Due to the lack of power tools, we had one of the associates in the lumber department at Home Depot make all of our straight cuts in the store. He was able to cut our 2x2 furring strip into the 6 inch blocks and the 2 inch block. He was also able to our 2x4s into the proper size for our support system underneath the course and our medium density fiber board into two 15 inch squares which saved us a good deal of time and effort.

Once we had our materials cut, we were able to start building the course. The first thing we did was to create the pathway that the robot would have to travel. Starting with the starting point of the course, we took our 4 foot wide board and marked it half way at the 2 foot mark. Since the path at the beginning is 10 inches wide, we marked the board 5 inches from the center on both sides (i.e. at 19 inches and 29 inches from the side of the board). Once we had those two points down, we moved the tape measure further up the board and made another mark 19 and 29 inches from the side of the board. We were then able to connect both points at 19 inches with a yard stick and then connected the 29 inch points together.

This gave us our straight lines that we could continue from the bottom/start of the course up to checkpoint C where the pathway splits at a V.
To create the areas where blocks A and B are located, we measured from the bottom of the board to the bottom of the wider spot which was 18 inches. Once we had that one marked off, we marked a line 14 inches above it. Using our carpenter’s triangle, we were able to draw a line at the two spots we had marked for the wide area.

We then made sure that those lines were 8 inches long and connected them to form a rectangle. We did the same thing on the other side of the board to create the second rectangle.
For the connecting branch of the path, we measured 21 inches from the bottom of the board and made a line on the rectangle that we just made and made a mark at 21 inches on the center path. We then used the yard stick to connect those points to form the bottom half of the connection.

To make the upper part, we did the same thing but measured 29 inches from the bottom of the board. (Giving us a connecting path that is 8 inches wide.)

To create the area for the third block, we followed the same process as before. This time however, the bottom of the wide part was 56 inches from the bottom of the board and the top part was 70 inches from the bottom of the board. Again, we used the triangle to make sure our lines were straight and drew them out 8 inches from the side of the board and connected them to form the rectangle.

We then marked out where the connecting branch would be at by measuring 3 inches down from the top part and 3 inches up from the bottom part. (i.e. 59 and 67 inches from the bottom of the board). We made the marks and left them as is until we finished the top part of the course.
We then set up the lines for the top part of the course. The first one we did was the inner triangle which would be enclosed by the path. We did this by measuring 2 feet from the side of the board in two places. Once near the top of the board and once just above the rectangle for block C. We then connected those points using the yard stick and extended the line further down. This line would be our centerline and the bottom point of the inner triangle will be on it.
In order to locate the tip of that triangle, we measured 62 inches from the bottom of the board and found where the 62 inches intersected our center line.

Once we had the tip, we found the opposite side. (Labeled as 25.50 inches) In order to do that, we measured 11.92 inches from the top of the board and marked off two points, one on either side of our center line. We then connected those two points with the yard stick. We then extended the line 12.75 inches on either side of our center line to give us the base of the triangle.

With the top line/base of the triangle in place, we connected the tip to each side of the base.

Once we had the inner triangle drawn, we could find the outside edge of the path using the method seen above. We placed the edge of the carpenter’s triangle on the line for our inner triangle which gave us a perpendicular line. We put the yard stick snuggly against the carpenter’s triangle and made a mark at 8 inches (the width of the path at this point in the course).

We did the same thing five more times (a total of twice on each side of the triangle) so that we could mark a point and connect them with our yard stick, making most of the outside edge of the path.
We then returned to the rectangle that would contain block C and using our carpenter’s triangle and yard stick, we made the upper and lower lines for our connecting branch.

The last couple of things we did were to make sure our uppermost line was 21.99 inches in length on both sides of our center line, and that if we extended the top line of the triangle, it would meet the angled part of the path 2.01 inches from the side of the board. Once it did, we connected the intersection point and the end of the upper line to complete our path.

Once our path was completed, we erased the unneeded marks to help clean up the course a little bit and make laying down the tape a little easier.
Once we had all the lines cleaned up, we used some painter’s tape that we had on hand to start outlining the pathway so that we could paint it.

**Note:** The tape we used was 1-7/8 inch painter’s tape which is the same size as the boundary layer for our lava. (1.88 inches) This made life easier when we laid down the tape for that.

In order to cut the tape to the right shape, we used a utility knife that we had on hand. We found that it was easier to cut the tape if you started the cut in front of the tape otherwise the knife could bunch up the tape instead of cutting through it.
When we started spray painting the course, we used some cardboard to help block any excess paint from moving off of the path.
After the paint for the path had dried, we put down some more tape over the path to give us some more room for error if we were to make any errors spray painting. As you can see in the picture above, we had taped off the area for the red paint.

After the red paint had dried, we removed the old tape and put down some new tape along the edge of the red so that we could paint the pink lava.

While we were waiting for the pink lava to dry, we spray painted our blocks with the white spray paint and then our power cell with the yellow paint.
The last thing that we had to do was create our ramp using the 1x3. The only tool we had that could cut it diagonally like we needed was our hack saw however a regular hand saw would have been easier. (See picture below) This part took a while and was not easy because it was a small piece of wood and if you have to use the same method as we did for this cut, take your time. It is easy for the saw to come off of the wood at the beginning before you are able to make a groove for the saw to follow.
Once you have the ramp cut, you will need to even it out with some sand paper. We had some 150 grit on hand which worked well.
For the tape line we were to follow, we made marks half the width of the course. For the upper part of the course in the picture above, that would be at the 4 inch mark from the side of the path. Once we had the center mark, we made a mark 3/8 of an inch on either side of the center which gave us the width of the tape and would be our guide when we laid it down.

**Note:** When you lay down the electrical tape, make sure that you are not stretching it. If it is stretched when you lay it down, it will pull up from the board and come undone.
When the branch splits, we used the tape measure to make a cut into the tape at every inch so that we could just pull every other one up to get our dashed line.

After taping had been completed, we were able to assemble our ramp and platform. (They are going on top of the unpainted part which is why we did not completely paint or mark that part)

For the platform, we put it into the corner, lining up the sides of the fiber board with the underlayment and screwed it in. (See pictures below. Also, we have 2x4s underneath the sides of our board for support and that’s what the screws ended up going into)

For both the 9 inch ramp and the 15 inch ramp, we used wood glue to fasten it to the board. After the wood glue had dried, we were able to put the last bit of tape on so that the tape on both parts of the path connected. We then cut the tape into the one inch pieces and completed building the course.
The completed course. (Just missing the blocks in their locations)