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## Quick View

Students determine the range of motion for each axis of the T-Bot.

## Standards Addressed

### NSTA 9-12

Students develop the abilities to do scientific inquiry.

- Students identify questions and concepts that guide scientific investigations.
- Students design and conduct scientific investigations.
- Students use technology and mathematics to improve investigations and communications.
- Students formulate and revise scientific explanations and models using logic and evidence.
- Students communicate and defend a scientific argument.

### NCTM 9-12

Students compute fluently and make reasonable estimates.

- Students judge the reasonableness of numerical computations and their results.

Students use mathematical models to represent and understand quantitative relationships.

- Students draw reasonable conclusions about a situation being modeled.

Students understand measurement attributes of objects and the units, systems, and processes of measurement.

- Students make decisions about units and scales that are appropriate for problem situations involving measurement.

Students recognize and use connections among mathematical ideas.

- Students recognize and apply mathematics in contexts outside of mathematics.

Students understand meanings of operations and how they relate to one another.

- Students judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes on quantities.

Students understand patterns, relations, and functions.

- Students interpret representations of functions of two variables.

Students represent and analyze mathematical situations and structures using algebraic symbols.

- Students understand the meaning of equivalent forms of expressions, equations, inequalities, and relations.
- Students use symbolic algebra to represent and explain mathematical relationships.

Students analyze characteristics and properties of two- and three-dimensional shapes and develop mathematical arguments about geometric relationships.

- Students use trigonometric relationships to determine lengths and angle measures.

Students understand measurable attributes of objects and the units, systems, and processes of measurement.

- Students make decisions about units and scales that are appropriate for problem situations involving measurement.

Students apply appropriate techniques, tools, and formulas to determine measurements.

- Students use unit analysis to check measurement computations.

Students build new mathematical knowledge through problem solving.

- Students solve problems that arise in mathematics and in other contexts.
- Students apply and adapt a variety of appropriate strategies to solve problems.
- Students monitor and reflect on the process of mathematical problem solving.

Students organize and consolidate their mathematical thinking through communication.

- Students communicate their mathematical thinking coherently and clearly to peers, teachers, and others.
- Students use the language of mathematics to express mathematical ideas precisely.

Students recognize and use connections among mathematical ideas.

- Students recognize and apply mathematics in contexts outside of mathematics.

Students create and use representations to organize, record, and communicate mathematical ideas.

- Students select, apply, and translate among mathematical representations to solve problems.

ITEA 9-12

Students develop an understanding of the attributes of design.

- Students learn design problems are rarely presented in a clearly defined form.
- Students learn that design needs to be continually checked and critiqued and the ideas of the design must be redefined and improved.

## Time Required

45-90 minutes (will vary with class size)

## Content Areas

Primary: Math

Secondary: Technology, science, language arts

## Vocabulary

- arc length
- radius
- range of motion

# Materials

- Completed Pitsco T-Bot
- Pencil
- Metric ruler
- “Work Envelope Data Sheet”
- Protractor



# Procedure

**1** The area in which a robot can perform work is called the work envelope. The T-Bot has a work envelope that is shaped similar to one quarter of a globe.

**2** Locate the Pitsco T-Bot.

**3** Locate the T-Bot's four different axes of motion. An axis is the point at which a body or a part rotates. The T-Bot moves in four axes of motion: Axis 1 – where the swivel base connects to the platform; Axis 2 – where the mid-arm connects to the swivel base; Axis 3 – where the mid-arm connects to the forearm; and Axis 4 – where the end effector (grippers) connects to the forearm.

**4** Determine the range of motion of the swivel base. The formula for figuring arc length is:  $\text{Arc Length} = \text{Radius} \times \text{Radians}$ .  
 $\text{Radians} = \text{Degree Measurement} \times (\pi/180)$

*Students will need to use a protractor and ruler to obtain the measurements.*

**5** Record these measurements on the "Work Envelope Data Sheet."

**6** Repeat these steps for the mid-arm, forearm, and the grippers.

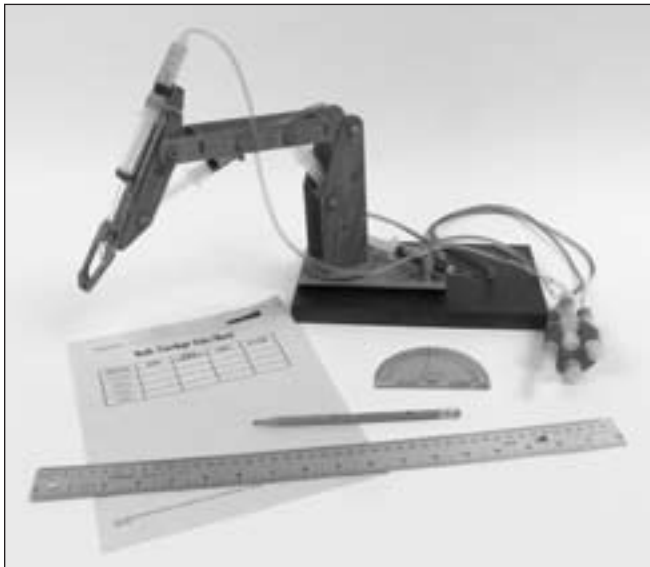
**7** Using the measurements obtained, complete the "Work Envelope Data Sheet."

# Quick View

Determine the range of motion for each axis of the T-Bot.

# Materials

- Completed Pitsco T-Bot
- Pencil
- Metric ruler
- “Work Envelope Data Sheet”
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- 5 Record these measurements on the "Work Envelope Data Sheet."
- 6 Repeat these steps for the mid-arm, forearm, and the grippers.
- 7 Using the measurements obtained, complete the "Work Envelope Data Sheet."

# Work Envelope Data Sheet

<b>Robot Axes</b>	<b>Radius</b>	<b>Degree Measurement</b>	<b>Radians</b>	<b>Arc Length</b>
Swivel Base				
Mid-Arm				
Forearm				
Grippers				