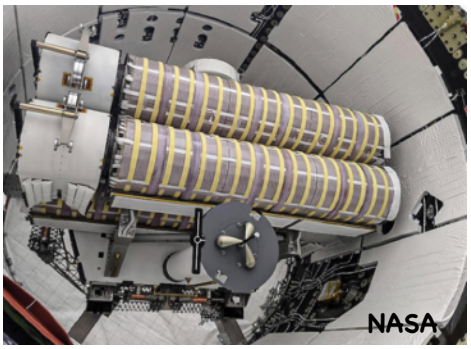
UNFOLD A SOLAR ARRAY
ISS - 1 ROSA STYLE!

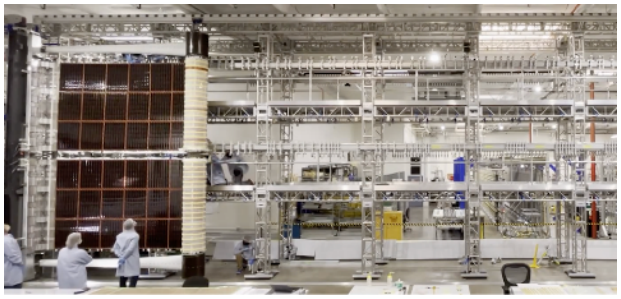
The ISS (International Space Station) uses photovoltaic solar arrays to generate power.

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 (in this case rolled) very tightly and then unrolled once in low-earth orbit (about 400 km - 250 miles). ISS arrays 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.

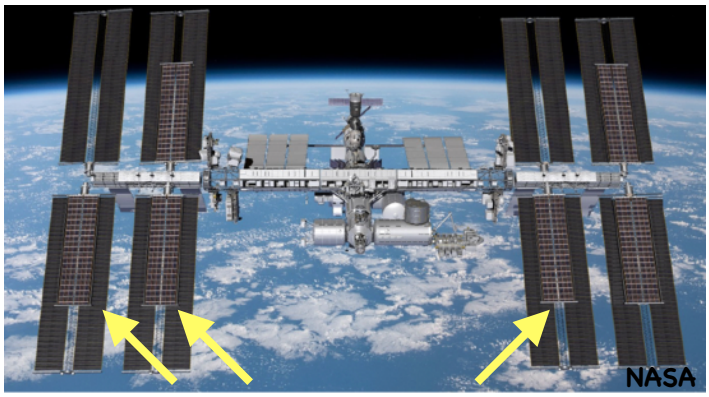
These ROSA (Roll Out Solar Array) panels are being deployed to add to the solar arrays the ISS already has, as the older ones are now less efficient (they've been there for almost 20 years!).



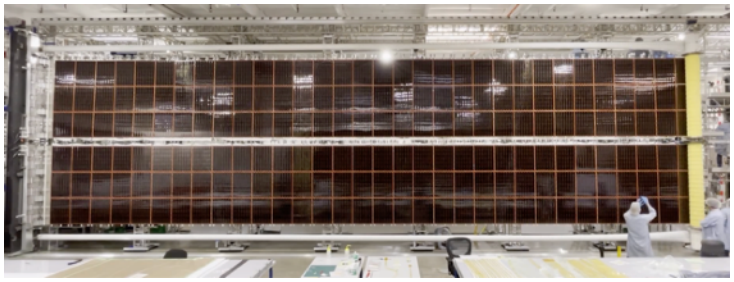
Starts rolled up in the rocket.



Unfolds... to be pretty impressive! This is the experimenting with the unrolling in the lab.



This image (above) shows the new smaller ROSA panels in front of the older ones. They shadow the older larger ones a bit, but still add more energy to the space station.

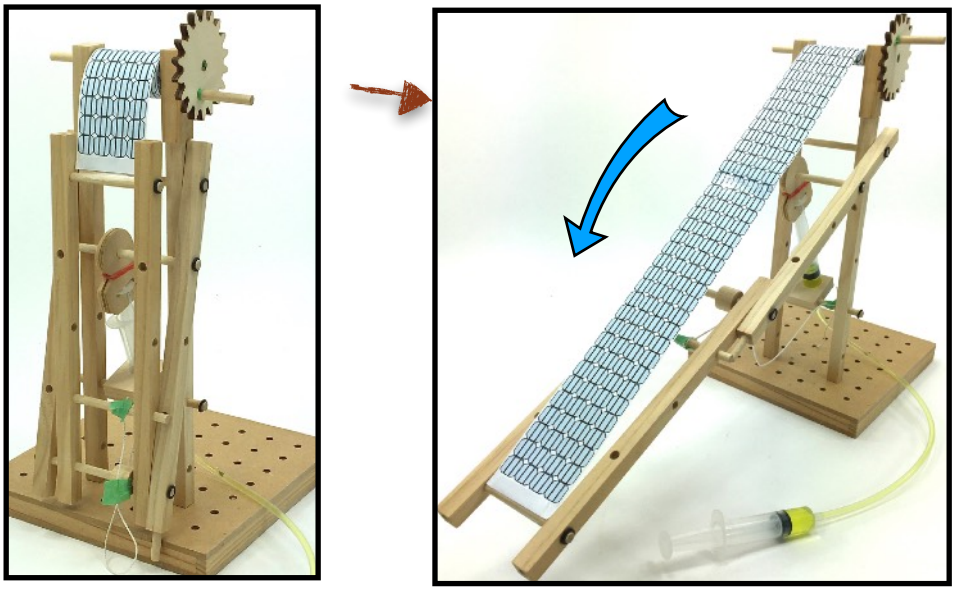


Nice!

This challenge is to make a mechanism that unrolls a solar array (well, a paper array) that is small at first, then rolls out to have a very large surface area.

We won't worry about the space station part - just the array for now.

This design is not exactly like the way they do it on the Space Station, but our budget is smaller, so its OK.

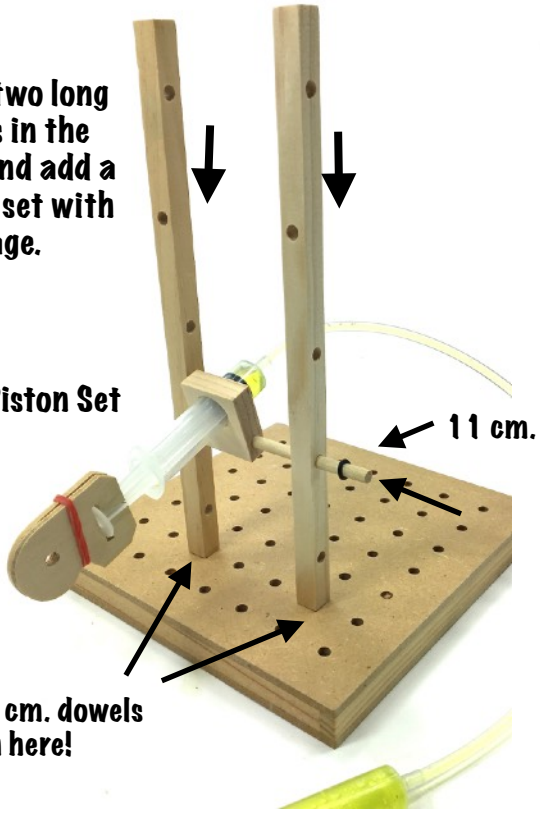


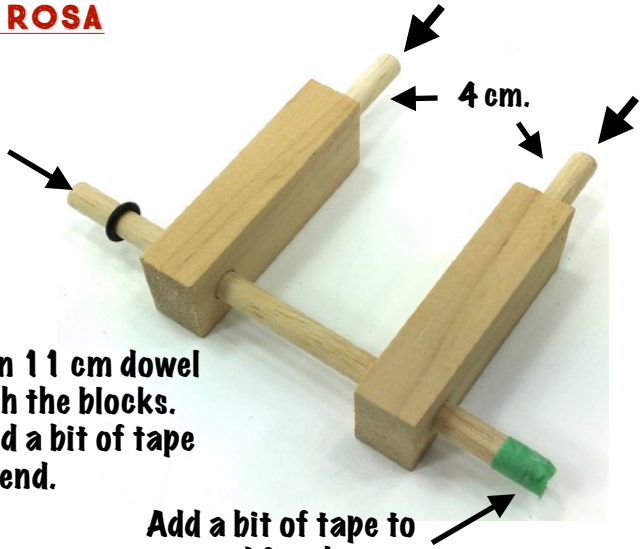
Requirements are that it is small to launch - then expand - a lot!

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

SOLAR ARRAY - ROSA

Place two long dowels in the base and add a piston set with a linkage.

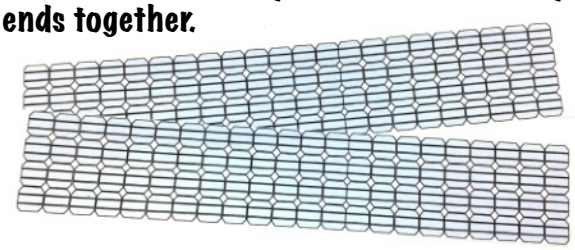




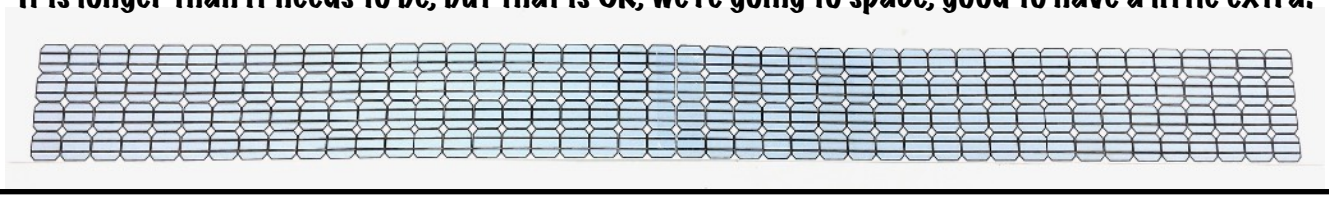
Slide an 11 cm dowel through the blocks. and add a bit of tape to one end.

Add a bit of tape to one end for the gear.

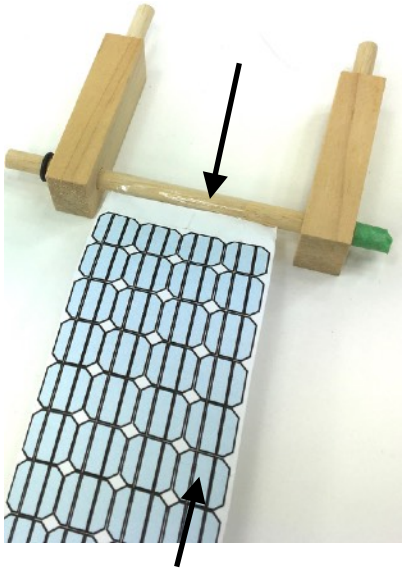
Print and cut the solar panel images and tape the ends together.



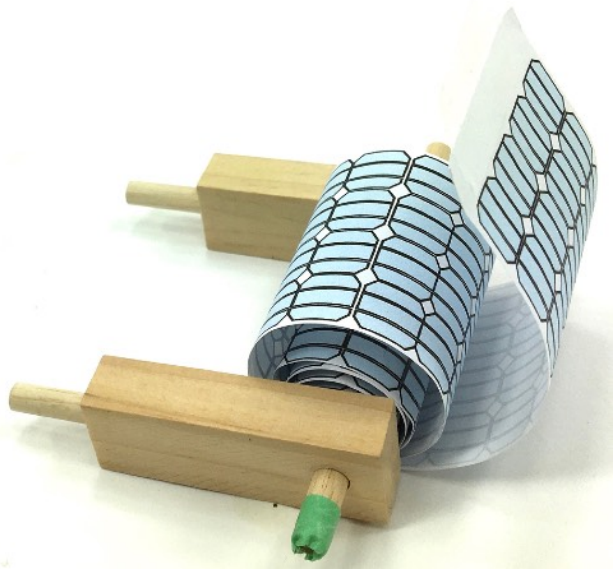
It is longer than it needs to be, but that is OK, we're going to space, good to have a little extra!



Tape the solar array to the dowel and roll it up very tightly around the dowel.



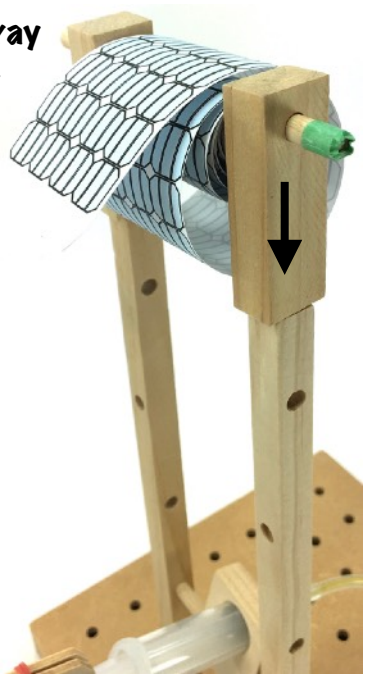
The paper will unroll when you let go - all good.



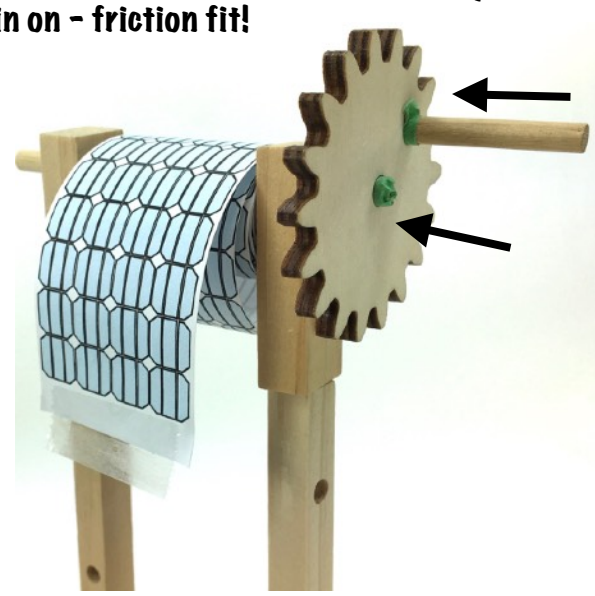
PATHFINDERS

SOLAR ARRAY - ROSA

Place the solar array assembly onto the main structure.



Push a gear over the tape - and add a small dowel as a winder. You will need a bit of tape to hold in on - friction fit!



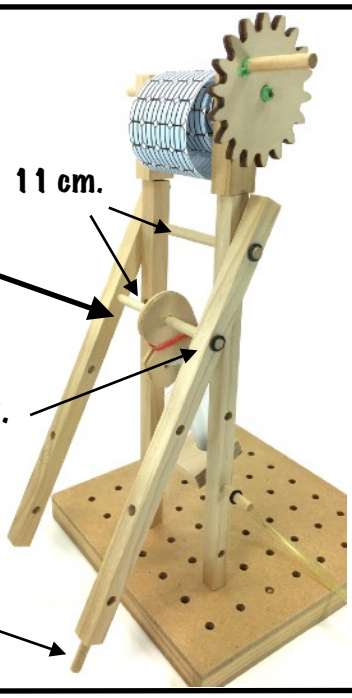
Add Long beams to the outside.

Attach the linkage to a dowel in the second hole.

11 cm.

Use O-rings on the dowels - it has a very small overhang.

Add a bit of tape to hold the 4 cm dowel in the hole.



Add the second arms.

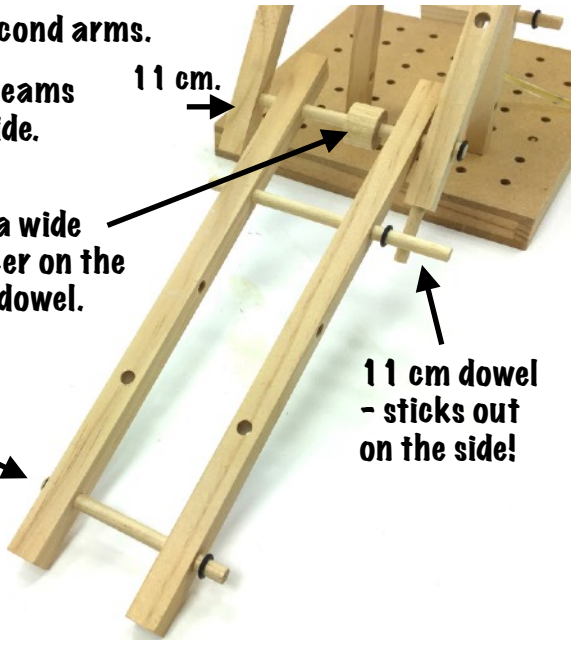
Two long beams on the inside.

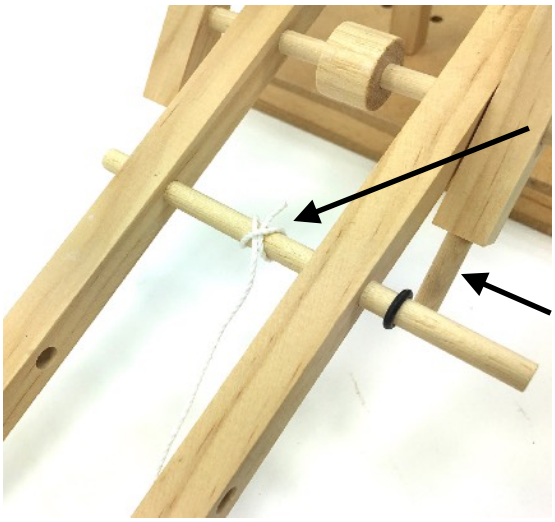
11 cm.

Put a wide spacer on the end dowel.

11 cm dowel - sticks out on the side!

8 cm.

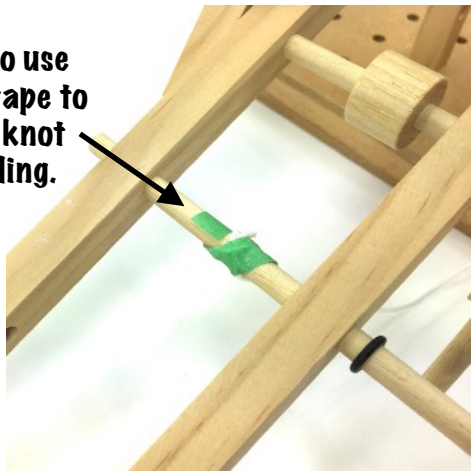




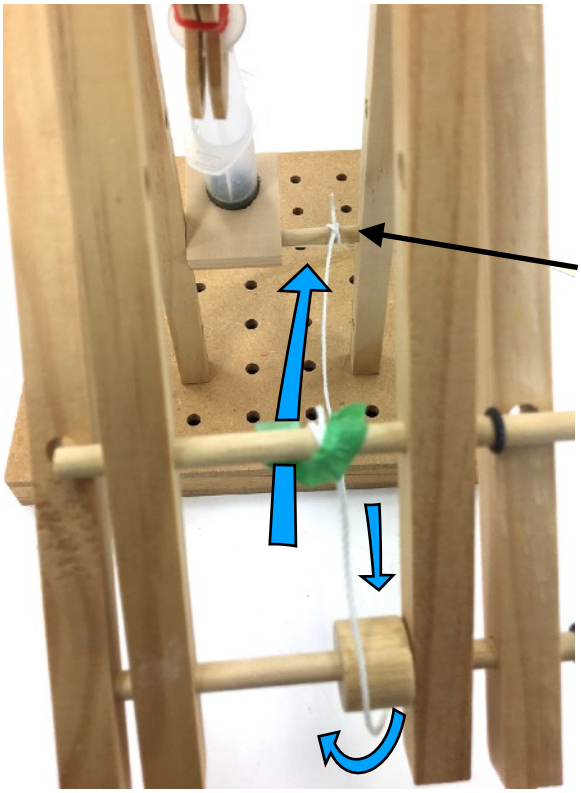
Tie a 40 cm string (or therabouts) to the dowel.

This peg stops the arm from dropping too far when open.

We like to use a bit of tape to stop the knot from sliding.



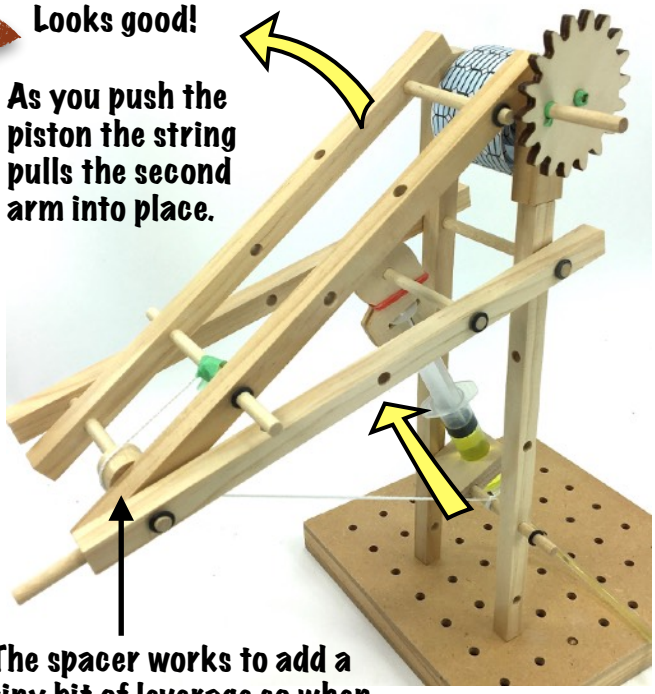
PATHFINDERS



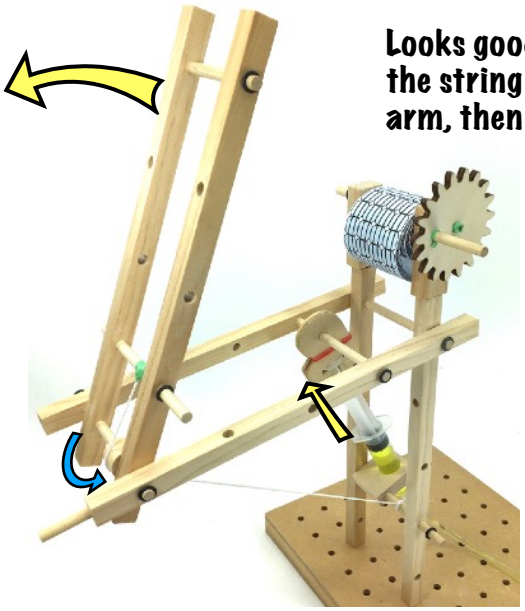
Run the string around the spacer and tie to the dowel on the main structure.

Looks good!

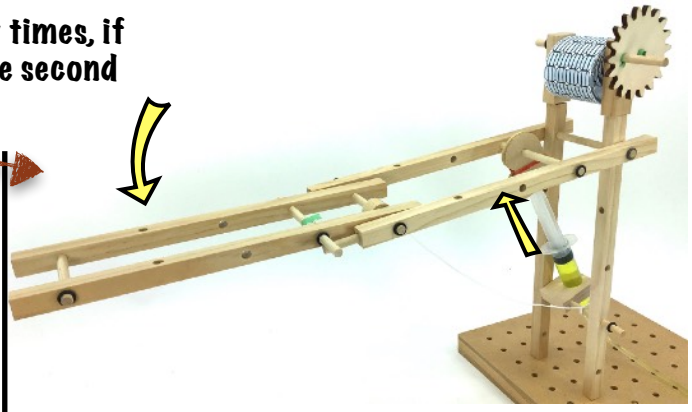
As you push the piston the string pulls the second arm into place.



The spacer works to add a tiny bit of leverage so when the swing arm moves up the second arm swings out.



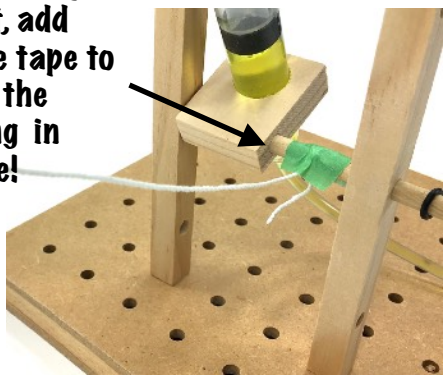
Looks good - open it up a few times, if the string is not pulling on the second arm, then tighten the string!



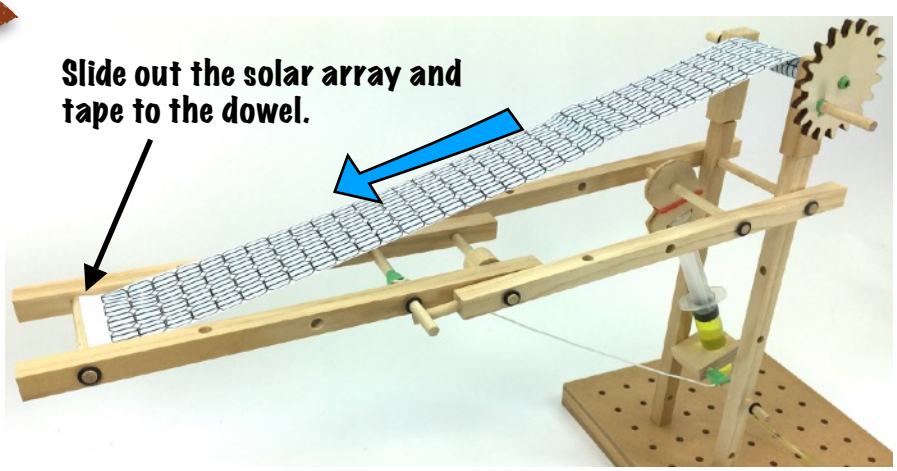
It does tend to flop a bit. In space there is no gravity so this would not happen!

No gravity - if you drop something - no problem - awesome!

Once it is just right, add some tape to hold the string in place!

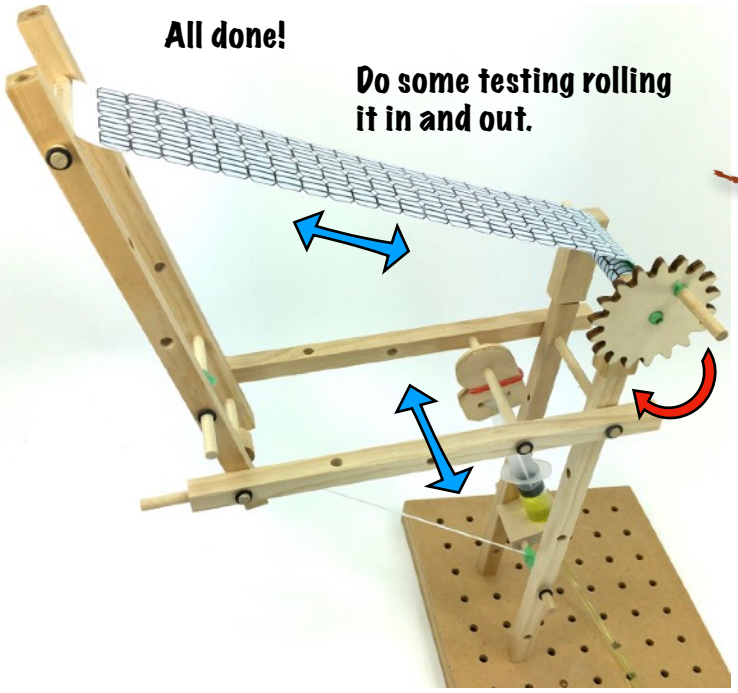


Slide out the solar array and tape to the dowel.



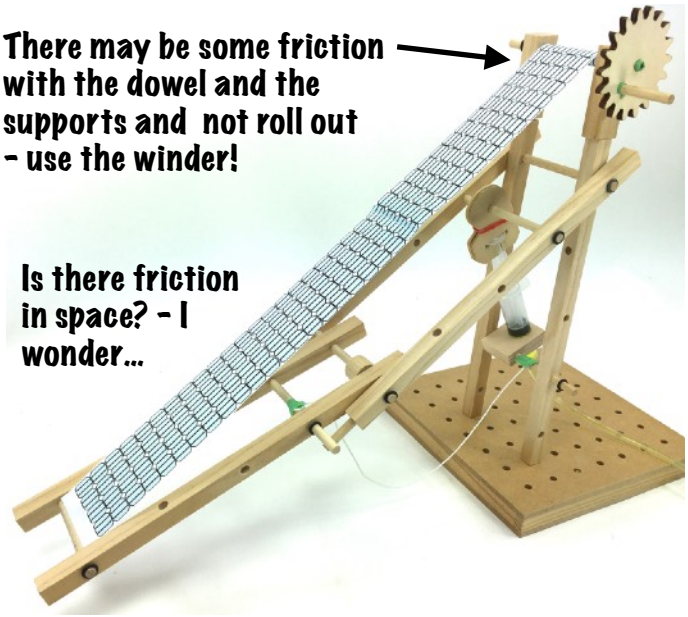
All done!

Do some testing rolling it in and out.



There may be some friction with the dowel and the supports and not roll out - use the winder!

Is there friction in space? - I wonder...



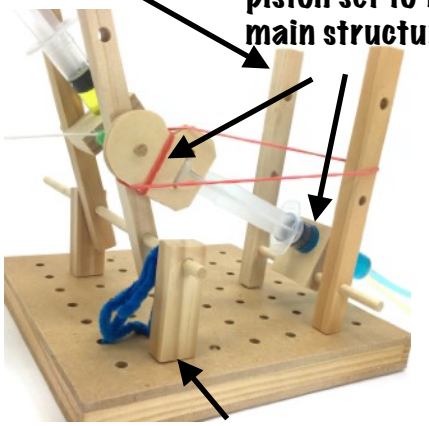
Super cool - your first step to becoming a space engineer (or is it rocket surgeon?).

EXTEND YOUR DESIGN!

All wound up and ready for launch!

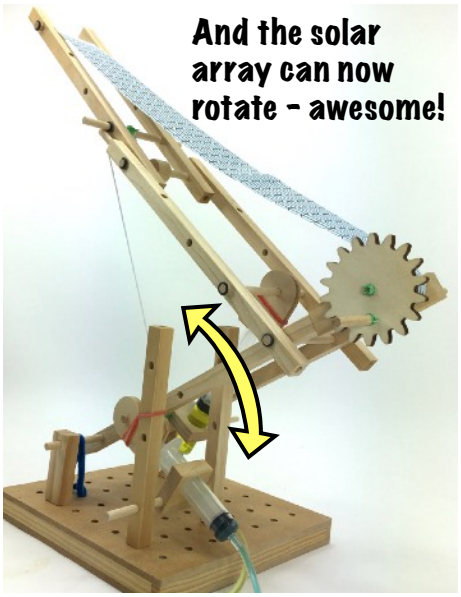
We added some small beams...

... attached a piston set to the main structure...

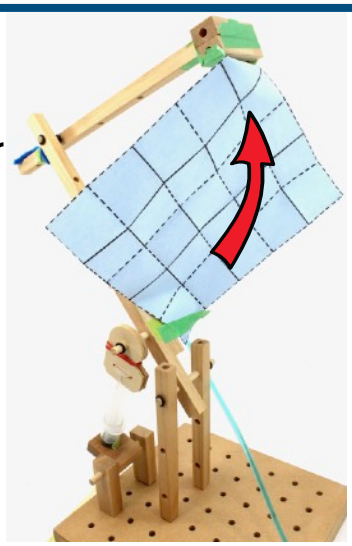


... and some small blocks to hold the main structure off the base.

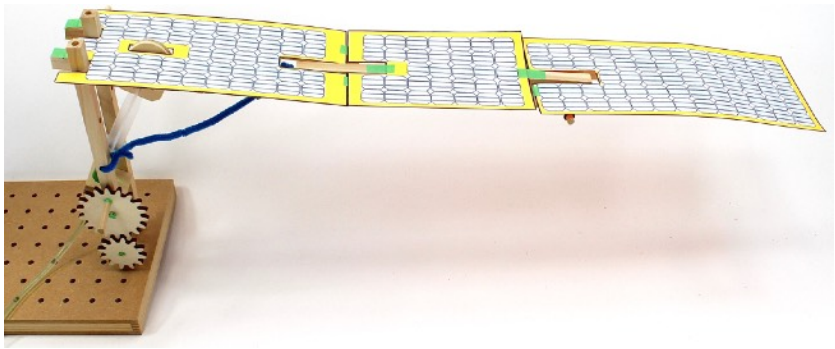
And the solar array can now rotate - awesome!



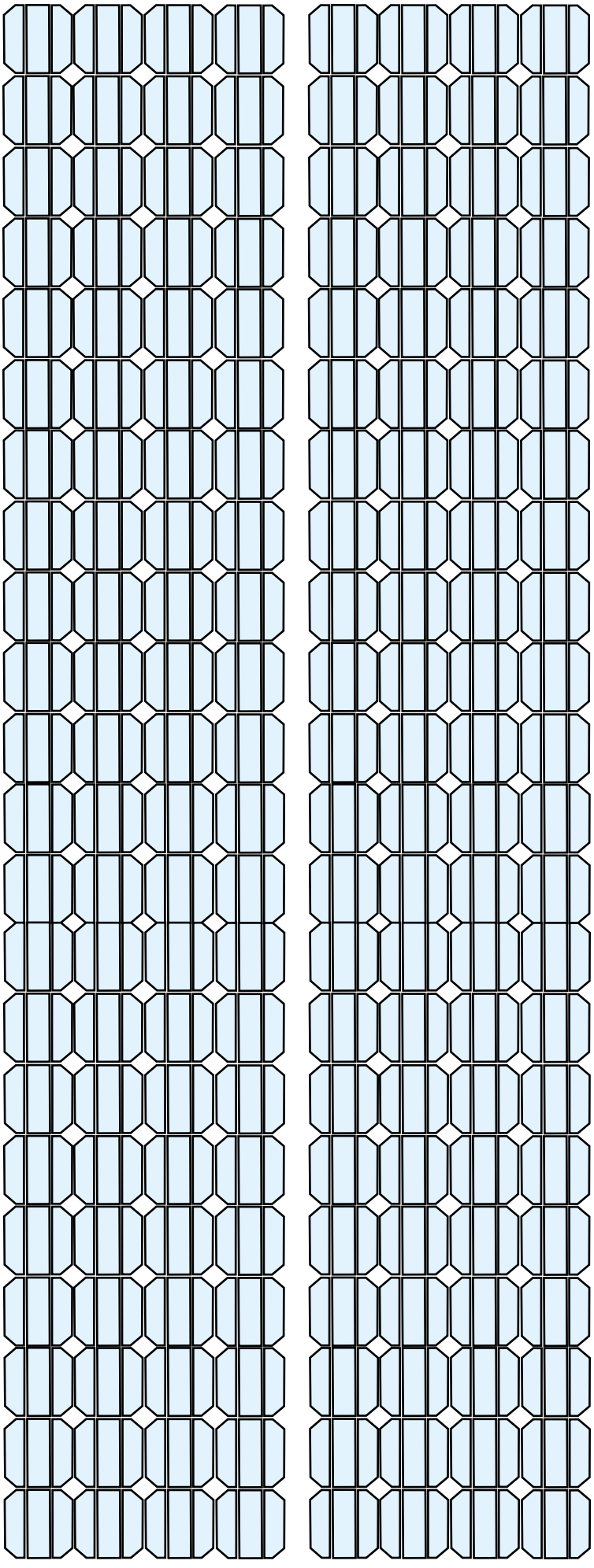
Like making solar array prototypes? We have another unfolding solar array activity - using an origami fold to go from small to large!



This is another solar array from the ISS - unfolded in a different way! Check out our website for instructions (below).



pathfindersdesign.com - Maker Set instruction manuals.



SOLAR ARRAY TEMPLATE

Instructions:

Cut and tape together, then tape to your mechanism.
(what, you wanted more?).

Some solar array questions next time you talk to someone from NASA.

How long do solar arrays last in space?

Is the power AC or DC? (also ask if they like that band).

What are the most common problems with solar arrays?

How are they different from the solar panels that we have on Earth?

How much energy does one of these ROSA arrays on the ISS provide? Will it power a dishwasher? (and do they have a dishwasher on the ISS?)

What do they do with them when they don't work anymore.

PATHFINDERS