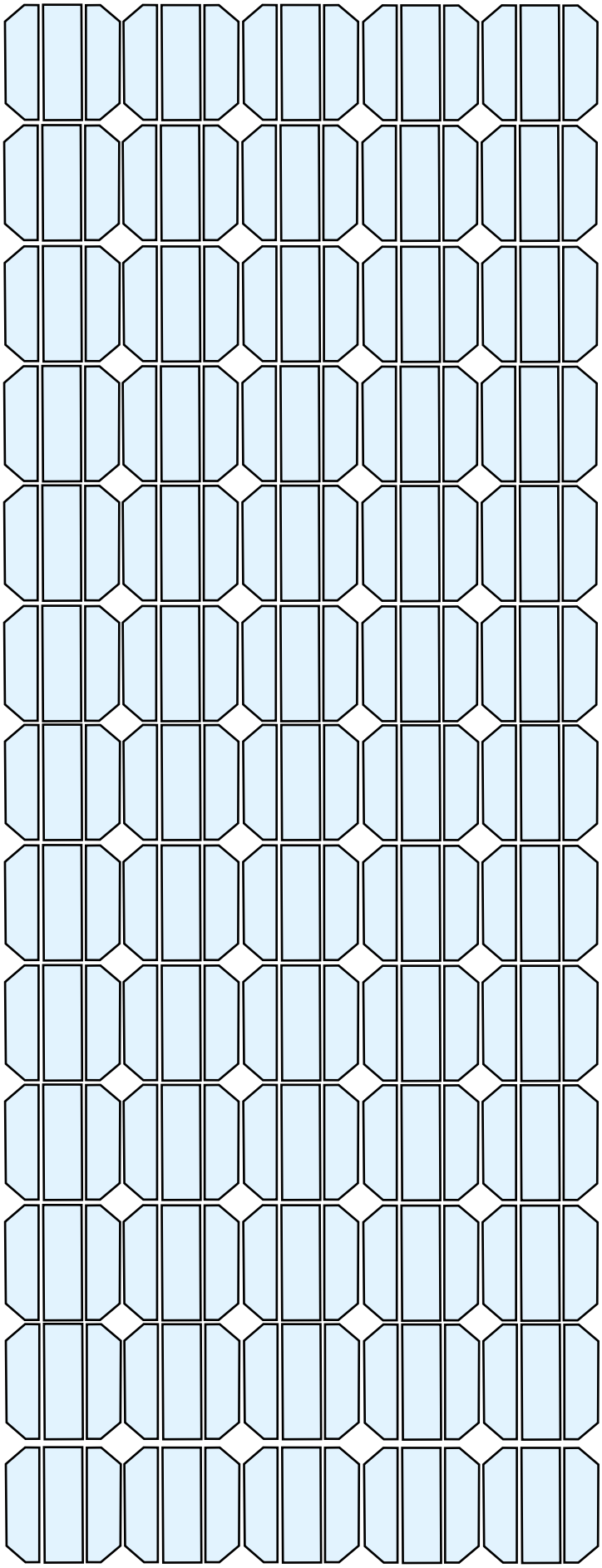


This satellite uses 10 panels that open to make a round(ish)solar array. Why do you think they use this design rather than the longer rectangular panels?

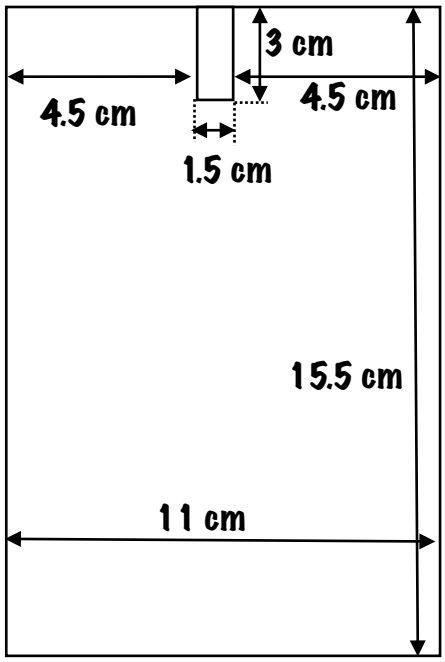
Would be fun to do some research and see if you can make an unfolding array like this!

Like making solar array prototypes? We have another unfolding solar panel activity - using an origami fold to go from small to large!

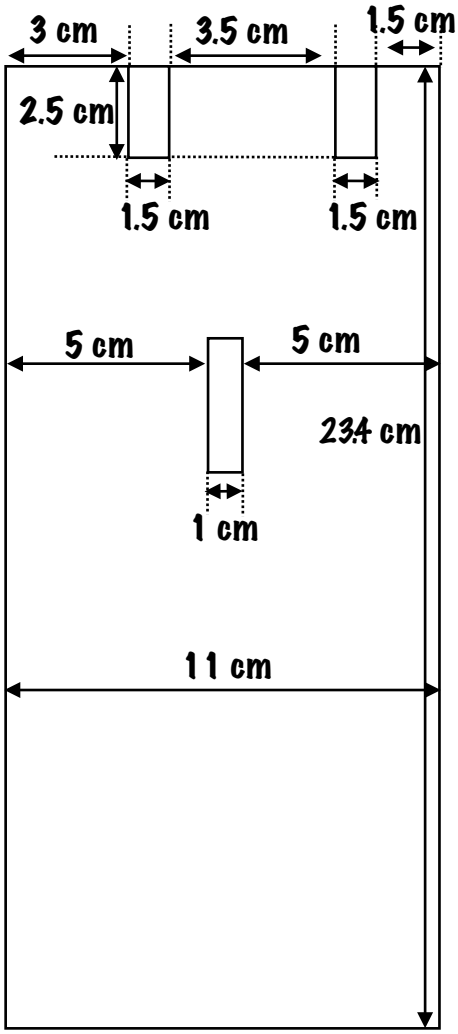


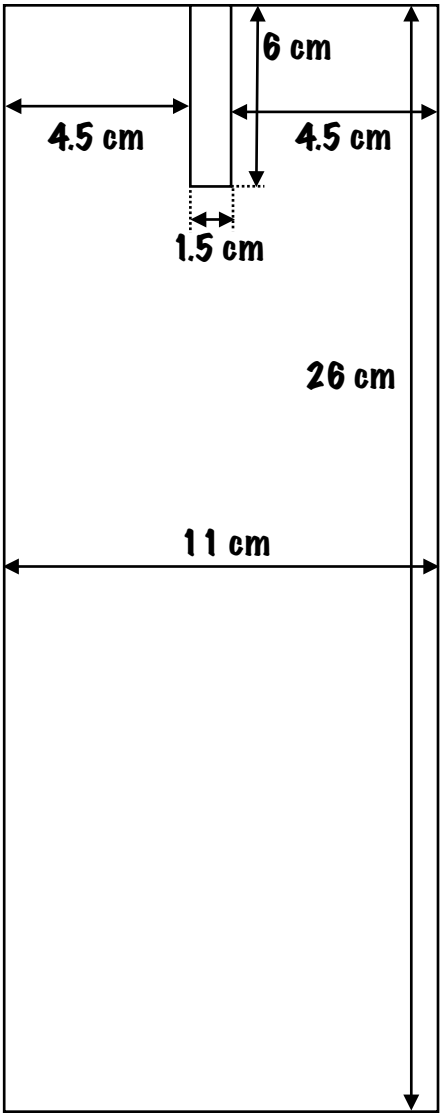



Panel dimensions



The card stock is cut in half lengthways (the 11 cm measurement). You need two 8 1/2 by 11 sheets.





You can also lay the pieces of card stock on the arms and just draw a line where the grooves need to be -that's how we did it!