

## Lesson A6–9

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# Using Robotics Systems

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**Unit A.** Mechanical Systems and Technology

**Problem Area 6.** Agricultural Power Systems

**Lesson 9.** Using Robotics Systems

### **New Mexico Content Standard:**

**Pathway Strand:** Power, Structural and Technical Systems

**Standard: IX:** Use the variety of tools available in computer systems to accomplish fast, accurate production in the workplace.

**Benchmark: IX-A:** Identify and explain various types of hardware systems to show their applications potential.

**Performance Standard:** 1. Identify and describe individual components of each system. 2. Discuss various types of diagnostic equipment. 3. Be able to show aptitude in use of various equipment. 4. Demonstrate competency on cable though put and set up.

**Student Learning Objectives.** Instruction in this lesson should result in students achieving the following objectives:

1. Discuss robotics terms and explain how robots differ from other machines.
2. Describe some functions of robots.
3. Explain robotic movements.

**List of Resources.** The following resources may be useful in teaching this lesson:

**Recommended Resources.** One of the following resources should be selected to accompany the lesson:

*Exploring Manufacturing Technology.* Columbia, Missouri: University of Missouri Instructional Materials Laboratory, 1997. (Curriculum Unit)

Herren, Ray V., and Elmer L. Cooper. *Agricultural Mechanics Fundamentals and Applications.* Albany, New York: Delmar Publishers, Inc., 2002. (Textbook, Chapter 37)

**Other Resources.** The following resources will be useful to students and teachers:

Burton, L. DeVere. *Agriscience & Technology.* Albany, New York: Delmar Publishers, 1998.

## List of Equipment, Tools, Supplies, and Facilities

Writing surface  
Overhead projector  
Transparencies from attached masters  
Microcomputer  
Presentation software  
TV converter hardware  
Copies of student lab sheet

**Terms.** The following terms are presented in this lesson (shown in bold italics):

Axis  
Cartesian work area  
Cylindrical work area  
Hollow sphere working area  
Robot  
Robotics  
Rotation  
Solid sphere working area  
Translation

**Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

*Ask the students if they can think of some practical uses of a robot. As they suggest ideas, steer them towards the use of robots in agriculture. Use the discussion to move into the lesson's first objective.*

# Summary of Content and Teaching Strategies

**Objective 1:** Discuss robotics terms and explain how robots differ from other machines.

**Anticipated Problem:** What terms are commonly used when discussing robotics? How do robots differ from other machines.

- I. In order to understand the use of robots in agriculture, it is helpful to know specific terms and how robots differ from other machines.
  - A. A **robot** is a mechanical device that is capable of performing human tasks. They are widely used in industry and are becoming more common in agriculture. Robots are commonly powered by hydraulics, pneumatics, and electricity. **Robotics** is the term used to describe the application of robot technology.
  - B. Robots differ from other machines in the following areas:
    1. Robots are freely computer programmable.
    2. Robots are able to do a variety of tasks.
    3. Robots have a three dimensional freedom of motion.
    4. Robots are equipped with grippers and/or tools.

*Have students read the appropriate sections in the recommended resources. Follow this up by displaying TM: A6–9A to help reinforce an understanding of terms associated with robots.*

**Objective 2:** Describe some functions of robots.

**Anticipated Problem:** What are some common functions of robots?

- II. Robots can be built for a variety of tasks. Often they can do these tasks faster and more accurately than humans. Robots have precise movements and are able to repeat the exact same movements for extended periods of time. Robots are especially useful when carrying out the following functions:
  - A. Arranging parts
  - B. Handling parts
  - C. Distributing items
  - D. Positioning tools and work pieces
  - E. Moving tools in predetermined patterns
  - F. Gripping, directing, and assembling
  - G. Fastening, attaching, and detaching

*Have students read the appropriate sections in the recommended resources. Use classroom discussion to reinforce the functions that robots do well. Ask students to come up with specific examples of the use of robotics.*

### **Objective 3:** Explain robotic movements.

**Anticipated Problem:** What types of motion are robots capable of?

- III. Robots are built to be capable of different types of motion. Circular robotic motion is called **rotation**. Linear robotic motion is called **translation**. Robots have at least one or more rotational and translational axes. An **axis** is the straight line around which a body rotates. Axes is the plural of axis. The more axes that a robot has, the more motions it can perform. Each axis provides the robot with one degree of freedom. A robot's degree of freedom is dependent on its number of axes. Robots can be categorized by the space of their motion.
- A. A **cartesian work area** refers to a box-like work space. A robot with three translational axes can perform motions in a cartesian work area.
  - B. A **cylindrical working area** describes a robot that has a working area in the shape of a cylinder. In this case at least one of the axes is a rotational axis.
  - C. A **hollow sphere working area** is one that is ball-shaped. It can be achieved with two rotary axes and one translational axis. A robot with this motion can work around the outside of a round area, but not in the middle of the sphere.
  - D. A **solid sphere working area** refers to robot motion similar to a solid ball. It can be achieved by robots with three rotational axes. Using this motion a robot can work in any part of a round area.

*Have students read the appropriate sections in the recommended resources. Use TM: A6–9B to reinforce the type of work areas that are capable through combination of axes.*

**Review/Summary.** The review and summary of the lesson may be accomplished by viewing the transparency masters with the students. A discussion should be performed with the students before proceeding with the laboratory activity and testing.

**Application.** Include the following student activity using the attached lab sheet.

Internet Web Search LS: A6–9A

**Evaluation.** Objectives should be reviewed by the students. Laboratory activities should be performed before the written test is given to students.

### **Answers to Sample Test:**

#### **Part One: Matching**

1 = b, 2 = d, 3 = a, 4 = e, 5 = c, 6 = f

#### **Part Two: Completion**

1. mechanical

2. Cartesian work area
3. Cylindrical working area
4. Hollow sphere working area
5. Solid sphere working area

**Part Three: Short Answer**

1. Robot functions are:
  - a. Arranging parts
  - b. Handling parts
  - c. Distributing items
  - d. Positioning tools and work pieces
  - e. Moving tools in predetermined patterns
  - f. Gripping, directing, and assembling
  - g. Fastening, attaching, and detaching
2. Robots differ from other machines in the following areas:
  - a. Robots are freely computer programmable.
  - b. Robots are able to do a variety of tasks.
  - c. Robots have a three dimensional freedom of motion.
  - d. Robots are equipped with grippers and/or tools.

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# Test

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## Lesson A6–9: Using Robotics Systems

### Part One: Matching

*Instructions.* Match the term with the correct response. Write the letter of the term by the definition.

- |                              |                |
|------------------------------|----------------|
| a. Robotics                  | d. Translation |
| b. Solid sphere working area | e. Axes        |
| c. Rotation                  | f. Axis        |

- \_\_\_\_\_ 1. Robot motion similar to a solid ball.
- \_\_\_\_\_ 2. Linear robotic motion.
- \_\_\_\_\_ 3. The study of the design and use of robot technology.
- \_\_\_\_\_ 4. More than one axis.
- \_\_\_\_\_ 5. Circular robotic motion.
- \_\_\_\_\_ 6. The straight line around which a body rotates.

### Part Two: Completion

*Instructions.* Provide the word or words to complete the following statements.

- 1. The robot is a \_\_\_\_\_ device that is capable of performing human tasks.
- 2. \_\_\_\_\_ refers to a box-like work space.
- 3. \_\_\_\_\_ describes a robot that has a working area in the shape of a cylinder.
- 4. \_\_\_\_\_ refers to a ball-shaped work space.
- 5. \_\_\_\_\_ refers to a box-like work space.



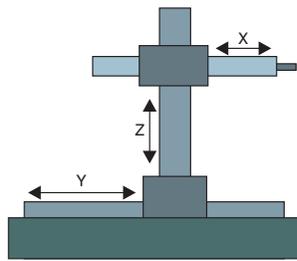
# COMMON TERMS

**Robot**—a mechanical device that is capable of performing human tasks

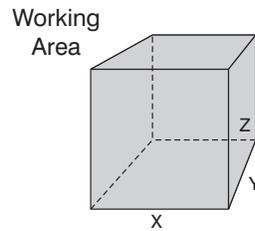
**Robotics**—the term used to describe the application of robot technology



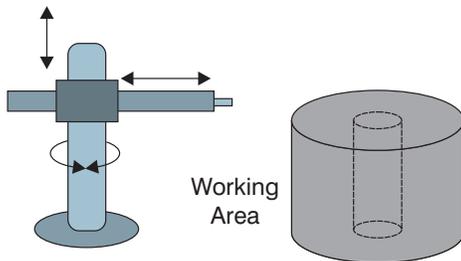
# AGRICULTURAL ROBOTIC ARM



3 Translational Axes

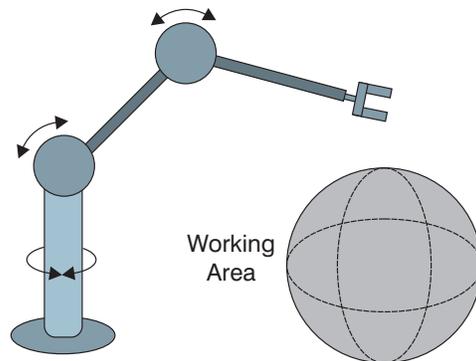


The cartesian work area of a three-translational robot.



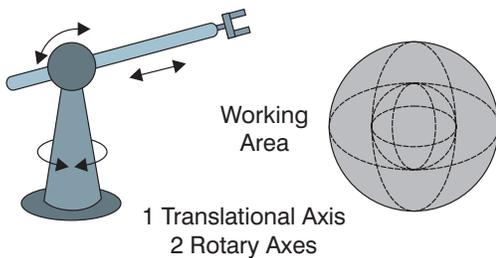
2 Translational Axes  
1 Rotary Axis

A cylindrical work area is possible with two translational axes and one rotational axis.



3 Rotational Axes

A solid sphere work area is possible using three rotational axes.



1 Translational Axis  
2 Rotary Axes

A hollow sphere work area is possible using two rotary axes and one translational axis.

(Courtesy, Interstate Publishers, Inc.)

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# **Lab Sheet**

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## **Internet Web Search**

*Instructions:* Use the key words “robotic systems” in agriculture to find a record as many web sites as possible.