GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

ENGINEERING & TECHNOLOGY

PATHWAY: Manufacturing

COURSE: Robotics and Automated Systems

UNIT: 6.1 Programming

INTRODUCTION

Annotation:

In this unit students will design solutions for simple programs using basic programming techniques and constructs.

Grade(s):

	9th
X	10th
X	11th
X	12th

Time:

10 hours

Author:

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Additional Author(s):

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

FOCUS STANDARDS

GPS Focus Standards:

ENGR-RAS-2. Students will identify and explain the major engineering tasks in organizing automated manufacturing.
ENGR-RAS-3. Students will discuss the systems and applications of automation including: AGV, PLC, CNC, CIM, CAD, CAM, and robotics as essential to succeeding globally in a manufacturing market.
ENGR-RAS-4. Students will outline the utilization of programmable control devices and data transfer.
ENGR-RAS-5. Students will apply the principles of PLC, CIM, CAD, CAM, and robotics in the manufacturing of a product.
ENGR-STEM-1. Students will recognize the systems, components, and processes of a technological system.
ENGR-STEM-3. Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
ENGR-STEM-4. Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.
ENGR-STEM-5. Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.
ENGR-STEM-6. Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

GPS Academic Standards:

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
SCSh3. Students will identify and investigate problems scientifically.
SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
SCSh5. Students will demonstrate the computation and estimation skills necessary for analyzing data and developing reasonable scientific explanations.
SCSh8. Students will understand important features of the process of scientific inquiry. MM3P1. Students will solve problems (using appropriate technology).
MM3P2. Students will reason and evaluate mathematical arguments.

National / Local Standards / Industry / ISTE:

UNDERSTANDINGS & GOALS

Enduring Understandings:

- Students will understand how basic programming concepts are used to control robotic equipment.

Essential Questions:

- What is programming?
- What jobs might a robotic programmer have to perform in a real world setting?

Knowledge from this Unit:

- Students will be able to identify primary concepts of programming
- Students will be able to explain the purpose of a compiler, interpreter, and assembler
- Students will be able to differentiate between tele-control, autonomous, and semi autonomous controls.

Skills from this Unit:

- Students will be able to create simple programs for robotic components
- Given a programming language for which instruction has been presented, students should be able to design a simple program that moves a robot on a predetermined path via distance, time, sensor, or motor control.

ASSESSMENT(S)

Assessment Method Type: Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

X Pre-test
____ Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
__ Unit test
____ Group project
X Individual project
X Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
__ Self-check during writing/planning process
__ Journal reflections on concepts, personal experiences and impact on one's life
__ Reflect on evaluations of work from teachers, business partners, and competition judges
__ Academic prompts
__ Practice quizzes/tests
X Subjective assessment/Informal observations
__ Essay tests
_x_ Observe students working with partners
__ Observe students role playing
____ Peer-assessment
__ Peer editing & commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
X Dialogue and Discussion
__ Student/teacher conferences
__ Partner and small group discussions
_x_ Whole group discussions
__ Interaction with/feedback from community members/speakers and business partners
____ Constructed Responses
__ Chart good reading/writing/listening/speaking habits
__ Application of skills to real-life situations/scenarios
____ Post-test

Assessment(s) Title:

Assessment(s) Description/Directions:

Attachments for Assessment(s):

LEARNING EXPERIENCES

Sequence of Instruction

1. **Identify the Standards. Standards should be posted in the classroom for each lesson.**
2. **Review Essential Questions.**
3. **Identify and review the unit vocabulary.**
4. **Assessment Activity.**

Step 1:
Discuss the concepts of programming. Show the Intro to Programming PowerPoint. *(see Intro to programming.ppt)*

Step 2:
Use programming language and tutorials appropriate to your robotic units to learn to program and operate your robot.

Step 3:
Use programming language appropriate to your robot to have the robots run in the Maze Race. *(see Robotic Maze Run.doc)* Robot maze can be constructed with a sheet of plywood, and 2x4 studs. Careful planning could allow for multiple paths, or removable components allowing new mazes for advanced trials or future classes.

Attachments for Learning Experiences:

Notes & Reflections:

The Programming Unit is a difficult one to write. There are many different programming languages available, and depending on the robotic kits a school may possess, or the personal experience of the instructor, or even preference of multiple languages, the choice is too varied to cover them all. For expediency sake, we will focus on a few, and allow for discovery on the rest.

If your robotic system is a fixed station, such as a robotic arm, instead of creating a maze, you might have students perform a series of movements and placement of objects in specified locations. A small maze could be created, keeping the area totally within the arm's envelope. Have the arm move a small object like a Hot Wheel car through the maze. Care must be made to ensure the gripper can reach inside the walls of the maze. Taped lines might be a good alternative.

NXT
The first language would be that of the LEGO Mindstorm NXT. This language is documented within the Mindstorm kit, and books have been written for it as well. While I cannot recommend one over another, you might look at the following possible selections:

Maximum Lego NXT: Building Robots with Java Brains by Brian Bagnall

The Lego Mindstorms NXT Idea Book: Design, Invent, and Build by Martin Boogaarts, Jonathan A. Daudelin, Brian L. Davis, Jim Kelly, Lou Morris, Fay and Rick Rhodes, Matthias Paul Scholz, Christopher R. Smith, Rob Torok, & Chris Anderson

LEGO MINDSTORMS NXT-G Programming Guide (Technology in Action) by James Floyd Kelly

Building Robots with LEGO Mindstorms NXT by Mario Ferrari; Guilio Ferrari; David Astolfo

The Unofficial LEGO MINDSTORMS NXT Inventor's Guide by David J. Perdue

The Internet offers some help as well. The following site is very informative, and has flash videos covering both the essential and advanced programming possibilities.

http://www.ortop.org/NXT_Tutorial/
additional tutorials include:
http://www.education.rec.ri.cmu.edu/roboticscurriculum/curriculum/introductiontoprogramming.htm
http://inside.catlin.edu/site/msrobotics/html/downloads.html
http://thenxtstep.blogspot.com/2008/07/nxt-video-tutorial.html
http://nxtasy.org/2006/08/08/kids-oriented-tutorial-on-nxt-g/
http://www.uaerobotchallenge.com/Tutorials/NXT%20Tutorial.pdf
http://blogs.mathworks.com/loren/2008/06/30/lego-mindstorms-nxt-in-teaching/

VEX
IFI's VEX robotics system is the next programming option. The Easy-C programming kit is an additional charge, and can be installed on a single computer, but can be used to program multiple robots. Lab sets are available.
See VexProgramming.wmv
http://www.engr.sjsu.edu/bjfurman/courses/E10/E10pdf/EasyC_environment.pdf
http://users.wpi.edu/~bamiller/VexProgramming.wmv
http://www.chiefdelphi.com/forums/attachment.php?attachmentid=4893&d=1168964099
https://www.cresis.ku.edu/~cgifford/eecs690/Vex_Robotics_Tutorial.pdf

RobotC
http://www.robotc.net/forums/
http://www.robotc.net/index.html

MP LAB
http://www.vexfan.com/viewforum.php?f=12
http://www.roboticsguy.com/tutorials/vex/getting-started-with-mplab/
http://www.chiefdelphi.com/media/papers/download/2281

SCORBOT
Check with Intelitek
See Scorbot Dos.doc

Other Languages
http://www.mvrt.com/notes/Basic_programming.pdf
http://www.mvrt.com/notes/Basic_programming_II.pdf
http://rossum.sourceforge.net/sim/index.html Rossum's Playhouse (RP1) is an open-source robot simulator.
Programming Microsoft® Robotics Studio by Sara Morgan
http://msdn.microsoft.com/en-us/robotics/aa731520.aspx
http://msdn.microsoft.com/en-us/robotics/aa731536.aspx
http://www.usfirst.org/community/frc/content.aspx?id=482

CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title:
Robotic Maze Run

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:
Robotic Maze Run provides students an opportunity to show their knowledge of programming a micro controller to move a simple robot through a series of runs to negotiate a maze.

Attachments for Culminating Performance Task:
(See Robotic Maze Run.doc)

UNIT RESOURCES

Web Resources:

http://www.education.rec.ri.cmu.edu/roboticscurriculum/curriculum/introductiontoprogramming.htm PPTs
www.cs.iupui.edu/~telliott/n201/ppt/n201IntroducingProgramming.ppt
www4.ncsu.edu/~jrbusby/TED%20384/Powerpoints/Week%205/programming.ppt
gicl.cs.drexel.edu/wiki-data/images/c/c7/Ferrier_DesignRation.ppt
http://www.wtec.org/robotics/us_workshop/June22/WTEC%20Robotics%20Workshop%20-%20Industrial%20Applications-combined.pdf
http://www.unisanet.unisa.edu.au/Resources/05487/Robotics/Lecture%20Note/Week%2012/week12A.pdf
http://rossum.sourceforge.net/
http://roboticsprimer.sourceforge.net/workbook/Main_Page
http://www.linuxdevices.com/articles/AT5739475111.html
http://educhoices.org/articles/Programming_with_Robots_OpenCourseWare_Free_Online_Undergraduate_Robotic_Programming_Course_by_Capilano_University.html
http://www.education.rec.ri.cmu.edu/
http://www.ortop.org/NXT_Tutorial/
http://www.vexrobotics.com/vex-robotics-programming-kit.shtml
http://www.roboticsguy.com/tutorials/vex/getting-started-with-mplab/
http://www.engr.sjsu.edu/bjfurman/courses/E10/E10pdf/EasyC_environment.pdf

Attachment(s):

Materials & Equipment:

What 21st Century Technology was used in this unit?

X	Slide Show Software		Graphing Software		Audio File(s)
	Interactive Whiteboard		Calculator		Graphic Organizer
	Student Response System		Desktop Publishing		Image File(s)
	Web Design Software		Blog	x	Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email	X	Website		