Randolph Township Schools
Randolph Middle School

Robotics II Curriculum

Department of Science, Technology, Engineering, and Math
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Supervisor

Curriculum Committee
Ned Sheehy
Nick Lavender

Curriculum Developed:
July 2016

Date of Board Approval:

Randolph Township Schools
Department of Science, Technology, Engineering, and Mathematics
Robotics II

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Randolph Township Schools

Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Randolph Township Schools
Affirmative Action Statement

Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the state's standards. The curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

RANDOLPH TOWNSHIP BOARD OF EDUCATION
EDUCATIONAL GOALS
VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences
- Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

Randolph Township Schools
Department of Science, Technology, Engineering, and Mathematics
Robotics II

Introduction

Robotics II will immerse students in activities that allow them to apply skills obtained in Robotics I. This is accomplished by providing problem-based learning lessons that expose students to real-world conditions. This learning approach creates a student-centered environment by providing a *learning by doing* setting which is the focal point of educational robotics. This program focuses on transferable skills and stresses understanding and demonstration of the science and mathematical knowledge, technological tools, machines, materials, processes and systems related to robotics. Robotics II provides opportunities for realistic high-tech interdisciplinary application of content students can relate to their lives. Through teamwork, students solve increasingly complex problems, cumulating with a project in which they apply all the skills obtained in previous units. Students are encouraged to take possession of their tasks and will feel empowered solving real-world problems they have chosen. This curriculum is based on building to learn. Robotics provides the means to apply this type of environment.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Robotics II

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
2 weeks	**I**	**Hazardous Waste Design Challenge**
2 weeks	**II**	**Obstacle Course Olympics**
2 weeks	**III**	**Robot Athletics: Bluetooth Connectivity**
3 weeks	**IV**	**Mars Land Surveyor**

RANDOLPH TOWNSHIP SCHOOL DISTRICT

<table>
<tr>
<td rowspan="7">STANDARDS / GOALS:

8.1.8.A.1
Demonstrate knowledge of a real world problem using digital tools.
8.1.8.A.4
Graph and calculate data within a spreadsheet and present a summary of the results
8.2.8.A.2
Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.
8.2.8.B.2
Identify the desired and undesired consequences from the use of a product or system.
8.2.8.D.1
Design and create a product that addresses a real world problem using a design process under specific constraints.
8.2.8.D.3
Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
8.2.8.E.4
Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

<u>CCSS.ELA-LITERACY.RST.6-8.3</u>
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</td>
<td>ENDURING UNDERSTANDINGS</td>
<td>ESSENTIAL QUESTIONS</td>
</tr>
<tr>
<td>Students can control their physical environment by coding software to manipulate a robot.</td>
<td>• How can the coding of software effect the environment around you?</td>
</tr>
<tr>
<td>Autonomous robots protect humans from harmful conditions (i.e hazardous waste conditions, bomb disposal, etc).</td>
<td>• Under what conditions should research be conducted for the development of robots to perform a task rather than a human?</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>KNOWLEDGE</td>
<td>SKILLS</td>
</tr>
<tr>
<td>Students will know:
Robotics has the ability to change the environment around us.

How to code robots to sort items by color distinction and properly execute robotic commands.

Gear ratios and their implementation to actuators.

Different types of hazardous waste such as paints, automotive wastes, electronics, etc.

VOCABULARY:
Hazardous waste, actuator</td>
<td>Students will be able to:
Research, design, build, code, and test a robot that will sort hazardous chemicals that have been discovered in an abandoned factory.

Progress through a self-paced challenge to master certain programming functions.

Construct robots that include gears and sensors.

Describe the effects of robotics on society.</td>
</tr>
</table>

	KEY TERMS: Color assortment, gear ratios	
ASSESSMENT EVIDENCE: Students will show their learning by: • See Appendix A		

Robotics II
UNIT I: Hazardous Waste Design Challenge

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Robotics 2
UNIT I: Hazardous Waste Design Challenge

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 Weeks	**UNIT I: Hazardous Waste Design Challenge** Research of Autonomous Robots Design and construct autonomous robots What is Hazardous Waste? Create code that sorts objects by color distinction Hazardous Waste Design Challenge	<u>BOOKS:</u> None Required Readings taken from various relevant sources. <u>Suggested Supplies:</u> Computers Programs such as Microsoft Word, PowerPoint, and Excel Open Source and Web 2.0 Applications NXT, EV3 and VEX robot kits. <u>Suggested Activities:</u> Research Parts definition Hazardous Waste Design Challenge

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Robotics II

<table>
<tr>
<td rowspan="8">STANDARDS / GOALS:

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Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.
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Identify the desired and undesired consequences from the use of a product or system.
8.2.8.D.1
Design and create a product that addresses a real world problem using a design process under specific constraints.
8.2.8.D.3
Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
8.2.8.E.4
Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

<u>CCSS.ELA-LITERACY.RST.6-8.3</u>
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</td>
<td>ENDURING UNDERSTANDINGS</td>
<td>ESSENTIAL QUESTIONS</td>
</tr>
<tr>
<td>Input sensors provide data about the environment in which robots reside.</td>
<td>How can software be coded that will modify the robots functions based on the data received from the sensor?</td>
</tr>
<tr>
<td>Mobility over various terrain is crucial for robots to perform specific tasks.</td>
<td>How does limited mobility effect both robot and human’s ability to function as designed?</td>
</tr>
<tr>
<td>Robots are designed to function properly on multiple terrain surfaces.</td>
<td>How can you design a robot to travel more efficiently over various terrains?</td>
</tr>
<tr>
<td>KNOWLEDGE</td>
<td>SKILLS</td>
</tr>
<tr>
<td>Students will know:
Different sensors (touch, ultrasonic, color, gyro sensors) can interact with the physical environment.

Robots can be designed and constructed to utilize different methods of mobility.

Topography (terrain) can affect how robots are designed and how they function.

VOCABULARY:
Topography, terrain, mobility, sensors

KEY TERMS:</td>
<td>Students will be able to:
Research, design, construct, code, and test a robot that will travel though a course using sensors to go around or remove obstacles

Code software programed to perform different tasks.

Develop robots that can successfully function on multiple terrains.</td>
</tr>
</table>

ASSESSMENT EVIDENCE: Students will show their learning by:

- See Appendix A

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Robotics II
Unit II: Obstacle Course Olympics

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 Weeks	**Unit II: Obstacle Course Olympics** Sensor installation Software modification using sensors How topography affects mobility Obstacle Course Olympics	<u>BOOKS:</u> None Required Readings taken from various relevant sources. <u>Suggested Supplies:</u> Computers Programs such as Microsoft Word, PowerPoint, and Excel Open Source and Web 2.0 Applications NXT, EV3 and VEX robot kits. <u>Suggested Activities:</u> Obstacle Course Olympics

RANDOLPH TOWNSHIP SCHOOL DISTRICT

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Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
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Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

<u>CCSS.ELA-LITERACY.RST.6-8.3</u>
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Wi-Fi and Bluetooth are different standards for wireless communication.</td><td>• How does Wi-Fi connection and Bluetooth connectivity compare?</td></tr>
<tr><td>Pairing two or more devices allows for control of robots remotely.</td><td>• Explain how you can use Bluetooth to pair multiple devices to control robots remotely.</td></tr>
<tr><td>Technology allows for communication and control to take place over long distances.</td><td>• How can technology be used to reach people or objects over long distances?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:
How to pair various devices via blue tooth.

How to create code to customize the layout on their device screen to the functions the robot executes.

How to design and construct an environment that facilitates communication over long distances.

VOCABULARY: Pairing, Wi-Fi, Bluetooth

KEY TERMS: Bluetooth Connectivity, technological</td><td>Students will be able to:
Create various robots to compete in athletic activities while controlling their robot using their personal devices via blue tooth.

Research, design, construct, code, and test a robot competed in multiple athletic events against other robots created by students.

Develop a means of communication between two devices over a long distance.</td></tr>
</table>

	communication	
ASSESSMENT EVIDENCE: Students will show their learning by: • See Appendix A		

Robotics II
UNIT III: Robot Athletics: Bluetooth Connectivity

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Robotics II
Unit III: Robot Athletics: Bluetooth Connectivity

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 Weeks	**Unit III: Robot Athletics: Bluetooth Connectivity** Understanding the difference between Wi-Fi and Bluetooth connections Pairing devices via Bluetooth Establishing long range communication environments Robot Athletics	<u>BOOKS:</u> None Required Readings taken from various relevant sources. <u>Suggested Supplies:</u> Computers Programs such as Microsoft Word, PowerPoint, and Excel Open Source and Web 2.0 Applications NXT, EV3 and VEX robot kits. <u>Suggested Activities:</u> Robot Golf Robot Soccer Robot Jousting Robot Hockey

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Robotics II
UNIT IV: Mars Land Surveyor

<table>
<tr><td rowspan="5">STANDARDS / GOALS:

8.1.8.A.1
Demonstrate knowledge of a real world problem using digital tools.
8.1.8.A.4
Graph and calculate data within a spreadsheet and present a summary of the results
8.2.8.A.2
Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.
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Identify the desired and undesired consequences from the use of a product or system.
8.2.8.D.1
Design and create a product that addresses a real world problem using a design process under specific constraints.
8.2.8.D.3
Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.
8.2.8.E.4
Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

<u>CCSS.ELA-LITERACY.RST.6-8.3</u>
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Scientists and Engineers need to consider the environment and conditions in which they are working when designing equipment.</td><td>• How can surveying Mars' landscape benefit our lives on Earth?
• Explain how the specifications and individual characteristics of an environment effect the manner in which you conduct research, design, build, and test a robot.</td></tr>
<tr><td>Students have the power to shape the future by developing new technologies that will benefit our society.</td><td>• How can we use technology to further explore unknown frontier on Earth?</td></tr>
<tr><td>Through the combination of hardware and software, robots can sense their environment, make decisions, and perform different tasks based on information received from input data.</td><td>• How can robots be used to perform tasks and solve problems?</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:
Appropriate navigation of their robot through several different geological sections.

Research, construction, and coding multifunction robots that use multiple sensors, make various decisions, and perform an assortment of tasks.

Pairing, mobility, and proper execution of robotic commands.
Stop and load minerals into robot cargo bay.</td><td>Students will be able to:
Utilize the Engineering Design Process to develop solutions for student-designed problem.

Apply current technical knowledge to their design of a robot.

Evaluate their project and modify it as needed.
Locate "RANtrium" mineral using various sensors.</td></tr>
</table>

	VOCABULARY: surveying, navigation	
ASSESSMENT EVIDENCE: Students will show their learning by: • See Appendix A		

RANDOLPH TOWNSHIP SCHOOL DISTRICT

Robotics II

Unit IV: Mars Land Surveyor

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
3 Weeks	**Unit IV: Mars Land Surveyor** Use the engineering design method to solve multiple problems simultaneously to accomplishing a task. Design the hardware to solve multiple problems based on information received from multiple sensors Design the software to solve multiple problems based on information received from multiple sensors Mars Land Surveyor	BOOKS: None Required Readings taken from various relevant sources. Suggested Supplies: Computers Programs such as Microsoft Word, PowerPoint, and Excel Open Source and Web 2.0 Applications NXT, EV3 and VEX robot kits. Suggested Activities: Mars Land Surveyor

APPENDIX A

UNIT I: Hazardous Waste Design Challenge

	3	2	1	0
Research	Student obtained plans that thoroughly demonstrated how the robot will move, detect containers, identify color, capture container and move it to the proper location.	Student obtained plans that demonstrated how the robot will move, detect containers, identify color, capture container and move it to the proper location.	Student obtained incomplete plans that demonstrates how the robot will move, detect containers, identify color, capture container and move it to the proper location.	Student was unable to find plans.
Design	Student exceeded design constraints of how the robot will move, detect containers, identify color, capture container and move it to the proper location.	Student met design constraints of how the robot will move, detect containers, identify color, capture container and move it to the proper location.	Student created an incomplete design of how the robot will move, detect containers, identify color, capture container and move it to the proper location.	Student was unable to create a design
Construct	Student constructed a robot that moves, detects containers, identifies color, captures container and moves it to the proper location.	Student constructed a robot that completes three out of four.	Student constructed a robot completes at least two functions.	Student did not create a robot.
Code	Student coded a program that moves, detects containers, identifies color, captures container and moves it to the proper location.	Student coded a robot that completes three out of four.	Student coded a robot that completes two out of four.	Student did not create code.
Test	Student tested their robot to insure that it moves, detects containers, identifies color, captures container and moves it to the proper location.	Student tested a robot that completes three out of four.	Student teste a robot that completes two out of four.	Student did not test.

Unit II: Obstacle Course Olympics

	3	2	1	0
Research	Student obtained plans that thoroughly demonstrated how the robot will move through different terrains, and detect objects of different sizes, shapes and colors.	Student obtained plans that demonstrated how the robot will move through different terrains, and detect objects of different sizes, shapes and colors.	Student obtained incomplete plans that thoroughly demonstrated how the robot will move through different terrains, and detect objects of different sizes, shapes and colors.	Student was unable to find plans.
Design	Student exceeded design constraints that will move through different terrains, and detect objects of different sizes, shapes and colors.	Student met design constraints that will move through different terrains, and detect objects of different sizes, shapes and colors.	Student incompletely created a design that will move through different terrains, and detect objects of different sizes, shapes and colors.	Student was unable to create a design
Construct	Student constructed a robot that will move through different terrains, and detect objects of different sizes, shapes and colors.	Student constructed a robot that completes three out of four.	Student constructed a robot completes at least two functions.	Student did not create a robot.
Code	Student coded a robot that will move through different terrains, and detect objects of different sizes, shapes and colors.	Student coded a robot that completes three out of four.	Student coded a robot that completes two out of four.	Student did not create code.
Test	Student tested a robot that moves through different terrains, and detects objects of different sizes, shapes and colors.	Student tested a robot that completes three out of four.	Student teste a robot that completes two out of four.	Student did not test.

UNIT III: Robot Athletics: Bluetooth Connectivity

	3	2	1	0
Research	Student obtained plans that thoroughly demonstrated how the robot will effectively compete in the athletic competition.	Student obtained plans that demonstrated how the robot will effectively compete in the athletic competition.	Student obtained plans that incompletely demonstrated how the robot will effectively compete in the athletic competition.	Student was unable to find plans.
Design	Student exceeded design constraints that will effectively compete in the athletic competition.	Student met design constraints that will effectively compete in the athletic competition.	Student incompletely created a design that will effectively compete in the athletic competition.	Student was unable to create a design
Construct	Student constructed a robot that will effectively compete in the athletic competition, pairs with their personal device, and has a proper screen layout.	Student constructed a robot that completes two out of three.	Student constructed a robot completes at least one function.	Student did not create a robot.
Test	Student tested a robot that effectively competes in the athletic competition, pairs with their personal device, and has a proper screen layout.	Student tested a robot that completes two out of three.	Student teste a robot that completes one function.	Student did not test.

Unit IV: Mars Land Surveyor

	3	2	1	0
Research	Student obtained plans that thoroughly demonstrated how the robot will effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student obtained plans that demonstrated how the robot will effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student obtained plans that incompletely demonstrated how the robot will effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student was unable to find plans.
Design	Student exceeded design constraints that will effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student met design constraints that will effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student incompletely created a design that will effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student was unable to create a design
Construct	Student constructed a robot that will effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student constructed a robot that completes two out of three.	Student constructed a robot completes at least one function.	Student did not create a robot.
Test	Student tested a robot that effectively navigate the Mars surface using their personal device, detect "RANitrium", and finally load it.	Student tested a robot that completes two out of three.	Student teste a robot that completes one function.	Student did not test.