

Nuclear Control Rod Automation:

Name: _____

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Nuclear Reactor - a device that produces and controls the release of energy from splitting the atoms of certain elements.

Control Rod- a rod inserted into a nuclear reactor to control the rate of a nuclear chain reaction.

Moderator - a material, like water, that slows down fast neutrons produced during fission.

Scram - short for scramble. The dropping of the control rods into the reactor stops the reaction.

Job Outlook - the likelihood that the selected occupation will be available and hiring in the future

Engage

Do you know where your power comes from? Is any of it generated by a nuclear plant?

Answers may vary based on students' background knowledge of regional power generation and how the power grid functions. The short answer is that yes, each of the regions in the United States has a nuclear power plant that feeds into the grid. The exception is the Hawaiian power grid.

Open up a map of [US Power Reactor Sites](#). Which power plant is the closest to you?

Answers may vary based on student location.

Explore

While robotic arms have a key role in today's lesson, we will explore the related career of Nuclear Power Generation. After watching the video, find the following information about Nuclear Power Plant Operators:

Education needed to be a Power Plant Operator	High School diploma or equivalent. Upper-level jobs require at least a bachelor's degree.
Skills Needed to be a Power Plant Operator	Must know how to work with machines and use tools. Must be familiar with how to operate, repair, and maintain equipment.
Duties of a Power Plant Operator	Duties include controlling the systems that generate and distribute electric power.
What kind of work environment does a Power Plant Operator work in?	Most power plant operators work full-time, and some work more than 40 hours per week. They typically work rotating 8- or 12-hour shifts in an office or industrial environment.
Average Salary in your state	Answers may vary based on student location. Median Salary is \$100,890 per year
What is the job outlook for this career?	About 3,800 openings for power plant operators, distributors, and dispatchers are projected each year

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Elaborate

In this challenge, you will evaluate a program that will be used to automatically control the reaction rate within the nuclear reactor as well as include a failsafe when the reaction rate is greater than or equal to 20.

[Elaborate Starter Code](#)

1. What happens when the reaction rate is less than or equal to 2?

ORA moves the control rod higher by 40 millimeters, allowing neutrons to react with the uranium. The reaction rate is then increased by the Z-height divided by 200.

2. What happens when the reaction rate is less than or equal to 7?

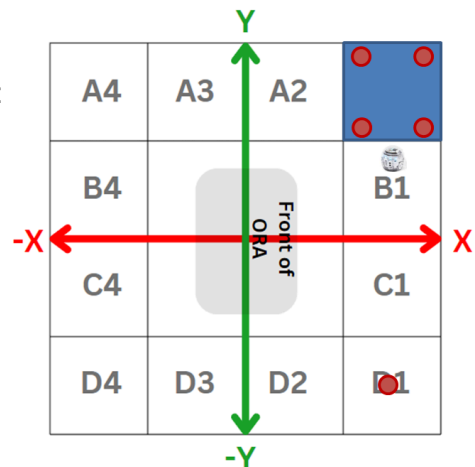
ORA moves the control rod higher by 10 millimeters, allowing neutrons to react with the uranium. The reaction rate is then increased by the Z-height divided by 200.

3. What happens when the reaction rate is greater than or equal to 13?

ORA moves the control rod lower by 10 millimeters, allowing more neutrons to be absorbed. The reaction rate is then decreased by the Z-height divided by negative 200.

Task Requirements:

1. You must alter the Elaborate Starter Code to include:
 - a. A failsafe to drop the fuel rod into the reactor when the reaction rate is greater than or equal to 20
 - b. An alert/alarm system using Evo's lights and sounds
 - c. In the event of a failsafe situation, ORA must return to the Initial Position.



Pseudocode	Code Blocks
	Example solution code

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Evaluate

Please answer the following prompts.

Remember to include your **name** and **date** on this paper!

1. After learning about robots and nuclear power, does this career path interest you? Why or why not?

Answers may vary based on student interest.

2. After testing your code in the Elaborate section, did your failsafe function as expected? How does your failsafe compare/differ from the failsafe used in actual nuclear power plants?

Answers may vary based on code outcomes. This is similar to the system used in nuclear power plants because dropping the control rods is a common failsafe. This differs from the systems used in nuclear power plants because those rods are usually controlled by a rail system and are dropped in precise locations to stop the reaction.

3. Besides moving hazardous materials, can you think of any other uses for robotic arms in a nuclear power plant?

Answers may vary but since these were not discussed in the lesson, they could draw from any application found in the ORA Essentials Course.