

# Meet the Vacuum Gripper

## Vocabulary

**Vacuum-** a space with negative pressure that has less pressure than the atmosphere.

**“Set Tool” Block-** code block in the Ozobot Editor that determines which end effector tool is attached to ORA.

**“Set Vacuum Gripper” Block-** code block in the Ozobot Editor that turns on and off the vacuum pump.

**Vacuum Pump-** a small pump in the end effector tool that controls the creation of the vacuum.

**Atmospheric Pressure-** the pressure exerted by the mass of the atmosphere

## Direct Instruction

### Engage: What is a Vacuum?

As students come in, have [EngageL5RunsConstantlyCode](#) running (Share Code: q7acbyu). Remember that the Evo must be placed in the middle of quadrant A1 and the vacuum gripper is attached.

Direct the students to the Engage section of the Student Activity Sheet and have students write down what they think is happening to get the ORA to move the Evo from Quadrant A1 to A4 and back.

After students have answered, ask a few volunteers to share. Some may know it is a vacuum gripper carrying the ORA from point to point. Then ask the students “Do you know how a vacuum works?”

The basic concept is that a motor pulls air out which creates negative pressure. The negative pressure is replaced by pressure from outside of the vacuum. In the case of the ORA, the Evo creates a seal around the vacuum cup and the force of the air trying to get in allows ORA to lift Evo.

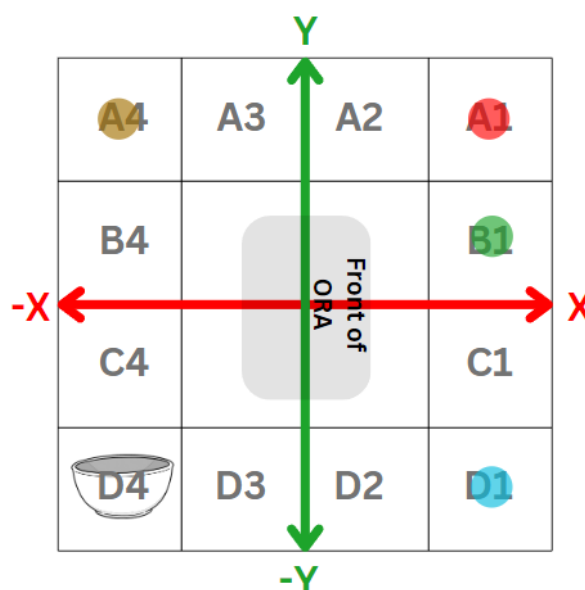
Next, show the Lesson 5 video.

### Explore the versatility of the vacuum gripper.

Direct students to the ORA Quadrant Map and the Explore section of the Student Activity Sheet. Either hand out or have students collect 1 straw and 4 M&M candies each.

Tell students that as they learned in the Engage section, a vacuum works through the use of negative pressure. When they drink from a straw, they are actually creating negative pressure in their mouth and the beverage is moving to fill that void through the power of atmospheric pressure!

In today’s activity, students will use the power of their own vacuum pumps (their mouths) to pick up M&M candies with a straw to move them around their own ORA Quadrant Maps. On



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the Student Activity Sheet, students are instructed to place a candy in quadrants A1, A4, B1, and D1. A candy collection bowl is located in D4. They will need to write the pseudocode and act out the commands necessary to move the candies with the “vacuum gripper” to the collection bowl.

Let students know they are acting the part of the ORA with a vacuum gripper end-effector tool. Make sure they are utilizing the code blocks/commands they already know and making educated guesses at how the vacuum gripper is coded.

After students have completed the activity, ask them, “what about the M&Ms made it effective to use the vacuum a tool to move them?” Students should have some responses that include:

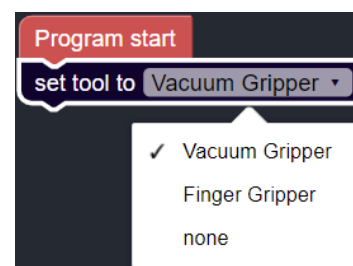
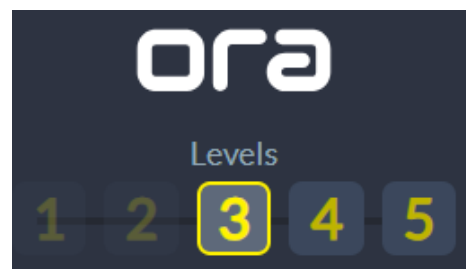
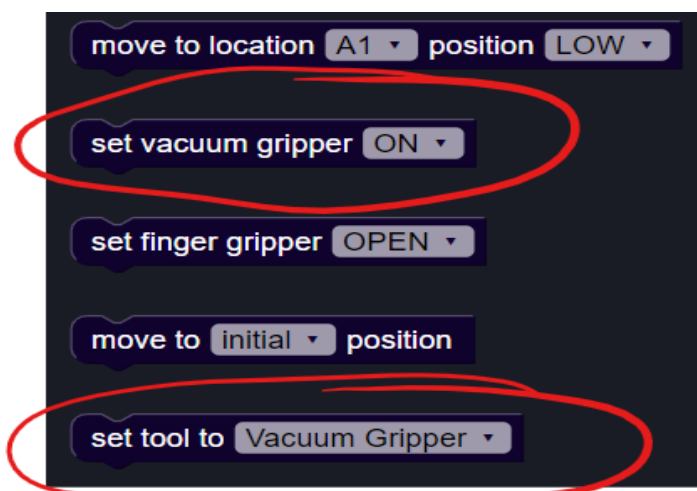
1. M&Ms have a smooth surface to make a good vacuum seal
2. M&Ms are a little odd in shape, making a vacuum gripper the best tool for the job

If students are having a hard time thinking of the second response, maybe give them something to mull over: “If you were given the option of a vacuum tool or a set of chopsticks to move the M&Ms, which would you choose?”

### Explain using the new ORA blocks.

On the display, open up the Ozobot Editor. Ensure the “Level 3” option is selected (the blocks we will be using will look different if Level 4 or 5 are selected).

On the right-hand side, select “ORA” and show the “Set Tool” and “Set Vacuum Gripper” blocks (below).



Drag these two blocks into the workspace. Attach the “Set Tool” block to the Program Start Block. Show the students the drop-down options.

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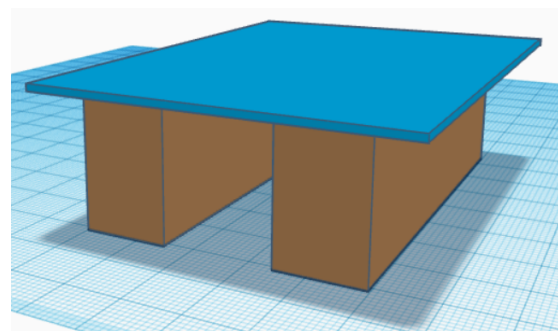
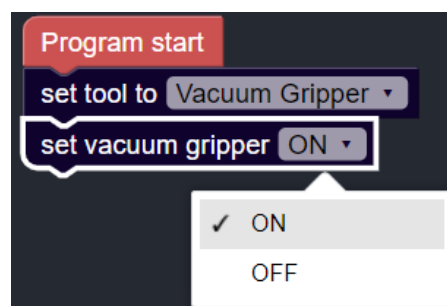
Direct students to the Explain section of their Student Activity Sheet. Tell students that the purpose of this block is to tell the ORA what end-effector tool it has attached to the end of the arm. Ask the students, "When do you think this block is used?" This block needs to be placed at the beginning of the code before the vacuum gripper is used because it tells ORA which tool is attached.

Leaving the "Set Tool" block attached to the Program Start block, add the "Set Vacuum Gripper" block underneath. Click on the drop down to show the options (right). Ask the students, "What do you think On/Off do/mean?"

After listening to a few student responses, explain that this block turns the vacuum on or off.

Explain to students that the vacuum gripper can be turned off in either a "high" or "Low" position; some objects can be dropped from a high position (like a playing card), but other more fragile objects should only be dropped from the low position (such as the EVO).

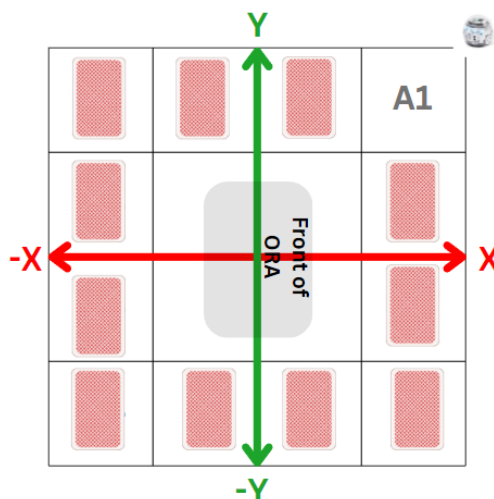
Place two jenga blocks and a playing card in the center of Quadrant A1. Place them so the playing card is elevated approximately 1 inch (2.5cm) above the quadrant map (see picture, right). Tell students that when ORA is in the "low position" for the "Move to Location" code block, the vacuum gripper is not touching the Quadrant Map. That is why we must use the Jenga Blocks.



### Elaborate how to use ORA in a card game.

In this challenge, students will use ORA as a cobot dealer in a High Card game of chance. ORA will be used to "deal" cards as the students program it. The students will program the ORA to pick up 2 cards and move them to A1. After the ORA moves to the initial position, the student picks up and looks at the cards and adds their values. The student they are facing off against will do the same, and the student with the highest hand wins!

**Setup:** Place Evo at the outside corner of Quadrant A1. Set Jenga blocks on their sides and place a card face down on the blocks (similar to the setup in the Explain section). Jenga blocks and



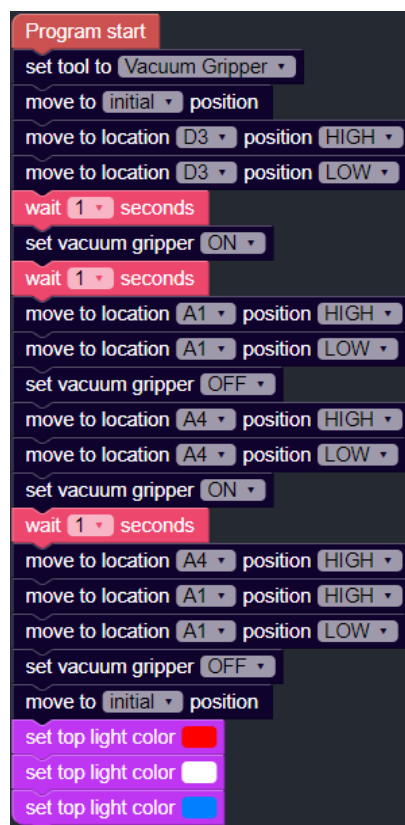
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cards will be set in the middle of each Map Quadrant except A1 (See diagram, right). When a card gets selected, deal another face-down card in the vacant square.

### Task Requirements:

1. ORA must start in the Initial Position.
2. The Vacuum Gripper Tool needs to be selected.
3. ORA must be coded to pick up one card, raise it to a high position within the same quadrant, and then place it in A1 in a low position, and then pick and place a second card in the same fashion.
4. ORA must return to the Initial Position after cards are 'dealt.'
5. Only after ORA has moved back to the Initial Position, Evo will be coded to flash the top light a series of colors (student preference) to signal that it is now safe to pick up the cards from A1.

Direct students to plan this code in the Elaborate section of their Student Activity Sheet. After creating the pseudocode, tell them to create this code on their devices in the Ozobot Editor (example of code given right). Host a sharing session (click Share and then Host Sharing Session) and allow students to join in.



As students complete their code, have them pair up and test their code. Allow the first student to come up to your device connected to ORA, click on their tab, and run their code. Deal cards as necessary and repeat the process with the second student. Have them tabulate their cards to see who is the winner!

If students are waiting for the ORA, they could:

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

### Evaluate: Exit Ticket

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

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### Optional Extension: 3 Card Pickup (AKA the Coolest Robot Vacuum Around)

In this extension, you will program the ORA to clean up a mess. If you have a robot vacuum in your home, you can thank a Robotic Software Engineer for programming your robot vacuum to plan and navigate paths to clean up the dirt and dust in your home!

Oh no! As you were cleaning up the Elaborate activity, one of your classmates fumbled as they were putting away the cards and three of them are missing. After some investigating, you hear that three of them have landed on the ORA Quadrant Map on some of the Jenga block stands. You know:



1. One card landed somewhere in the A quadrants
2. One card landed somewhere in the D quadrants
3. One card landed somewhere in the B or C quadrants.

In this activity, you will program the ORA cleaning Cobot to visit each of these quadrants, looking for these missing cards and depositing them in A1. Create the pseudocode and Ozobot Editor block codes to complete the activity.

**Setup:** Place a barrier between the student and the ORA so the student cannot see the ORA or the Quadrant Map. Place one card randomly on a set of Jenga blocks somewhere in the A quadrant, D quadrant, and B/C quadrants. For purposes of meeting the safety protocol. A designated observer (likely the teacher) will watch the ORA complete the task and have the emergency stop at hand.

#### Task Requirements:

1. ORA must start in the Initial Position.
2. The Vacuum Gripper Tool needs to be selected.
3. ORA must visit each of the identified quadrants at an appropriate height to search for the card.
4. After each 'sweep,' ORA must move to a high position and then to A1 to deposit the found card.
5. Quadrants must be 'swept' in the order A, D, and B/C
6. ORA must return to the Initial Position after sweeping and depositing cards from all three areas.