**Randolph Township Schools**
**Randolph Middle School**

# Technology Challenges

*"It's not that we use technology, we live technology."*

- Godfrey Reggio

**Department of Science, Technology, Engineering, and Math**
Anne Vitale Richardson, Supervisor

**Curriculum Committee**
Nick Lavender

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August 2017

**Date of Board Approval:**
September 2017

# Randolph Township Schools
# Department of Science, Technology, Engineering, and Mathematics
# Technology Challenges

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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, & Mathematics
Introduction

The Randolph Township School District is committed to excellence. We believe that all children are entitled to an education that will equip them to become productive citizens of the 21st century. We believe that an education grounded in the fundamental principles of science, technology, engineering, and math (STEM) will provide students with the skills and content necessary to become future leaders and lifelong learners.

A sound STEM education is grounded in the principles of inquiry, rigor, and relevance. Students will be actively engaged in learning as they use real-world STEM skills to construct knowledge. They will have ample opportunities to manipulate materials and solve problems in ways that are developmentally appropriate to their age. They will work in an environment that encourages them to take risks, think critically, build models, observe patterns, and recognize anomalies in those patterns. Students will be encouraged to ask questions, not just the "how" and the "what" of observed phenomena, but also the "why". They will develop the ability, confidence, and motivation to succeed academically and personally.

STEM literacy requires understandings and habits of mind that enable students to make sense of how our world works. Scientifically and technologically literate citizens deal sensibly with problems that involve mathematics, evidence, patterns, logical arguments, uncertainty, and problem-solving.

## Technology Challenges
Introduction

This is a marking period cycle course offered to 7th grade students interested in technology and engineering. This course focuses heavily on the concept of simple machines and how they can assist us with tasks in our everyday lives. Technology Challenges includes hands-on activities that are centered on the different forms of simple machines: pulleys, levers, wheels, screws, inclined planes, and wedges. Through these activities, students will develop and apply problem solving, creative and technological skills to create real world solutions. By the end of this course, students will gain a fundamental understanding of simple machines, how they can be used simultaneously to form larger machines (Rube Goldberg) and how they benefit our society.

**RANDOLPH TOWNSHIP SCHOOL DISTRICT**
**Curriculum Pacing Chart**
**Technology Challenges**

| SUGGESTED TIME ALLOTMENT | UNIT NUMBER | CONTENT - UNIT OF STUDY |
|---|---|---|
| **7 weeks** | **I** | **Simple Machines: Pulleys, Levers, Wheels, Screws, Wedges, and Inclined Planes** |
| **2 weeks** | **II** | **Rube Goldberg Machines** |
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**RANDOLPH TOWNSHIP SCHOOL DISTRICT**
**Technology Challenges**
**Unit I: Simple Machines: Pulleys, Levers, Wheels, Screws, Wedges, and Inclined Planes**

<table>
<tr><td rowspan="6">STANDARDS / GOALS:<br><br><u>NJCCCS Technology</u><br><br>8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.<br><br>8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results<br><br>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.<br><br>8.2.8.B.2 Identify the desired and undesired consequences from the use of a product or system.<br><br>8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.<br><br>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.</td><td>ENDURING UNDERSTANDINGS</td><td>ESSENTIAL QUESTIONS</td></tr>
<tr><td>Work is a quantity that measures a force acting on an object over a distance.</td><td>How can understanding the amount of work needed impact work force habits?</td></tr>
<tr><td>Simple machines provide a mechanical advantage to our everyday tasks.</td><td>How is the mechanization of everyday tasks effecting the way our society is functioning in the 21st century?</td></tr>
<tr><td>KNOWLEDGE</td><td>SKILLS</td></tr>
<tr><td>Students will know:<br><br>Work can be calculated by measuring the amount of newtons used to move an object over a specific distance (meters).<br><br>By changing the position of the fulcrum on a lever, you can gain extra power with less effort.<br><br>A system of pulleys may be used to improve advantage in lifting weights, thereby reducing the force required to move an object.</td><td>Students will be able to:<br><br>Identify measuring tools to conduct an experiment for calculating the amount of scientific work.<br><br>Design and construct a trebuchet that can launch a small object a desired distance.<br><br>Test, evaluate, and redesign trebuchet prototypes.<br><br>Reframe engineering failures into positive results.<br><br>Establish small teams to brainstorm and plan</td></tr>
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| | | |
|---|---|---|
| | | project proposals.<br><br>Design and construct an elevator that uses multiple pulleys in order to function.<br><br>Incorporate various woodworking and crafting tools around the technology classroom. |
| | Wheels help you move an object across the ground by limiting the amount of friction between what you are trying to move and the surface you are pulling it against. | Design and construct a vehicle that is powered by rubber bands.<br><br>Research and test various wheel materials for determining which wheels increase traction and reduce friction. |
| | A ramp works by helping you lift things more easily up to a higher level.<br><br>A wedge helps you push things apart or hold things in place. | Evaluate vehicle prototypes for speed and aerodynamic abilities.<br><br>Investigate various inclined plane heights and lengths.<br><br>Examine how wedges compare to inclined planes.<br><br>Analyze various uses for the wedge. |
| | Screws are used in many different places to hold things together. | Examine how screws compare to inclined planes and wedges.<br><br>Construct a model screw using classroom items. |
| | **VOCABULARY:** work, mechanical advantage, leverage, friction, fulcrum, trebuchet, gears, inclined plane, wedge, lever, pitch, screwdriver. | |

| | | |
|---|---|---|
| | **KEY TERMS:** newtons. | |

**ASSESSMENT EVIDENCE: Students will show their learning by:**

- Calculating the amount of work that is used to pull various objects around the room
- Planning multiple project proposals to communicate ideas
- Constructing an elevator system
- Constructing a trebuchet
- Constructing a rubber band powered vehicle
- Planning and designing a paper screw

**RANDOLPH TOWNSHIP SCHOOL DISTRICT**
**Technology Challenges**
**Unit I: Simple Machines: Pulleys, Levers, Wheels, Screws, Wedges, and Inclined Planes**

| SUGGESTED TIME ALLOTMENT | CONTENT-UNIT OF STUDY | SUPPLEMENTAL UNIT RESOURCES |
|---|---|---|
| **7 Weeks** | **Simple Machines: Pulleys, Levers, Wheels, Screws, Wedges, and Inclined Planes**<br><br>Scientific Work<br><br>Pulleys: Elevator Control<br><br>Levers: Trebuchet Design<br><br>Wheels: Rubber Band Cars<br><br>Inclined Planes, Screws, Wedges | <u>BOOKS:</u><br>None Required<br>Readings taken from various relevant sources.<br><br><u>Suggested Supplies:</u><br>Computers<br>Various woodworking and crafting tools<br>Measuring and drafting tools<br>Craft Sticks<br>Balsa Wood<br>String/Yarn<br>Pulleys<br>Dowels<br>Cardboard<br>Other scrap material<br><br><u>Suggested Activities:</u><br>“Scientific Work Experiment”<br>“Elevator Control”<br>“Trebuchet Toss”<br>“Ferrari Design”<br>“Building a Screw” |

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<td rowspan="5">STANDARDS / GOALS:<br><br><u>NJCCCS Technology</u><br><br>8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.<br><br>8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results<br><br>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.<br><br>8.2.8.B.2 Identify the desired and undesired consequences from the use of a product or system.<br><br>8.2.8.D.1 Design and create a product that addresses a real world problem using a design process under specific constraints.<br><br>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.</td>
<td>ENDURING UNDERSTANDINGS</td>
<td>ESSENTIAL QUESTIONS</td>
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<tr>
<td>Combining multiple simple machines to form one larger machine can enhance productivity and efficiency</td>
<td>• In what ways does production efficiency effect the overall success or failure of an invention?</td>
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<tr>
<td>KNOWLEDGE</td>
<td>SKILLS</td>
</tr>
<tr>
<td>Students will know:<br><br>A Rube Goldberg Machine is a complicated device embodying a very simple job contraption that does many activities with little result.<br><br>A Rube Goldberg often puts objects through a “cause and effect” trial.<br><br>Multiple simple machines are used in every Rube Goldberg.<br><br>VOCABULARY: Rube Goldberg Machine, cause and effect.<br><br>KEY TERMS: simple machines.</td>
<td>Students will be able to:<br><br>Research various Rube Goldberg machine ideas and how they are designed and constructed.<br><br>Produce a detailed proposal that outlines the various steps for an innovative Rube Goldberg Machine.<br><br>Distinguish which simple machines will best fit their own Rube Goldberg machines plans.</td>
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**ASSESSMENT EVIDENCE: Students will show their learning by:**

- Planning a detailed project proposal
- Constructing a multi-step Rube Goldberg Machine that completes a given task

**RANDOLPH TOWNSHIP SCHOOL DISTRICT**

**Technology Challenges**

**UNIT II: Rube Goldberg Machines**

| SUGGESTED TIME ALLOTMENT | CONTENT-UNIT OF STUDY | SUPPLEMENTAL UNIT RESOURCES |
|---|---|---|
| **2 Weeks** | **Rube Goldberg Machines**<br><br>Rube Goldberg Machines Overview<br><br>Rube Goldberg Machines Creation | BOOKS:<br>None Required<br>Readings taken from various relevant sources.<br><br>Suggested Supplies:<br>Computers<br>Various woodworking and crafting tools<br>Craft Sticks<br>Balsa Wood<br>String/Yarn<br>Pulleys<br>Dowels<br>Cardboard<br>Other scrap material<br><br>Suggested Activities:<br>“Project Proposal”<br>“Rube Goldberg Construction” |

## APPENDIX A

Resources:

Text and Electronic Text:

None

Suggested Web Addresses:

www.google.com
www.tinkercad.com
http://www.cartoonnetwork.com/games/tj/trapomatic/index.html
http://pbskids.org/zoom/games/goldburgertogo/rubegame.html
http://pbskids.org/designsquad/
http://tryengineering.org/play-games

Software Names:

Microsoft Word
Microsoft PowerPoint
Microsoft Excel
Internet Sources

## APPENDIX B

Assessments

- Elevator Control
- Trebuchet Toss
- Ferrari Design
- Rube Goldberg Creation

# Trebuchet Toss Rubric

| Grade Scale | Efficiency | Project Proposal | Creativity |
|---|---|---|---|
| 5 | Trebuchet was able to launch a distance of 12+ feet and accurately hit the target. | Project represents excellent use of materials and drawing was clear and thought out. | Trebuchet design is quite unique to common designs found during the Middle Ages, while still being effective |
| 4 | Trebuchet was able to launch a distance of 12+ feet but did not accurately hit the target. | Project represents fair use of materials and drawing was clear. | The trebuchet incorporates a lot of effective design elements that makes it an effective design to utilize and build. |
| 3 | Trebuchet was able to launch a distance of 10-12 feet and accurately hit the target. | Project does not utilize materials correctly and drawing is rushed or incomplete.<br>OR<br>Proposal was not submitted on due date | Trebuchet is an ordinary design, but still represents effective features of common catapults from the Middle Ages. |
| 2 | Trebuchet was able to launch a distance of 5-10 feet but did not hit the target. | Project displays minimal effort and is incomplete in some areas. | Trebuchet has only a few good design elements within its structure, and it based upon a common design. |
| 1 | Trebuchet did not hit the target. | Project was clearly done with little regard to the instructions. | Trebuchet is a poor design that clearly takes minimal effort to create. |

# Elevator Control Rubric

| Grade Scale | Efficiency | Project Proposal | Creativity |
|---|---|---|---|
| **5** | Elevator displayed the proper use of a pulley system, included two pulleys, and was able to reach the top of the desk. | Project represents excellent use of materials and drawing was clear and thought out. | Elevator design is quite unique to common designs found today, while still being effective |
| **4** | Elevator displayed proper use of a pulley system, included two pullets, however was not able to reach the top of the desk. | Project represents fair use of materials and drawing was clear. | The elevator incorporates a lot of design elements that makes it an effective design to utilize and build. |
| **3** | Elevator displayed proper use of a pulley system, was able to reach the top of the desk, however the project used an incorrect amount of pulleys. | Project does not utilize materials correctly and drawing is rushed or incomplete.<br>**OR**<br>**Proposal was not submitted on due date** | Elevator is an ordinary design, but still represents effective features of common cars today |
| **2** | Elevator displayed proper use of a pulley system, however it was not able to reach the top of the desk and used an incorrect amount of pulleys. | Project displays minimal effort and is incomplete in some areas. | Elevator has only a few good design elements within its structure, and it based upon a common design. |
| **1** | Elevator did not display proper use of a pulley system, it was not able to reach the top of the desk and used an incorrect amount of pulleys. | Project was clearly done with little regard to the instructions. | Elevator is a poor design that clearly takes minimal effort to create. |

# Ferrari Design Rubric

| Grade Scale | Efficiency | Project Proposal | Creativity |
|---|---|---|---|
| 5 | Vehicle was able to travel 12+ feet by using only rubber band power. | Project represents excellent use of materials and drawing was clear and thought out. | Vehicle design is quite unique to common designs found today, while still being effective |
| 4 | Vehicle was able to travel 10-12 feet by using only rubber band power. | Project represents fair use of materials and drawing was clear. | The vehicle incorporates a lot of effective design elements that makes it an effective design to utilize and build. |
| 3 | Vehicle was able to travel 8-10 feet by using only rubber band power. | Project does not utilize materials correctly and drawing is rushed or incomplete.<br>OR<br>Proposal was not submitted on due date | Vehicle is an ordinary design, but still represents effective features of common cars today |
| 2 | Vehicle was able to travel 6-8 feet by using only rubber band power. | Project displays minimal effort and is incomplete in some areas. | Vehicle has only a few good design elements within its structure, and it based upon a common design. |
| 1 | Vehicle traveled less than 6 feet by using only rubber band power. | Project was clearly done with little regard to the instructions. | Vehicle is a poor design that clearly takes minimal effort to create. |

# Rube Goldberg Creation

| Grade Scale | Efficiency | Simple Machines | Creativity | Drawing Relation |
|---|---|---|---|---|
| **5** | Rube Goldberg Machine completed simple task without any stops between steps | Rube Goldberg includes at least 2 simple machines. | Rube Goldberg design is quite unique while still being effective | Rube Goldberg is an identical representation of the drawing that was created. |
| **4** | Rube Goldberg Machine completed simple task with 1 stop between steps, which caused a restart. | None | Rube Goldberg incorporates a lot of design elements that makes it an effective design to utilize and build. | Rube Goldberg has only slight differences from the drawing. |
| **3** | Rube Goldberg Machine completed simple task with 2 stops between steps, which caused a restart. | Rube Goldberg includes only 1 simple machine. | Rube Goldberg is an ordinary design. | Rube Goldberg has multiple parts that are different from the drawing that was created. |
| **2** | Rube Goldberg Machine completed simple task with 3 stops between steps, which caused a restart. | None | Rube Goldberg has only a few good design elements within its structure. | Rube Goldberg has many errors compared to how the drawing was created. |
| **1** | Rube Goldberg Machine did not complete the simple task. | Does not include any simple machines. | Rube Goldberg is a poor design that clearly takes minimal effort to create. | Rube Goldberg does a very poor job of representing the drawing. |