Algebraic Equations: Calculator Controlled Robots

Presented by: Marti Phipps

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Hosted by

Marti Phipps
NES Education Specialist
Jet Propulsion Lab
Introduction

• Hands-on, inquiry-based missions.
• Ten missions and three exploratory extensions.
• Missions are built sequentially upon knowledge from prior activities.
• Students discover math concepts by programming robots to complete challenges.
Poll Question

Are you currently a member of NASA Explorer Schools?

✔ Yes
✖ No
Subject Areas

- Math and technology
- Grade Levels: 6th – 8th
National Standards - Technology

- Basic operations and concepts
- Technology productivity tools
- Technology research tools
- Technology problem solving and decision making
National Standards - Mathematics

- Numbers and operations
- Algebra
- Geometry
- Measurement
- Data analysis and probability
- Problem solving
Objectives

• Students will be able to use and apply algebraic concepts and science concepts to direct their robots through a variety of challenges.
Mission Overview

- Introduction
- Materials list
- Robot challenge
Mission Overview

- Introduction
- Materials list
- Robot challenge
- Programming instructions
Mission Overview

• Introduction
• Materials list
• Robot challenge
• Programming instructions
• Teacher notes
Let’s pause for questions from the audience.
NASA Connection

Calculator Controlled Robots

http://nasaed.okstate.edu/nes/e-PD/Live/CCR/Curiosity.mov
Rovers

- Spirit/Opportunity: 2004
- Sojourner: 1997
- Curiosity: 2011
Phoenix Lander
Tour of Educational Site
Just for Kids

http://phoenix.lpl.arizona.edu/kids.php
Curiosity
Mars Spirit
Jeopardy
Which Robot:

• Following the water
• Science laboratory looking for life
• Discovered water ice
• R2D2 and C3P0
Mars for Kids
Web Tour

http://marsprogram.jpl.nasa.gov/participate/funzone/
Mars for Educators
Web Tour

http://marsrover.nasa.gov/classroom/
Calculator Controlled Robots
Grade Level 6 - 8
Touch Sensor
TI Robot Application

• The TI Application may already be on your calculator or can be downloaded from:
  http://mste.illinois.edu/resources/ti/robot/about/index.html
TI Connect Computer Software

• Software can be found on the Product CD that comes with your calculator or it can be downloaded from:
Introduction to Missions

• Ten missions
• Algebra
• Highly engaging
• Inquiry-based
• Problem solving
Primary Materials List

- Norland calculator robot
- Graphing calculator
- Meter stick
- Graph paper
- Safety goggles
Missions Materials List

- Student copies of CCR
- AA Batteries
- Small balloons
- Model rockets
- Glue gun
- Popsicle sticks, straws, form meat treats
- String
- Washable markers
- White poster board
- Pen holders
- Drawing paper
- 3” rubber ball
- Data link cables and Submini Couplers
Let’s pause for questions from the audience.
Mission 1 Measure

• Measure the width of a hallway.
Mission 2
Graph and Predict

• Come as close to crashing your robot into an object as possible, without actually hitting the object.
Mission 3

Turns and Mazes

• Navigate a maze
• Retrieve a secret package
• Return to starting point
Mission 4
Circles

• Draw circles using the robot
  – three different diameter circles using three different wheel motions...
Mission 5
Game Spinner

• Instruct robot to spin
• Randomly land on numbers 1 to 8
Mission 6
Game Day

- Fun applications
- Experimentation
Mission 7

\[ E=mc^2 \]

- Standard notation
- Scientific notation
- Exponents
- Formulae
Mission 8
Cool Stuff

• Graph Equations
  – Linear
  – Quadratic
  – Absolute value
  – Radical

• Create solution table
Mission 9
Mission to Mars

- Functions
- Estimations
Mission 10
Popbots

• Final assessment
• 10 problems to solve
Let’s pause for questions from the audience.
Programming Basics

Calculator Controlled Robots
Instructions to Program

Detailed instructions for programming the robot are located at the end of the activity.

<table>
<thead>
<tr>
<th>MISSION</th>
<th>1</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Programming Instructions</td>
</tr>
</tbody>
</table>

Turn on your graphing calculator. Press [PRGM], use the arrow to highlight NEW. Press [ENTER], then spell out [GO] by pressing the appropriate keys. Press [ENTER]. You're ready to enter the first command for the program.

**Line 1:** Press [PRGM], use the arrow to highlight I/O. Use the arrow to scroll down to B: Send(. Press [ENTER]. Press 2nd and then press [1] for an open brace. Type in 2(2). Close the braces and parentheses by pressing 2nd [1], then [1]. Press [ENTER]. The first line should appear as:

:Send (222)

**Line 2:** Press [PRGM], use the arrow to highlight I/O. Use the arrow to scroll down to A: Get( Press [ENTER]. Press [ALPHA], then [R]. Press [1], then [ENTER]. The second line should appear as:

:Get (R)

**Line 3:** Press [PRGM], then use the arrow to highlight I/O. Use the arrow to scroll down to 3: Disp. Press [ENTER]. Press [ALPHA], then press [R]. Press [ENTER]. The third line should appear as:

:Disp R
New Program

- Press the APPS key
- Choose the application “TiRobot”
- Choose “1: New Program”
Edit a Program

• Choose “2: Edit Program”
• Use arrows to locate the command
• Change the command
• Press the enter key
To Save a Program

• You CANNOT save your program!
• You can edit your program, but as soon as you change it the changes are permanent!
• WRITE DOWN YOUR COMMANDS to see what you’ve done in the past.
Commands

1 = a certain amount of time
Commands

1 = a certain amount of time
2 = move until the front bumper hits something
Commands

1 = a certain amount of time
2 = move until the front bumper hits something
3 = move for a certain time unless the front bumper hits something
Commands

Left Wheel

0 = Rotate backwards
Commands

XXX

Left Wheel
0 = Rotate backwards
1 = No motion
Commands

Left Wheel
0 = Rotate backwards
1 = No motion
2 = Rotate forward
Commands

Right Wheel

0 = Rotate backwards
Commands

XXX

Right Wheel

0 = Rotate backwards
1 = No motion
Commands

2

Right Wheel
0 = Rotate backwards
1 = No motion
2 = Rotate forward
Test Yourself

• What will your robot do?
• 1 0 0 ?
• 2 2 2 ?
• 1 0 2 ?
• 2 2 1 ?
Extra Information

• After you type in your command, you will need to push ENTER

• Choose a **Time** in centi-seconds (100 = 1 second, 200 = 2 sec, 300 = 3 sec)

• After entering all commands, press the **MODE** button to return to the main menu

• Place the robot on the floor and select “3: Run Program”
Congratulations!

YOU NOW KNOW HOW TO DRIVE YOUR CAR-BOT!
Let’s pause for questions from the audience.
Extensions and Resources

Calculator Controlled Robots
Brainstorm

How could you use this in the classroom?
Websites

• Norland Research
• Illinois Education
• Texas Instruments
Preloaded Programs

• DEMO
• EXPLORE2
• GAME1
• MACER
DEMO Program

• Demonstrates basic capabilities of the CCR
  – Forward
  – Backward
  – Circular motions as well as bumper switch responses
EXPLORE2 Program

• For use with Missions 9 & 10
• It allows the operator to remotely control CCR’s movements by pressing numbers on the key pad
  - 8 forward 1.0 second
  - 2 backward 1.0 second
  - 6 turns to the right
  - 4 turns to the left
GAME1 Program

• Demonstrates random number selection feature of the calculator. It can be used in a contest to race CCRs to a wall.

• Calculator randomly selects numbers from 1 to 10. Some numbers will move robot forward, others will slow its progress.
MACER Program

• Can be used in a contest to race CCRs to a wall.

• Simple math problems are displayed. Enter correct answers to move the robot forward.
More Extensions

- Laser Altimeter
- Crawler Transporter
- Mission Patches and Demos
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