Quality Control with ORA

Direct Instruction

Engage with Inspection and Logic!

Start the Engage section by presenting the students with the lesson challenge. Tell students:

"For this challenge, you will assume the role of Quality Control Inspector at ORA Mechatronics. Cylinders-R-Us, an international manufacturer of precision, red, wooden cylinders, has hired your team to use ORA and Evo to perform quality control testing on their latest batch. Someone reverted the code to an older version and it is up to your team to finish the code and perform the quality testing!

Have the students spend a few minutes thinking about the lessons learned from ORA Essentials (specifically, Lesson 9: Inspection and Logic) and answering the questions in the Engage section of the Student Activity Sheet. Then tell the students:

"Before we can solve this challenge, we need to learn more about robotic arms in quality control and the careers related to them!"

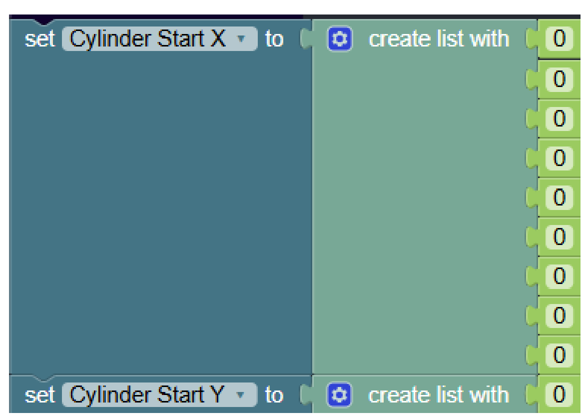
Next, show the Lesson 9 video.

Explore Quality Control Inspector Career Connections

Students will do a brief guided virtual scavenger hunt related to the Quality Control Inspector career connection. Individually or in small groups, have them complete the Explore section on the Student Activity Sheet. If students are struggling with the job outlook section, have them go to the [US Department of Labor and Statistics Occupational Outlook Handbook](). In this tool, you can find information about thousands of jobs. On the Index page, search for your career (Use Ctrl+F on a Windows machine or Chromebook). When you click on the career of your choice, there is a short video about the career as well as several key pieces of information.

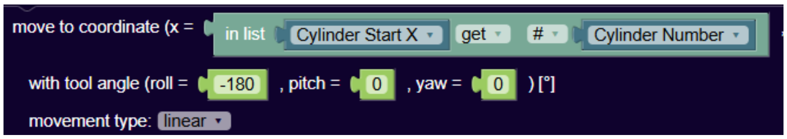
Explain Part 1: Lists

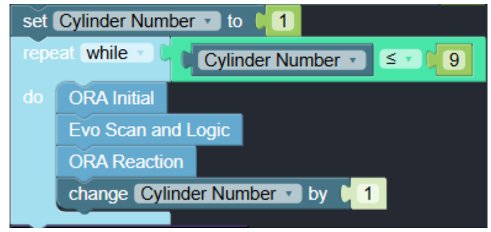
Start the Explain section by asking the students, "Have any of you used lists in programming?" Students may or may not have ever used lists, so if no students have experience, tell them, "Lists are collections of stored values. Like a to-do list, ORA can start at the top of these lists and work down. If we add X, Y, and Z values, we can tell ORA to pick up objects at particular places and not need to involve all of the movement commands!"



© Ozo EDU, Inc

Open up and show the top part of the Elaborate Starter Code. Under the Program Start, there are three variables with list blocks; Start Cylinder X, Start Cylinder Y, and Start Cylinder Z. These blocks code for the X, Y, and Z positions of the cylinders in A1. Right now they are all zero, but you will put in the X, Y, and Z values!





The function on the right, called ORA Initial, looks at the list and selects the first X, first Y, and first Z values from the list. Then, ORA moves to pick up that cylinder.

Under the lists, the repeat while loop goes through the various functions and then changes the Cylinder Number variable by 1. This means that the next set of X, Y, and Z values will be used. The values in the list will be used one by one until all 9 blocks are used!

Explain Part 2: ORA Quality Control

As discussed in the video, robotic arms are used to perform quality control. This can include visual inspections with advanced machine learning or performing testing. In this lesson, ORA will move the cylinders so Evo can scan them. If the cylinder passes inspection, it will go into the box in D1. If the cylinder has a defect, Evo will react differently and ORA will place it in the reject box in D2.

Set up the Elaborate challenge (see below) and run the Example Solution Code. Do not show the students the code, but rather just have them observe the process and answer the following questions:

1. Were there any rejects in the sample batch?
   [There should be at least one (though the whole set may pass) If none fail the Evo Scan, that is okay]
2. If there were any rejects, how did Evo react vs a passed test?
   [In a passed test, Evo will light up green, say 'one,' and then play a tone. In a failed test, Evo will light up red, say 'zero,' and then play a different tone]

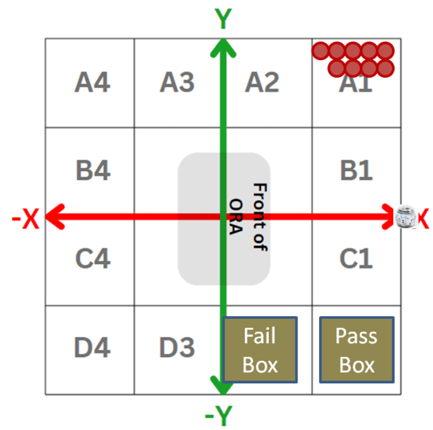
3. Going off the information you have, what is the rejection rate for the sample set?
   [To find the rejection rate of the sample set, divide the number of rejected cylinders by the total number of cylinders, i.e. 2/9 = .2222 or a 22.2% rejection rate.]

© Ozo EDU, Inc

After students have answered these questions, show the Evo Scan function of the Elaborate Starter Code, the scan function relies on a random integer between 1 and 10. If the number is less than 9 (i.e. 1-8) the cylinder will pass the test. If the number is greater than or equal to 9 (i.e. 9 or 10) the cylinder will fail the test. This means the expected rejection rate should be approximately 2/10 or 20%.

Elaborate: ORA-Evo Quality Control Team

In this challenge, students will modify the Elaborate Starter Code to include the X, Y, and Z values of the cylinders in A1 in the Starter Cylinder lists. Students will then modify the Evo Scan and ORA Reaction functions to code ORA and Evo's reactions to the passed or failed tests.



Setup:
Have students place the nine cylinders in A1 (see the setup image to the right or below). Place ORA on the outside edge of the quadrant map where B1 and C1 meet. Place the two cardboard boxes in D1 and D2.

Task Requirements:

1. ORA must start in the initial position.
2. Students must measure (using the Printable ORA Coordinate Tool or ruler) and record the X, Y, and Z coordinates for ORA's end tool to pick up each cylinder.
    a. These values must be entered into the lists in the Elaborate Starter Code.
3. ORA must pick up each cylinder and place it in front of Evo.
4. Students must program Evo to react differently when a cylinder passes or fails a test. This includes saying 1 or 0 for a binary pass/fail indicator.
5. ORA will move the cylinder to the appropriate box.
6. This process will occur for all 9 cylinders.
7. ORA must finish in the Initial Position.

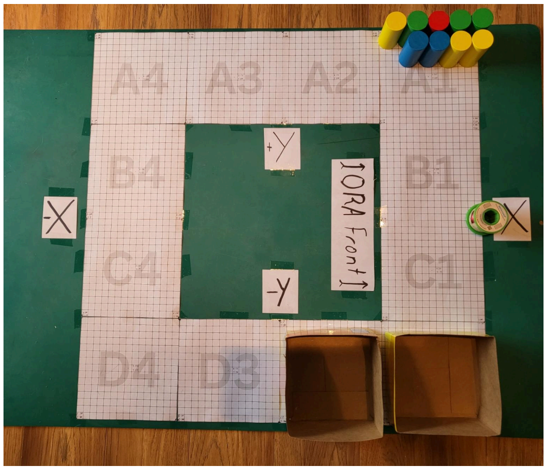
Direct students to plan this code in the Elaborate section of the Activity Sheet. After writing the pseudocode, direct students to create the code in the Ozobot Editor. Ensure students are connected to your shared workspace.

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 materials between each code run. Remember to follow the Safety Protocol established in ORA Essentials. Example Solution Code

If students are waiting for ORA, they could complete the Evaluate section of the Activity Sheets as an Exit Ticket.

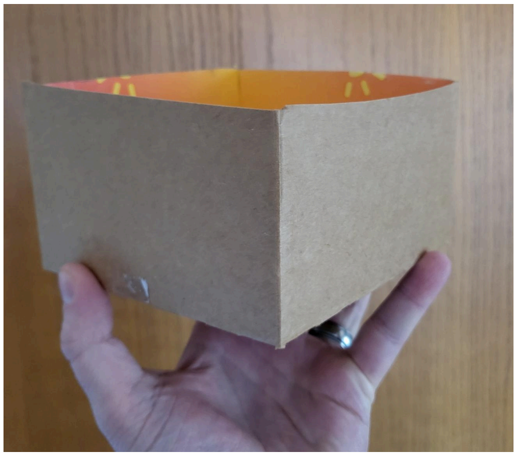
© Ozo EDU, Inc

Elaborate: Example solution



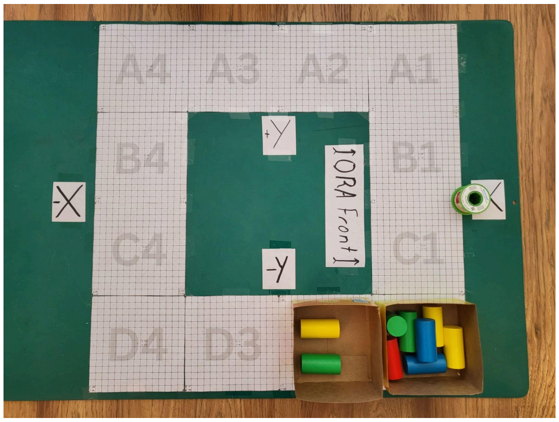
1. **Setup**
   a. Right is an image of the setup for the lesson challenge.

2. **Designed Materials**
   a. For this challenge, you will need two boxes that are approximately 150mm x 150mm x 60mm. A 12-pack of soda is a good box to use as they are roughly the proper shape. A quick solution is shown at right.



   Sample Code
   b. [Example Solution Code]

3. **Code Description**
   a. The list function stores the X, Y, and Z values for each of the wooden cylinders. The ORA Initial function will pick up the cylinders and move them between B1 and C1, right in front of Evo. The Evo Scan function will generate an integer while Evo lights up to 'scan' the cylinder. Evo will light up green and say 'one' if the cylinder passes. Evo will light up red and say 'zero' if the cylinder fails the scan. ORA will then move to pick up the cylinder and place it in the appropriate pass or fail box (D1 and D2, respectively). The process repeats until all 9 cylinders have been tested.
   b. Right is an image of the final state after the code has been run.



Evaluate: Exit Ticket

Students will fill out and submit the Evaluate section of the Activity Sheets as an Exit Ticket.

© Ozo EDU, Inc

Optional Extension: Hole Cut Tolerance Testing

In this activity, students will program ORA to perform tolerance testing for Harry's Hole-Cutting Hut. He has sent you the latest batch of hole stencils and wants you to check to see if the holes are up to spec!

The holes should be 30mm, but if they are a little on the larger side, that is acceptable. If a cylinder cannot fit in a hole, that hole is too small. On the other end, a little large is okay, but too large is also a failure of the Hole-Cutting Hut!

Source: Canva

Setup: Glue the Extension Hole Document to the side of a cardboard box. Carefully cut out the holes and the cardboard to the precise shape of the holes. Place a single, red wooden cylinder on the quadrant map. Place the cardboard box, hole side up, on the quadrant map.

Task Requirements:

1. Students will create a list of criteria for:
    a. Too small holes
    b. Too large holes
2. Acceptable-sized holes.
3. Students will program ORA to pick up the wooden cylinder and attempt to fit it through each hole in the stencil. Students should note which holes pass and which fail the test.
4. ORA will finish in the starting position.
5. After finishing the testing, students will write up a recommendation for Harry to tell him which hole-cutting machines need to be calibrated.

© Ozo EDU, Inc