Lesson 7: Meet the Finger Gripper

Vocabulary

Pneumatic- operated by air.
Coordinate- a specific location defined by X, Y, and Z measurements.
Actuator- a mechanical device for moving or controlling something.
Move to Coordinate block- code block that allows precise X, Y, and Z movements.
Number Block- code block in the Math tab that allows the user to enter a number.

Direct Instruction

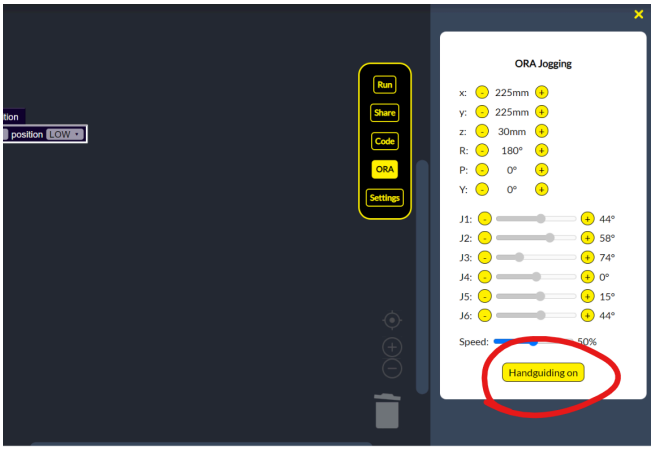
Engage: What is this tool?

On the connected display, open and show the **EngageL7Code** (Share Code: 5gbnarw) as students enter the classroom. For this demonstration, you will need to place a wooden cylinder, on its side, in the center of A1. Direct the students to the Engage section of the Student Activity Sheet and have students write down their best understanding of how the finger grippers function. Encourage students to use more senses than just their sight. They will be able to hear the vacuum motor running, which might give them a clue about how the finger grippers function. The video will show students how these pneumatic grippers function.

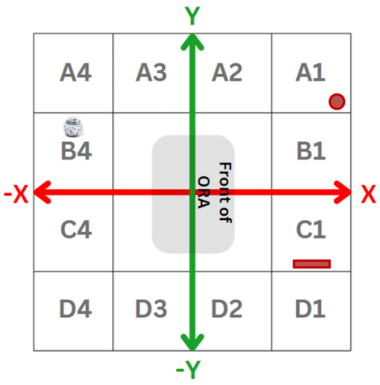
Show the Lesson 7 video. After the video, have students revisit the Engage section to check their predictions on how the finger gripper functions.

Explore the X, Y, and Z planes and finger gripper compatibility.

Student groups will complete two tasks. The first task is to handguide the ORA arm to locate and record X, Y, and Z positions using the Ozobot Editor. Demonstrate this to the students. On the right-hand side, select ORA. Then, select "Handguiding On". When the 'handguide' button on the ORA is pressed and held (the same button used during calibration), a person may physically move the ORA around. The Ozobot Editor updates the X, Y, and Z coordinates in real time.



Set up the ORA Quadrant map with a wooden cylinder, on end, in the corner of A1, an Evo off-center in B4, and a wooden cylinder on its side in C1 (see diagram). These are Objects A, B, and C, respectively. Students will handguide ORA to a position where it can pick up each object. Students will record the X, Y, and Z coordinates for each object.



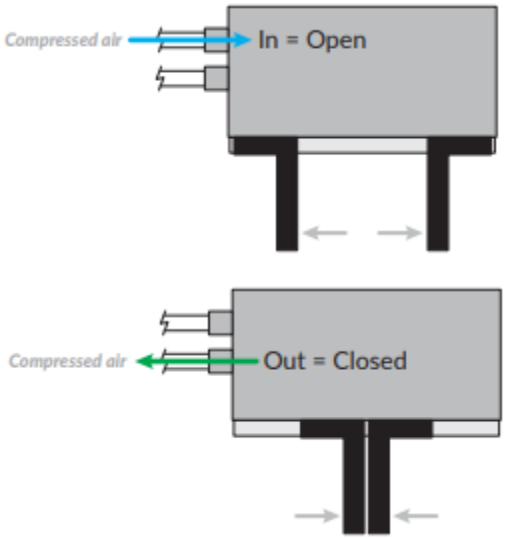
The table below shows the *approximate* X, Y, and Z coordinates for each object.

Object	X	Y	Z
Upright cylinder in A1	282 mm	166 mm	60 mm
EVO in B4	-225 mm	135 mm	30 mm
Horizontal Cylinder in C1	225 mm	-135 mm	30 mm

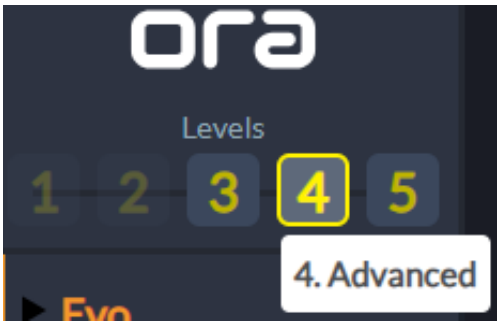
While one group of students works with the ORA, the rest of the class will be looking at the variety of everyday objects they investigated in Lesson 6. Students will rank these objects from most compatible to least compatible for being used with the finger grippers. They will write a short explanation for why they ranked the objects in the order they did.

Explain the finger gripper function and precision ORA Movement.

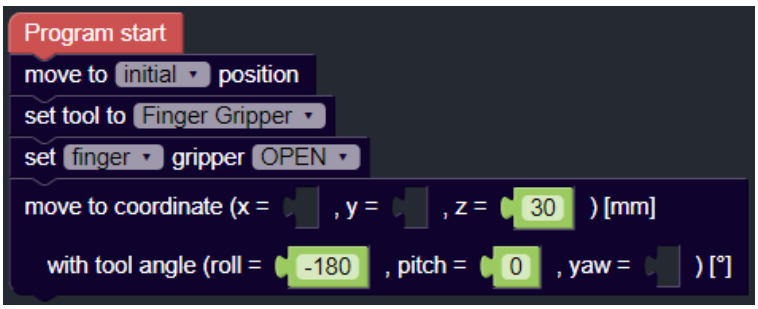
Tell students that the finger gripper is pneumatic. That means that there is a pump inside ORA that pushes air in or pulls air out of an actuator. This actuator, when air is pushed in, opens the fingers. Conversely, when the air is pulled out, the finger grippers close. We will use the finger gripper along with precise X, Y, and Z movements to complete today's tasks.



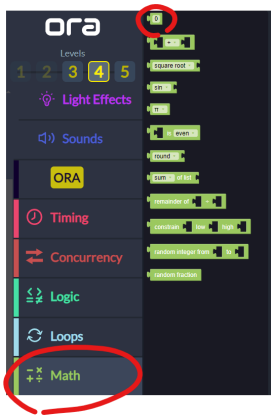
To open up the precision movement blocks, we need to move to Level 4 of the Ozobot Editor. In Level 4, some of the blocks we have used in previous lessons may be slightly changed. On top of that, we have access to many new blocks. The ones we will use today are the 'Move to Coordinate' and 'Number' blocks.



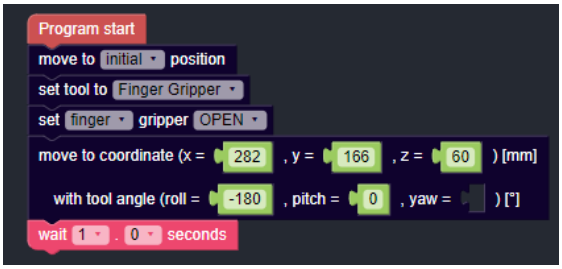
In the Ozobot Editor on Level 4, drag the four blocks shown in the image from the ORA tab into the workspace and attach them to the Program Start.



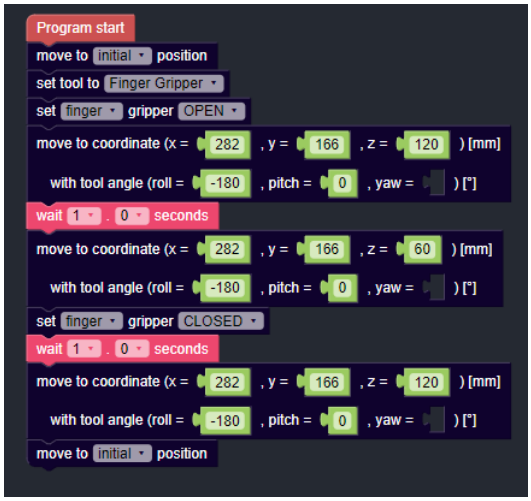
Show the students that the X and Y coordinates are empty. You cannot just click on them and enter in numbers. This is where the 'Number' block comes in. Click on the Math tab and grab a 'Number' block for X and Y.



Ask the students, "What do we need to do to grab the objects on the Quadrant map?" The items from the Explore activity should still be there. Ask students to give you X, Y, and Z coordinates for the first object (the wooden cylinder standing in A1). Enter the coordinates and run the code while students observe. If ORA moves to that location, does it move to a position to grab the cylinder or does it just knock the cylinder over?



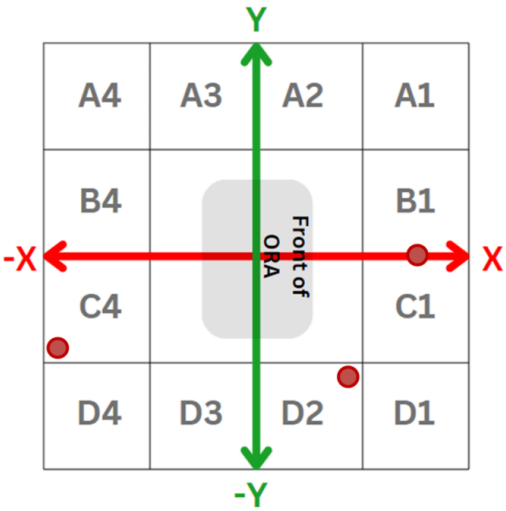
Ask the students to think back to previous lessons and how the ORA approached picking up objects with the vacuum gripper. After getting student responses, explain that the ORA needed to move into a 'High' position before moving down to the object. Students should create a second "Move to Coordinate" block with the same X and Y values but a higher Z value before moving to the block itself. This will help the students in the Elaborate activity.



Elaborate: Precision stacking with ORA

In this challenge, students will use ORA as a cobot to precisely pick and place components on top of each other. You could tell students that precisely stacking is something that a palletizing robot does in an industrial setting.

Setup: Place one wooden cylinder, on end, in between B1 and C1. Place a second cylinder in the corner of D2. If you have students needing an extra challenge, place a third cylinder in C4. Place Evo outside the quadrant map at the intersection of B1/C1.



Task Requirements:

1. Students may investigate the Quadrant map and task setup before coding. They may handguide the ORA and take measurements but ***MAY NOT*** move the cylinders.
2. ORA must start in the Initial Position.
3. ORA must use precise movements to pick up the cylinder in D2 and place it on top of the cylinder in B1/C1 without knocking over either cylinder.
4. The Evo must also use lights to signal that the stacking has occurred.
5. ORA must return to the Initial Position after stacking.
6. Optional: Students will use the three cylinders to make a small pyramid.

After allowing students the opportunity to move the ORA and make any necessary measurements, direct students to plan this code in the Elaborate section of their Student Activity Sheet. After creating the pseudocode, direct them to create this code on their devices in the Ozobot Editor (example of code with incorrect X, Y, Z). If they have disconnected from the Shared Workspace, follow the instructions from the Explain section to get them connected to the workspace.

As students complete their code, they will test it. Click on a given student's or student group's tab on the Ozobot Editor. Click "Run" to execute their code. Reset the cylinders between each code run.

If students are waiting for the ORA, they could:

- Answer Questions on the Student Activity Sheet
- Complete the Evaluate section of the Activity Sheets.

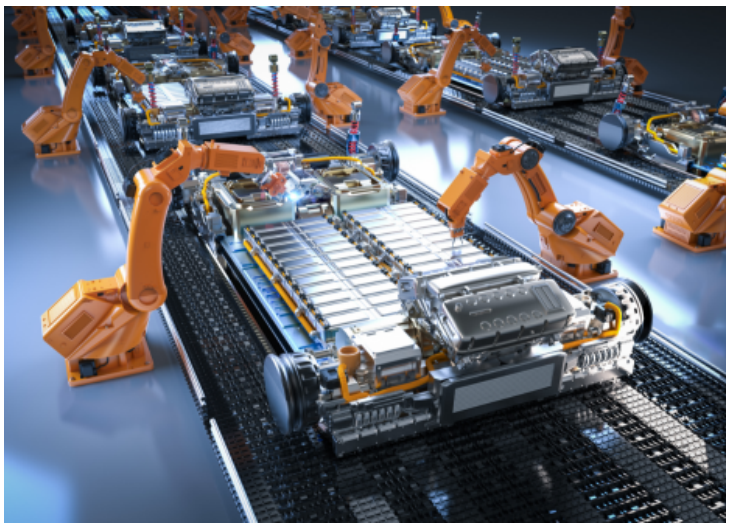
Evaluate: Exit Ticket

Students will fill out and submit the Evaluate section of the Activity Sheets as an Exit Ticket. (The last page of the Student Activity Sheet).

Optional Extension: Designing for Manufacturing

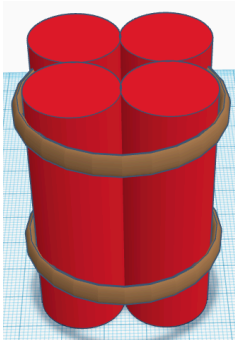
In this activity, students will modify the design of a part to be more usable by a finger-gripper-equipped robot.

In industrial settings, many parts of vehicles are manufactured with robotic assembly in mind. Car doors or batteries can be difficult objects for a finger gripper to 'grab' onto as the robot arms precisely pick and place the parts.



Source: Canva

In this task, students will be given a part that cannot be picked up by the ORA finger grippers. Students will design a "grab tab" for this part to be picked up by ORA



Setup: Take four of the red cylinders and rubber band them together (see right)

Task Requirements:

1. You must design and prototype a "grab tab" for this part.
2. You must test ORA's ability to pick up the object by the tab.
3. ORA must start in the Initial Position.
4. ORA must precisely pick up the object from the corner of B1 and deposit the object on the inside edge of D3 (see diagram, right).
5. ORA must return to the Initial Position after placing the object.