



CRSP

Canadian Restructured School Plan
Le Projet D'une École Canadienne Restructurée

Robotics
Technology Education

CRSP is a project of the



Canadian Vocational Association
Association canadienne de la formation professionnelle

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Why study the topic?

A **robot** is a mechanical device that belongs in a sub-category of the field of automation technology. Why have robots been developed? Because they are able to perform some tasks more quickly, cheaply, and accurately than humans. Recent advances in computing, mobility, and energy storage have made the sophisticated robots of science fiction stories and movies almost a reality.

But have you ever noticed how the robots of stories and movies often have humanoid looks and move around a lot like humans? In reality, the majority of robots being developed and used today do not resemble humans at all. They are machines designed to work on an assembly line and perform a very specific task. This is the type of robot you will study in this learner guide.

Studying this guide will permit you to:

- Explore the early history of robots and automation.
- Use computer application software to create, edit, and simulate a robot's automated routine.
- Develop an awareness of the operations and sequences required to create an automated robot routine.
- Write a computer program that enables a robot to complete a specific task.
- Explore career and academic options in the fields of robotics and automation.

Robots are part of our present and our future. They are a good example of a useful application of science and technology. Studying robotics will also allow you to see just how useful computers can be.

What do I need to know before I begin?

You need to have some basic computer skills.

You should also know how to access information on a CD-ROM encyclopaedia.

You should be able to work independently and as part of a team.

What will I know and be able to do when I have completed the guide?

You will be able to:

- Summarize the stages in the development of robots.
- Explain the impact that robots and automation has had on society and on the economy.
- Identify the basic components of a robotics system.
- Identify the parts of a robot.
- Identify the basic moves of a robot.
- Teach a robot various positions.
- Write and edit a robotics computer program for picking up and placing objects.
- Problem solve by creating a materials handling program.
- Test, save, retrieve and plot a robotics materials handling program.
- Run materials handling programs that exist in the computer's memory.

What resources are available to help me?

You will need to have access to a robot with the manufacturer's manual and controller.

You will also need to have access to a work station with the equipment you need. This includes the following:

- An Internet-ready multimedia computer.
- Robotics computer software.
- A CD-ROM encyclopaedia (Encarta, Grolier's, Compton's, for example).

Other Resources

Thode, Brad, and Terry Thode. *Technology*. Albany, N.Y.: Delmar Publishers, 1994.

Choices career software. (Human Resources Development Canada. *Choices*. Ottawa, Ontario: I.S.M. Information Systems Management Corporation, 1996.)

Resource people within your community who use robots in automation manufacturing.

How may I meet the expectations of the guide?

By completing all the activities in the learner guide. This includes researching, writing, editing, and running a robotics program.

When should my work be done?

This module is designed to take approximately 10 hours.

How will I demonstrate I have met the expectations?

You will submit to your teacher (or mentor in the case of independent learners) all the work you did to complete this guide. In one of the activities, you will create a robotics materials handling computer

program. The quality and accuracy of this program will be assessed. Your program should have fewer than three mistakes in the teaching positions and/or gripper openings and closings.

You will also do a test at the very end of the guide to demonstrate what you have learned.

What activities do I need to do?

There are five activities in this guide. Most of them involve working at a robotics station. Before you begin, you need to familiarize yourself with the robotics station you are going to use. Start by completing the robotics station resource checklist given below. Any missing items should be marked with an “X.” Make sure you get these missing items so that your station will be complete.

(insert the Robotics Station Resource Checklist—to be obtained from the authors of this learner guide.)

Activity 1: How Robots Came to Be

Using CD-ROM encyclopaedias and any other reference materials that are available to you, research the following topics:

- how robots developed (outline the stages in their development)
- the impact robots and automation have had on society and the economy

Present your findings in a 300-word written report.

Activity 2: Familiarizing Yourself with Your Robot

Using the resource material at your station, identify the basic parts of a robot’s anatomy and describe how each part functions. You may find it useful to prepare a diagram and consult reference materials like the *Technology* book in this guide’s resource list.

On graph paper, measure and draw the “work envelope” for your robot. Again, refer to the *Technology* book or another source for ideas on how to demonstrate this information on paper.

Activity 3: Robot Motion

Practise all the movements your robot can make. (Your robot should be able to make eight different moves.) The movements are determined by “toggling” the keys on your computer keyboard. Consult your robot’s manual and software for this information.

Teach the robot to pick and place a wooden block. Record each position as a number so that your robot can return to the position again later. The command to close the gripper on the block is the letter “C” on your computer’s keyboard; the command to open the gripper is the letter “O.”

Teach the robot to pick and place two blocks between three different positions. You may want to stack the blocks according to either size or colour.

Now fine-tune the positions you taught the robot by including the necessary opening and closings of the gripper between positions.

Save the program you created on a disk in your floppy drive or on the computer’s hard drive.

Now use the program to correctly “home” the robot. Your computer should have speed keys for this. Consult the robot’s software and manual for more information on the speed keys.

Activity 4: Create Your Own Robotics Handling Program

Write your own robotics handling program. The program should involve picking, placing, and stacking three blocks between three different positions. Remember that your program must have fewer than three (3) programming mistakes. Demonstrate your program to your teacher or mentor, if he or she is available, or to a friend. Print out a hard copy of your program and save it on a floppy disk.

Activity 5: Test Your Knowledge of Robotics

Now you are ready to show what you have learned about robotics.
Record your answers on the answer sheet provided.

Are you ready? Begin by taking the following pre-test.

Robotics--Pre-Test

For each question, write the letter of the best answer on your answer sheet.

1. The device on the end of the robot arm is called a
 - a. shoulder.
 - b. controller.
 - c. solenoid.
 - d. gripper.

2. The number of pivot points on a robot is referred to as
 - a. flexibility.
 - b. degrees of freedom.
 - c. rotational flex.
 - d. co-ordinates.

3. Which of the following is an improbable use for a robot?
 - a. Fixing a TV.
 - b. Welding.
 - c. Lifting boxes.
 - d. Painting a car.

4. A device that allows robots to react to their surroundings is a/an
 - a. neural net.
 - b. inducer.
 - c. sensor.
 - d. interface.

5. An arm that **pivots** uses what kind of motion?
 - a. Pivotal.
 - b. Longitudinal.
 - c. Lateral.
 - d. Rotational.

6. An arm that **slides** uses what kind of motion?
 - a. Lateral.
 - b. Longitudinal.
 - c. Pivotal.
 - d. Rotational.

7. Moving a part from one place to another is called
 - a. transporting.
 - b. interface.
 - c. stepper.
 - d. pick and place.

8. What happens when the robot arm that you used for this learner guide hits a solid object like a table?
 - a. It goes through the table.
 - b. A “motor error” occurs.
 - c. It breaks.
 - d. The computer shuts down.

9. Which of the following would probably **not** be done by a robot?
 - a. Monitoring plant operations.
 - b. Unloading trucks.
 - c. Painting.
 - d. Loading parts into machines.

10. Locating a position using X, Y, and Z references uses
 - a. linear co-ordinates.
 - b. rotary co-ordinates.
 - c. polar co-ordinates.
 - d. Cartesian co-ordinates.

11. Which of the following would be an advantage of using robots to dispose of bombs?
- a. Robots are smarter than people.
 - b. Robots don't make mistakes.
 - c. Robots know more about bombs since they are also machines.
 - d. There is minimal danger to human life.
12. The device that allows a computer to send messages to a robot is called a/an
- a. pulsator.
 - b. interface.
 - c. transmitter.
 - d. monitor.
13. A predefined position used as a reference point for a robot is called a
- a. modem.
 - b. stop place.
 - c. home.
 - d. co-ordinate.
14. Which of the following is a reason to set the robot arm to the **slowest** speed?
- a. The computer is less likely to “crash.”
 - b. There is less wear on the robot.
 - c. There is more precise movement.
 - d. All of the above.
15. The three axes of the Cartesian co-ordinate system are
- a. rotary, slide, and swivel.
 - b. x, y, and z.
 - c. up, down, and sideways.
 - d. A, B, C.

16. Which of the following is an example of **linear** motion?
- a. A turning gear.
 - b. Your wrist.
 - c. A sliding drawer.
 - d. Your knee.
17. A “road map” of a program showing how it should run is a
- a. program atlas.
 - b. modem.
 - c. vector.
 - d. flowchart.
18. Instructing a computer to give commands to the robot in a certain sequence is
- a. informing.
 - b. positioning.
 - c. programming.
 - d. sequencing.
19. The part of the robot that moves the device on the end of the arm is the
- a. shoulder.
 - b. reflex.
 - c. waist.
 - d. wrist.
20. Changing an existing program to work out the “bugs” or meet another purpose is called
- a. editing.
 - b. “on-line” programming.
 - c. harmonizing.
 - d. improvising.

Now you should be ready to take the final test. If you wish, you can spend a little more time preparing for the test.

There are two final tests to choose from, Test A or Test B. On your answer sheet, be sure to indicate which test you are taking.

Robotics--Test A

For each question, write the letter for the best answer on your answer sheet.

1. A “road map” of a program showing how it should run is a
 - a. flowchart.
 - b. vector.
 - c. modem.
 - d. program atlas.

2. What happens when the robot arm that you used for this learner guide hits a solid object like a table?
 - a. It blows a fuse.
 - b. The computer shuts down.
 - c. A “motor error” occurs.
 - d. It breaks.

3. Changing an existing program to work out the “bugs” or meet another purpose is called
 - a. synthesizing.
 - b. “on-line” programming.
 - c. editing.
 - d. harmonizing.

4. A device that allows robots to react to their surroundings is a/an
 - a. stepper.
 - b. interface.
 - c. feedback inducer.
 - d. sensor.

5. The three axes of the Cartesian co-ordinate system are
 - a. rotary, slide, and swivel.
 - b. up, down, and sideways.
 - c. x, y, z.
 - d. A, B, C.

6. Which of the following is a reason to set the robot arm to the **slowest** speed?
 - a. The computer is less likely to “crash.”
 - b. There is less wear on the robot.
 - c. It gives the robot more time to think.
 - d. There is smoother, more precise movement.

7. An arm that **slides** uses what kind of motion?
 - a. Linear.
 - b. Longitudinal.
 - c. Pivotal.
 - d. Lateral.

8. Which of the following would probably **not** be done by a robot?
 - a. Painting.
 - b. Transporting parts.
 - c. Loading parts into machines.
 - d. Unloading trucks.

9. Locating a position using X, Y and Z references uses
 - a. linear co-ordinates.
 - b. xerographic co-ordinates.
 - c. polar co-ordinates.
 - d. rotary co-ordinates.

10. The device on the end of the robot arm is called a
 - a. shoulder.
 - b. controller.
 - c. capacitor.
 - d. gripper.

11. The number of pivot points on a robot is referred to as
 - a. flexibility.
 - b. rotational flex.
 - c. degrees of freedom.
 - d. co-ordinates.

12. The part of the robot that moves the device on the end of the arm is the
- waist.
 - controller.
 - shoulder.
 - wrist.
13. Which of the following is an improbable use for a robot?
- Welding.
 - Fixing a TV.
 - Lifting boxes.
 - Assembling a computer.
14. Which of the following would be a major advantage of using robots to dispose of bombs?
- Robots are smarter than people.
 - There is minimal danger to human life.
 - Robots know more about bombs since they are also machines.
 - Robots don't make mistakes.
15. The device that allows a computer to send messages to a robot is called a/an
- interface.
 - transmitter.
 - pulsator.
 - sector.
16. A predefined position used as a reference point for a robot is called a/an
- stop point.
 - f-stop.
 - home.
 - locator.

17. Which of the following is an example of **linear** motion?
- a. Your wrist.
 - b. Your knee.
 - c. A turning gear.
 - d. A sliding drawer.
18. An arm that **pivots** uses what kind of motion?
- a. Rotational.
 - b. Pivotal.
 - c. Linear.
 - d. Longitudinal.
19. Instructing a computer to give commands to the robot in a certain sequence is
- a. interfacing.
 - b. programming.
 - c. informing.
 - d. positioning.
20. Moving a part from one place to another is called
- a. transmitting.
 - b. pick and place.
 - c. replicating.
 - d. stacking.

Robotics – Test B

For each question, write the letter for the best answer on your answer sheet.

1. Locating a position using X, Y, and Z references uses
 - a. linear co-ordinates.
 - b. polar co-ordinates.
 - c. rotary co-ordinates.
 - d. Cartesian co-ordinates.

2. The device on the end of a robot arm is called a
 - a. gripper.
 - b. controller.
 - c. capacitor.
 - d. shoulder.

3. The part of the robot that moves the device on the end of the arm is the
 - a. wrist.
 - b. controller.
 - c. reflex.
 - d. shoulder.

4. Changing an existing program to work out the “bugs” or meet another purpose is called
 - a. synthesizing.
 - b. improvising.
 - c. editing.
 - d. harmonizing.

5. The number of pivot points on a robot is referred to as
 - a. flexibility.
 - b. co-ordinates.
 - c. rotational flex.
 - d. degrees of freedom.

6. A predefined position used as a reference point for a robot is called a/an
 - a. f-stop.
 - b. home.
 - c. stop point.
 - d. locator.

7. Which of the following is an improbable use for a robot?
 - a. Welding.
 - b. Fixing a TV.
 - c. Painting a car.
 - d. Assembling a computer.

8. A “road map” of a program showing how it should run is a/an
 - a. modem.
 - b. program.
 - c. algorithm.
 - d. flowchart.

9. The device that allows a computer to send messages to a robot is called a/an
 - a. pulsator.
 - b. sector.
 - c. monitor.
 - d. interface.

10. The three axes of the Cartesian co-ordinate system are
 - a. rotary, slide, and swivel.
 - b. up, down, and sideways.
 - c. x, y, and z.
 - d. A, B, C.

11. A device that allows robots to react to their surroundings is a
 - a. neural net.
 - b. stepper.
 - c. sensor.
 - d. feedback inducer.

12. An arm that **pivots** uses what kind of motion?
- Linear.
 - Pivotal.
 - Rotational.
 - Longitudinal.
13. Which of the following is an example of **linear** motion?
- Your wrist.
 - A sliding drawer.
 - Your knee.
 - A wheel and axle.
14. What happens when the robot arm that you used for this learner guide hits a solid object like a table?
- A “motor error” occurs.
 - The computer shuts down.
 - It breaks.
 - It goes through the table.
15. Instructing a computer to give commands to the robot in a certain sequence is
- positioning.
 - sequencing.
 - informing.
 - programming.
16. An arm that **slides** uses what kind of motion?
- Rotational.
 - Linear.
 - Lateral.
 - Longitudinal.
17. Which of the following would be an advantage of using robots to dispose of bombs?
- There is minimal danger to human life.
 - Robots are smarter than people.
 - Robots know more about bombs since they are also machines.
 - Robots don't make mistakes.

18. Which of the following would probably **not** be done by a robot?
- a. Unloading trucks.
 - b. Monitoring plant operations.
 - c. Painting.
 - d. Loading parts into machines.
19. Moving a part from one place to another is called
- a. transmitting.
 - b. replicating.
 - c. stacking.
 - d. pick and place.
20. Which of the following is a reason to set the robot arm to the **slowest** speed?
- a. It gives the robot more time to think
 - b. There is less wear on the robot.
 - c. The computer is less likely to “crash.”
 - d. Smoother, more precise movement.

ROBOTICS TESTS -- ANSWER SHEET

Name: _____

Class: _____

Pre-Test

1. ____

2. ____

3. ____

4. ____

5. ____

6. ____

7. ____

8. ____

9. ____

10. ____

11. ____

12. ____

13. ____

14. ____

15. ____

16. ____

17. ____

18. ____

19. ____

20. ____

Test A or Test B (circle one)

1. ____

2. ____

3. ____

4. ____

5. ____

6. ____

7. ____

8. ____

9. ____

10. ____

11. ____

12. ____

13. ____

14. ____

15. ____

16. ____

17. ____

18. ____

19. ____

20. ____

Where do I go from here?

Have you enjoyed working with robots? See your guidance counsellor about future curriculum choices in physics and micro-electronics. You might also want to consult the *Choices* software from this guide's resource list to explore the academic and vocational options available for working with robots and automation.

Search the following Internet sites for additional information on Robots:

- <http://www.edgechaos.com./meca/robots/robots/html>
- <http://stanford.edu/home.html>
- <http://www.americanrobot.com/merlin>
- <http://www.robotics.com>
- <http://cs.brown.edu/research/robots>

Be on the lookout for robotics applications in various places around you.

Do you think robots will ever be smarter than humans? Find out who or what Deep Blue is. You might also want to spend some time studying artificial intelligence.

LEARNER GUIDE WRITING TEAMS

NEW BRUNSWICK SITE

Site Leaders: Dr. Neil Wortman (1996); Chris Fleming (1997).

Participating Schools:

Campobello Island Consolidated School
Carleton North Senior High School
Fundy High School
Grand Manan High School
John Caldwell School
Nackawic High School
Southern Victoria High School
St. Stephen High School
Sir James Dunn Academy
Tobique Valley High School
Woodstock High School

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Alison Milne	Nackawic Senior High School

7. Physical Education

Jon Brain, Leader	Southern Victoria High School
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Keith Pierce	Campobello Island Consolidated High School
Rick Savage	Tobique Valley High School

10. Technology

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