

Our project for the 2018 edition of CoderdojoBelgium's Coolest Projects was this

Lego Boost-powered Skittle sorter

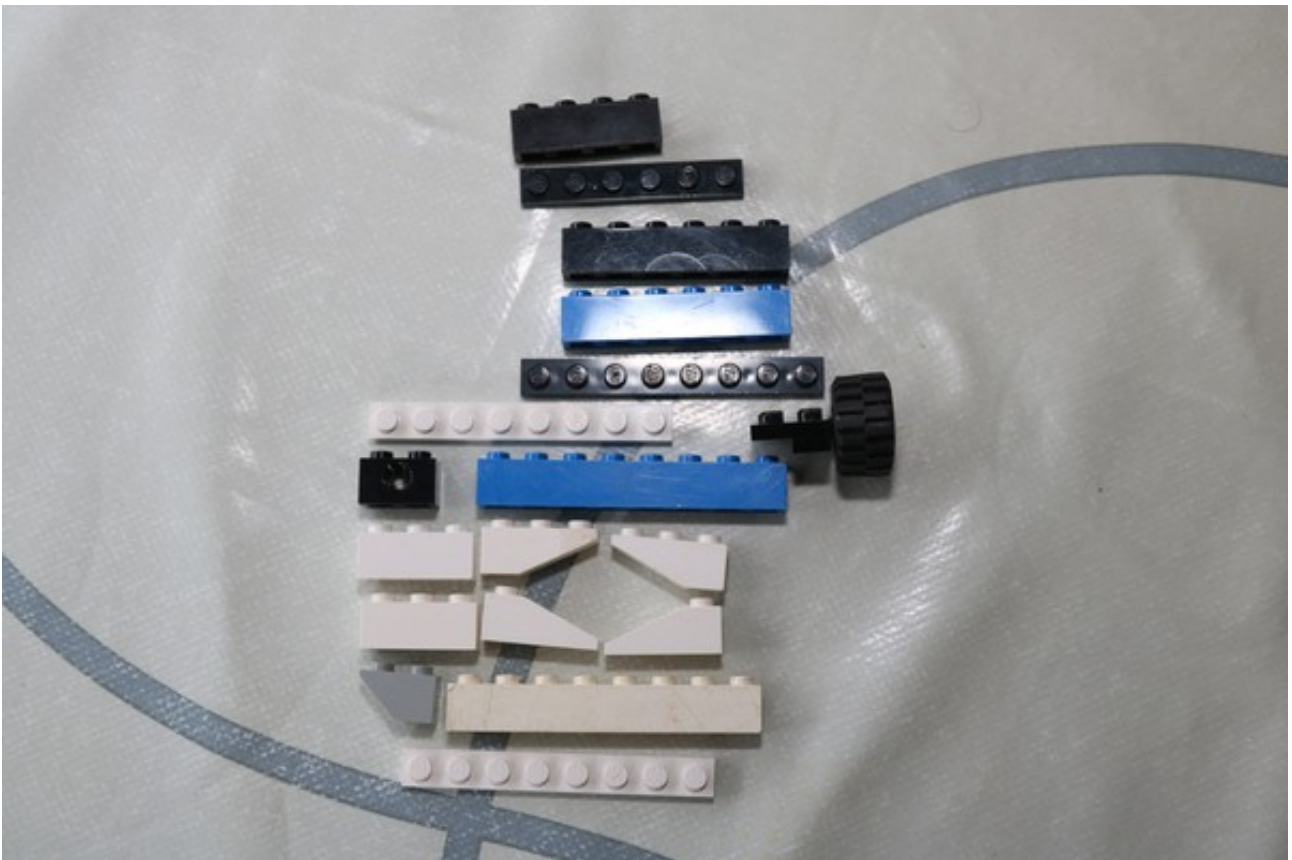
Inspired by an Arduino-based sorter (<https://howtomechatronics.com/projects/arduino-color-sorter-project/>), we decided to try and build this with Lego. It took several iterations and a lot of trial-and-error, but we succeeded in building a working four-color Skittle sorter in the end. Apart from the Lego Boost motor brick, all parts came from our collection of spare Lego parts. There is no record of which sets those belonged to.

We documented the dismantling of the sorter, and we'll use these pictures to provide you with building instructions.

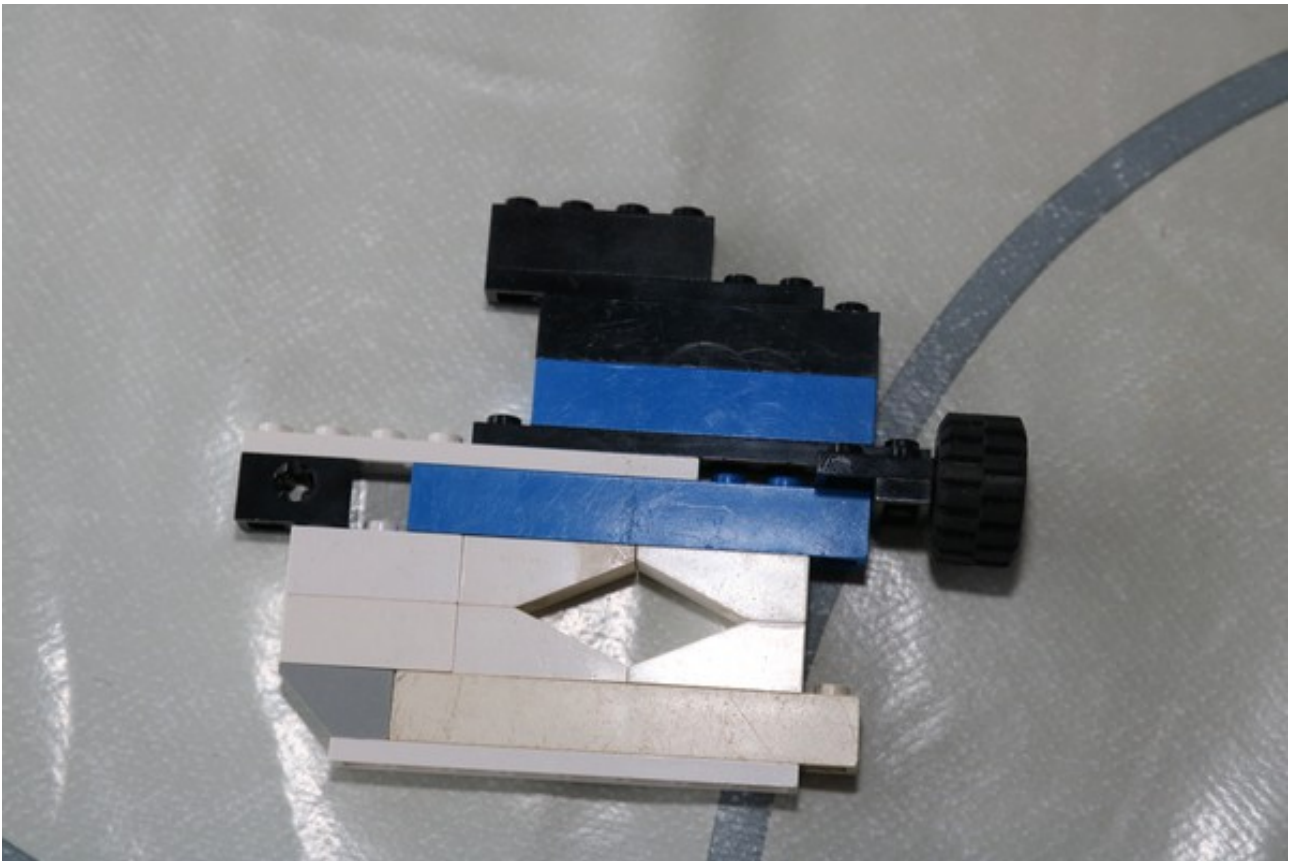
The first thing we'll build is the transport plate. Like a lot of the project, it's built sideways. You'll see later that only a small part of the sorter is “studs-up”.

Step 1:

Get the following parts. The slopes should be white, the other parts can probably be any color. The hole in the small Technic block is not a regular hole, rather one that doesn't allow the axle to turn (as seen here <https://www.bricklink.com/v2/catalog/catalogitem.page?P=32064#T=C>). That will be crucial later.

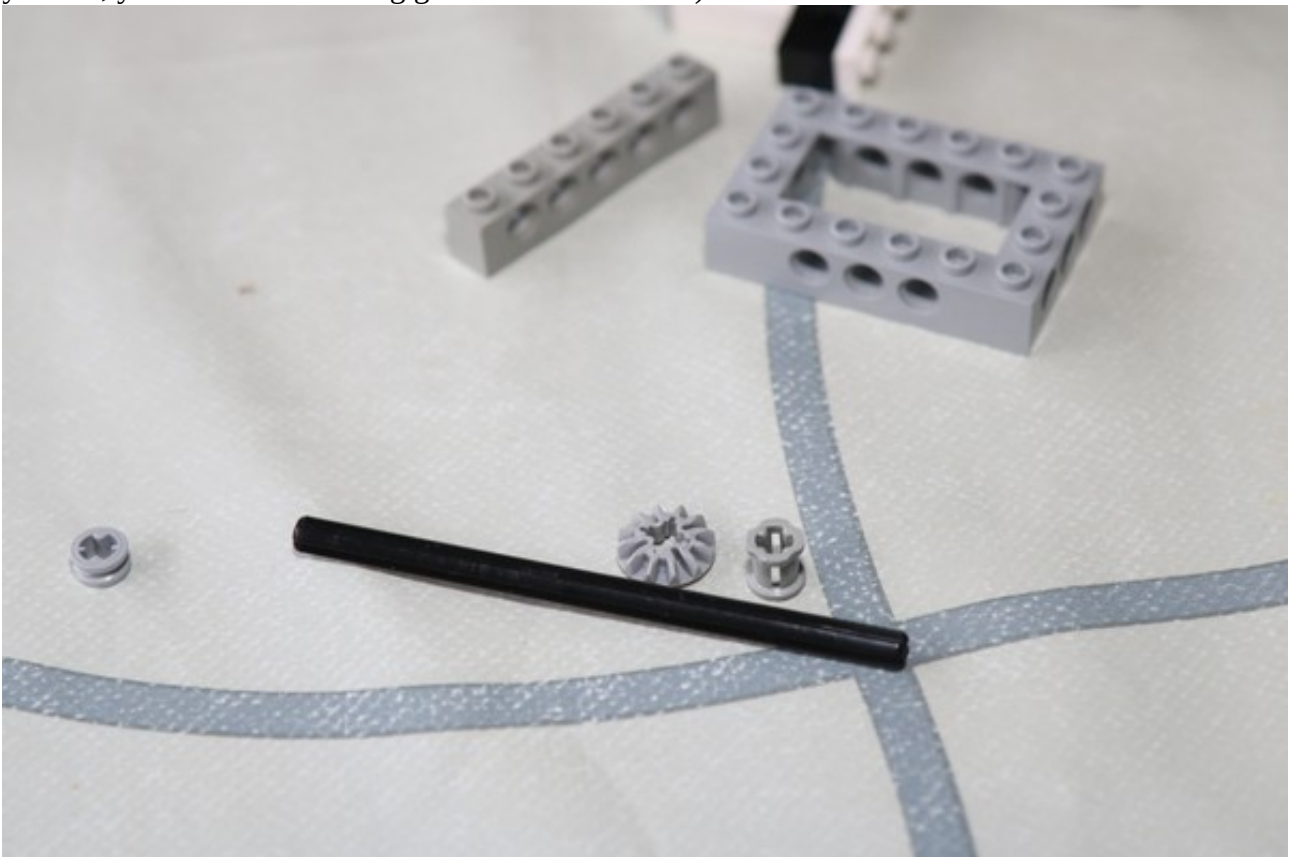


Assemble the parts like this. This plate will be swinging back and forth to transport candy from the supply to the color sensor, to the sorting ramp, and then back to its starting position to pick up the next piece of candy.

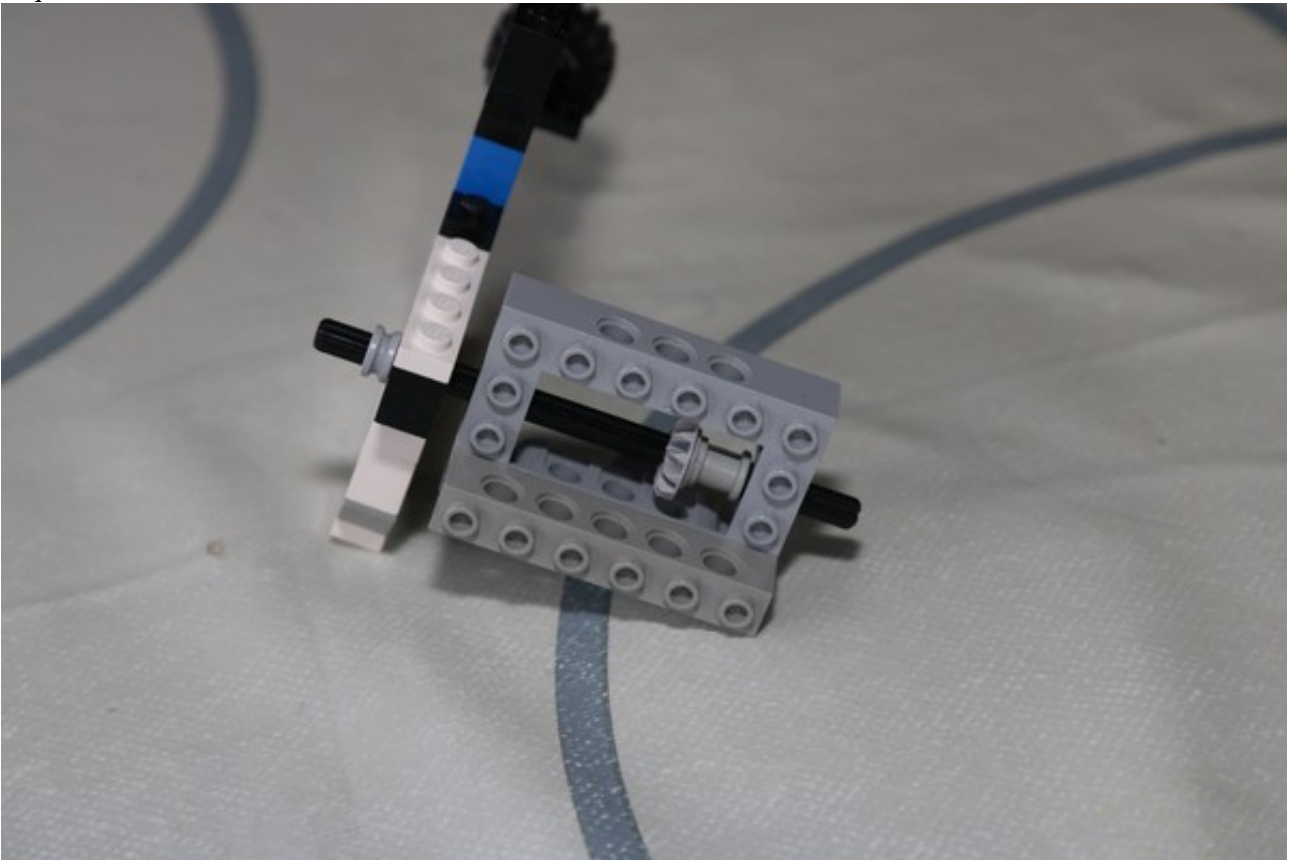


Step 2:

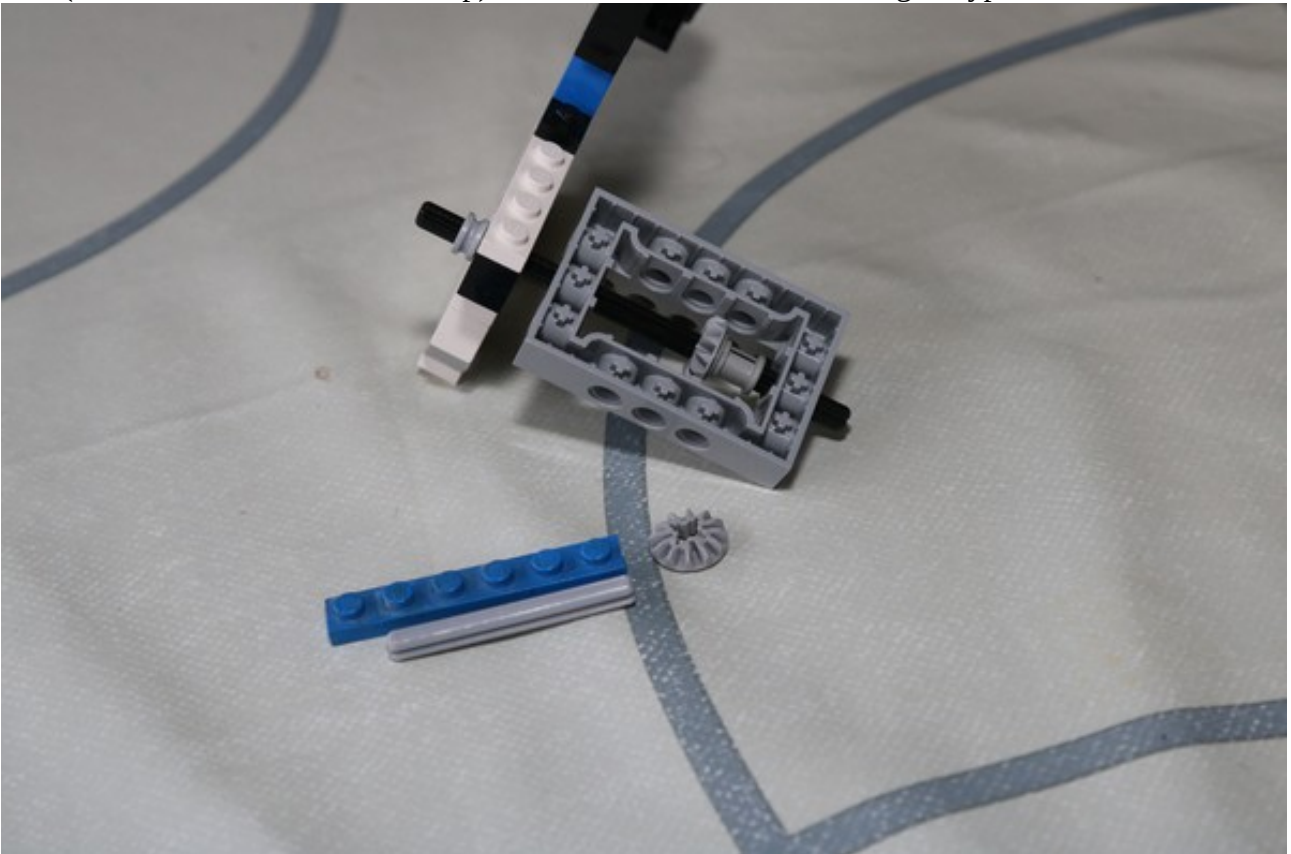
Get the following parts (N.B. the bevel gear pictured is a 12-tooth version. This part was introduced in 1995. An earlier 14-tooth version as introduced in 1980 would work just fine. Whatever version you use, you'll need a matching gear later in the build.)



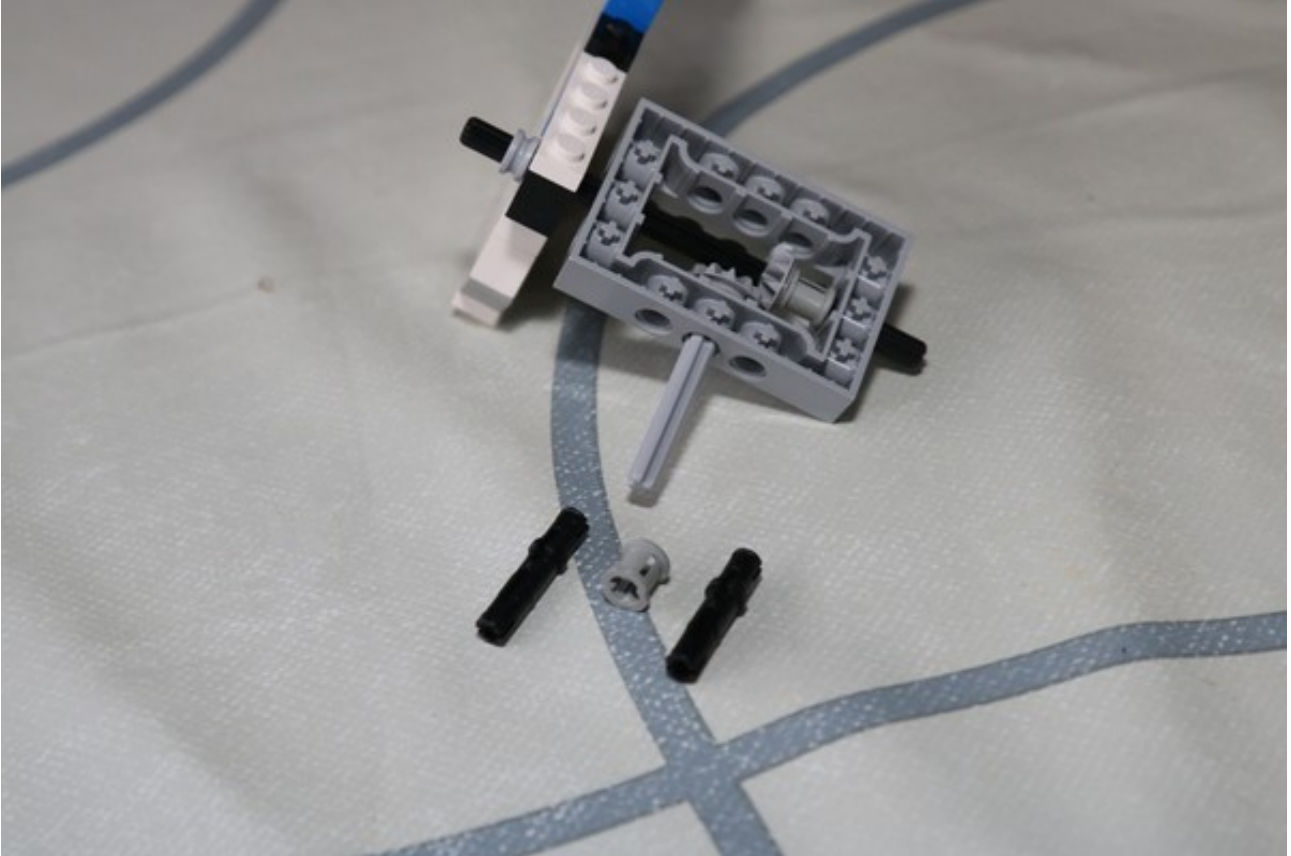
Next, join both pieces together. Push the axle through the special non-rotating-hole-brick you used in step 1, then add a half-width spacer. We used a version without teeth, but this is not a requirement.



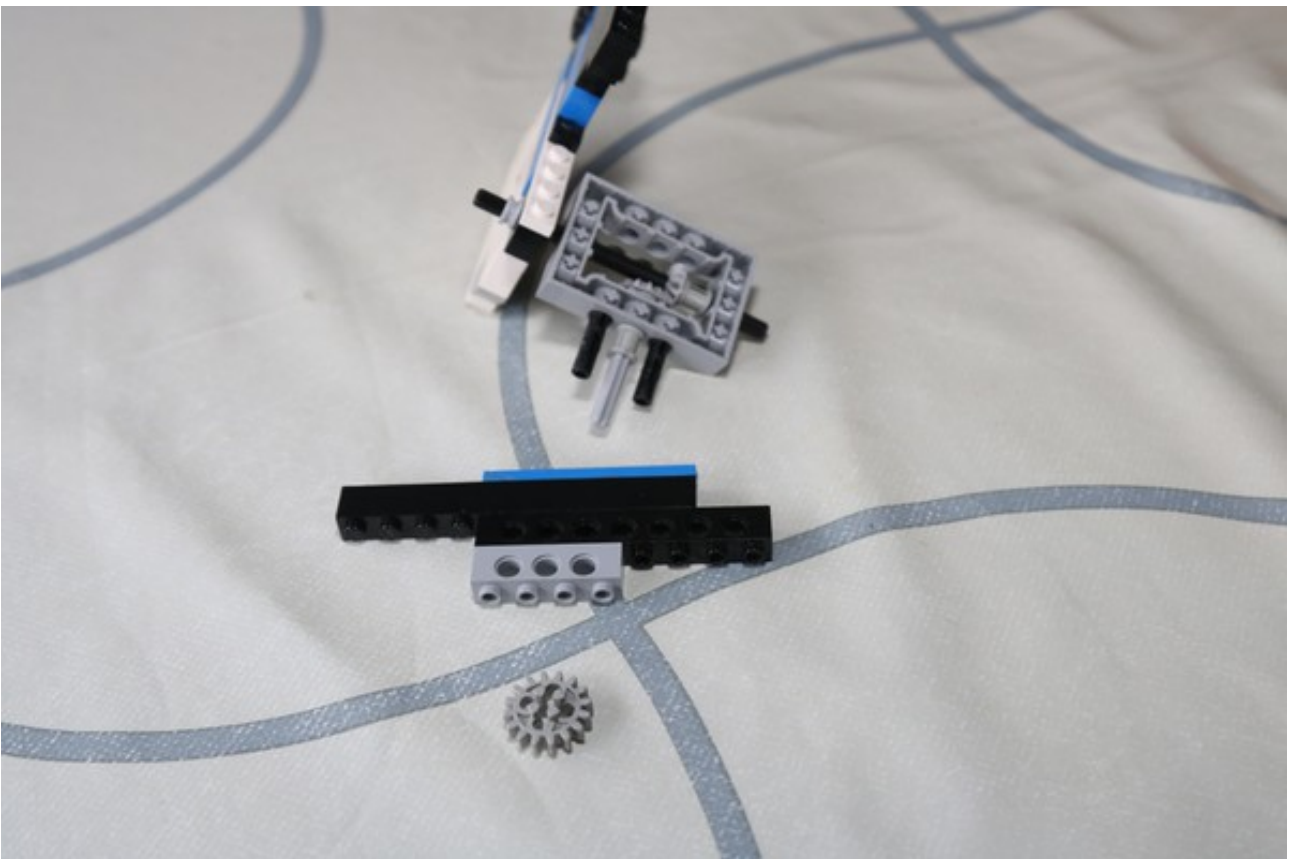
Step 3: get an axle and another bevel gear. The blue piece is there as a reference for the length of the axle (but will be used in the next step). Remember to match the bevel gear type to the earlier one.



Assemble the parts, and get the following parts:

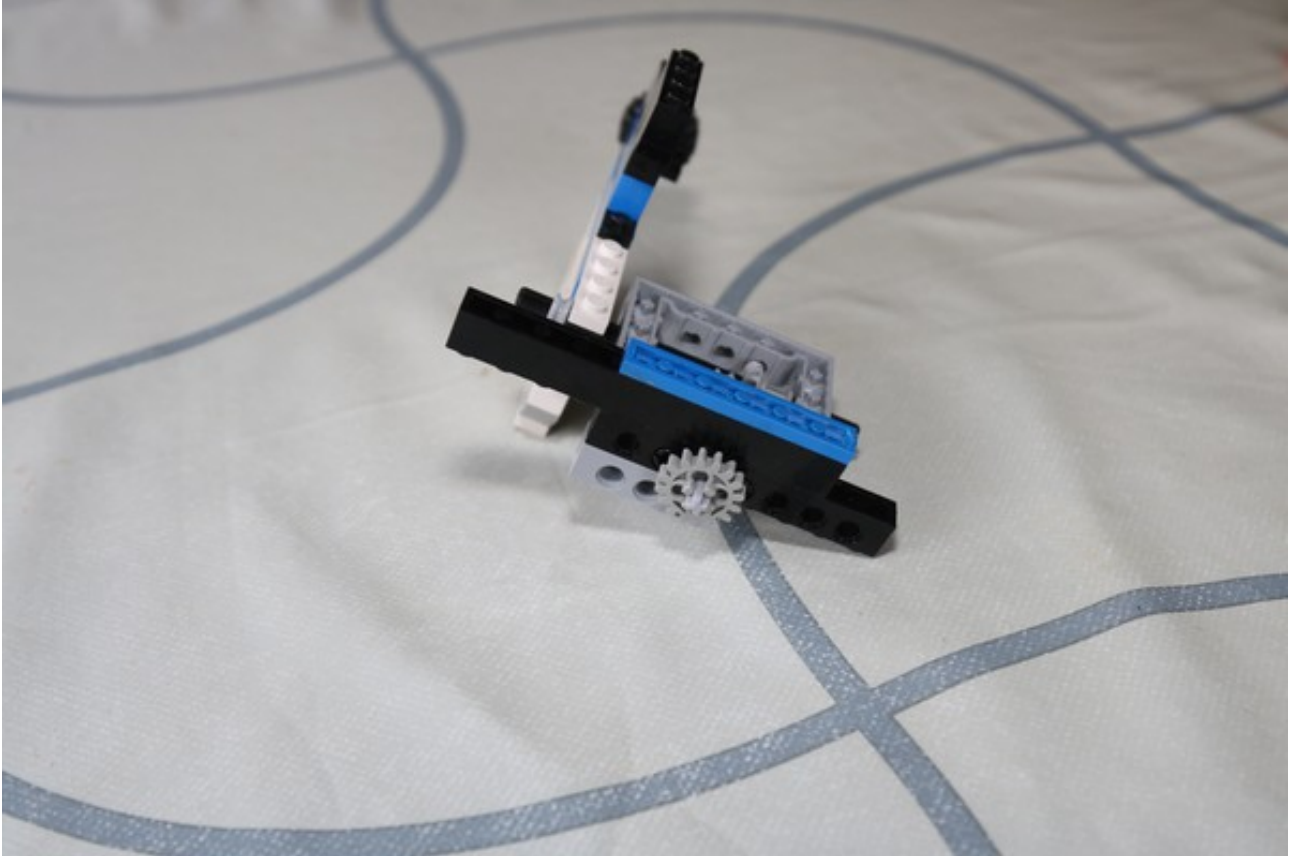


The spacer goes onto the grey axle, and the length 3 pins go on either side. Assemble the next 4 blocks and get a 16 tooth gear.



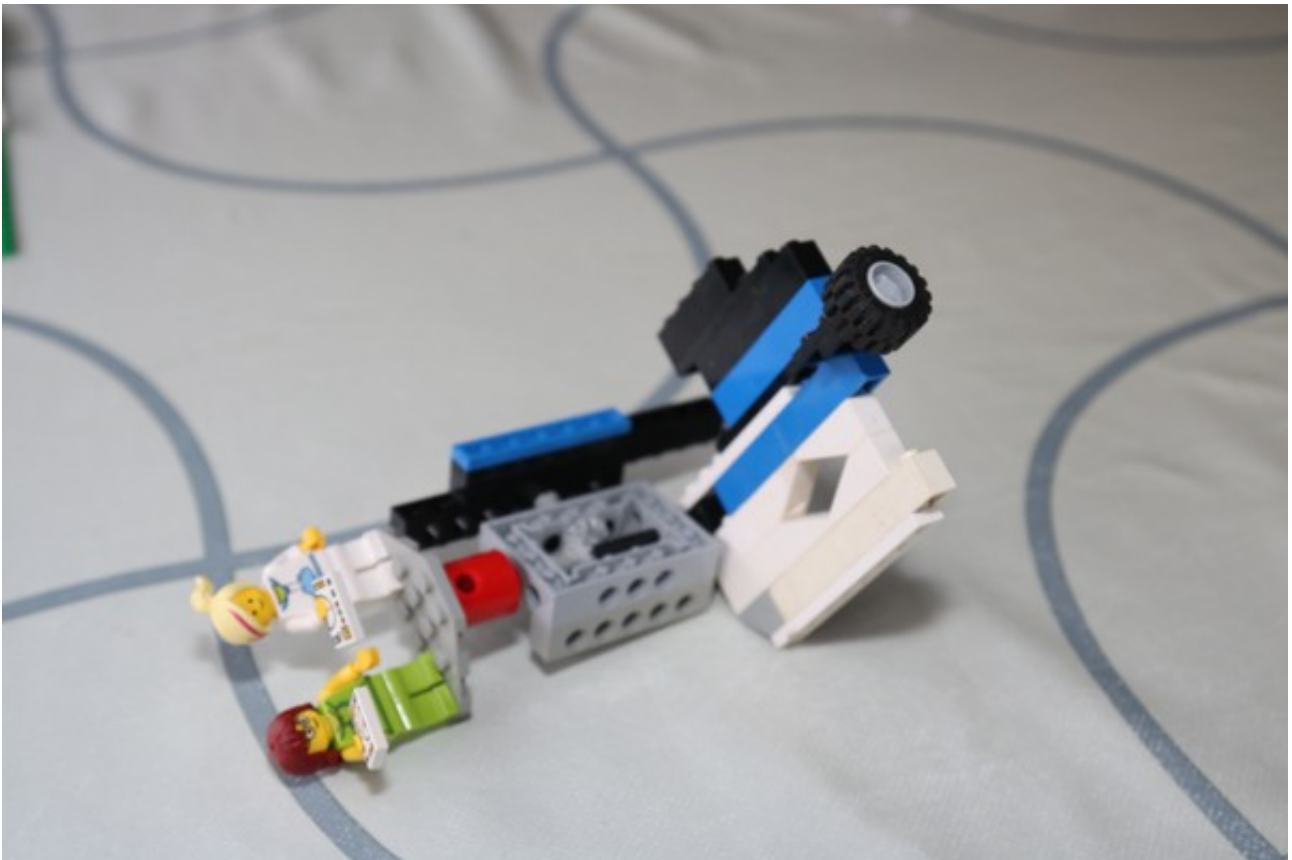
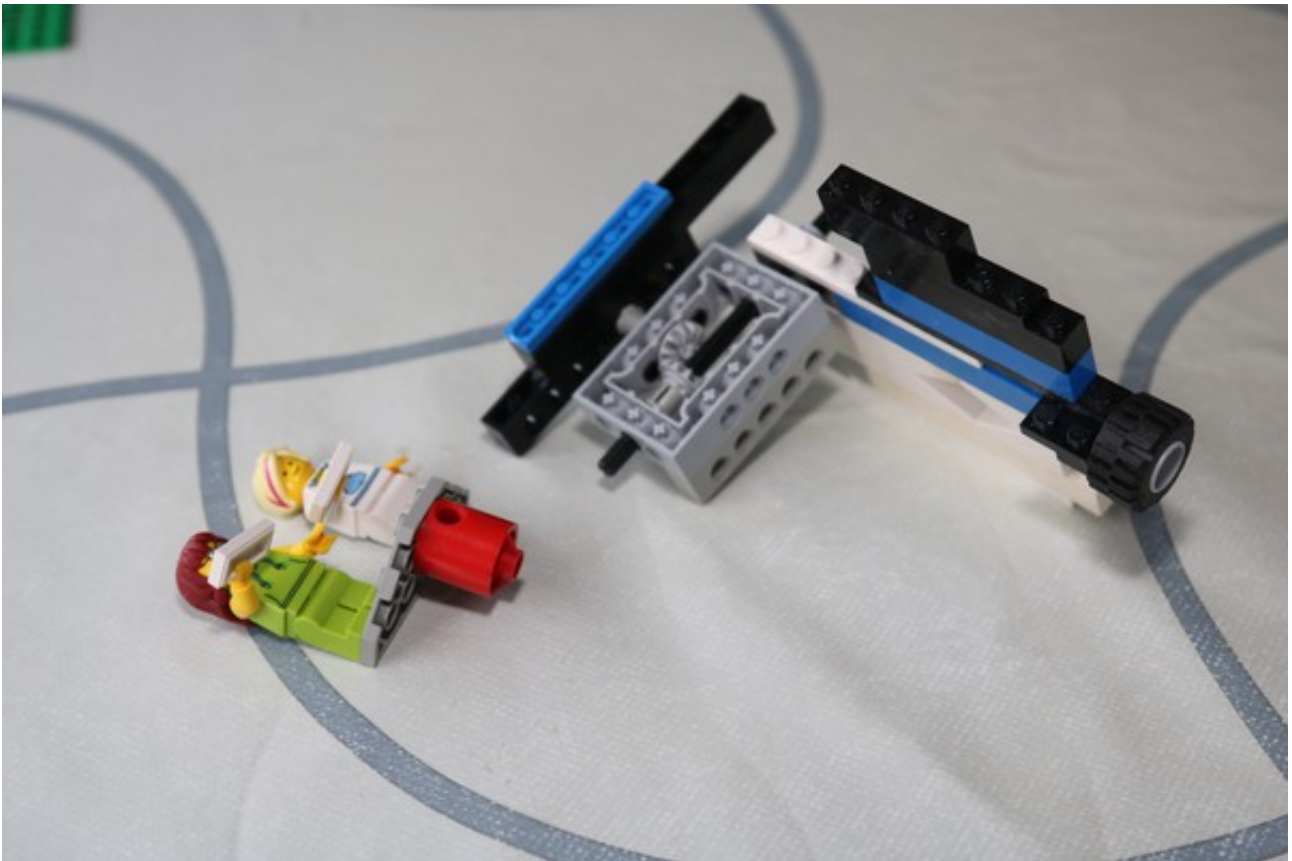
Join the new part on the previous one. The new part sits at spacer distance from the old part. Slide

the gear onto the grey axle where it protrudes from the new part.

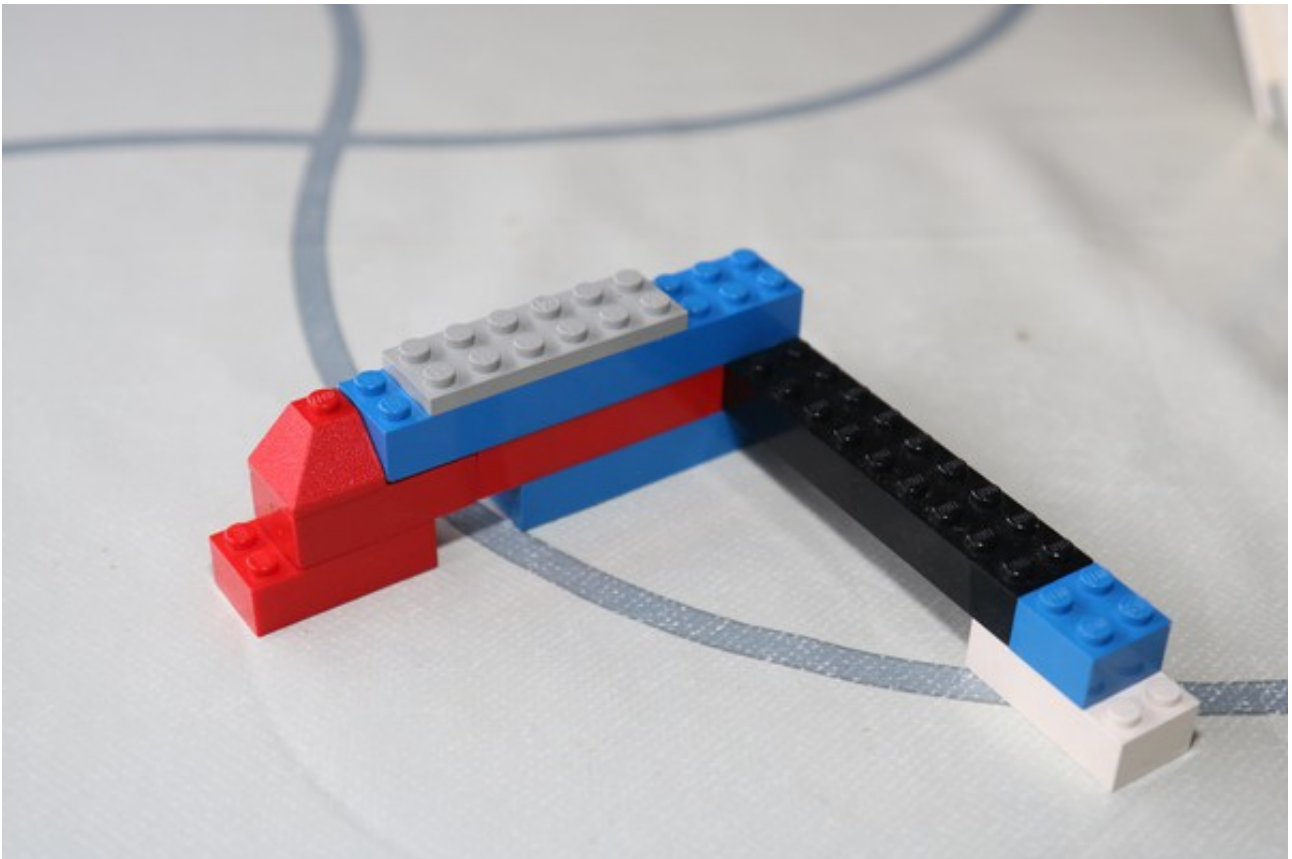


Step 4 is optional, as it was purely decorative. I created two minifigs that look a bit like my children, gave them a tablet in their hands (a decorated 1x2 tile with buttons and dials). I mounted them on a small plate attached on top of the long black axle so they turn back and forth as the sorter is working.

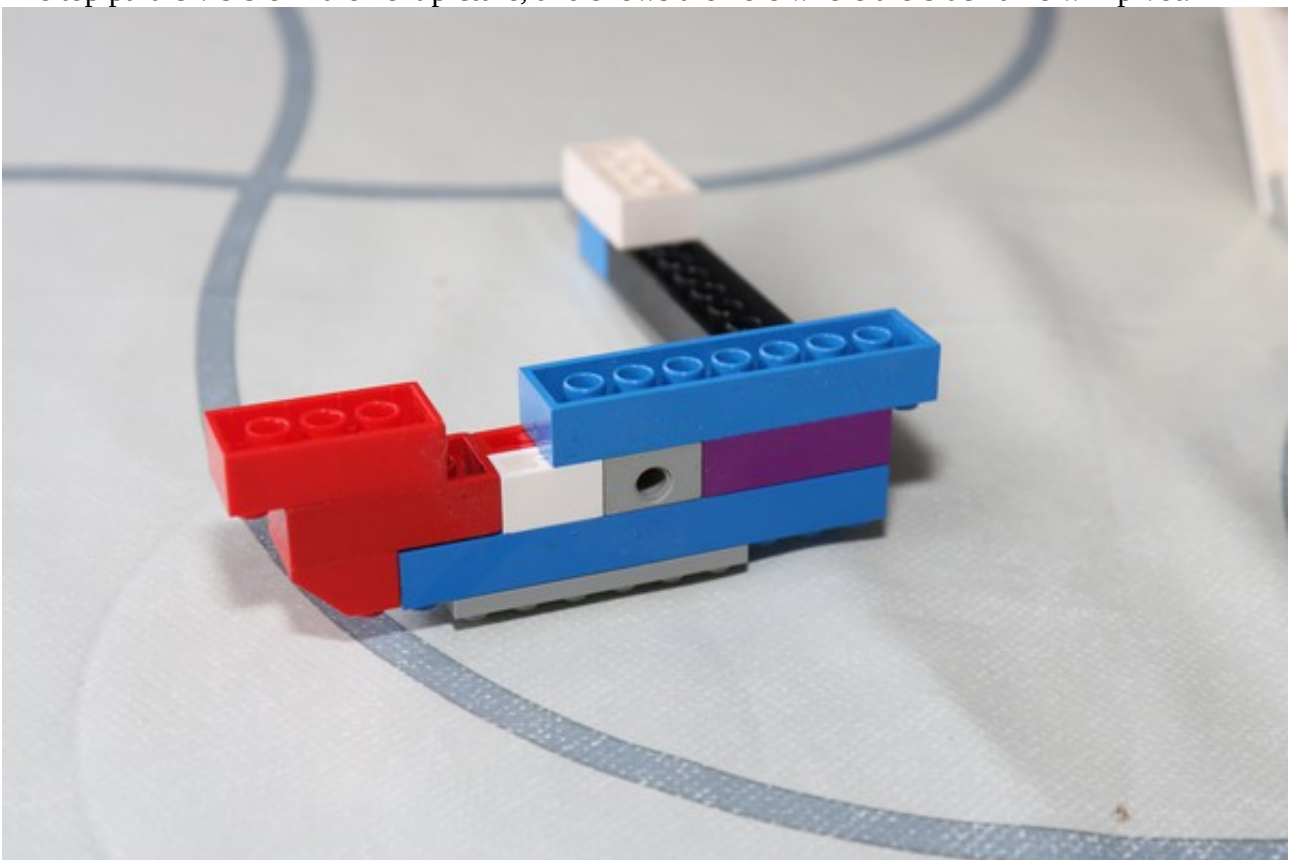




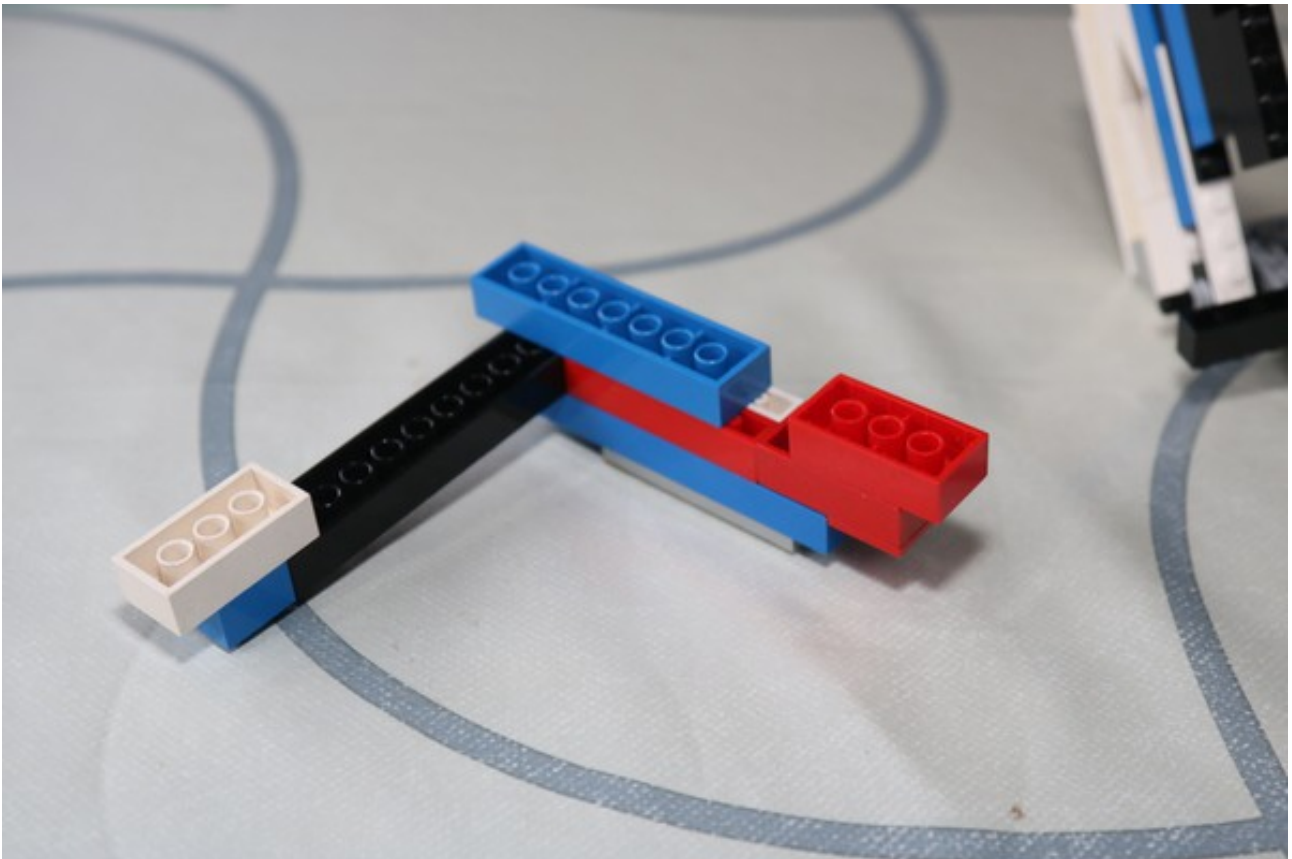
Step 5: with assorted (and mostly regular) bricks, we're building the structure that will hold the mechanism up and provide the floor for the Skittles mover. The black block pictured will be one of the legs on which the structure stands.



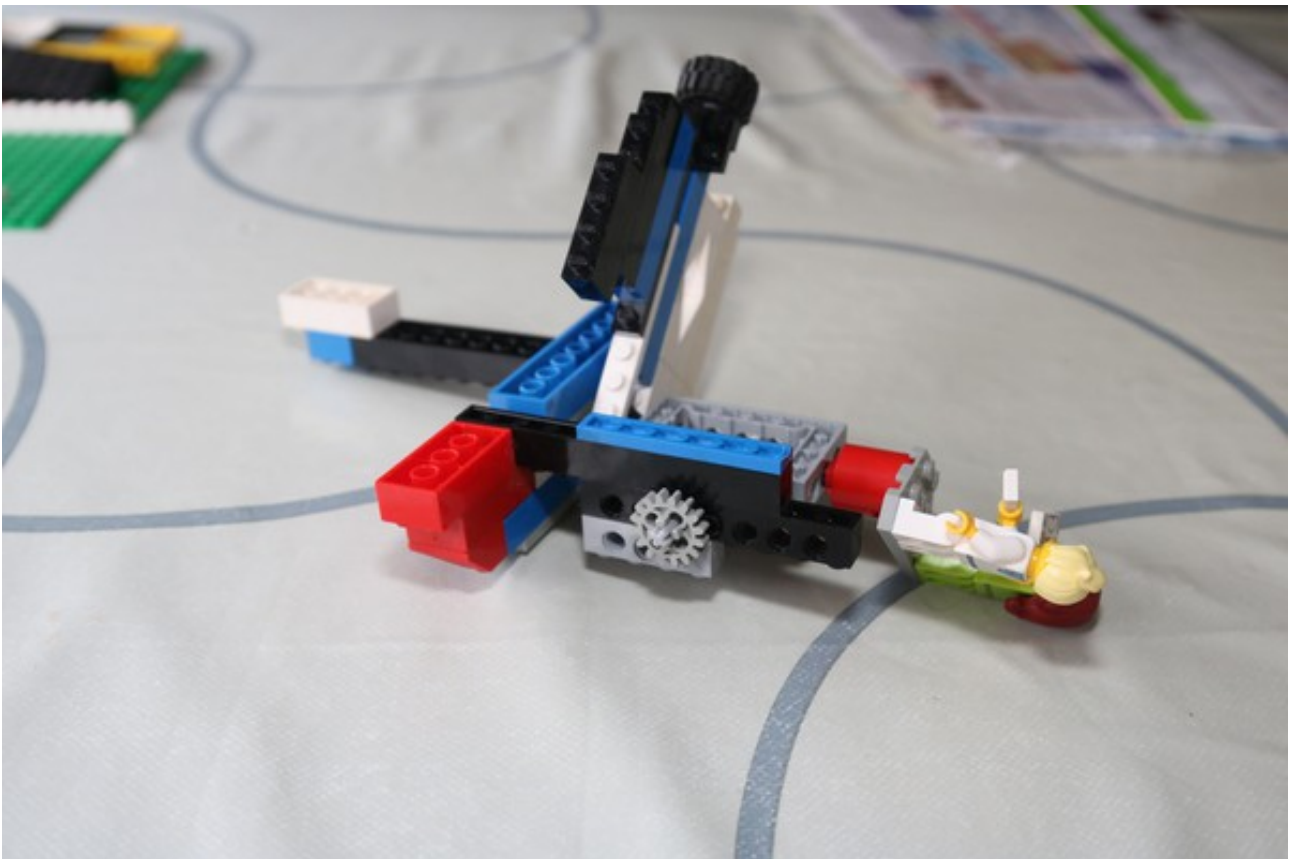
The top part is visible in the next picture, and shows the hole where the black axle will pivot.



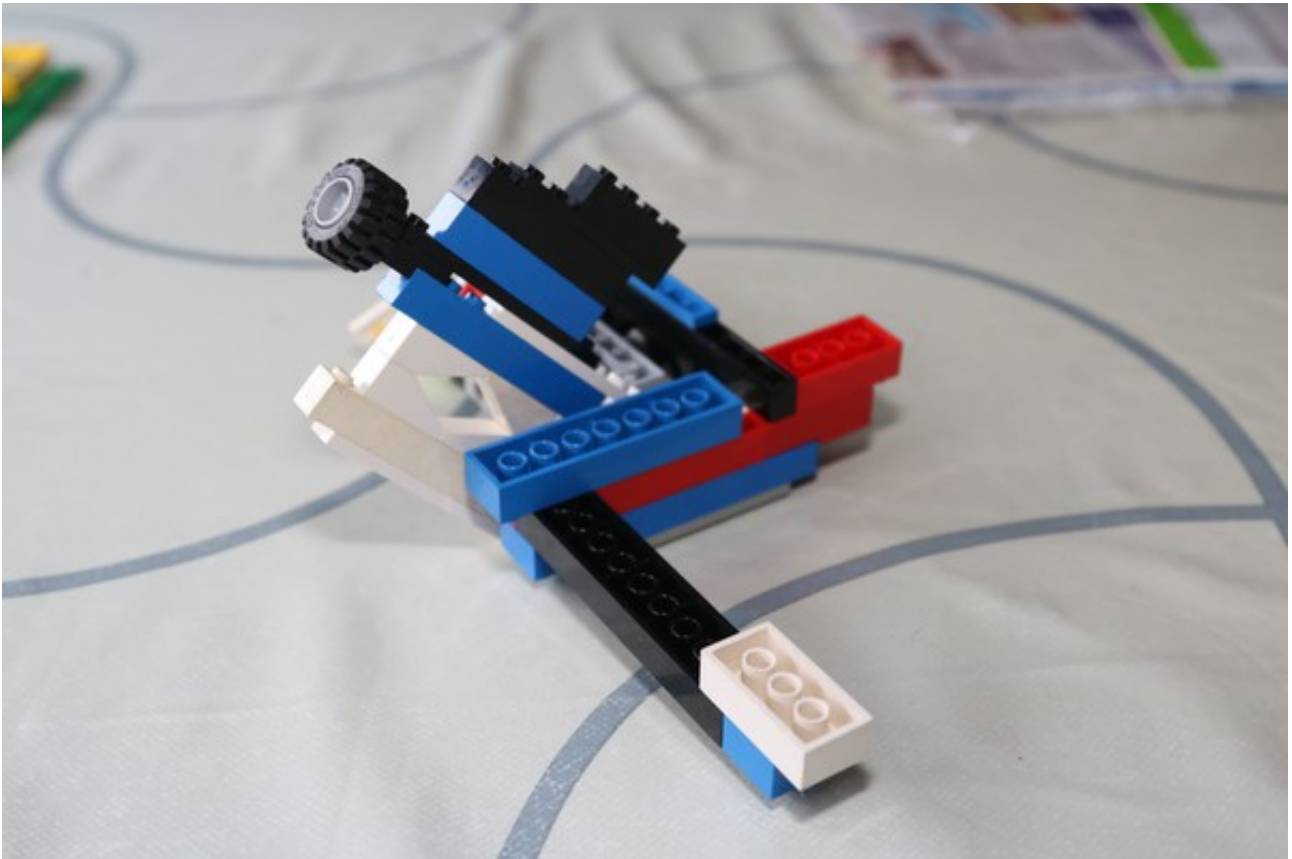
From the bottom, this is invisible. The hole is only one unit deep.



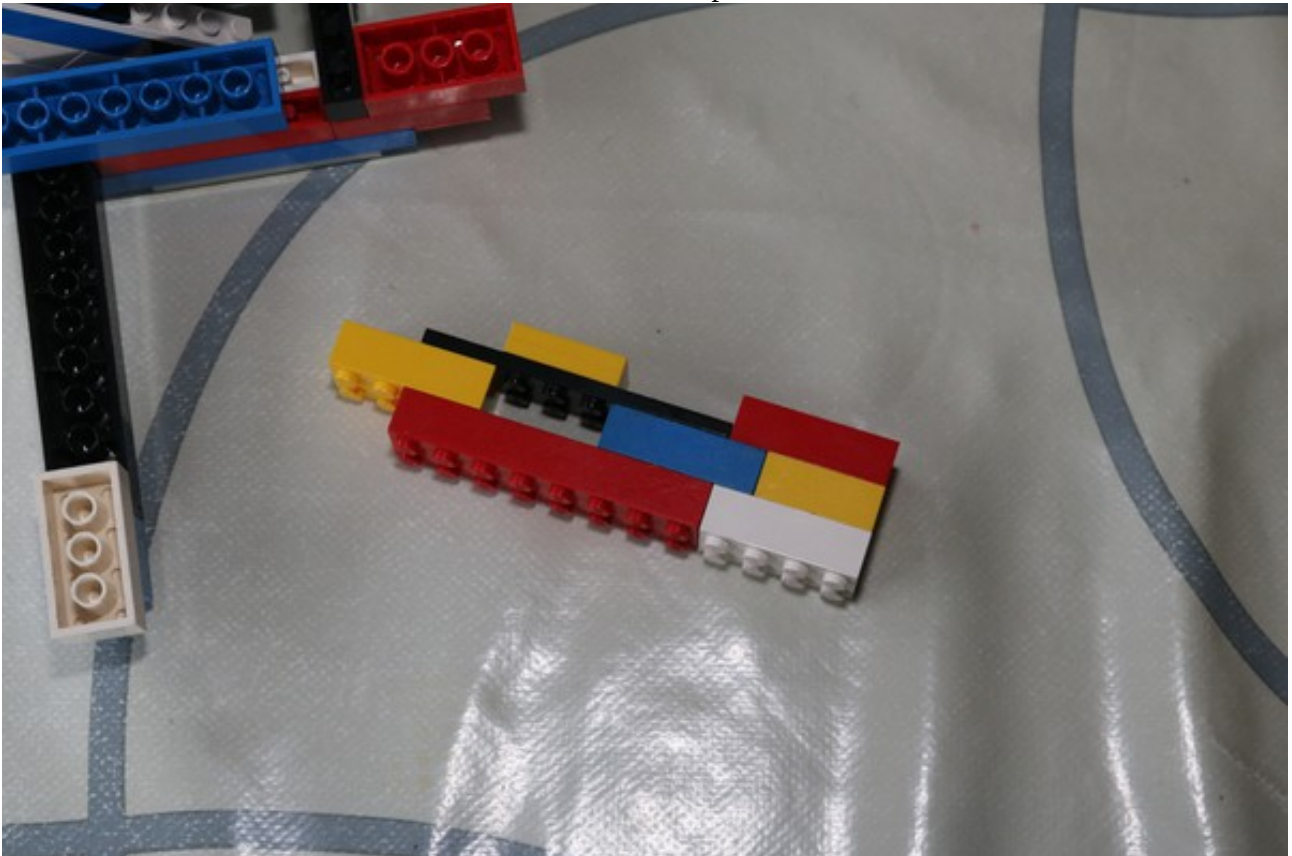
The previous part can then be attached to the new one:



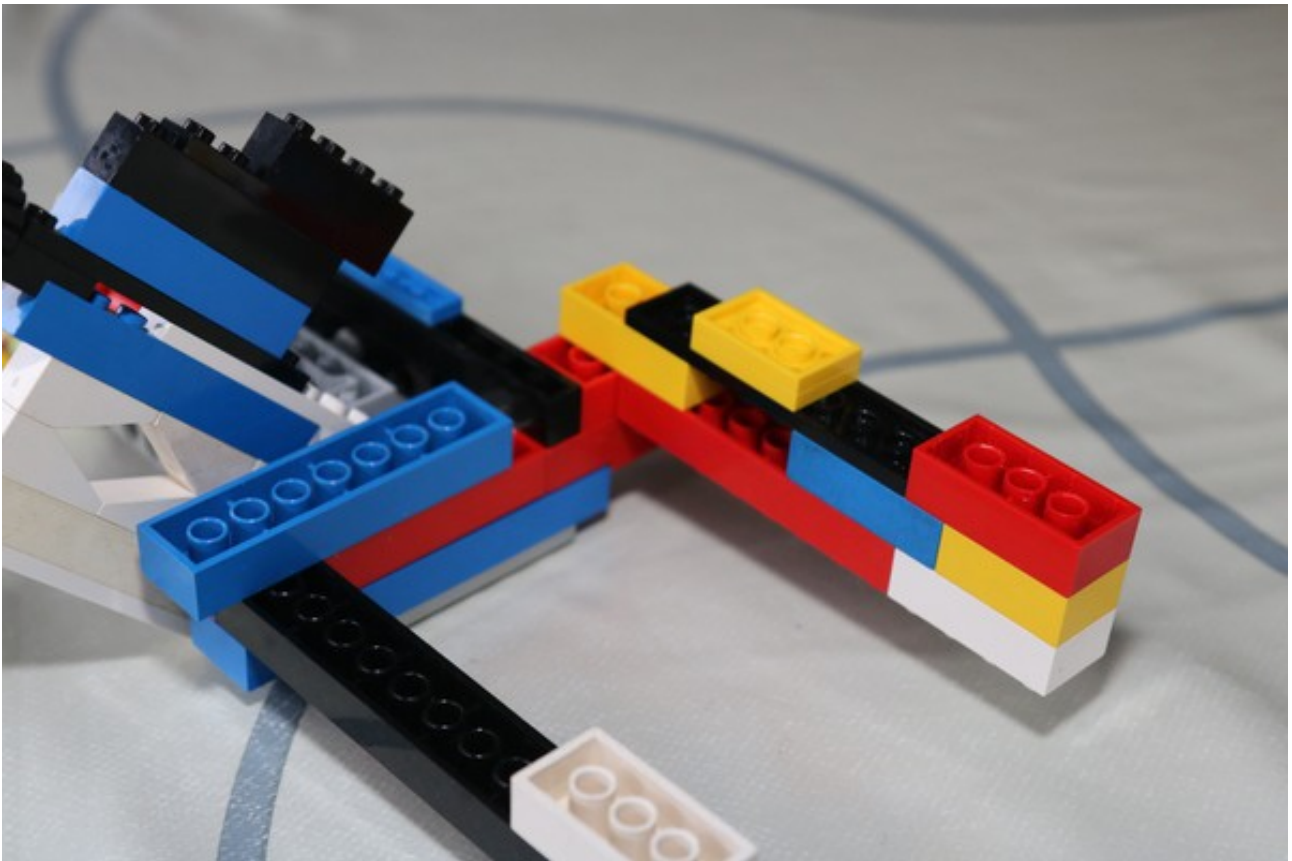
You'll see that the conveyor plate can turn freely around the black axle, and the 16-tooth gear can drive that motion via the perpendicular bevel gear.



Step 6: build the large standing structure of the sorter, starting with another leg. We used two short yellow plates on top of a black 2x10 plate to provide support for the slide assembly. Three plates have the same thickness as a standard brick, so that simplifies the overall construction.



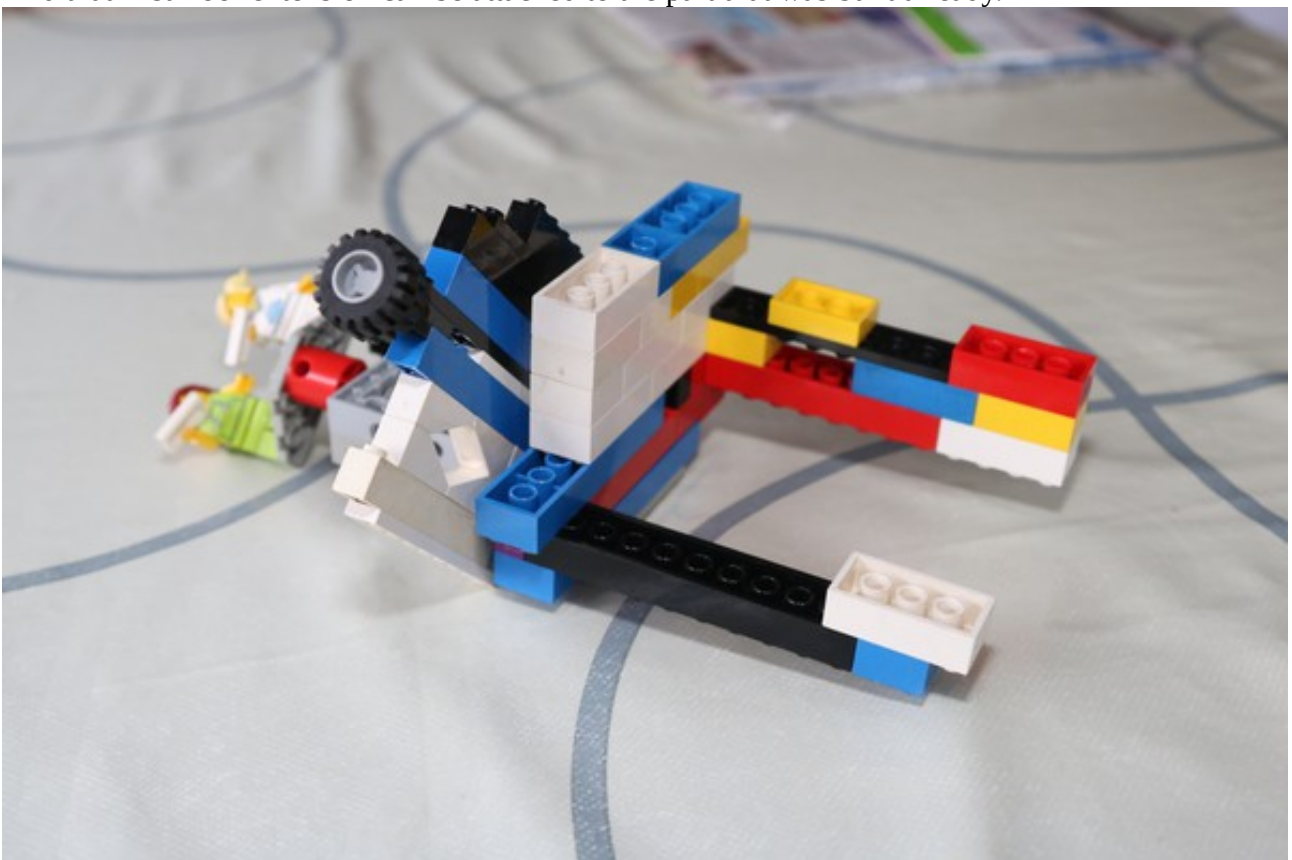
Attach it like this. The legs stick out evenly.



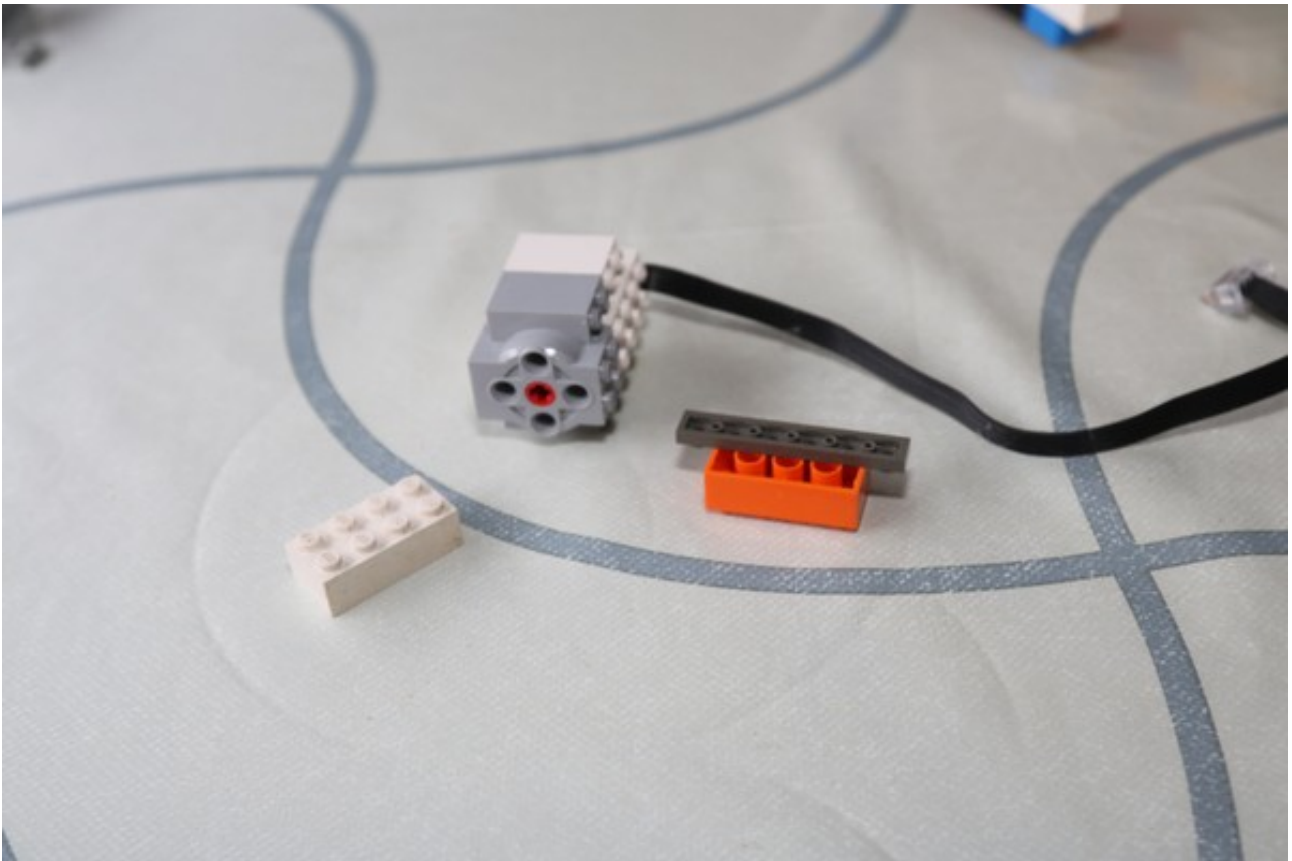
Step 7 is part of the raised floor of the structure. This floor is two units thick throughout. Color choice is arbitrary except for the white blocks. In the area around the color sensor, we've selected white bricks to avoid influencing the Boost color sensor.



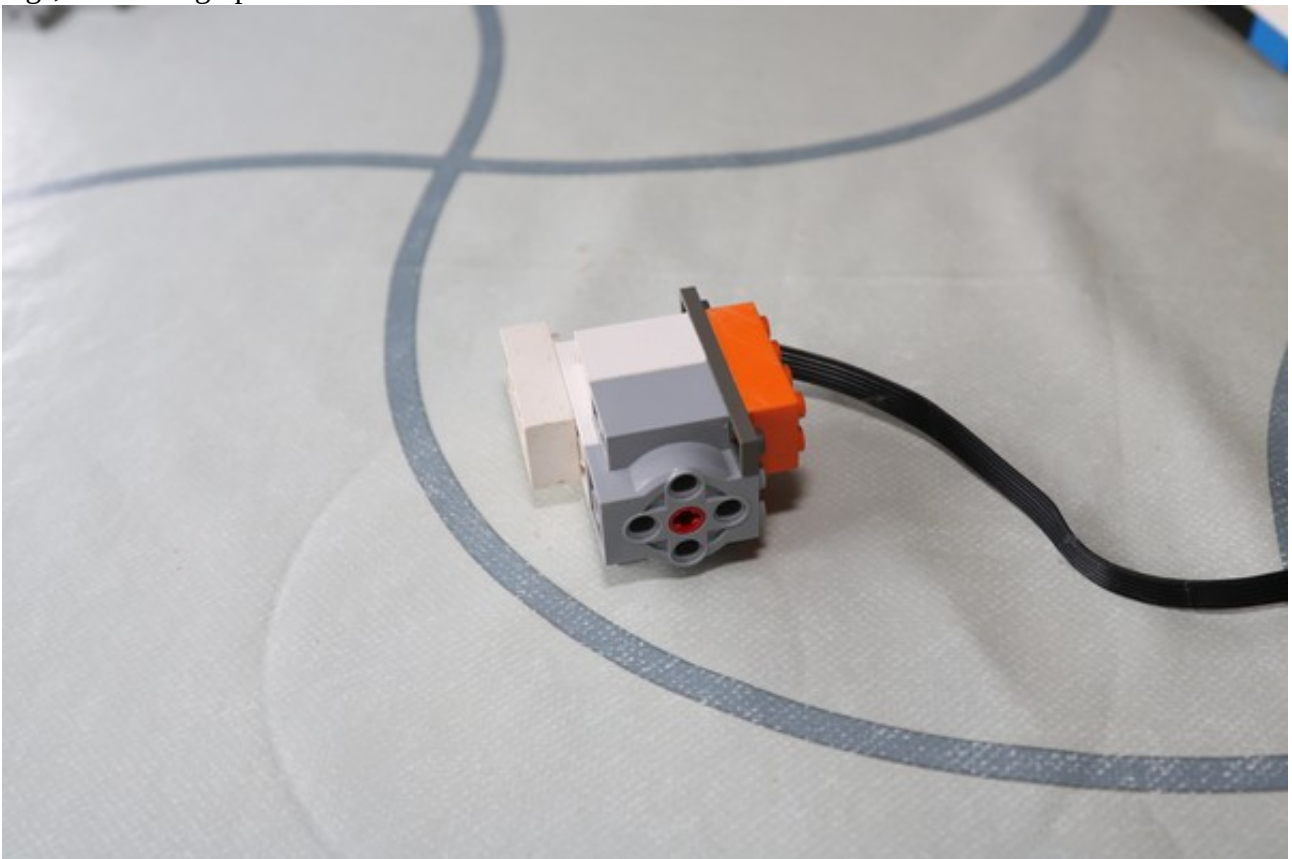
And that first floor extension can be attached to the part that was built already.



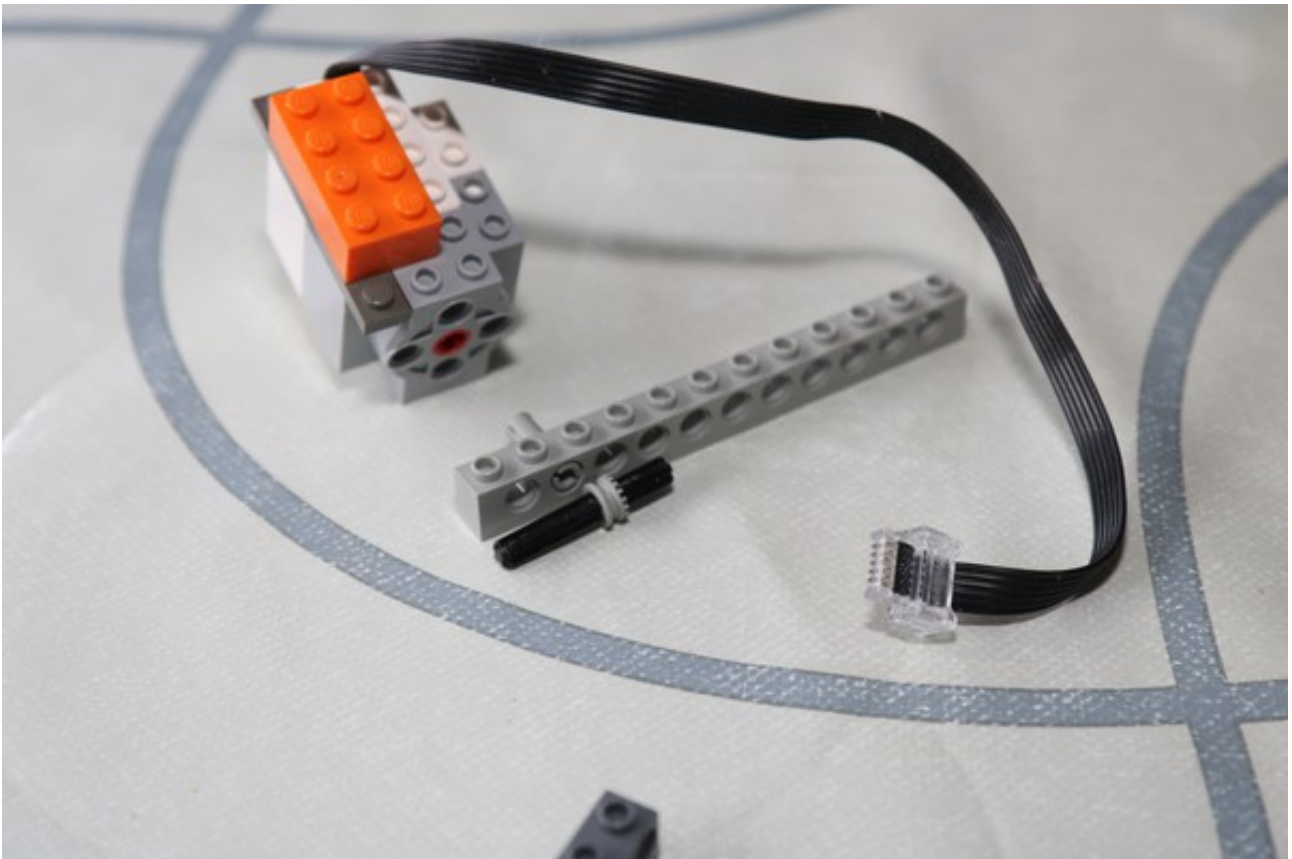
Step 8: build the rotating slide that will guide the Skittles to the correct color bucket. The external motor is the first Boost part we'll integrate.



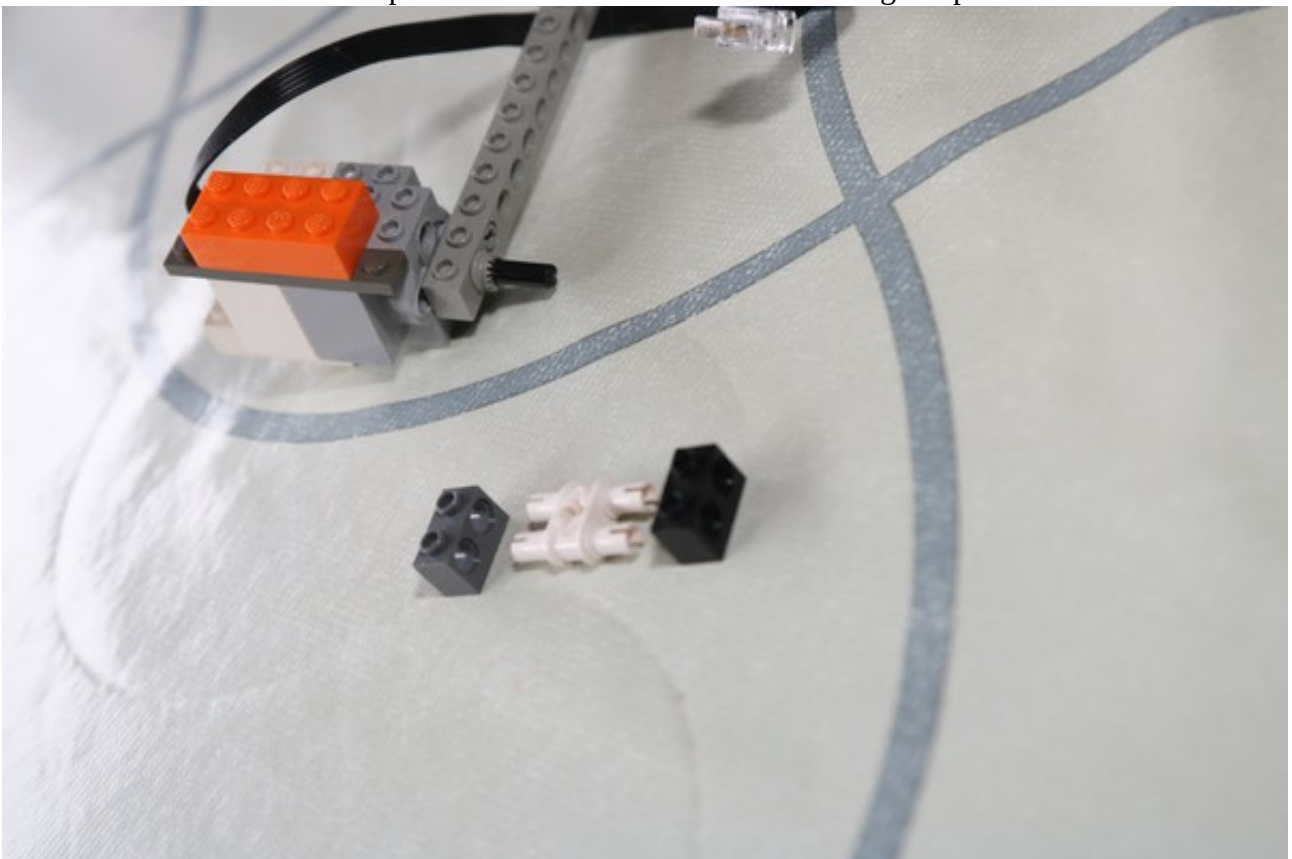
The extra bricks on either side of the motor allow it to be mounted in between two of the supporting legs, axle facing upwards.



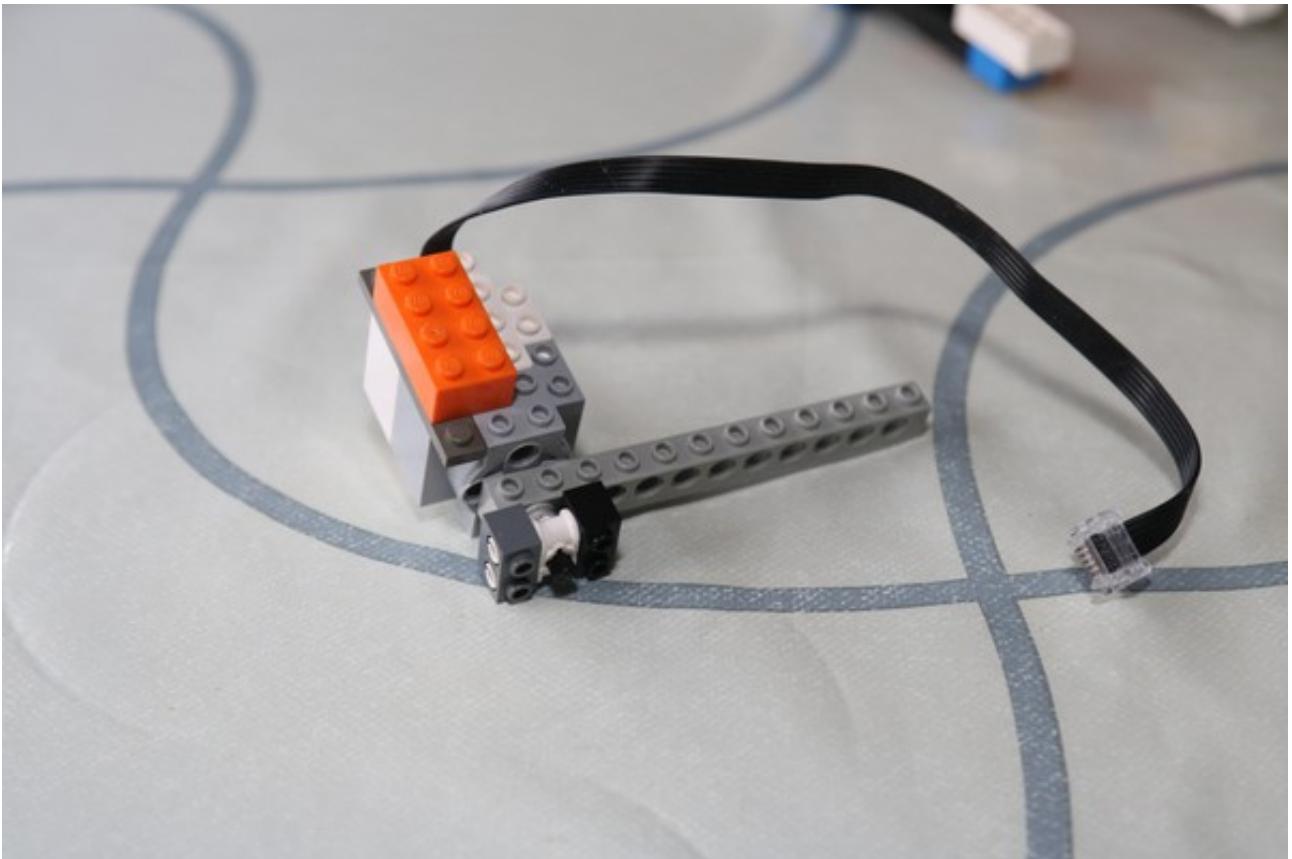
A couple of Technic parts to fix the motor to the construction even better.



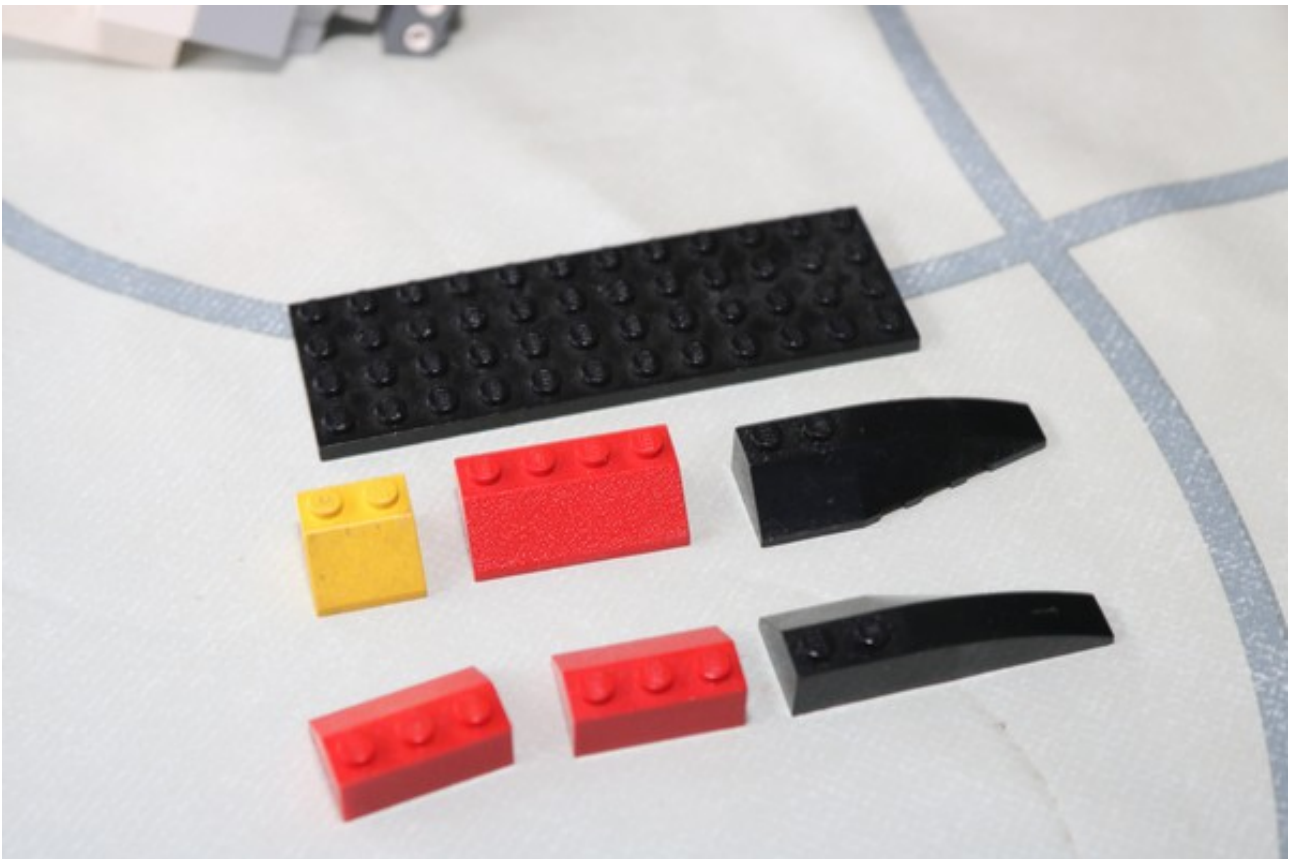
Step 9: the slide itself. Mount the previous components, with the axle going through the first hole and the pin going through the second.
We continue with two double-perforated 1x2 bricks and a double length 3 pin.

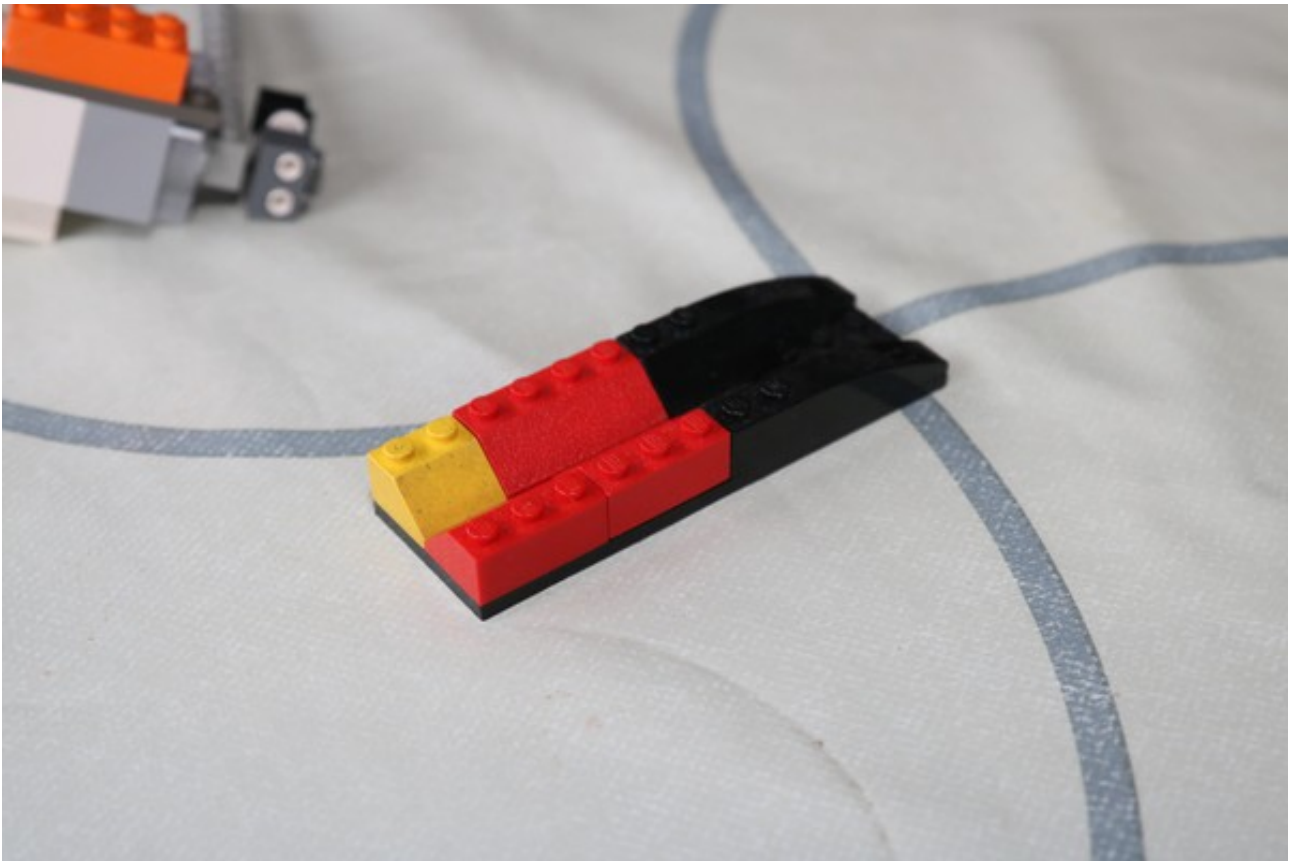


Mount the double pin on the axle.

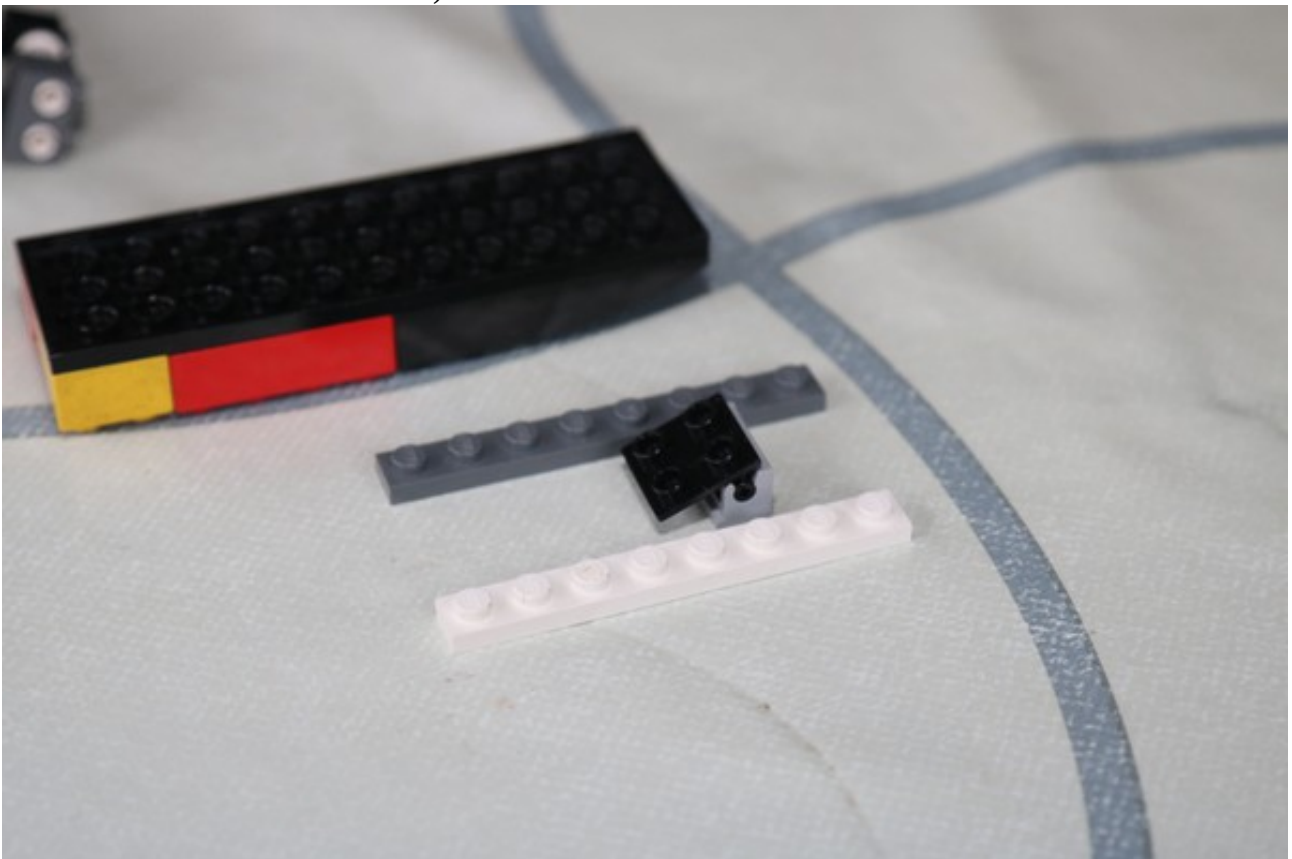


Now the components of the actual slide. The black slopes are tapered ones, because that allows the slide to rotate closer to the raised floor of the construction.

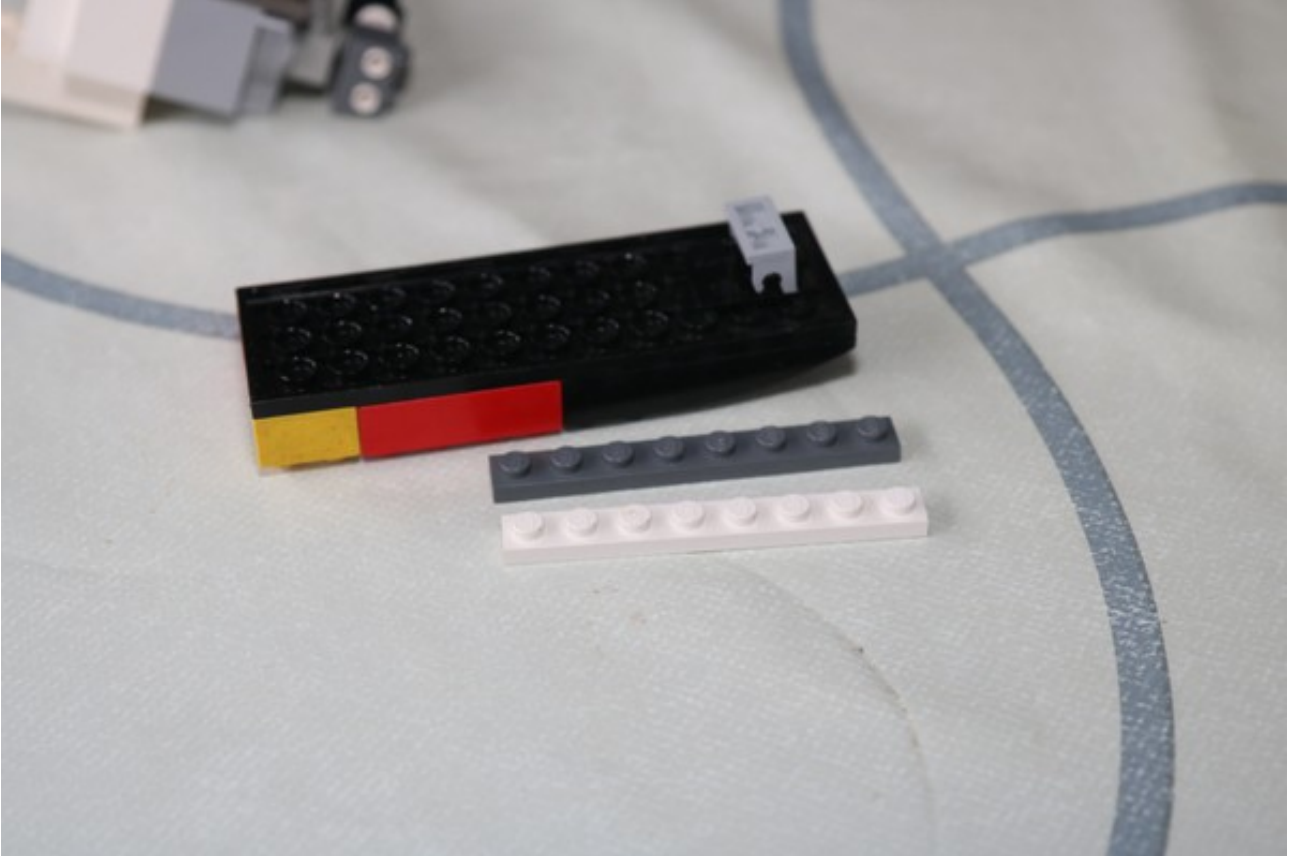




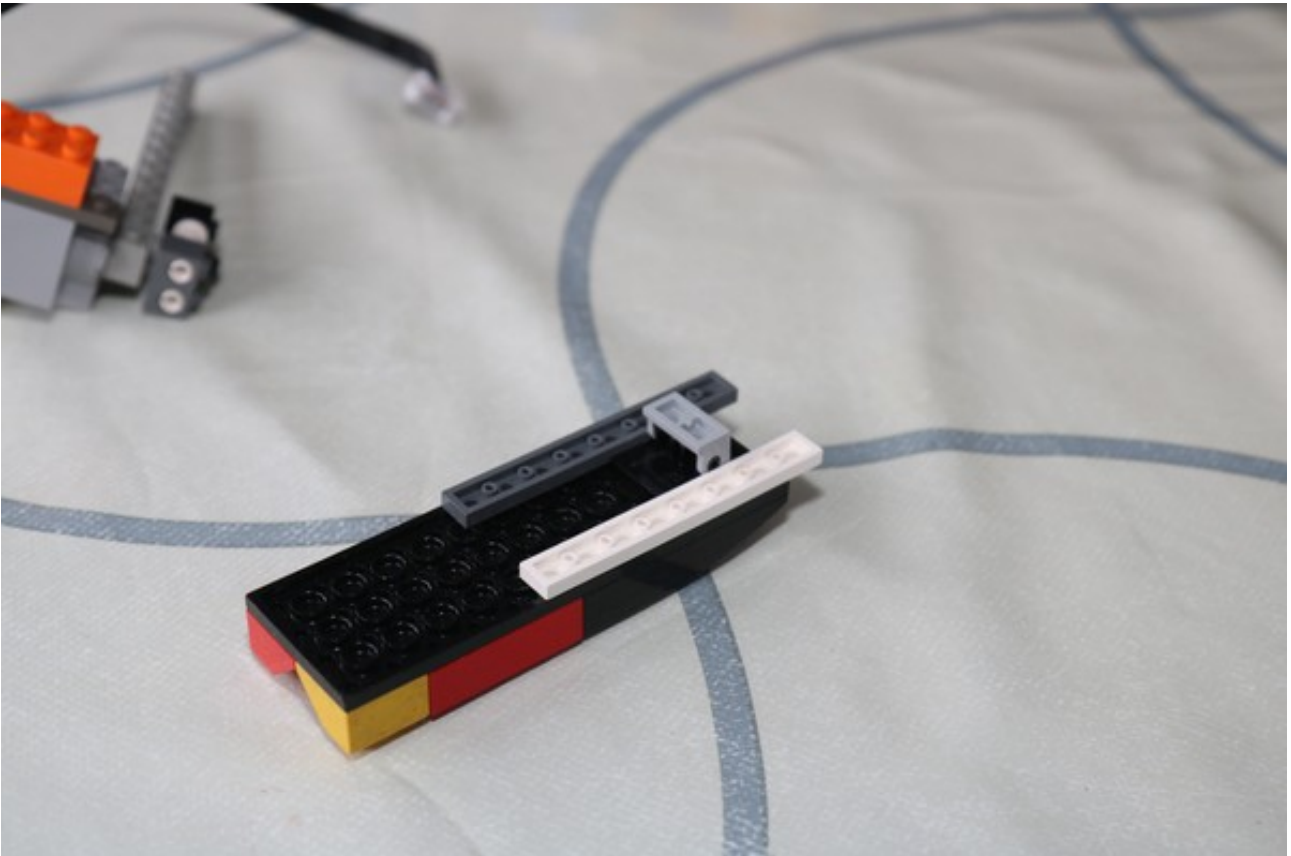
The slide attaches to the axle using a pivot (we found this 2x2 pivot, but the 1x2 ones are more abundant and would work as well).



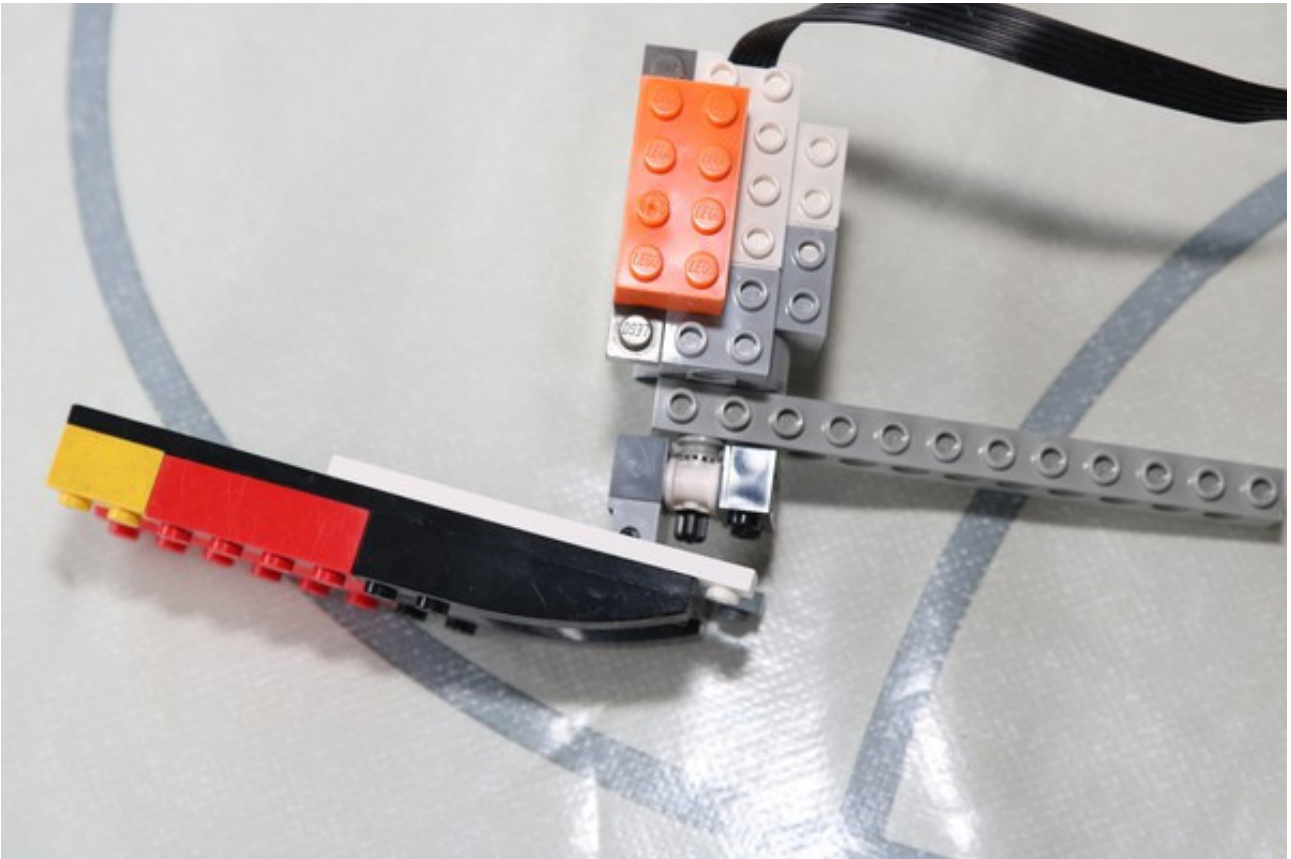
We attach the pivot first.



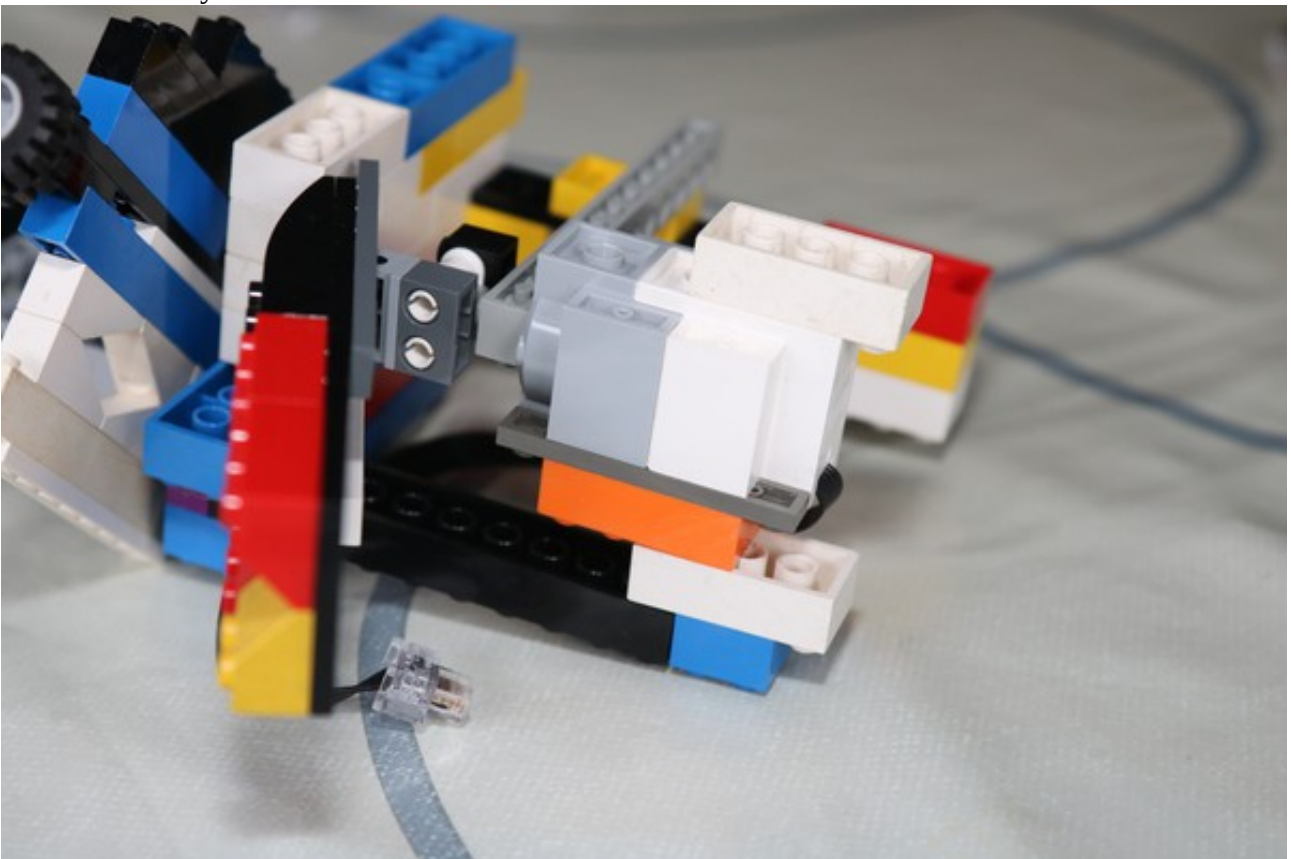
And the 1x8 plates go next. They extend one unit, to avoid the slide tilting down too much when it doesn't make contact with the underside of the floor.



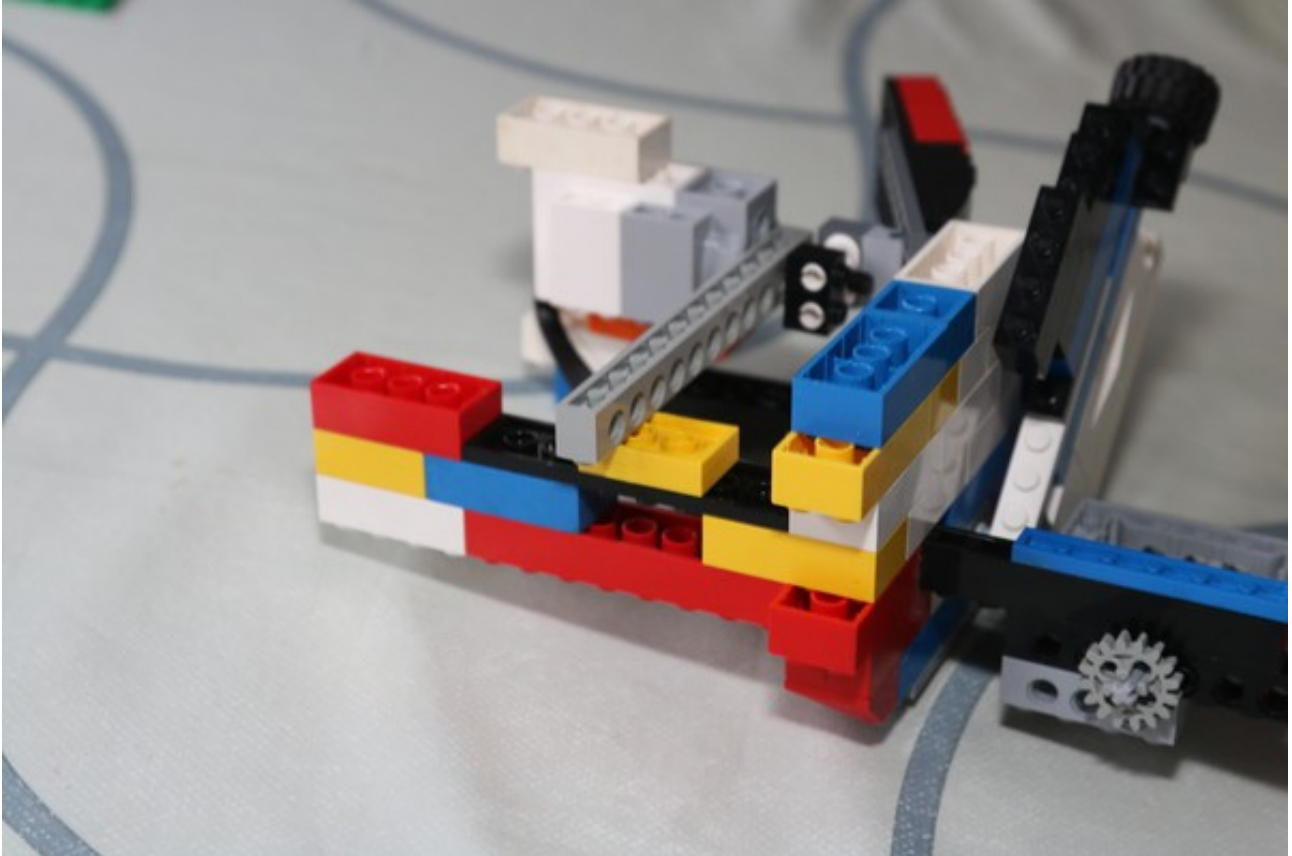
Now the slide can be mounted on the motor.



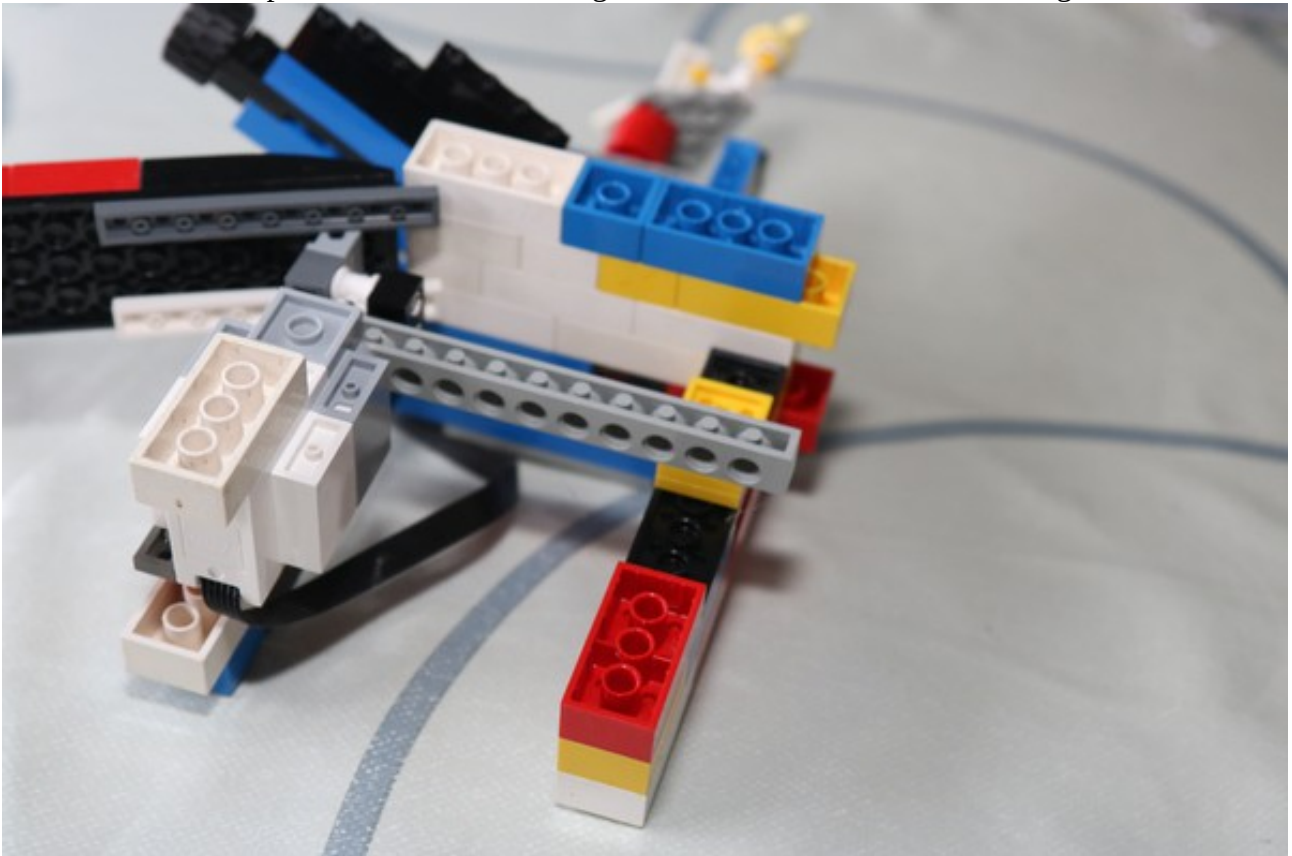
We're now ready to attach the motor to the rest of the construction.



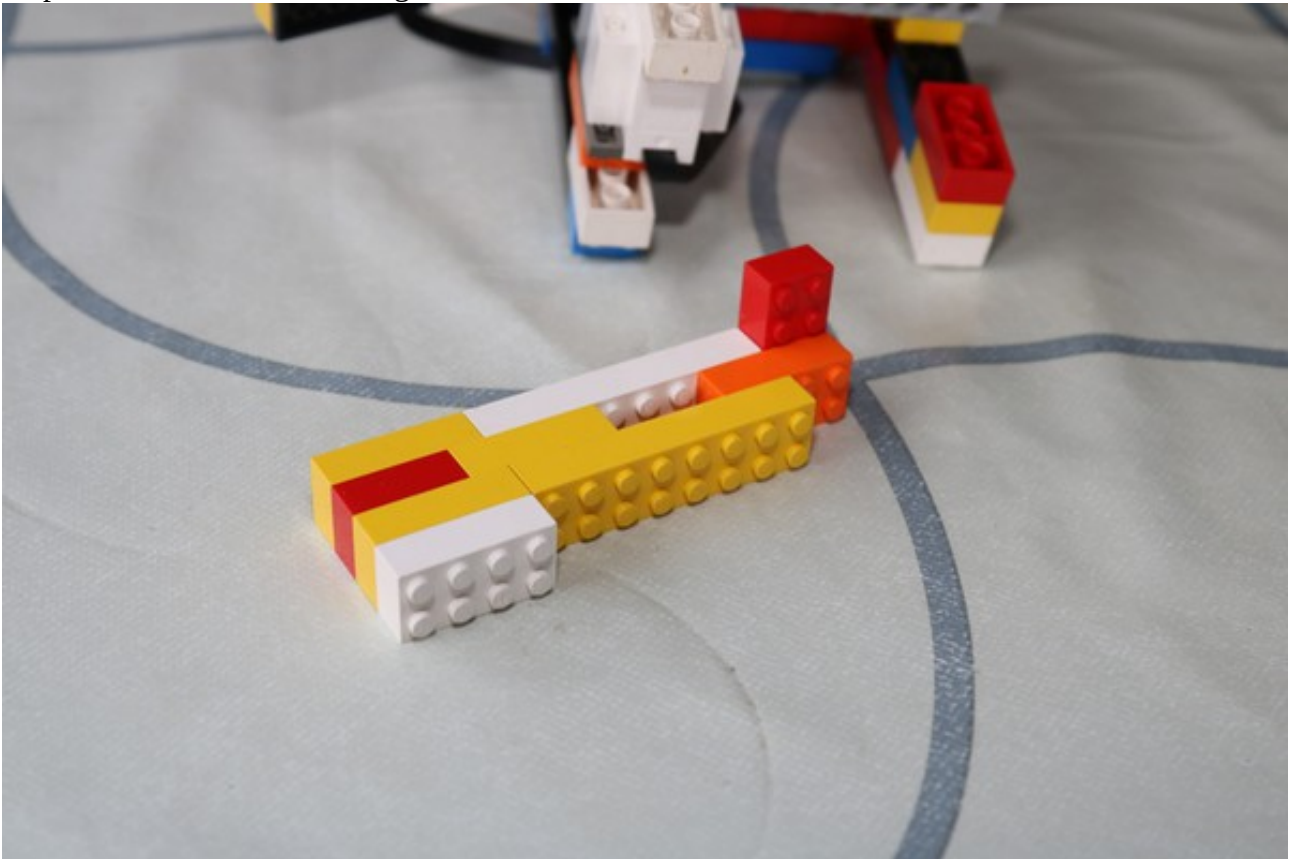
A view from another angle shows how the long perforated Technics beam attaches to the 2 yellow plates mounted earlier.



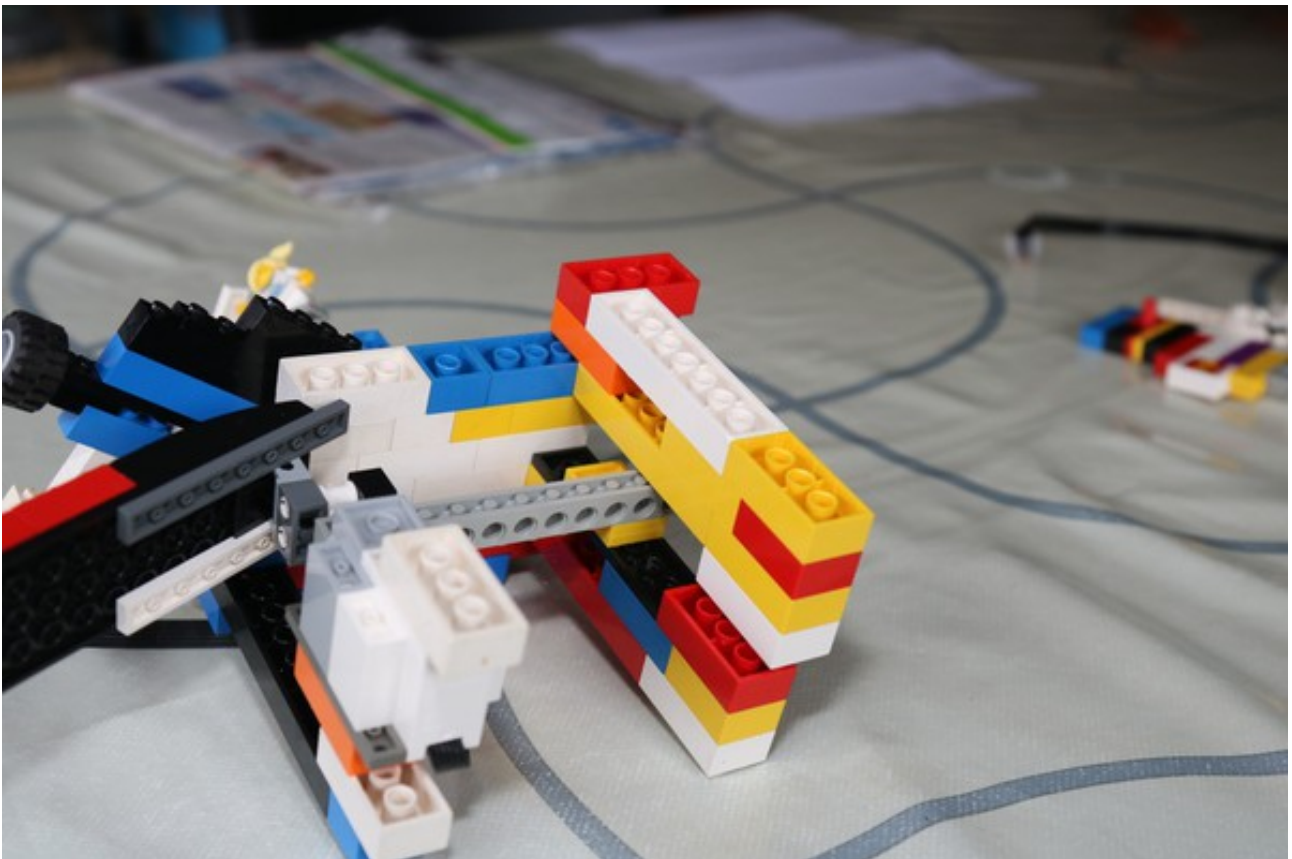
There are now three points that will touch the ground when the structure is standing.



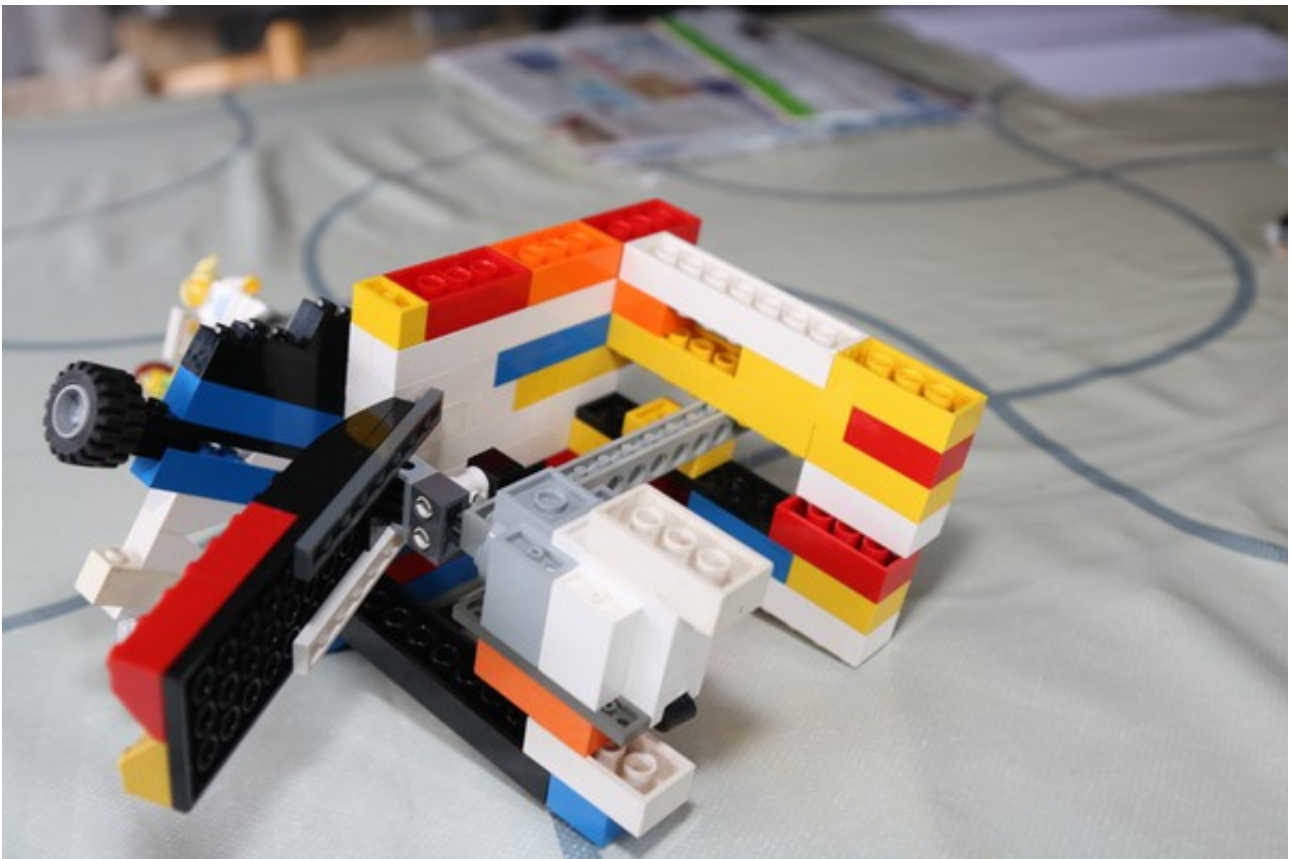
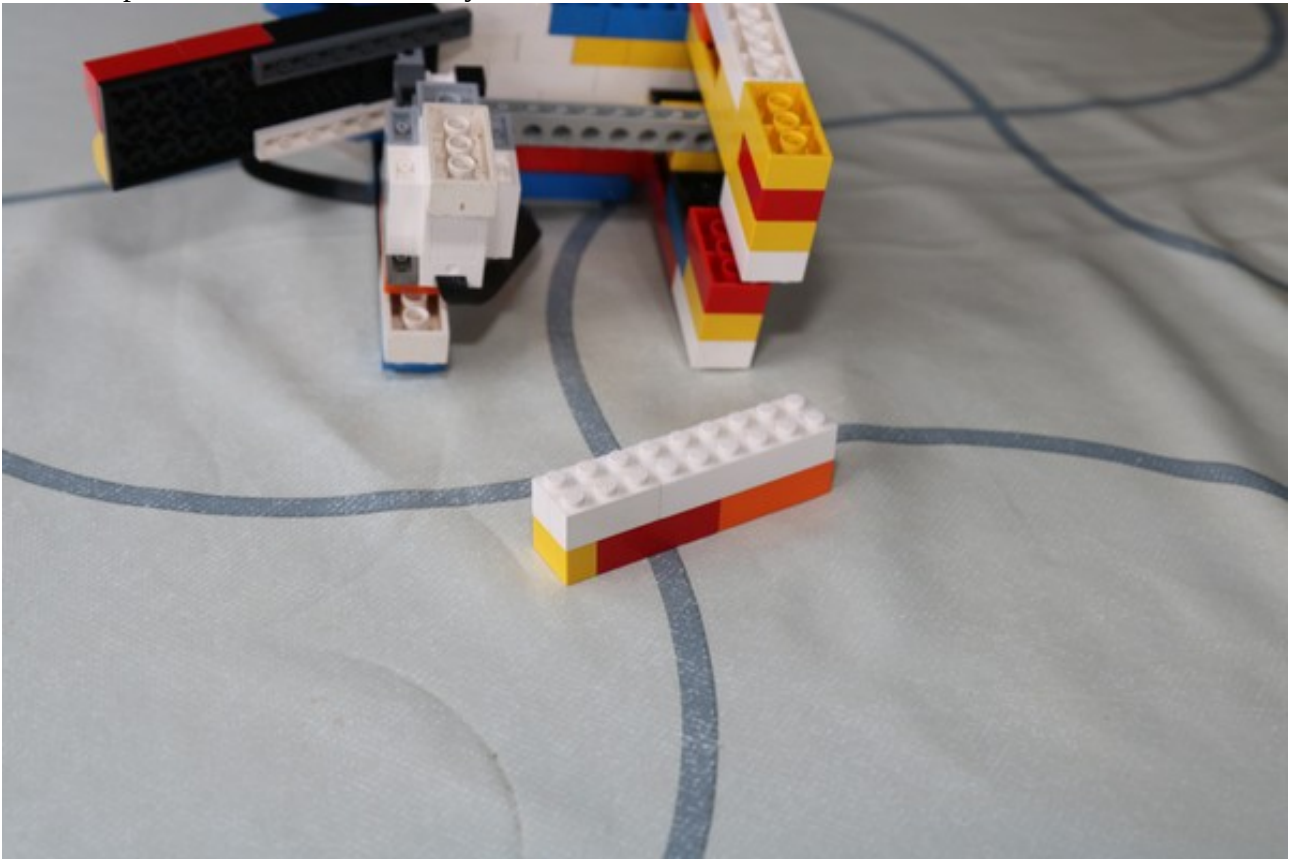
Step 10: time to add another leg:



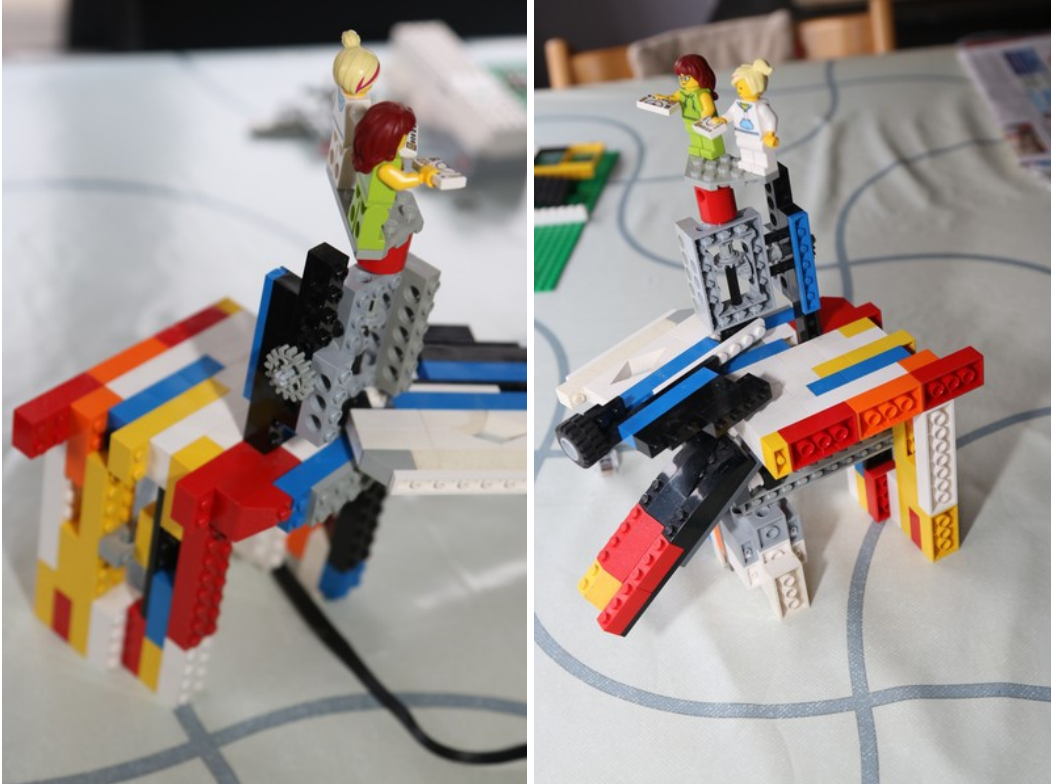
We can mount it like this.



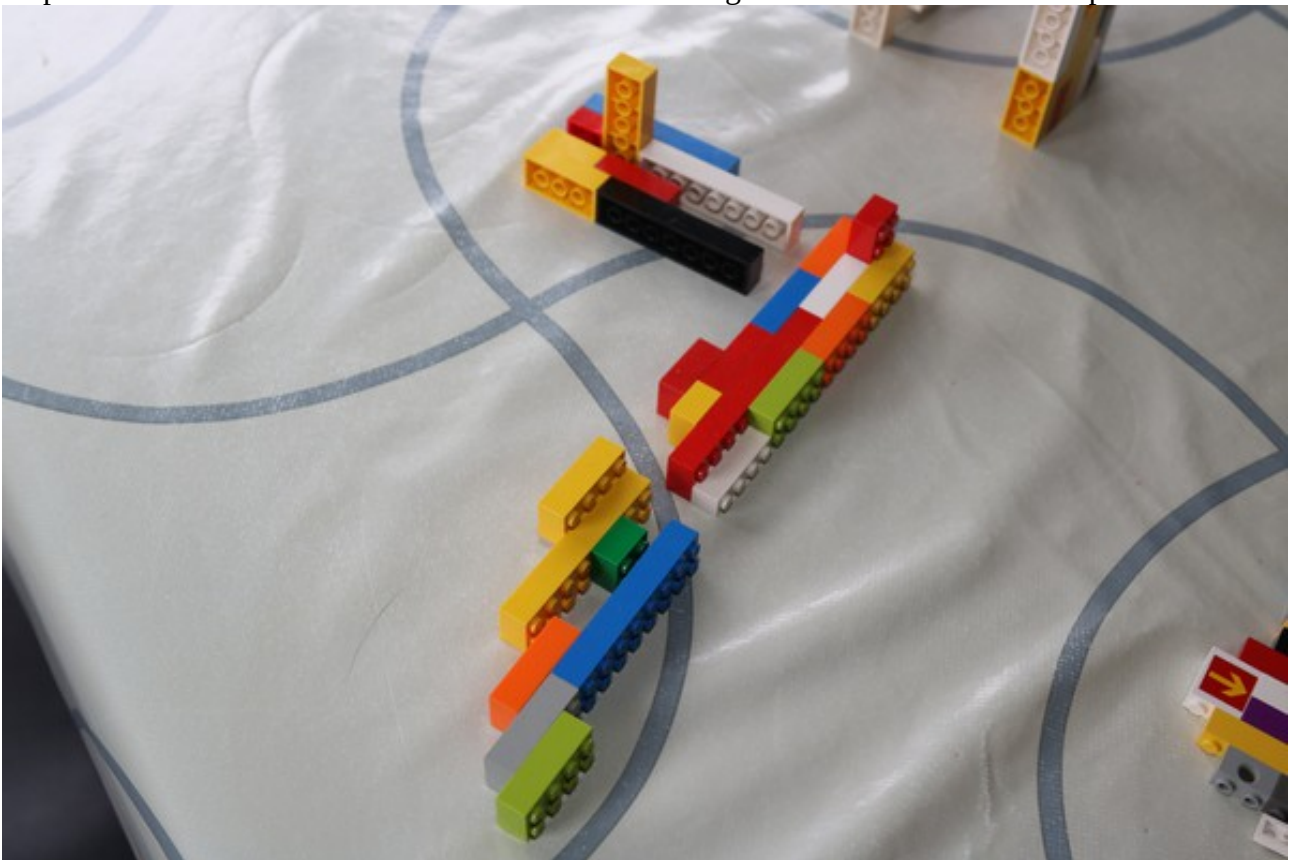
The next part will extend the floor by two rows.



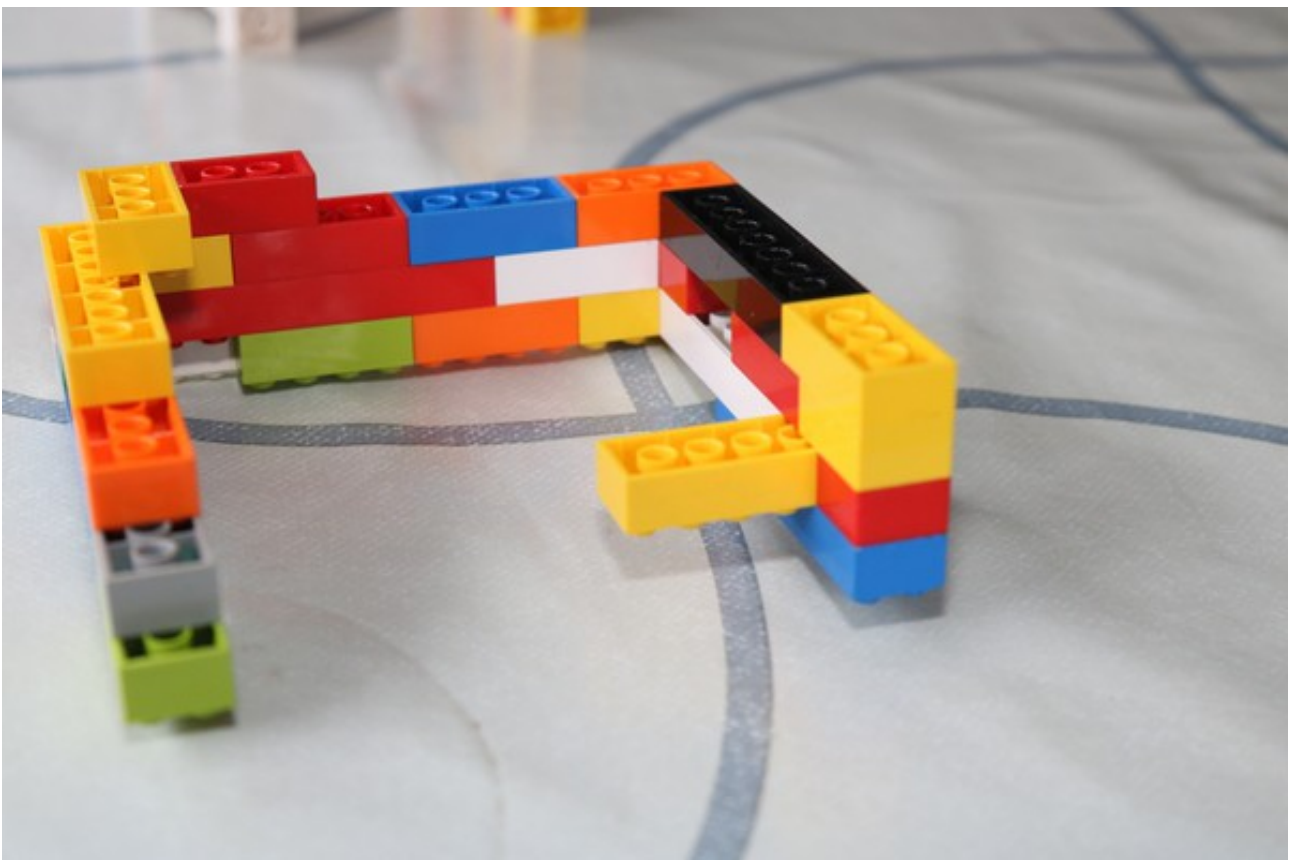
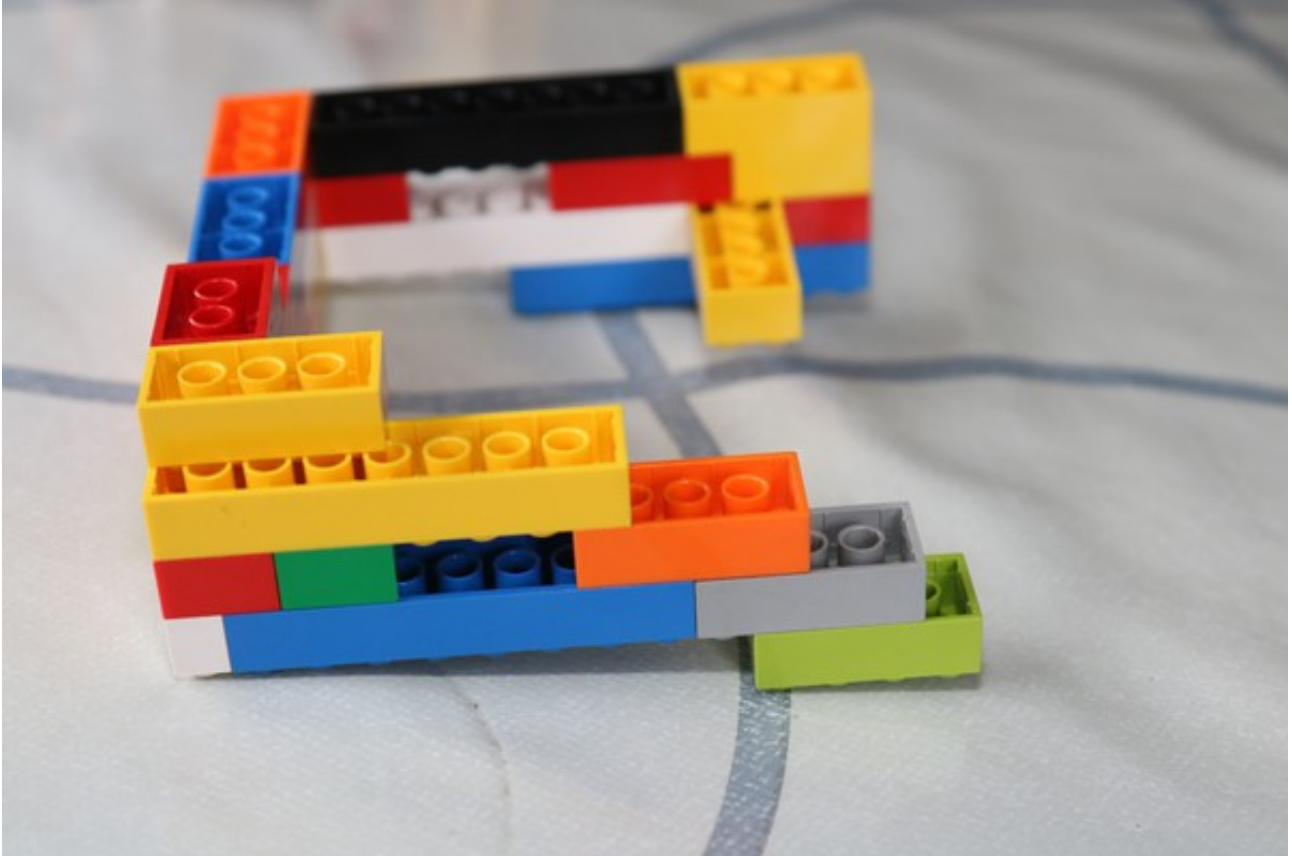
We can turn the partial structure onto its feet and see it standing for the first time.

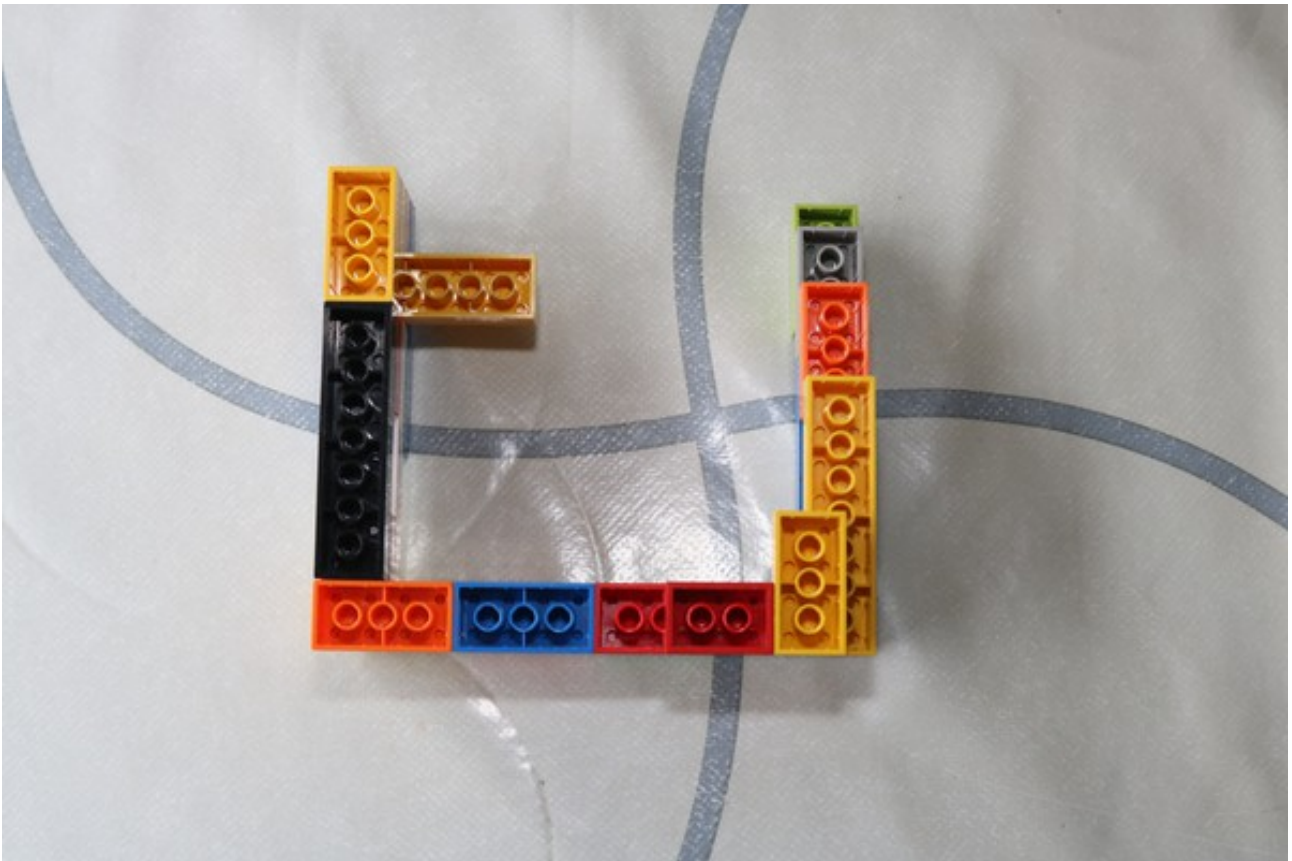


Step 11: time to build some more floor extensions and legs. Start with these five components.

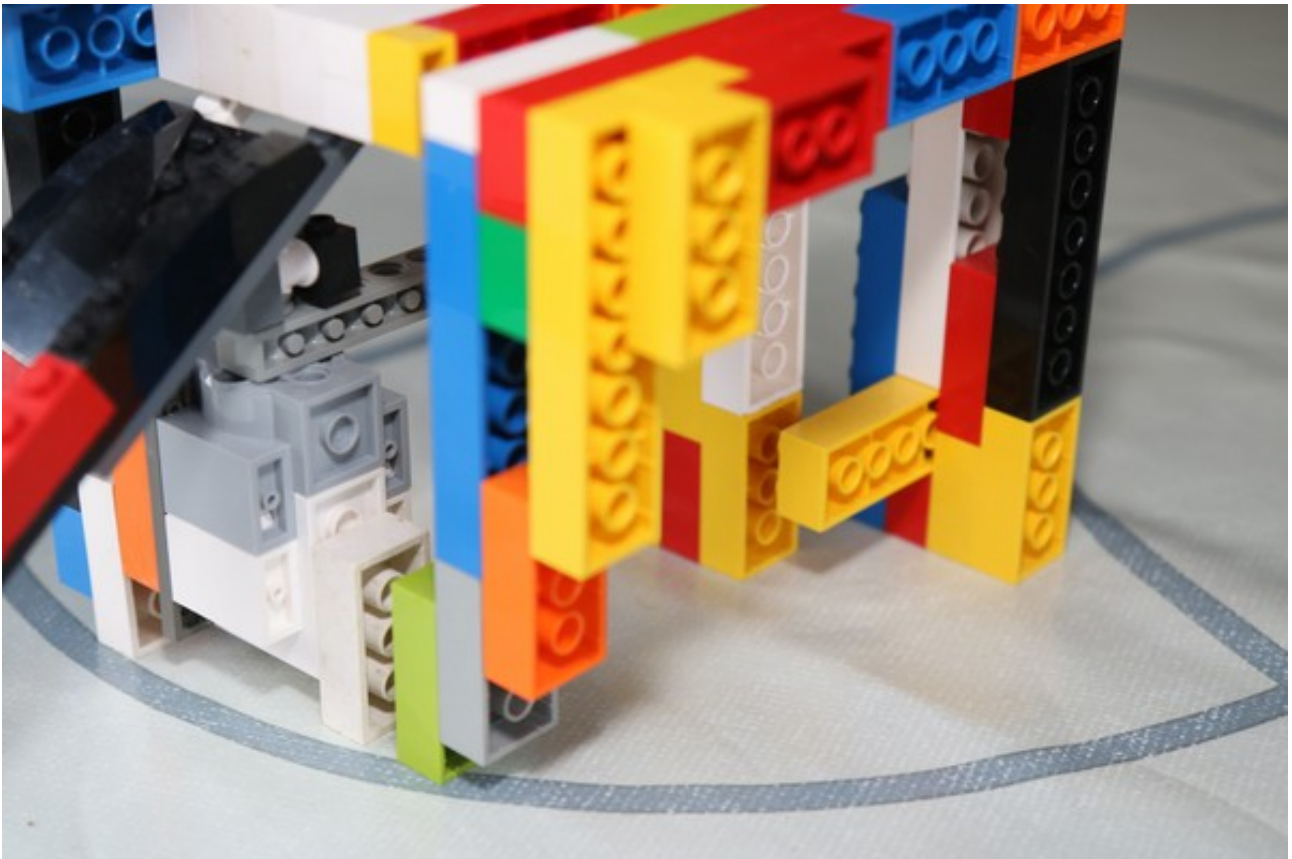


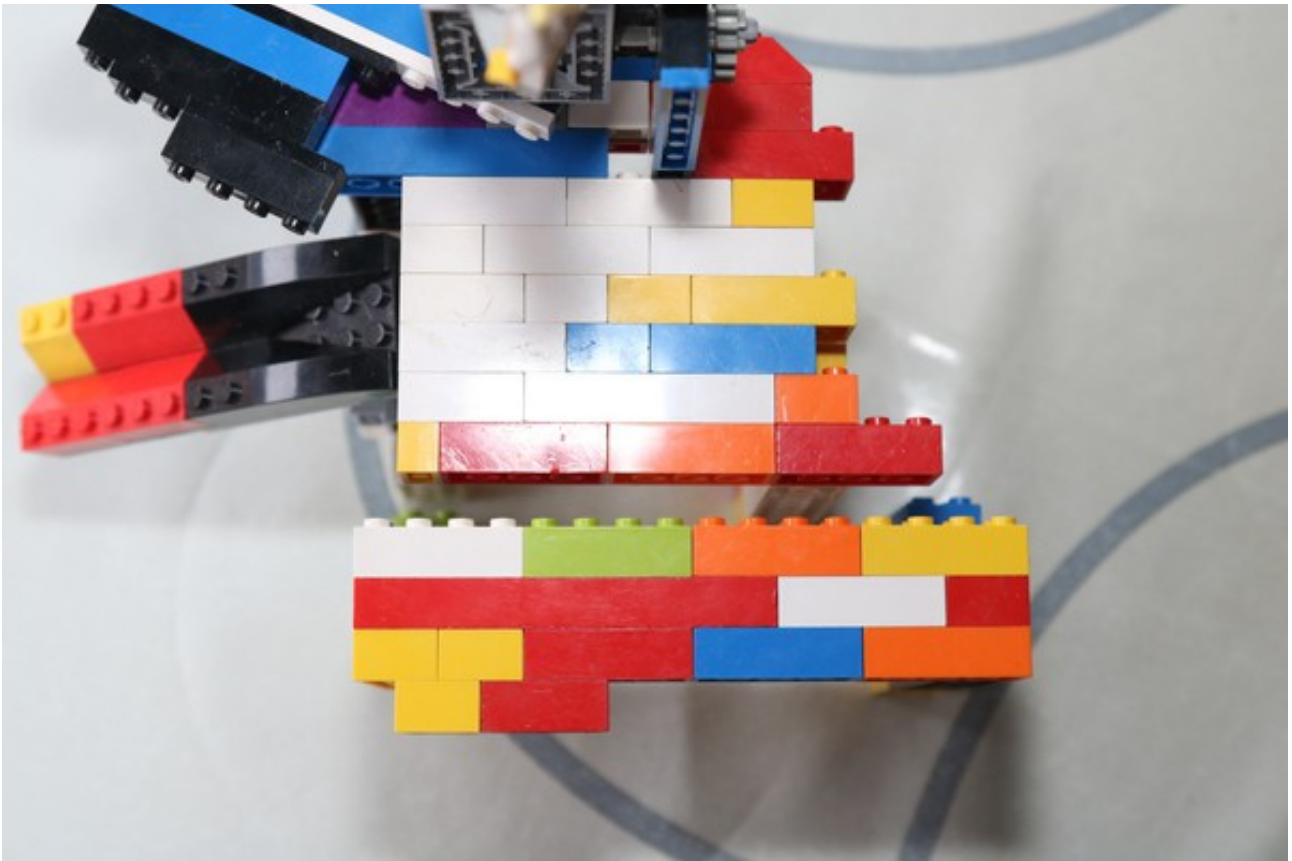
Assembly as shown in these three pictures:



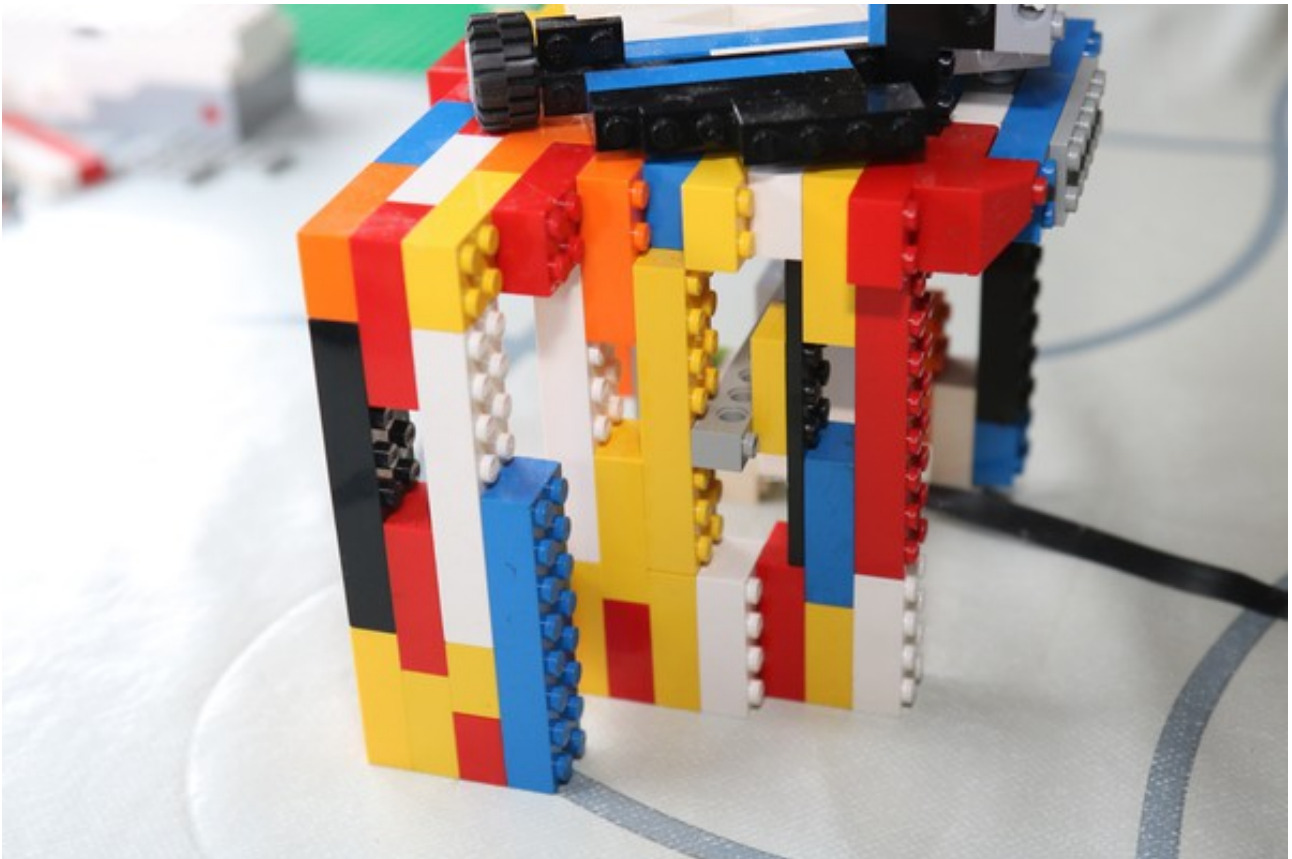


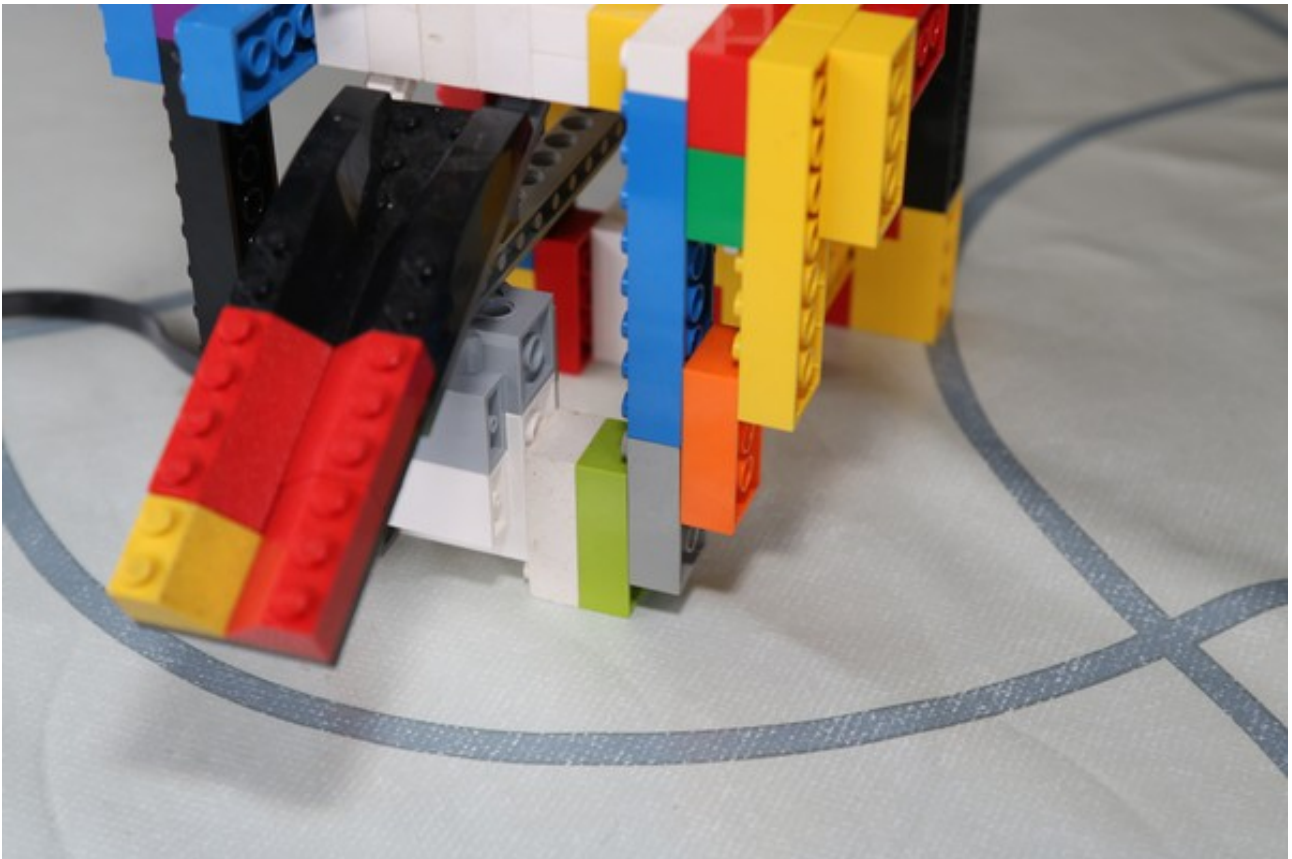
Then move it next to the structure like this:



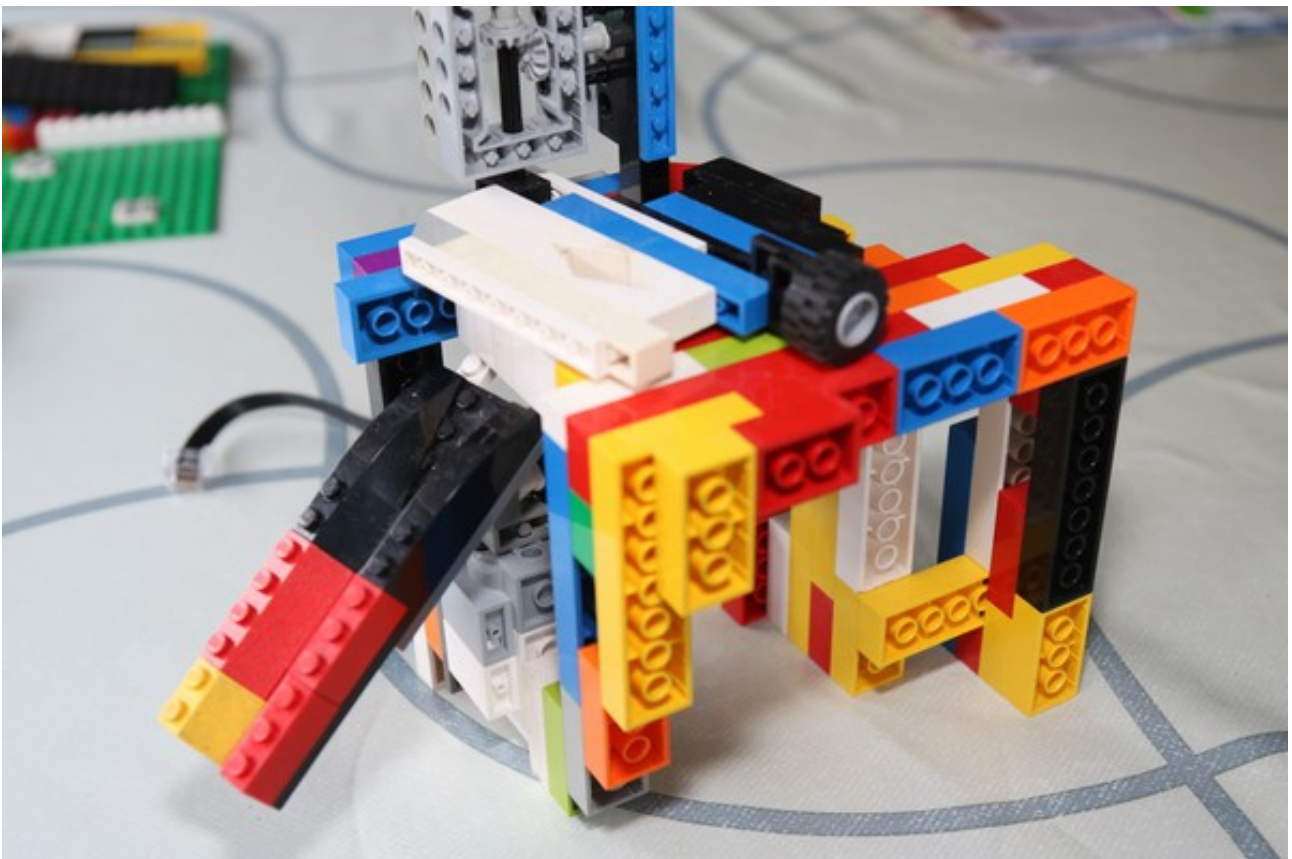


And attach it:



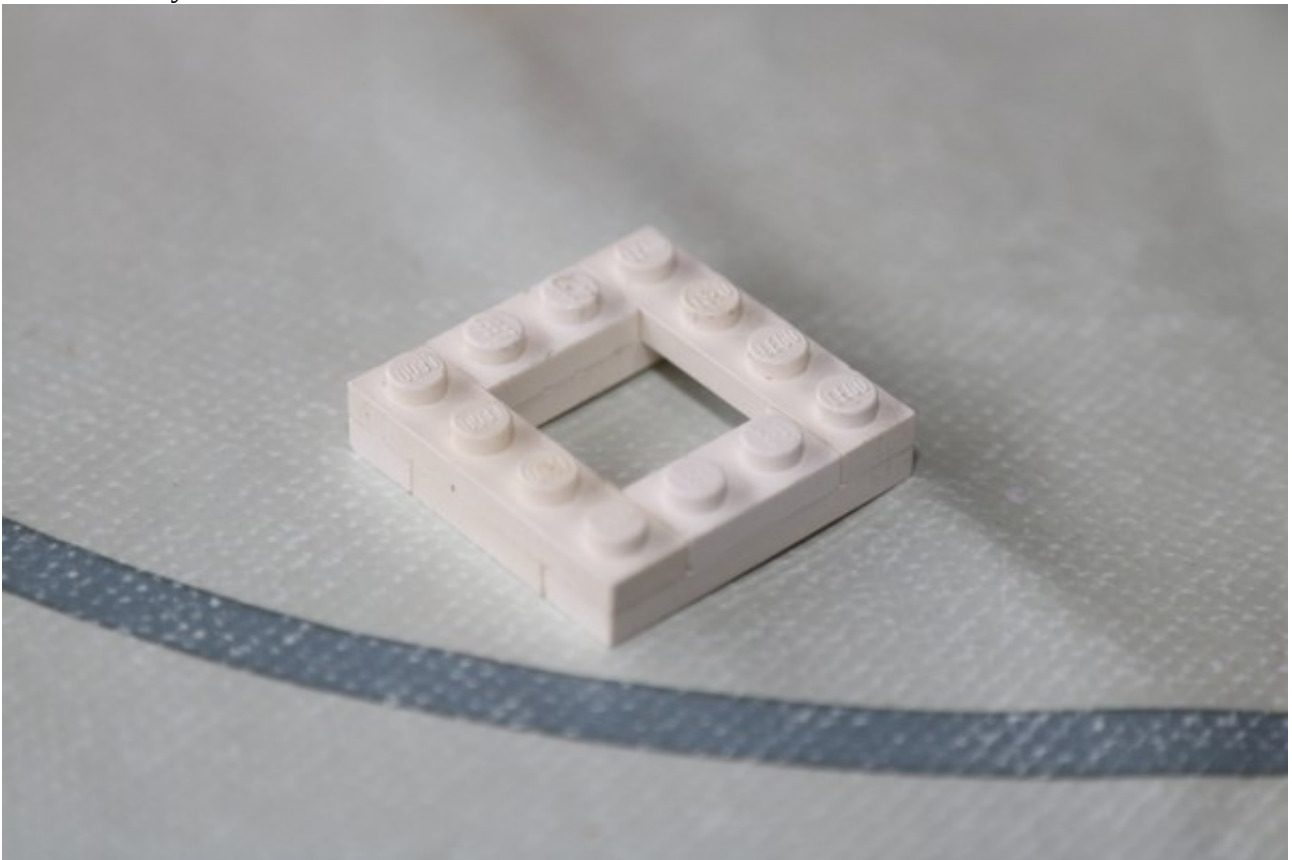


The floor is now large enough to allow the transport swivel plate to swing (and maybe ride) back and forth. You should see basic alignment between the hole in the transport plate and the top of the slide.

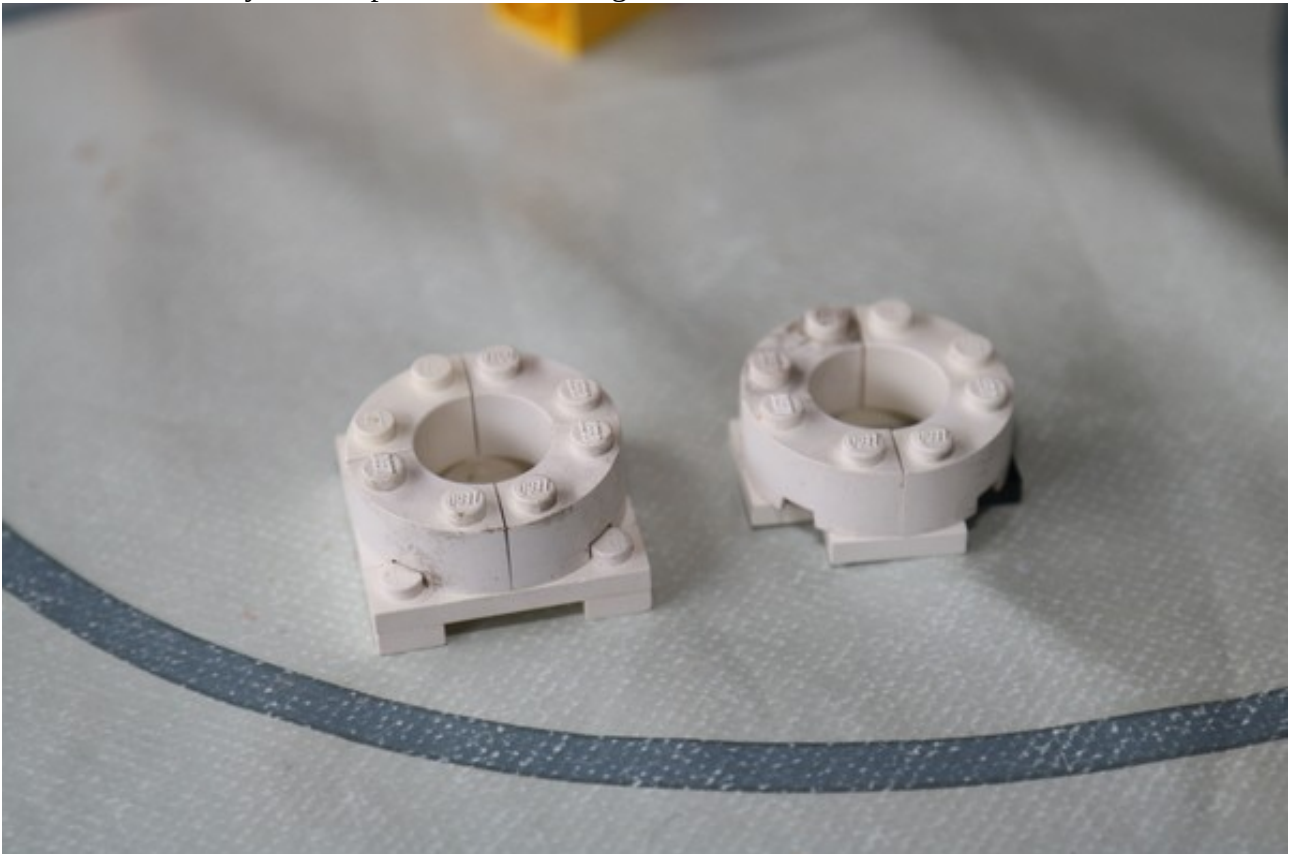


Before the sorting begins, Skittles need to be fed into the sorter at the correct position. To facilitate this, we construct a feeding tube.

Step 11: we start with a 4x4 square of plates. Notice that one 1x2 piece is intentionally missing on the bottom layer.



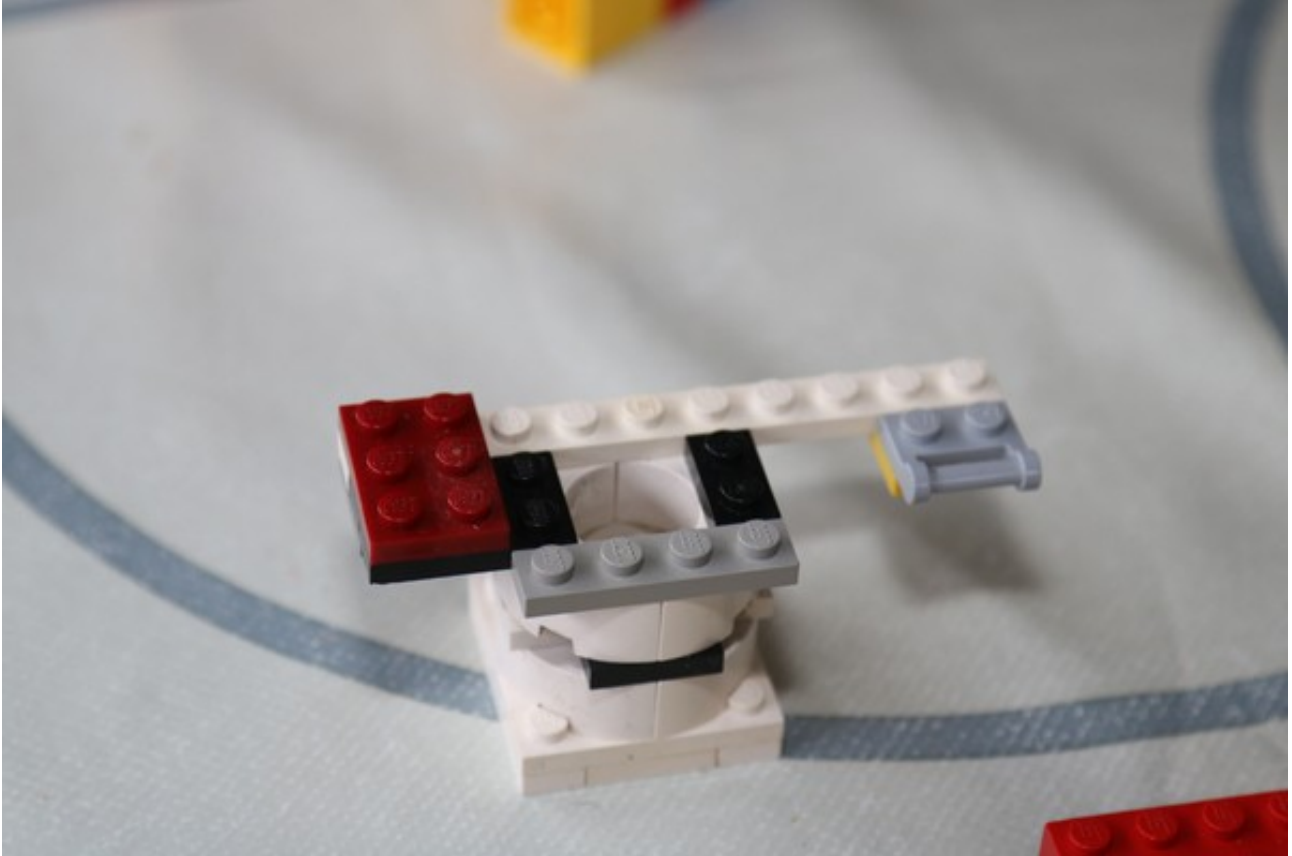
We then build in layers on top of that base, using rounded bricks:



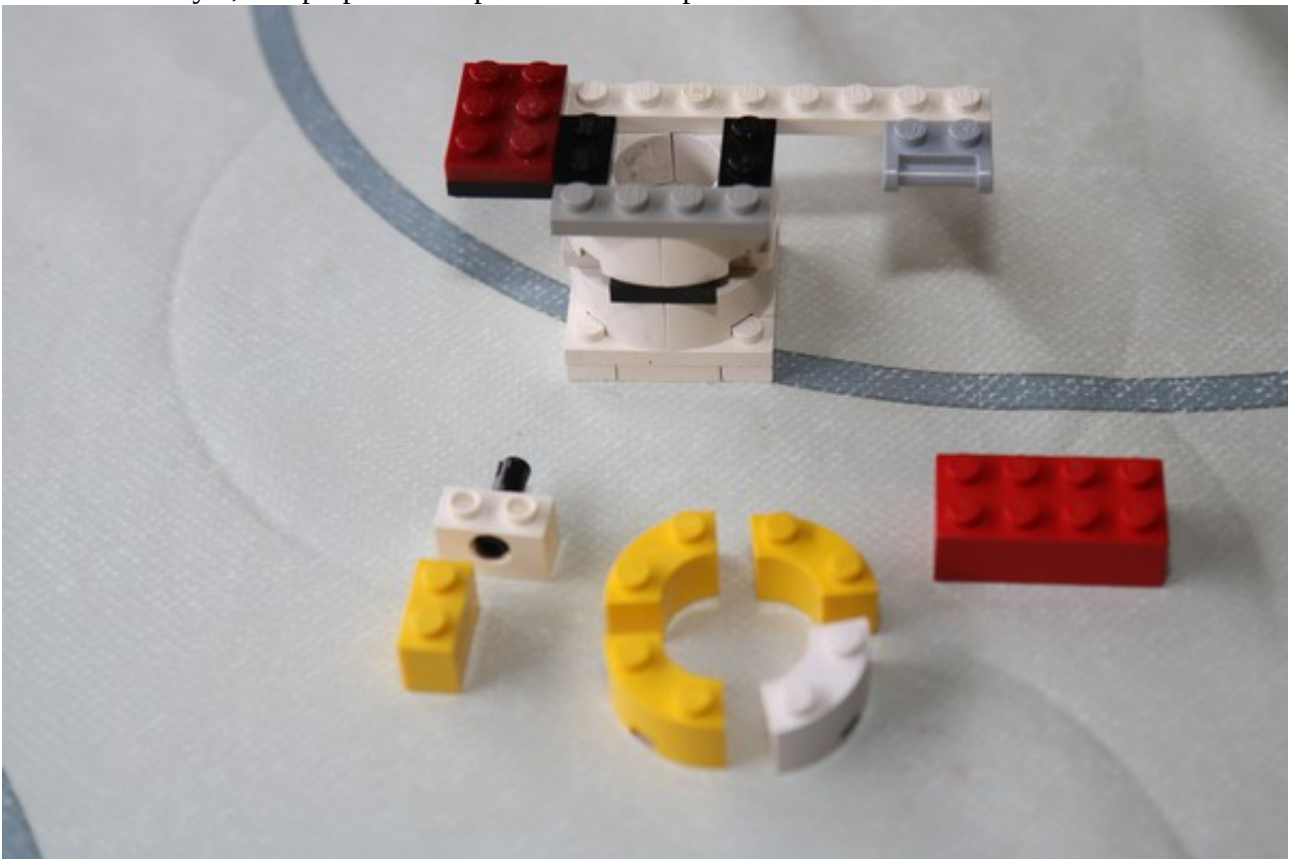
A small, white, cylindrical LEGO structure with a central hole, sitting on a white surface with a blue curved line. The structure is composed of several white LEGO bricks and a black band. The top of the structure has a circular opening with a black band around it. The structure is positioned on a white surface with a blue curved line.

A collection of LEGO Technic parts is shown on a light-colored surface with blue circular patterns. The parts include a white circular connector, a red 1x3 plate, a black 1x3 plate, a grey 1x3 plate, a black 1x2 plate, a grey 1x2 plate, a black 1x1 plate, a yellow 1x2 plate, and a long white 1x10 Technic beam.

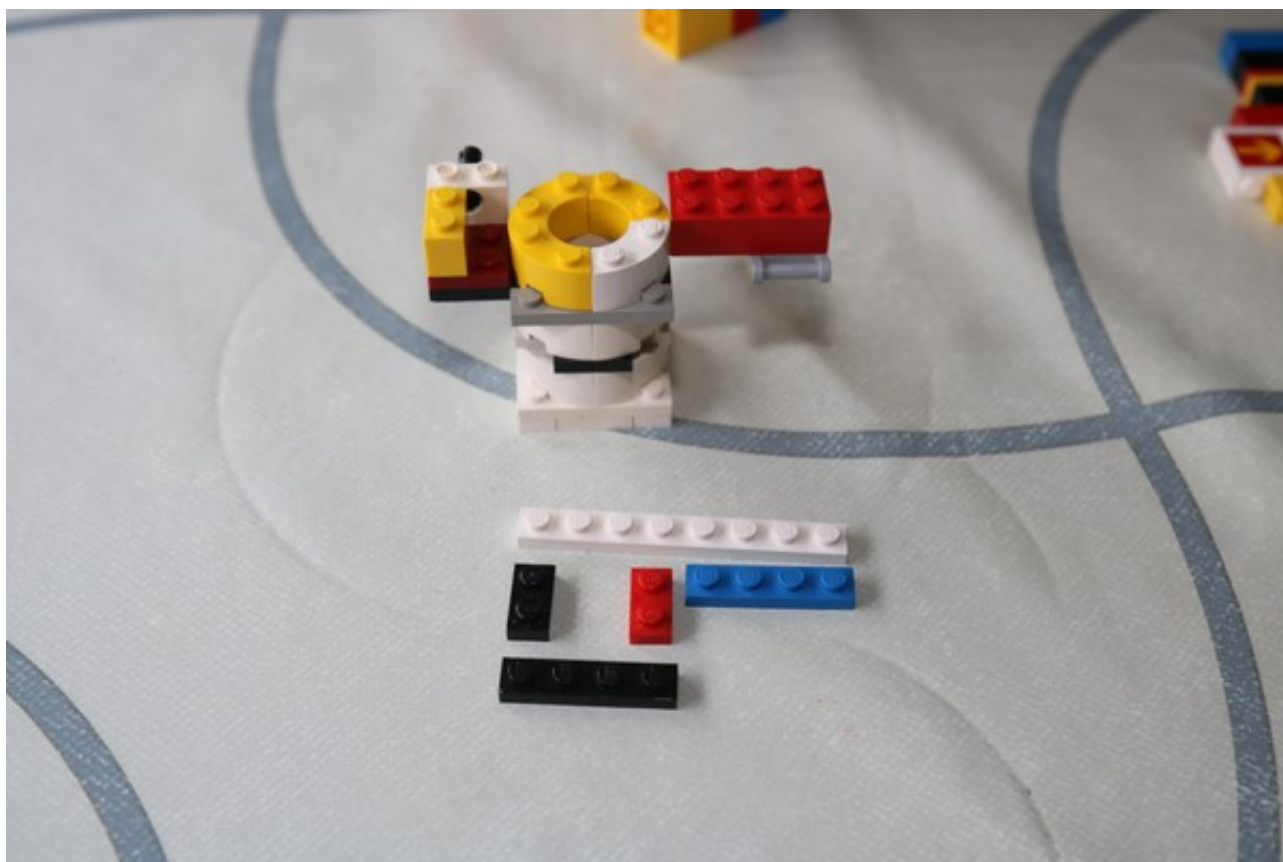
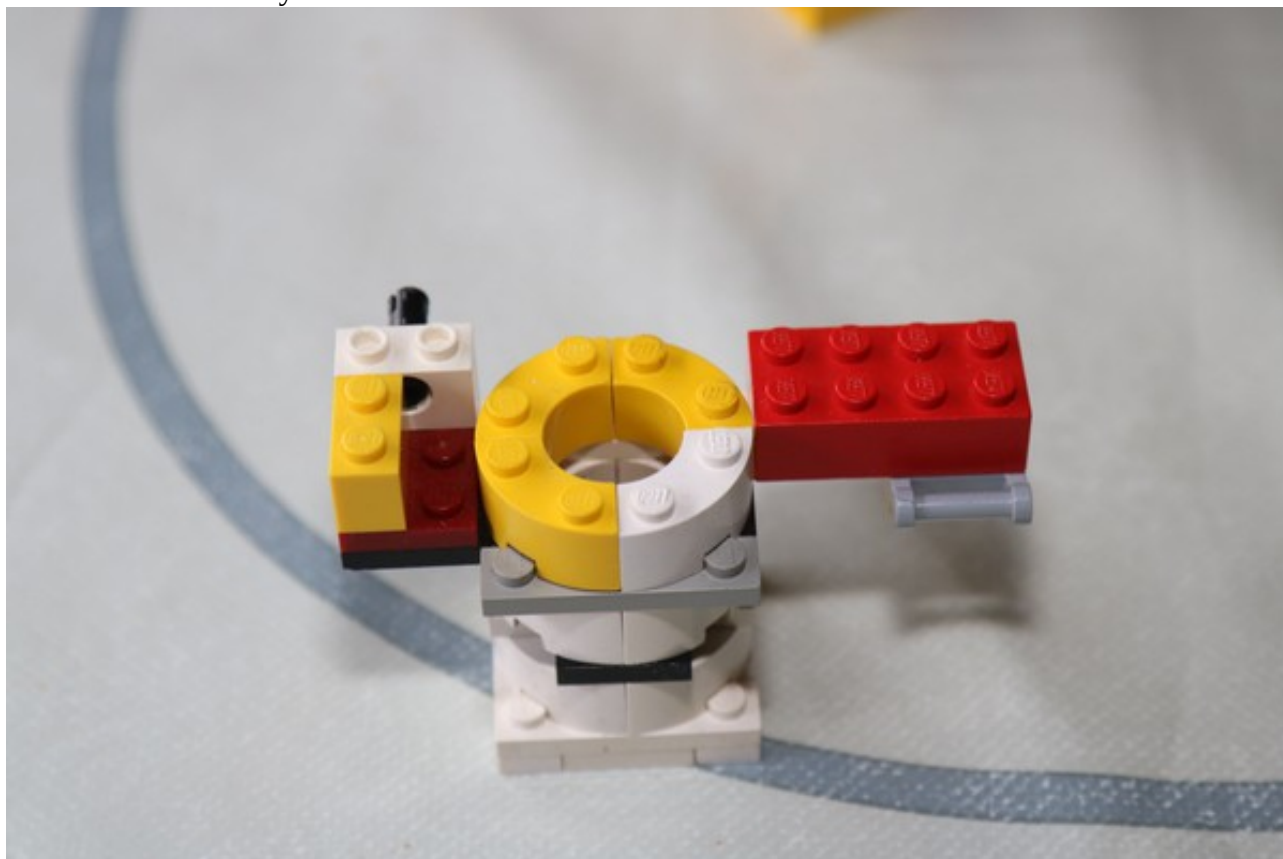
We build the next layer of the tube so that it attaches to the two 2x2 plates with a sideways hole.

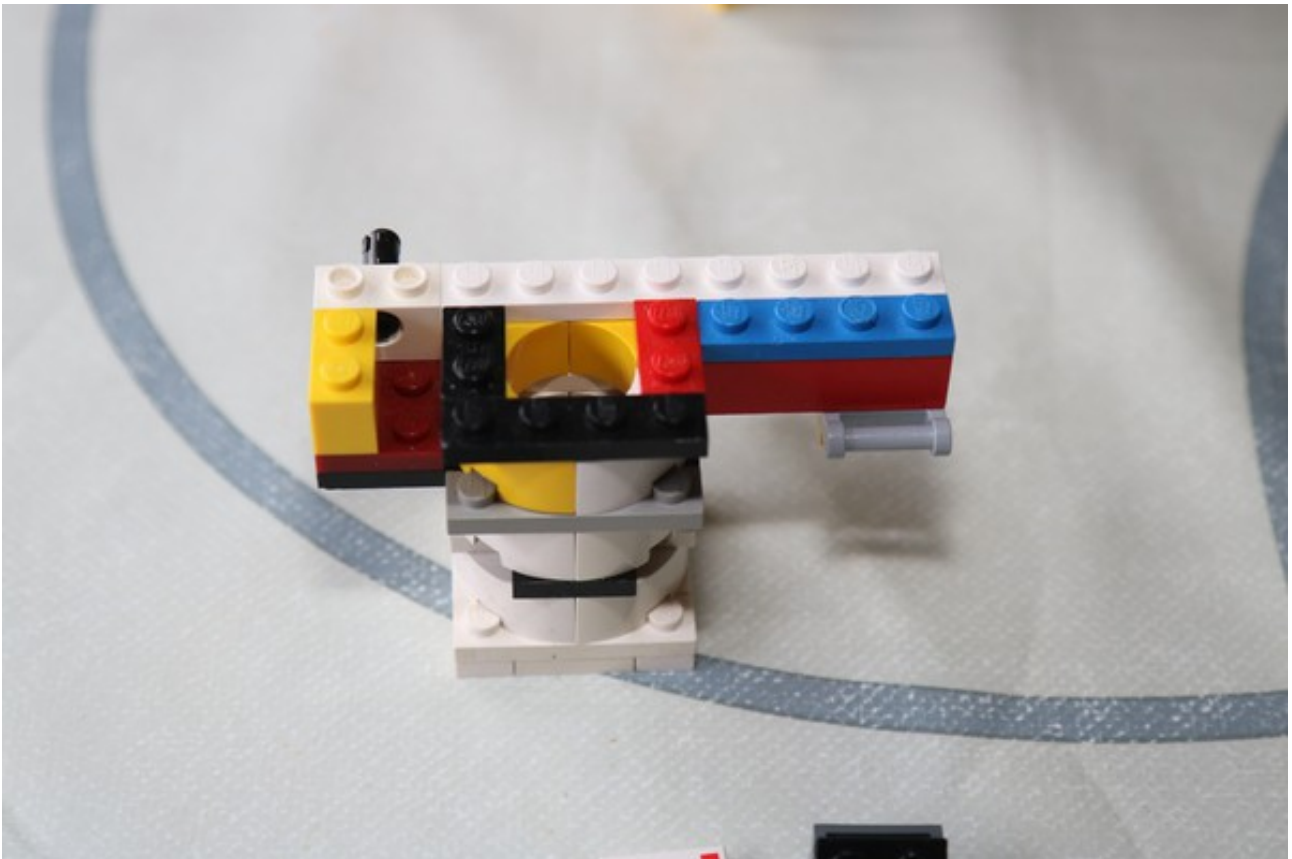


Add another layer, and prepare a couple of extra components:

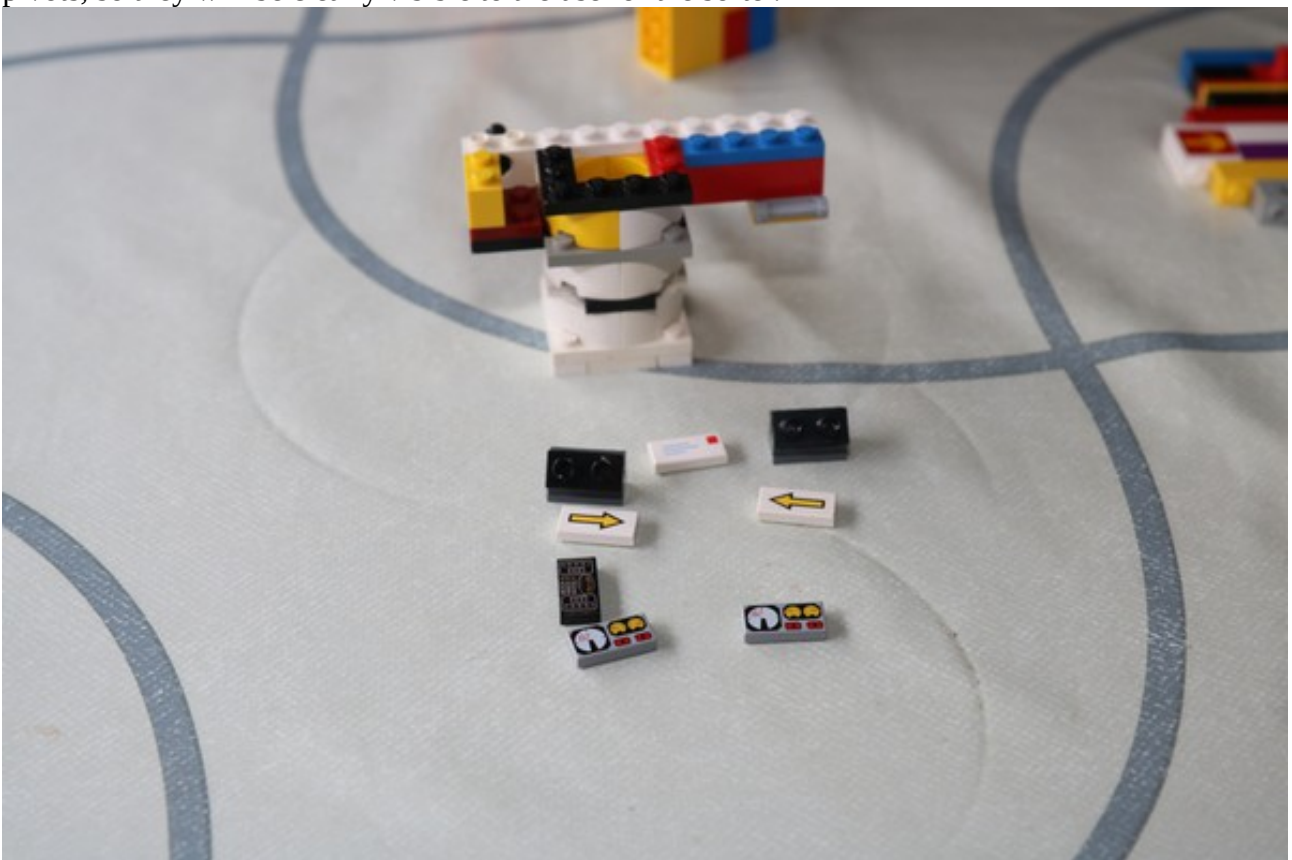


Assemble the third layer like this:

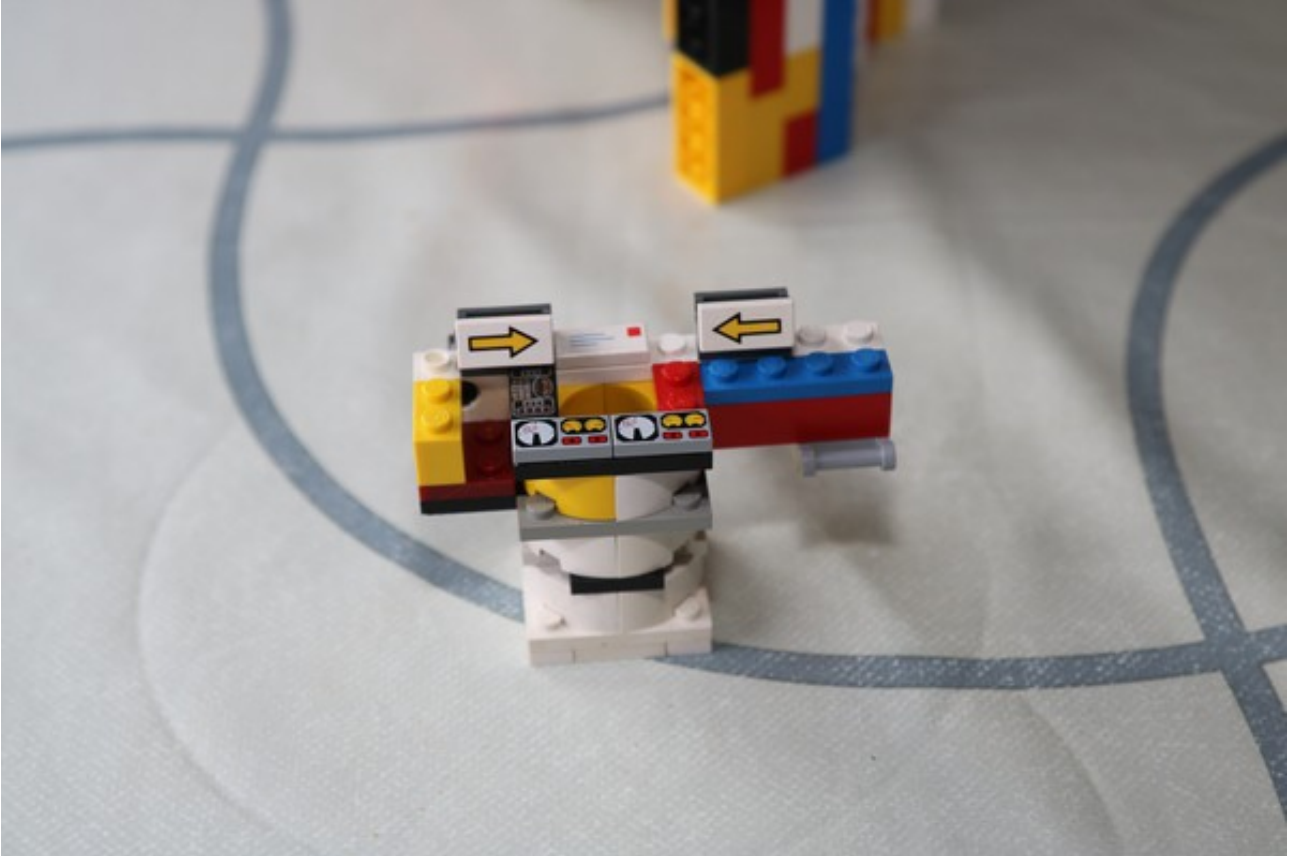




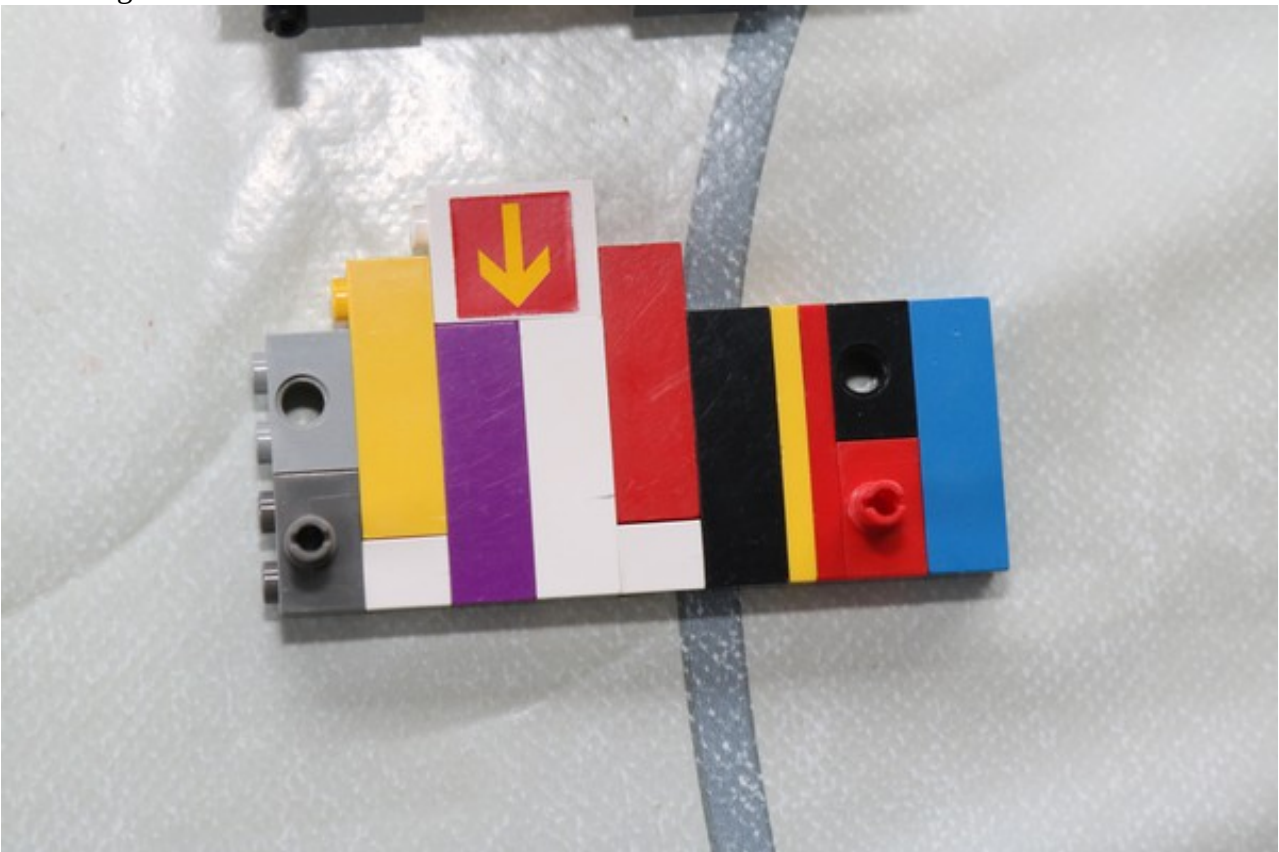
We finish the tube construction with some decorative elements. The arrow plates are mounted on pivots, so they will be clearly visible to the user of the sorter.



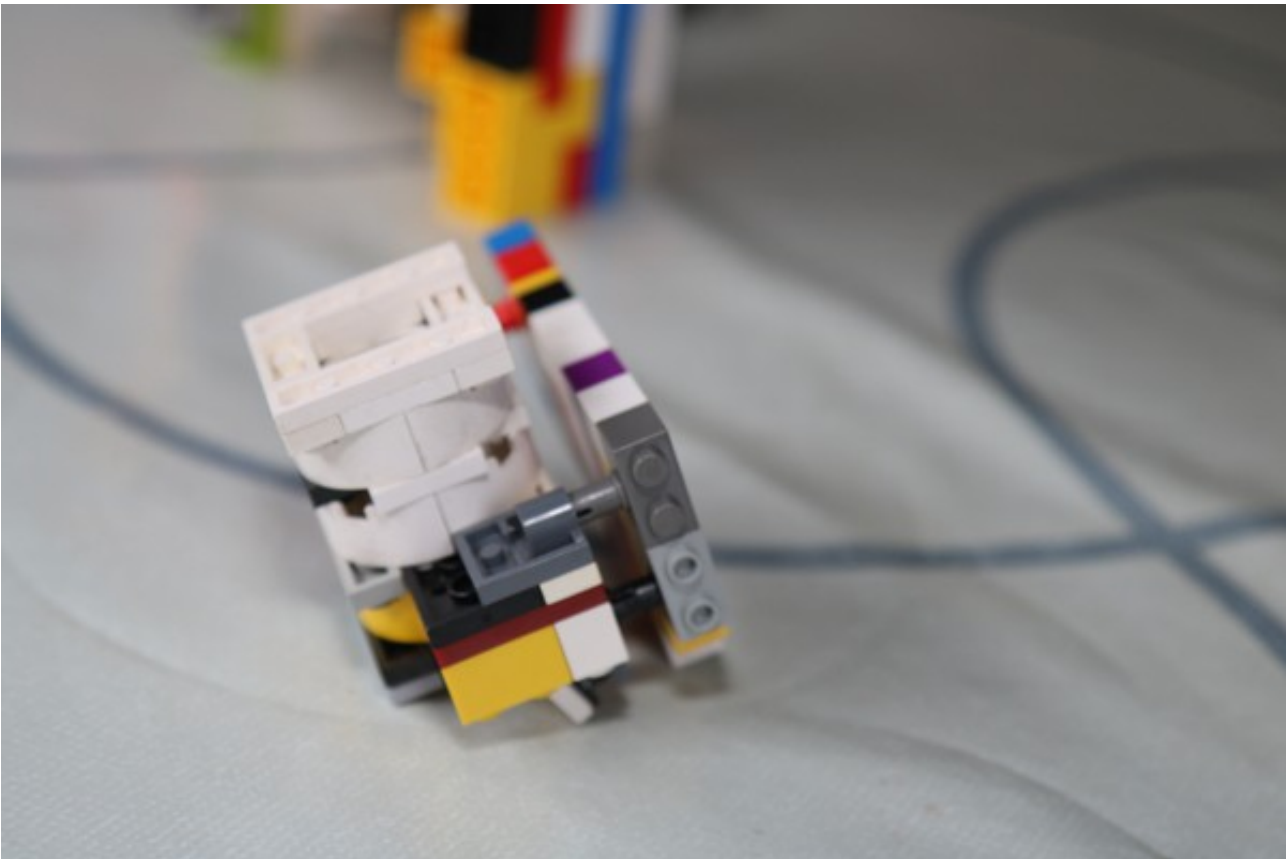
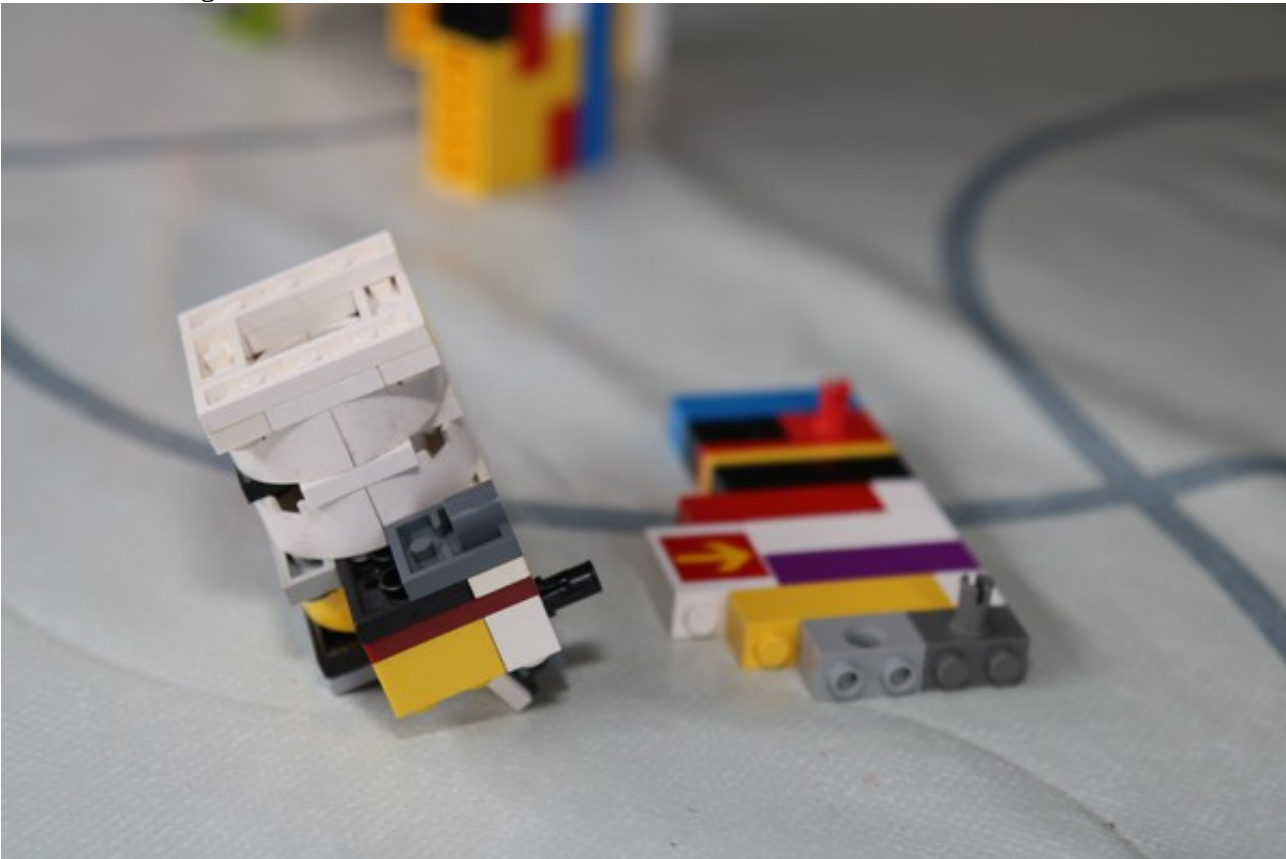
This is the complete tube assembly:

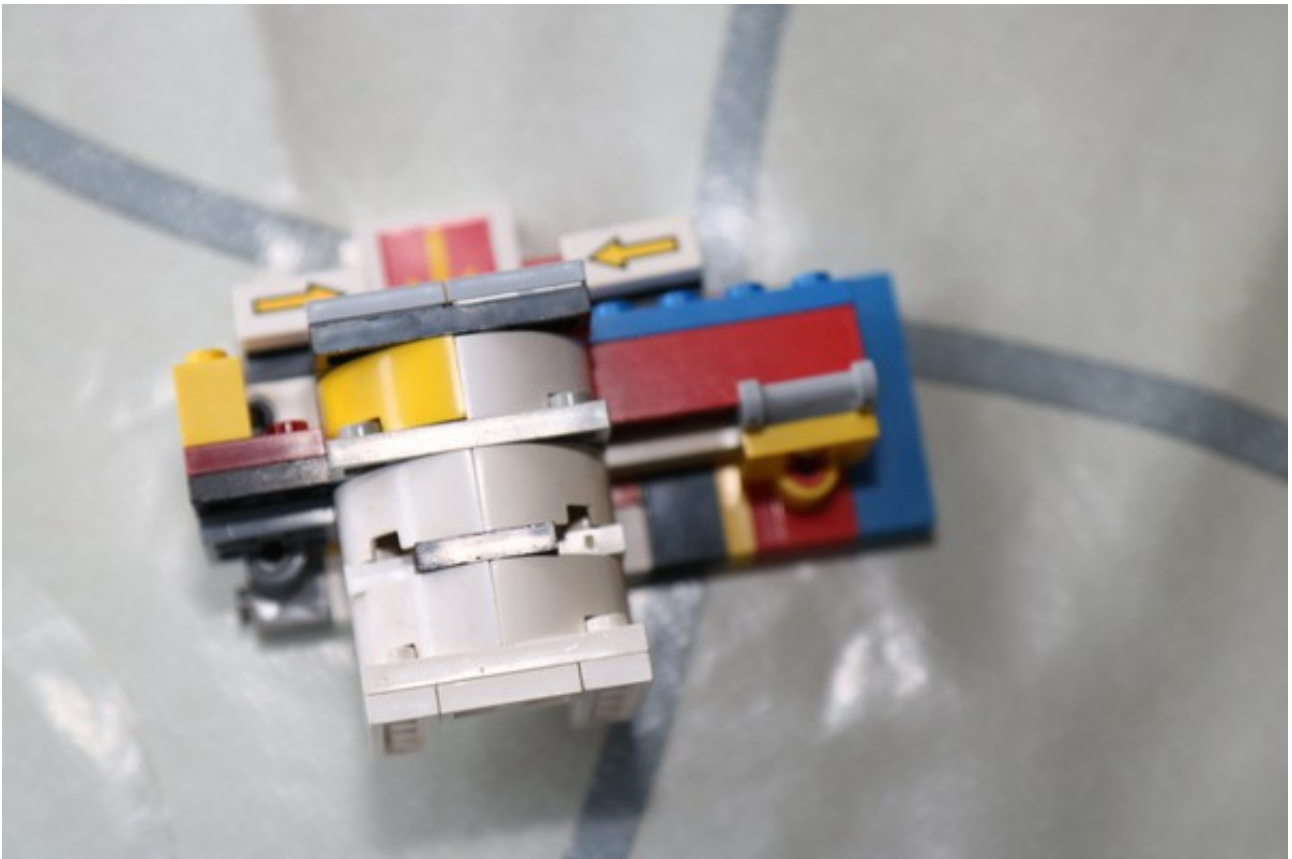


Step 12: we need a sideways wall to mount this tube onto. The arrow is only there for decoration and user guidance.



With correct alignment, it's obvious how the tube attaches to the wall.

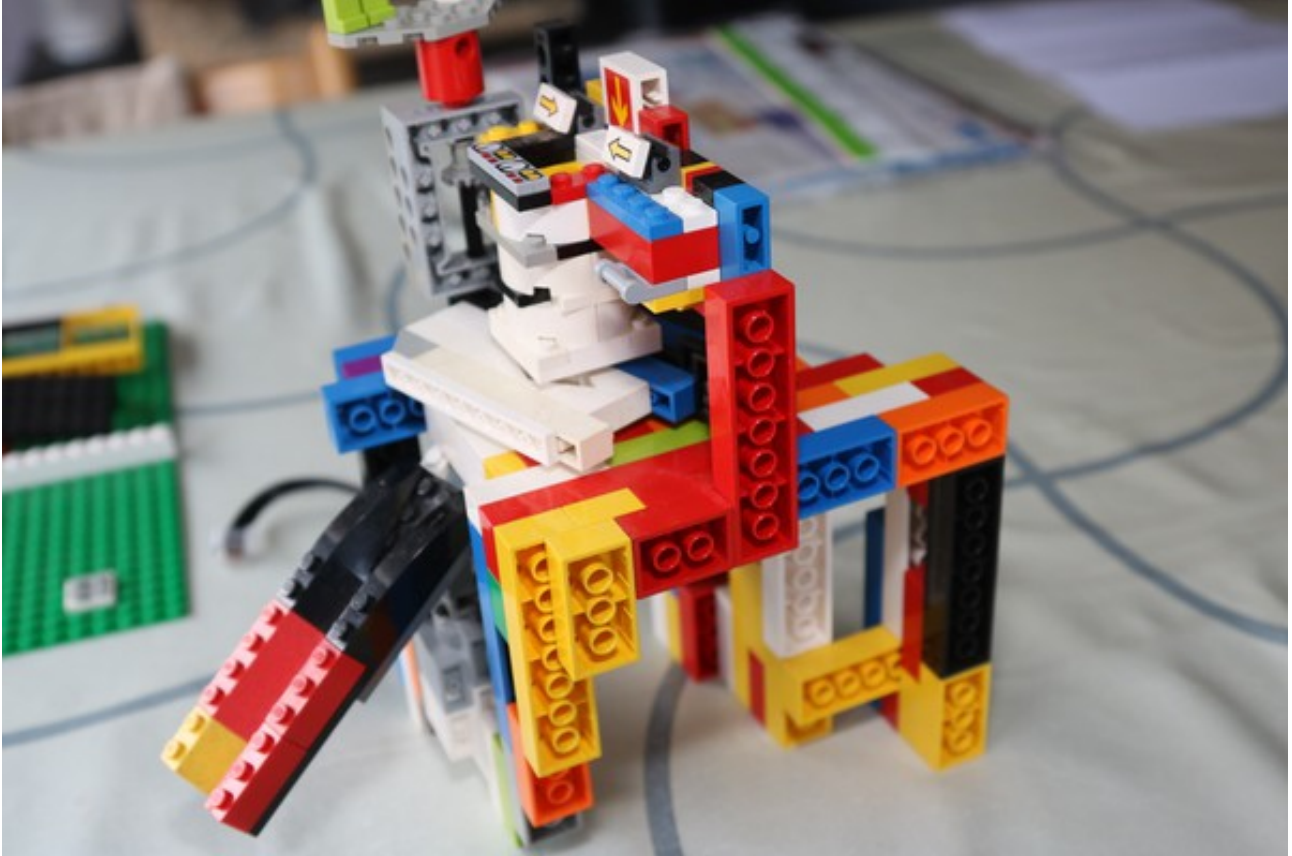




Mounting this part to the sorter is easy. The two plates in the wall (yellow and red in the picture) are needed to get the correct distance between the connecting pins. Together with the blue plate we mounted earlier, this makes the wall 9 bricks high. We can support it from the floor level on both sides now. The wall does need to extend far enough and be mounted high enough to allow the swiveling transport plate to move underneath.

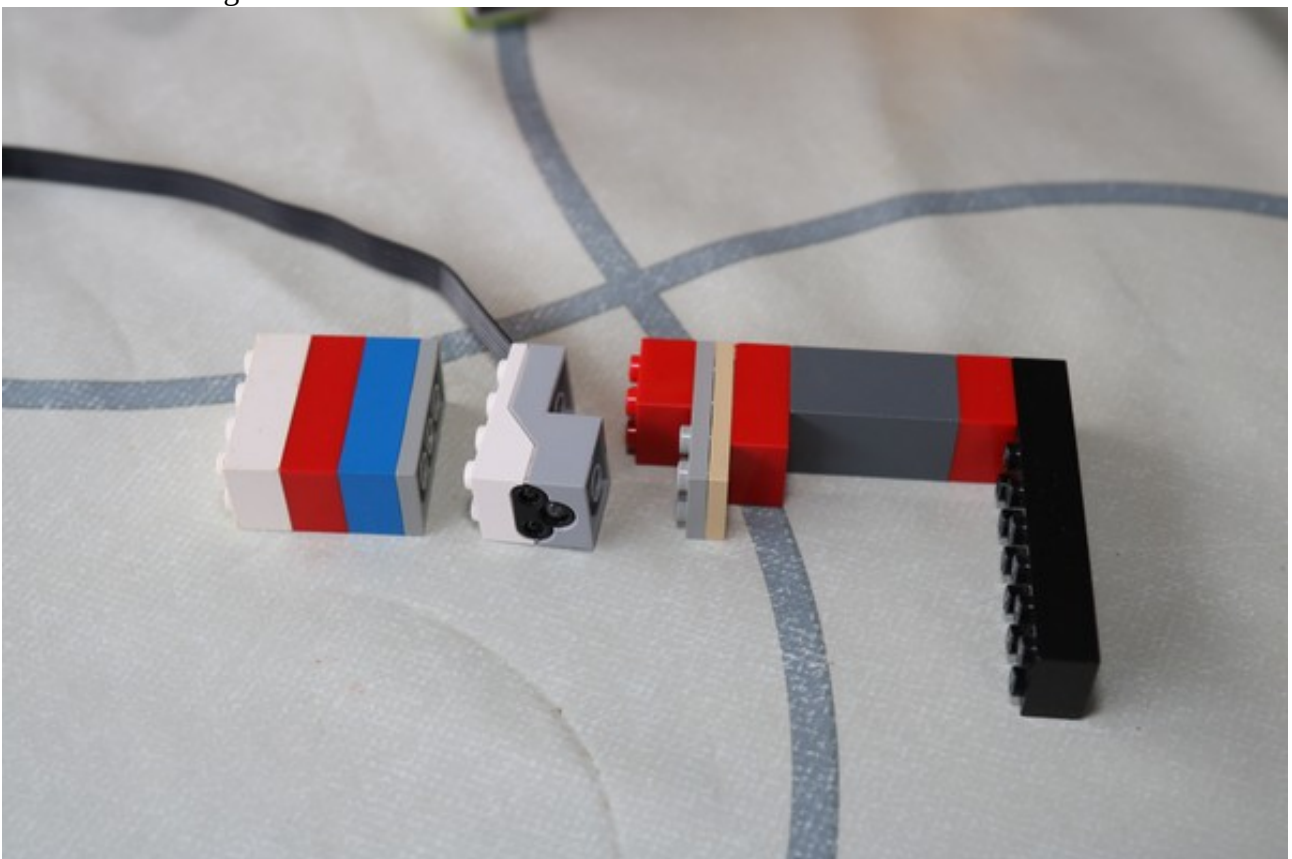


We use a 2x8 brick to support the wall on the other side.

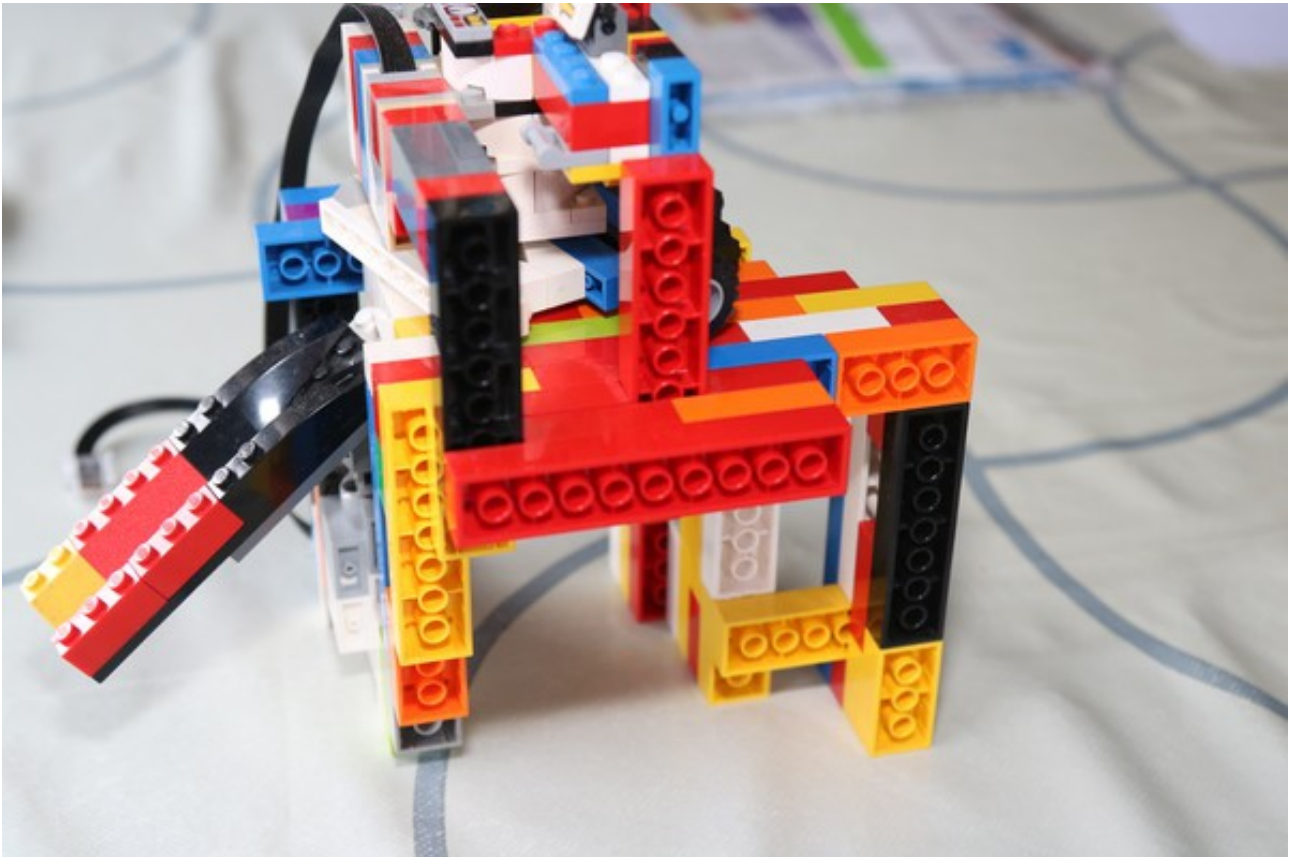


Step 13: mounting the Boost color sensor. We used a grey 2x2 column as high as 3 regular bricks here, but a regular stack of bricks will do.

This forms a bridge that we can mount over the floor next to the Skittle feeder.

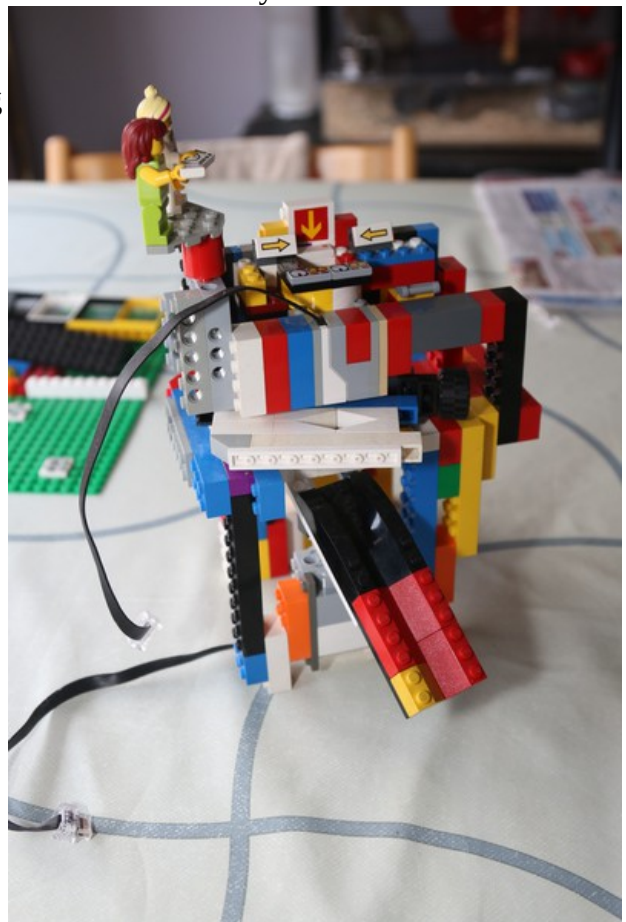


We can mount it on the structure, and make it more solid with a couple of extra bricks on floor level.

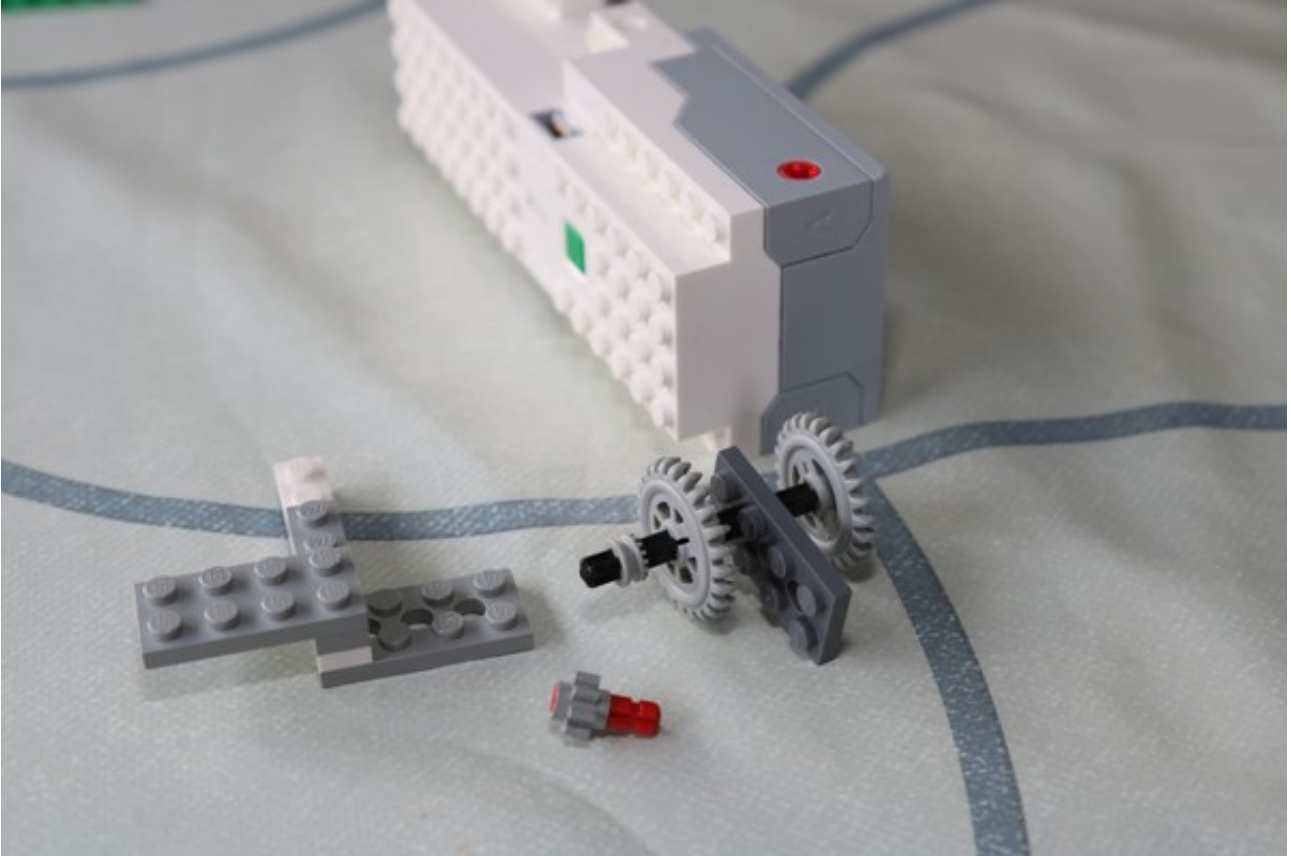


With the color sensor bridge mounted, the swiveling transport plate should align at different angles with the feeder tube, the color sensor, and the drop point where the candy falls onto the slide.

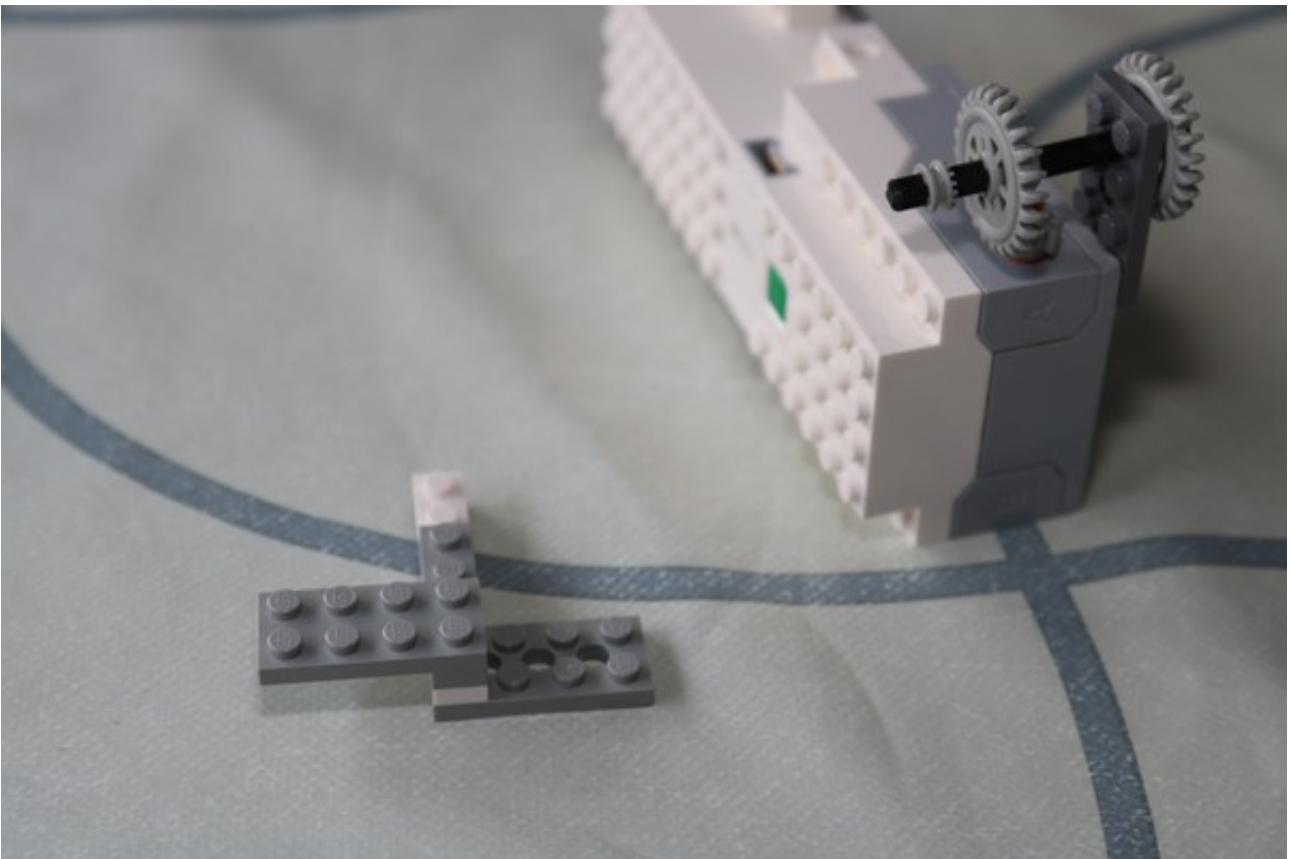
This means you can test the mechanism manually, by manually rotating the 16-tooth gear and inserting a Skittle into the feeder tube.

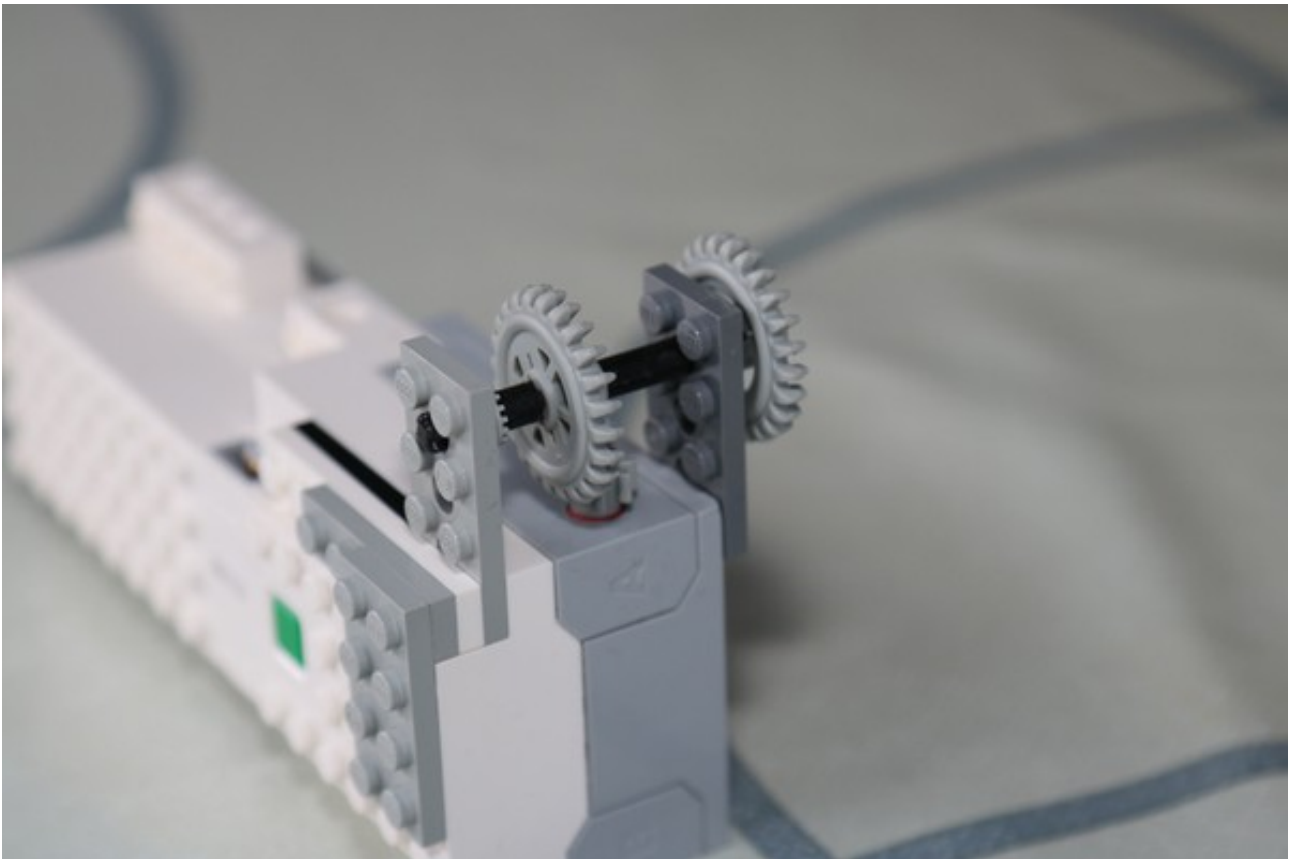


Step 14: the Boost motor assembly. Gather these parts. The Technic parts include two 24-tooth crown gears and an 8 tooth gear.

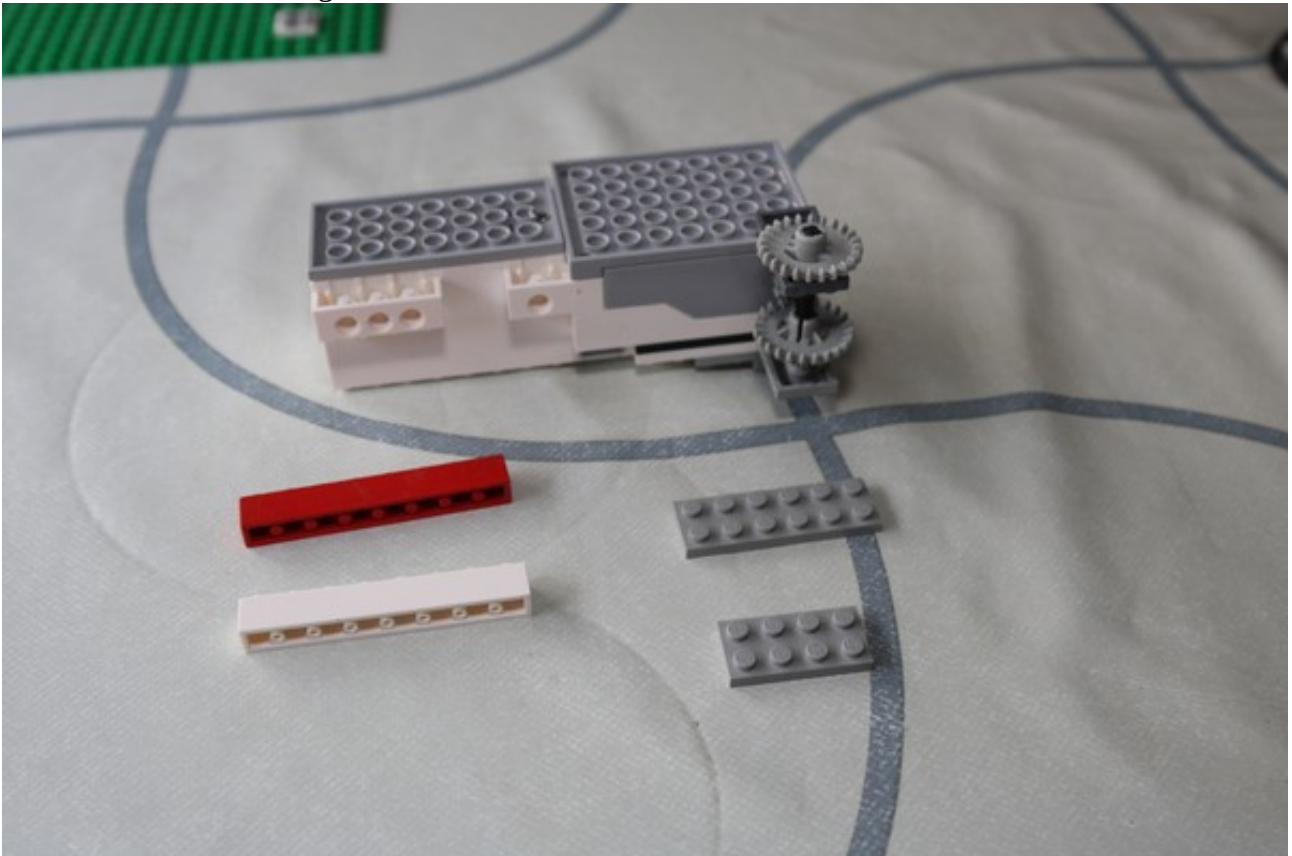


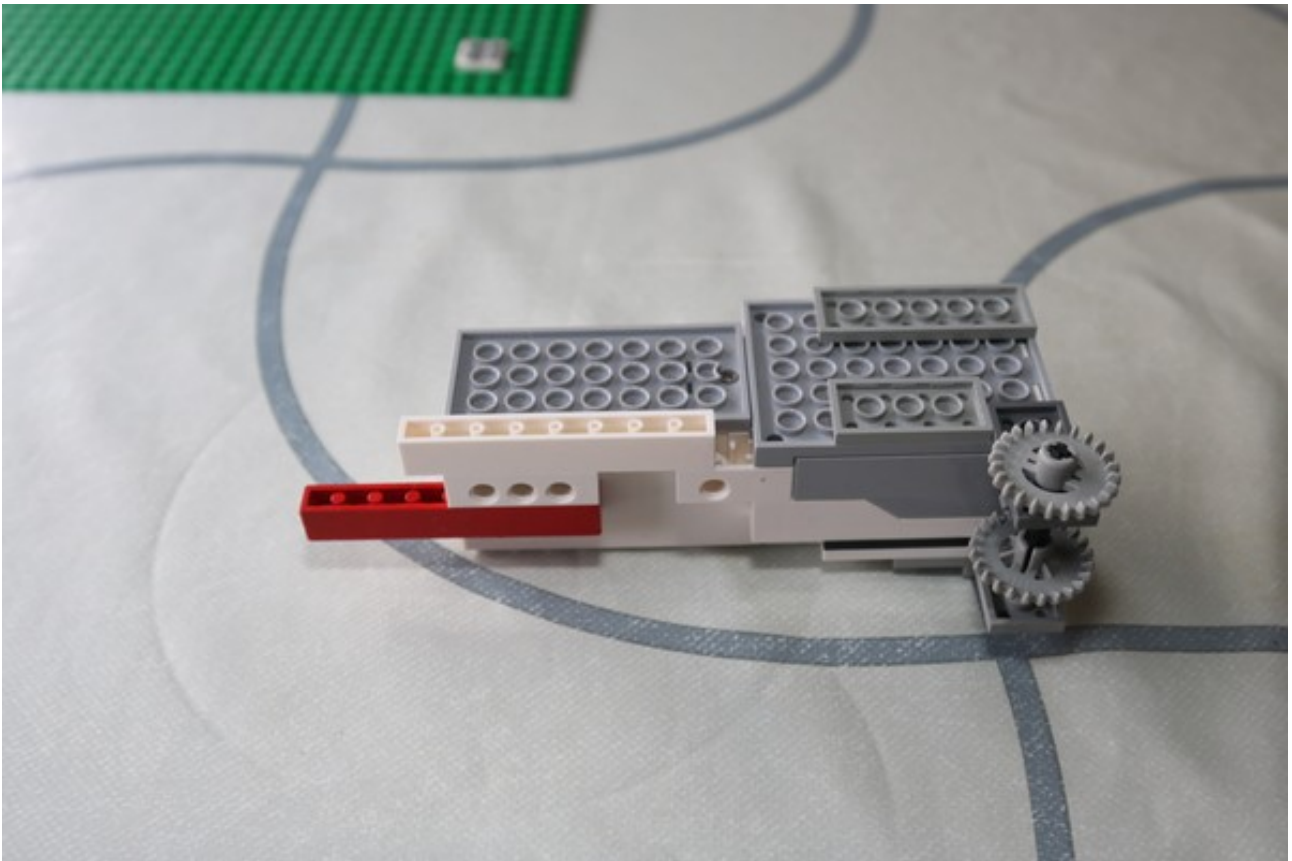
Then mount it on the A side of the motor block.



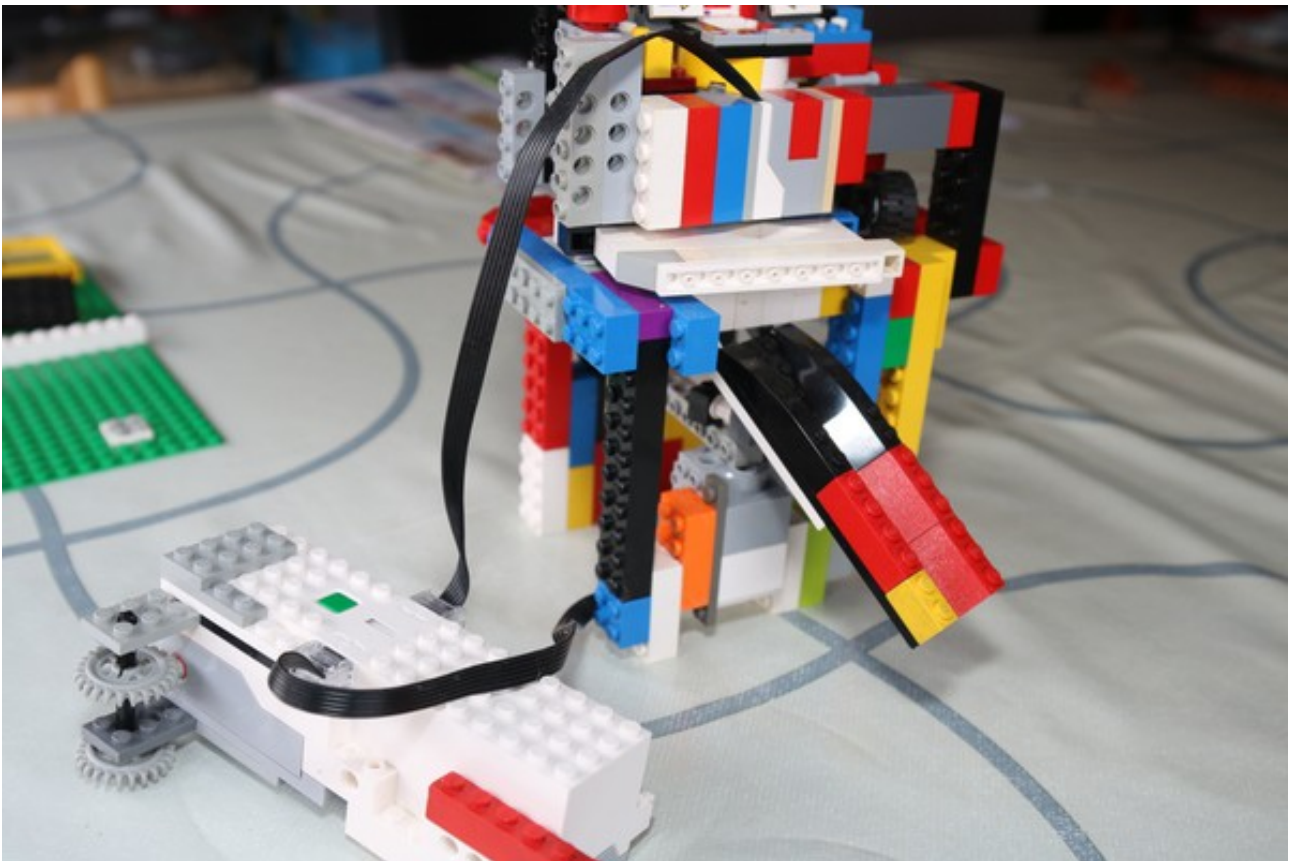


The stopper prevents the axle from sliding away, but leaves enough space to allow you to manually slide the crown gear away from the 8-tooth gear to stop automatic movement, or to calibrate the starting position before starting the sorter.
Next we'll add a small leg to the motor block.

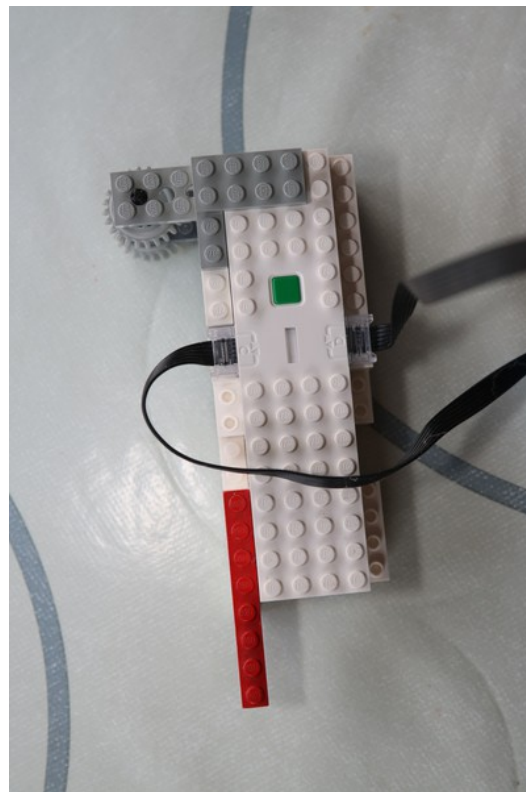




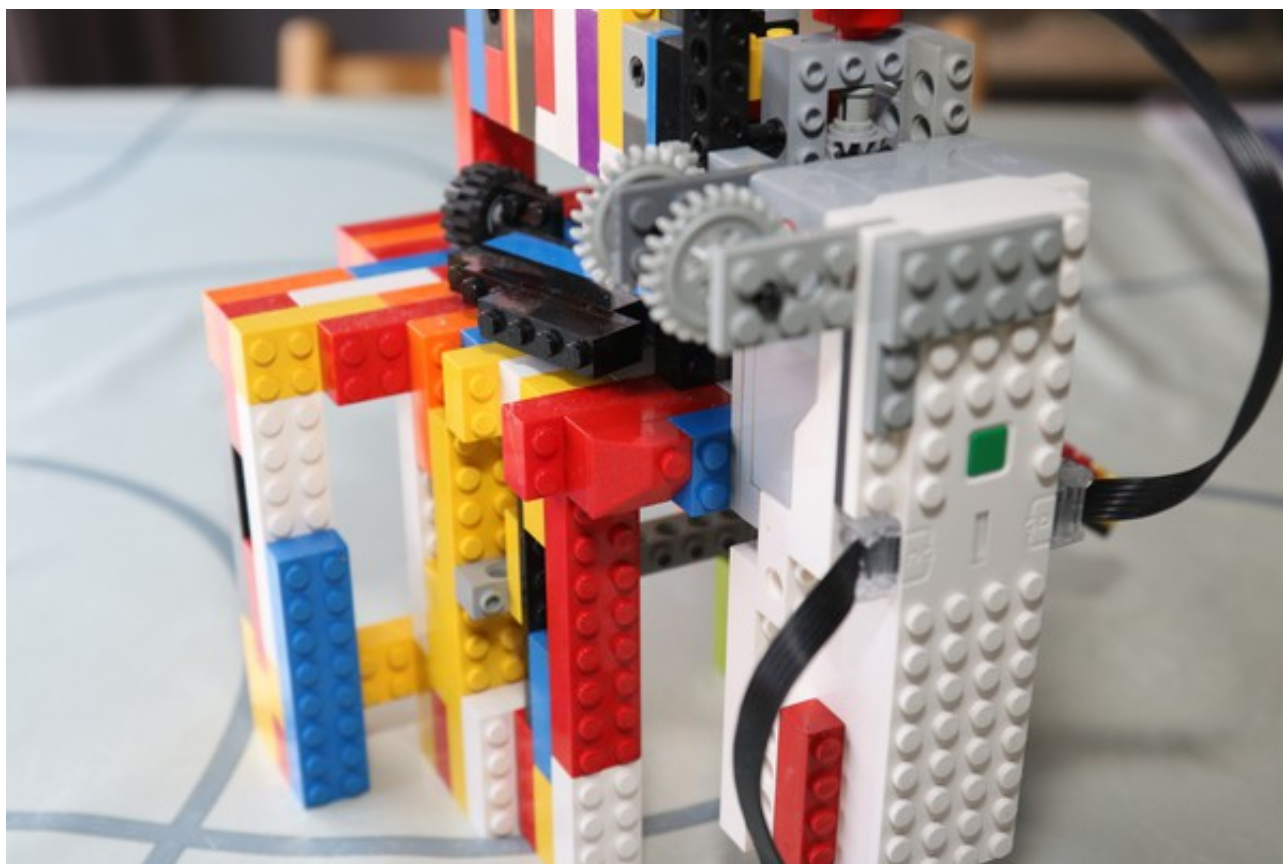
You can now attach the external motor and the color sensor to the main motor block.

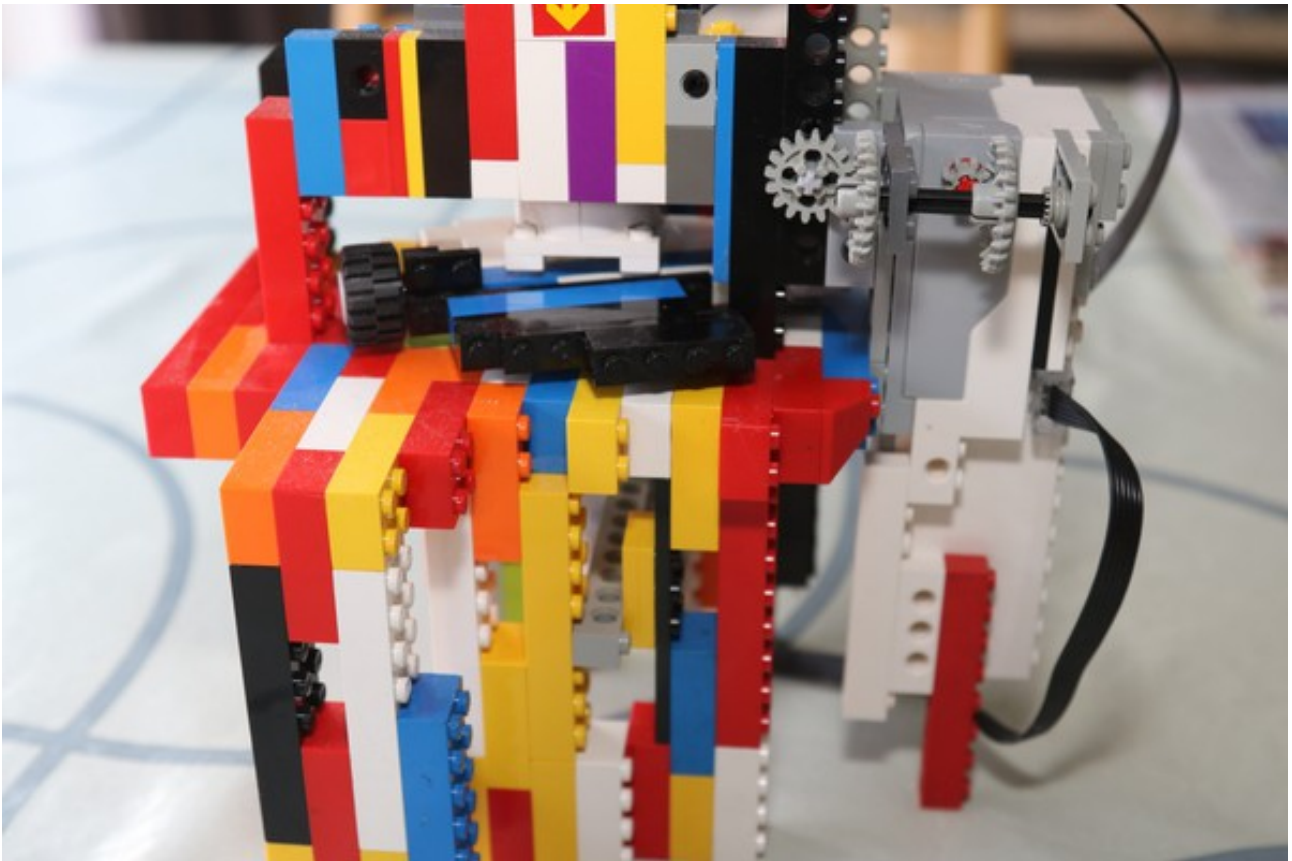


The top view of the motor block should look like this. If you haven't replaced the batteries in the motor block, this would be a good time to do that.



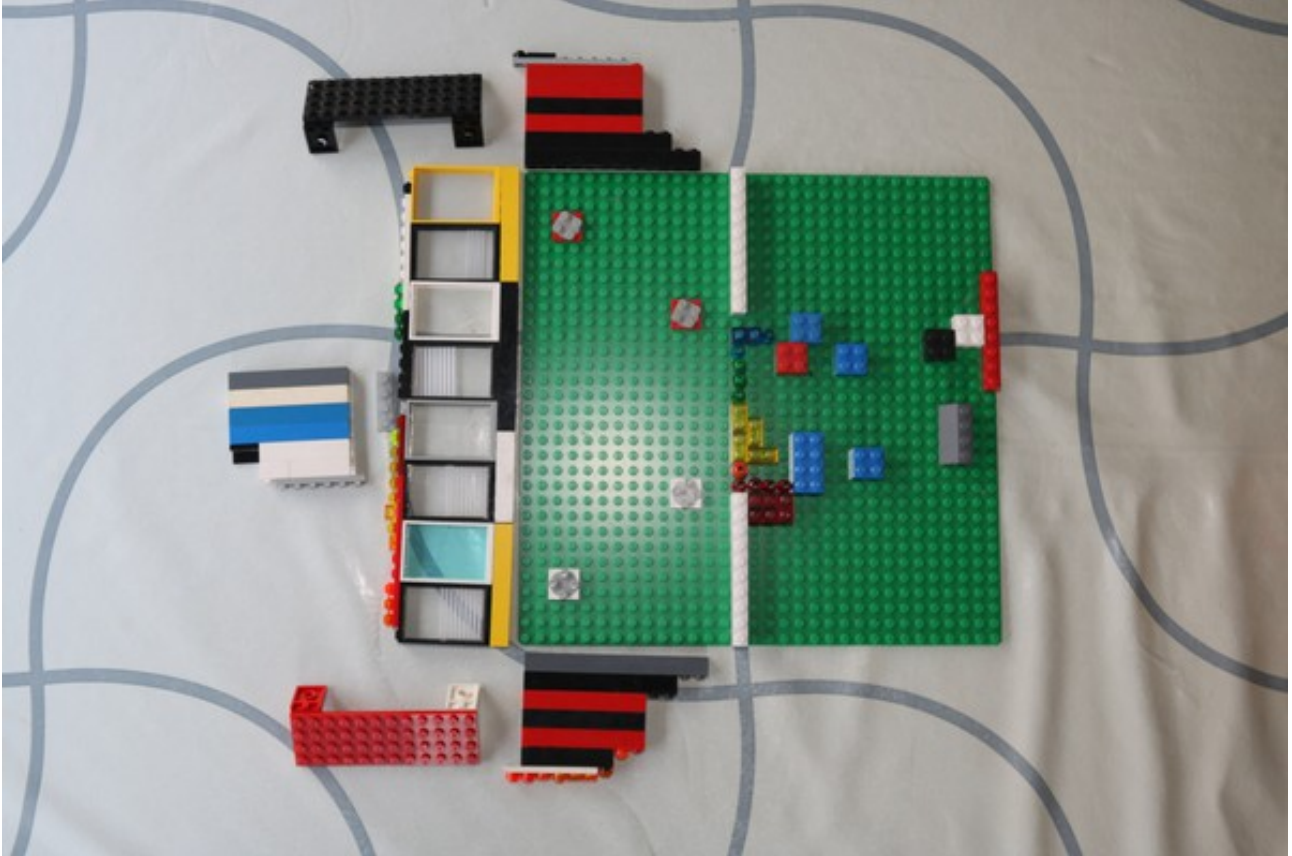
We can now mount the motor block onto the rest of the sorter, and slide the crown gears over their axle so they grip the 8 and 16-tooth gears.





With this 14th step, the sorter itself is finished. However we also built a base plate with sorting buckets in Lego. Step 15!

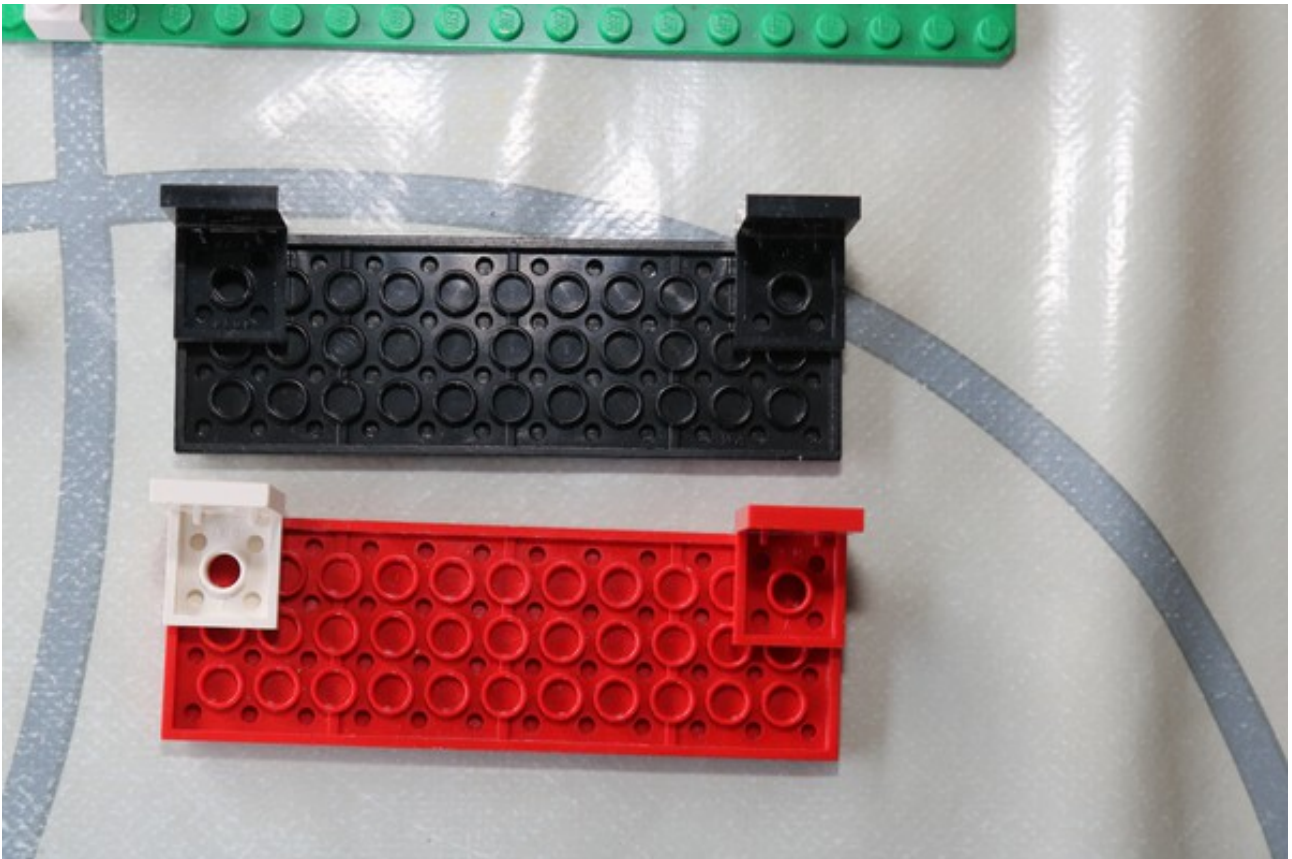
This overview image shows all the parts for the collection bucket assembly.



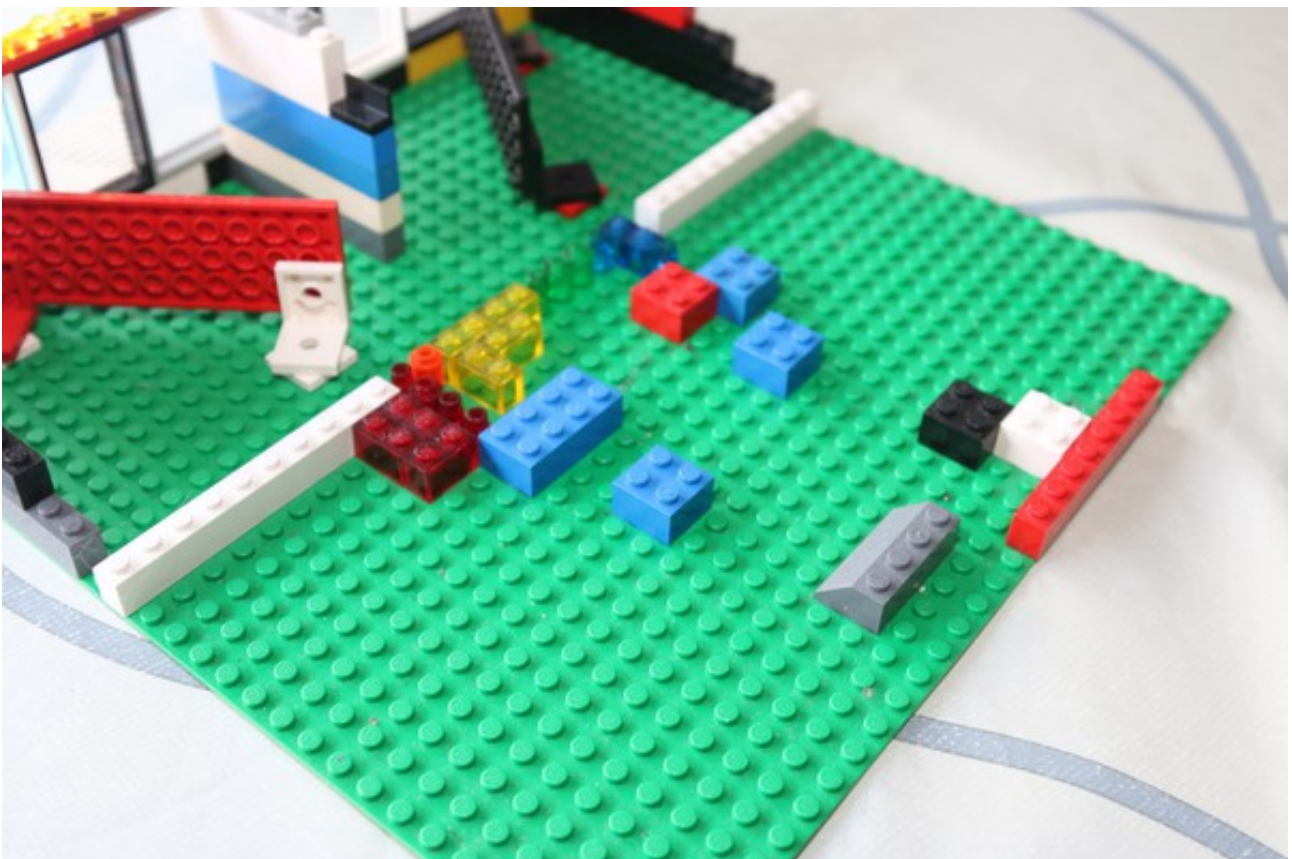
It is built on a 32x32 base plate. One side is a wall of windows, which is great for demoing this sorter for a public. The colored translucent pieces on top of that wall are there mainly for decoration, but also they are placed in front of the zone where Skittles of that color will be deposited. The same goes for the translucent blocks in the middle of the base plate.

The side walls are there to hold up the wall and to avoid spillage. The middle wall is the divider between green and yellow. It features a small 1x2 ridge to avoid Skittles hitting the divider head-on and bouncing back. That's probably a corner case, but we found the piece so we used it.

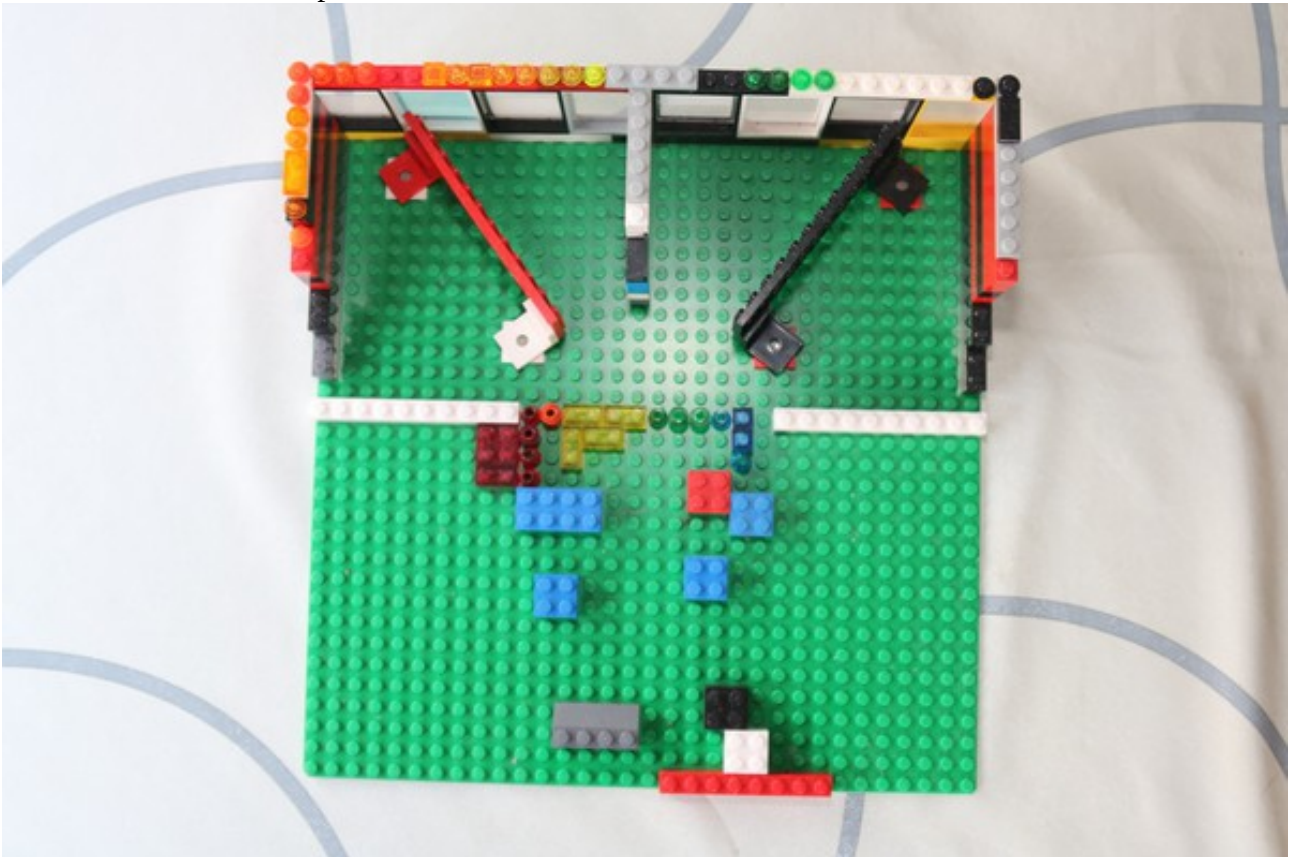
The two other dividers can't be placed in standard perpendicular Lego fashion. We worked around that by using 2x2 rotary plates on the base, at a distance of 6x4 of each other, and 12x4 plates with 90 degree angle attachments at the last position.



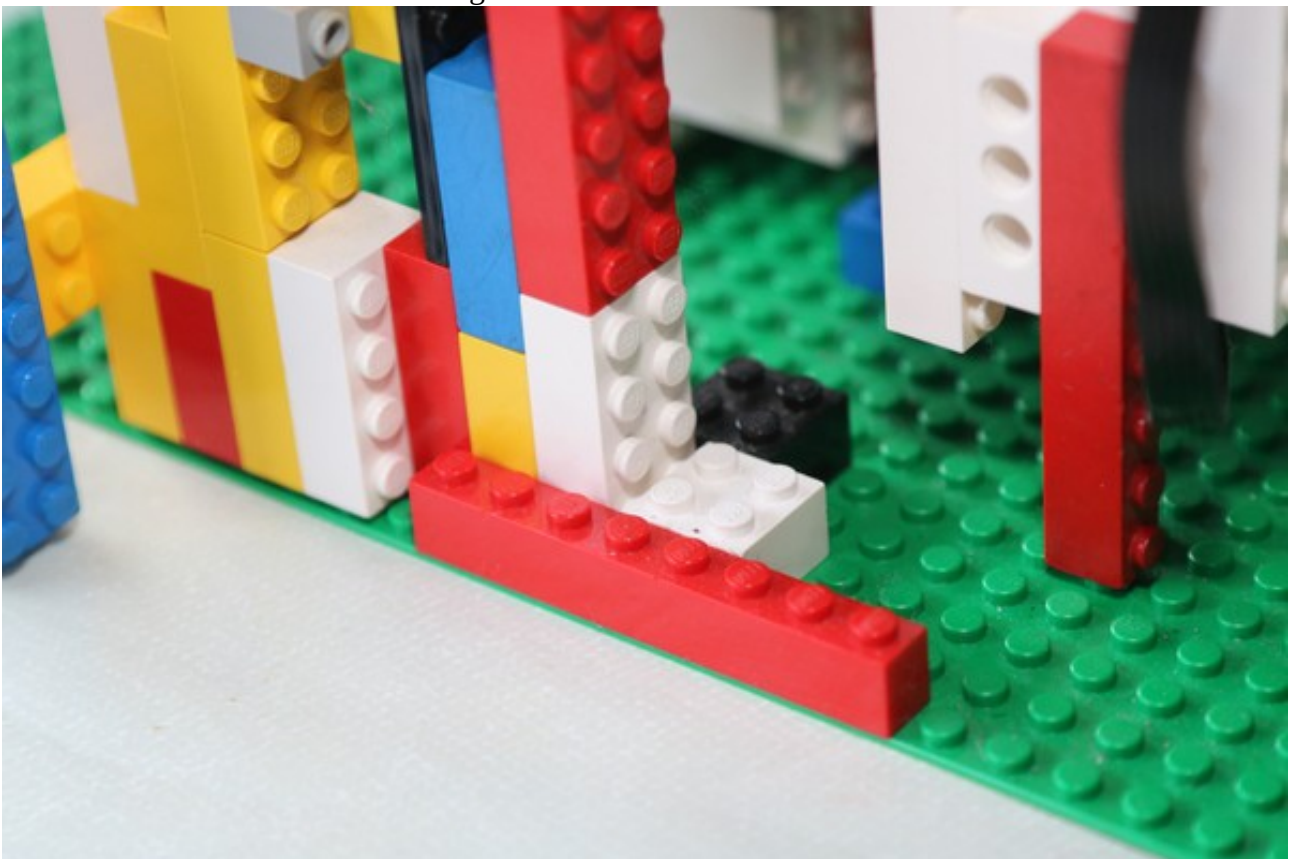
This allows us to divide the collection zone in four zones, radiating from the point where the slide pivot will be. To easily position the sorter on the base plate, we mounted a couple of regular bricks on the other half of the base plate, so that the sorter legs fit right next to those bricks.

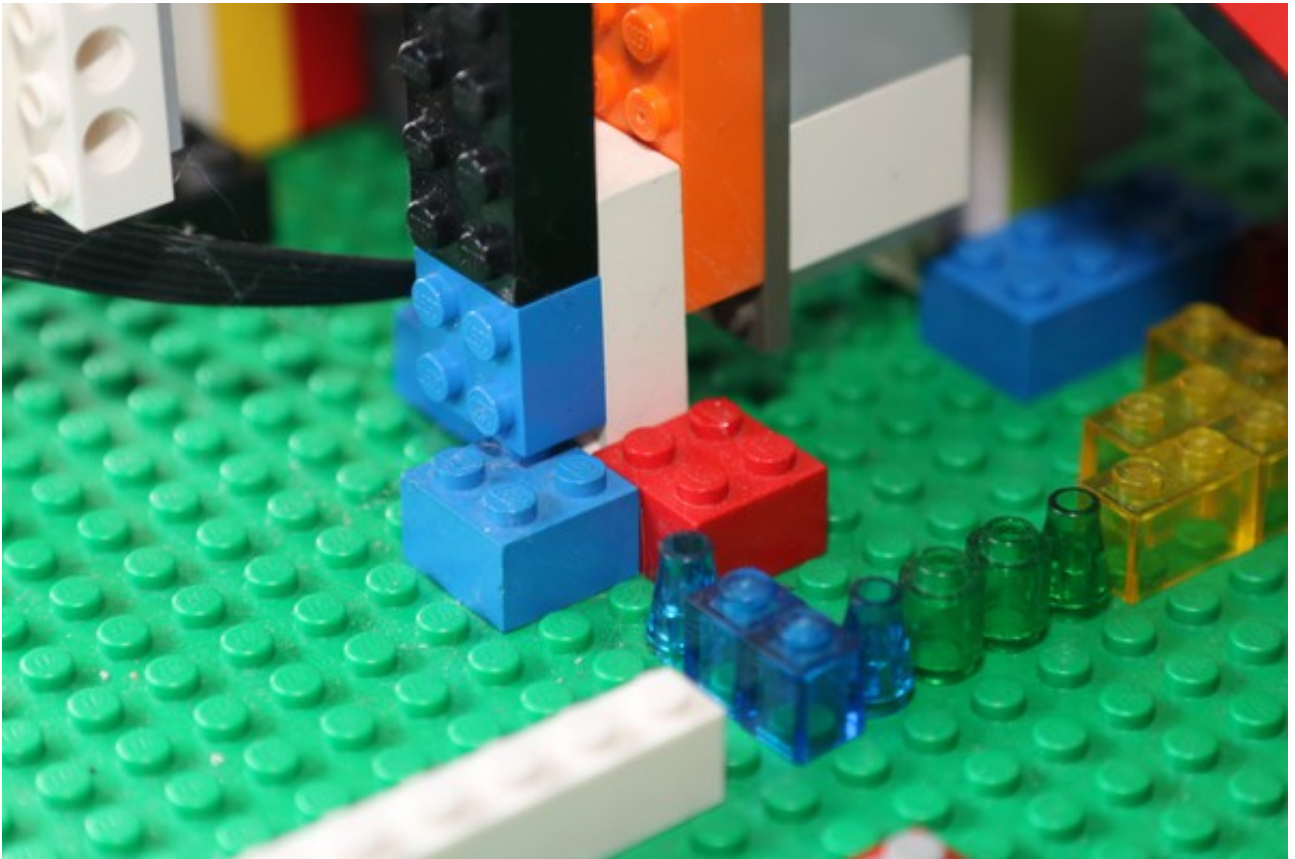


When finished, the base plate looks like this:

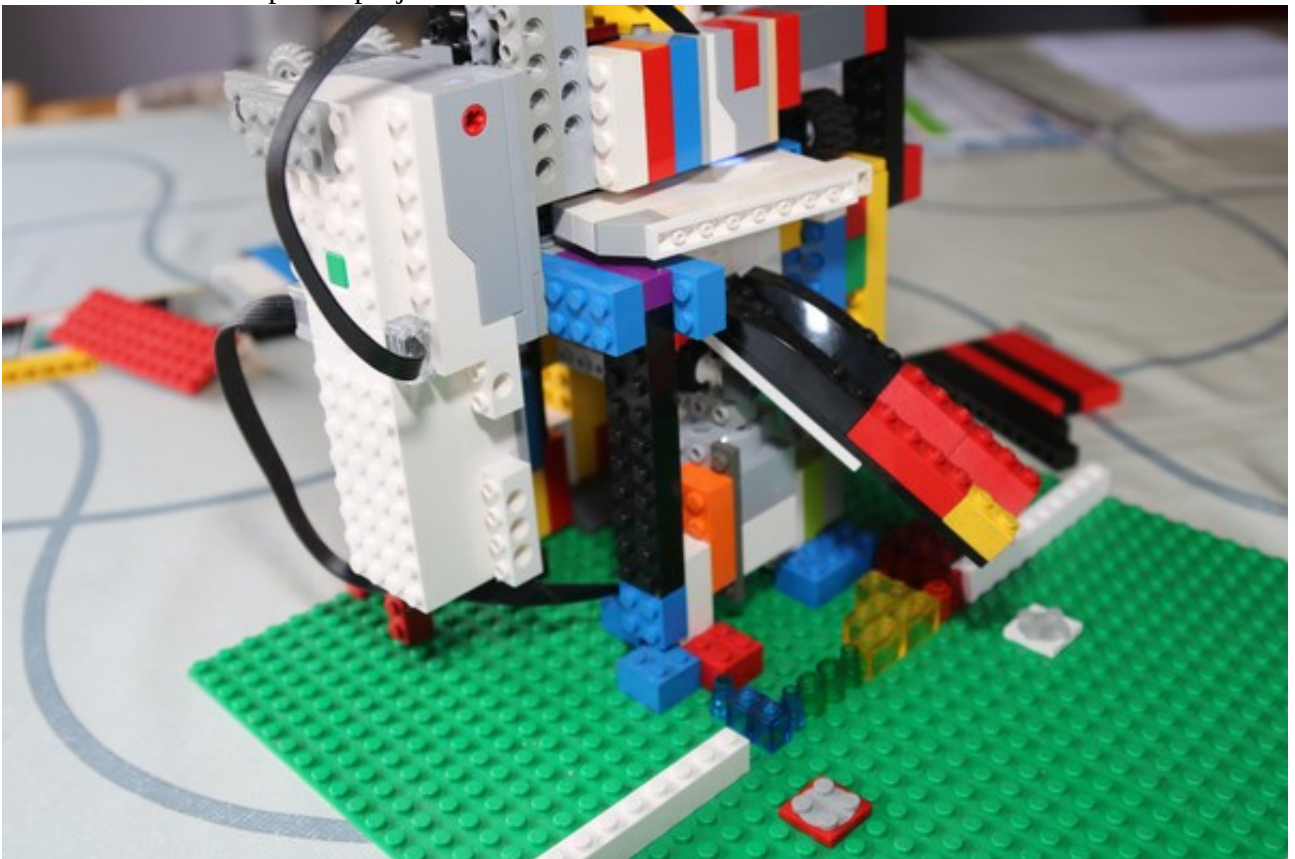


if you built the legs of the main unit differently, adjust the alignment bricks in the lower half of the picture so that your robot fits between them, and doesn't move easily. The next two pictures show how the robot stands between the alignment bricks.





This is what the completed project looks like:



Step 16 is the Lego boost program: the project uses the left internal (A) motor of the Boost block, the external motor and the color sensor. Combining these elements in a program can be done via the “create a project” function of the Lego Boost app. If you've never created your own project, find instructions on the Lego website: <https://www.lego.com/en-us/themes/boost/articles/how-to-create-a-new-project-in-lego-boost-46fadf12331a4c8eb0ea5456665a2832>

The main movement is the swiveling candy mover plate, driven by the A motor. Initialize it so the hole aligns with the feeder tube (slide away one of the crown gears to allow free movement, then slide the crown gear in place again). Initialize the slide in the central position.

The program can now, in an eternal loop,

- move the plate “a” steps further using the A motor, “a” being just enough to position the candy below the color sensor. Adapt the “a” constant by experimenting.
- One of the color sensor detection blocks will fire when the candy is in place, setting the “d” variable to the degrees of movement needed from the external motor to swing the slide to the correct zone. In the example, I associate red with -45, yellow with -15, green with 15, and black with 45. You might want to add a detection block for white, setting “d” to 0, to avoid movement when there is no candy.
- The main loop waits for one second, then reads “d” and stores it in variable “c”. Storing the current value of “d” is needed because the color sensor will see bricks of other colors when plate moves. We need to remember the value associated with the candy color so we can move the slide back to the central position.
- The external motor then activates, moving the slide “c” degrees.
- The candy mover plate will now move the plate “b” steps further using the A motor, covering the distance between the color sensor and the drop position above the slide. Adapt the “b” constant by experimenting.
- The program waits one second, which should be enough for the candy to drop in the correct zone.
- The candy mover plate moves back “a” + “b” steps. We specify a negative speed to get the motor to turn in the other direction.
- The slide turns back “c” degrees using the same trick: negative speed with a positive degree value.

This is an example of what the program could look like.



Have fun!

If you tried this project, we'd like to hear from you! Please send us a message at Bert de Bruijn <legoboostcandysorter@debruijn.be>.

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