Randolph Township Schools
Randolph High School

PRINCIPLES OF ENGINEERING
Curriculum

Department of
Science, Technology, Engineering, and Math
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Curriculum Developed
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Randolph Township Schools
Department of Science, Technology, Engineering, and Math

Principles of Engineering

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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 addresses the elimination of discrimination and the achievement gap, as identified by underperforming school-level AYP reports for state assessments. 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 Math

Introduction

Randolph Township Schools 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. As described in Project 2061's *Benchmarks in Science Literacy, The Standards for Technological Literacy,* and *Professional Standards for Teaching Mathematics,* literacy in these subject areas enables people to think critically and independently. Scientifically and technologically literate citizens deal sensibly with problems that involve mathematics, evidence, patterns, logical arguments, uncertainty, and problem-solving.

Randolph Township Schools
Department of Science, Technology, Engineering, and Math

PRINCIPLES OF ENGINEERING

Course Introduction:

Principles of Engineering is a full-year course intended for students planning on, or at least interested in, a career in engineering. Learners will see how the engineering design process is applied to the production of real-world, often mass produced artifacts. An understanding of the basic principles of mathematics and science, achieved primarily through hands-on activities, will help students develop solutions that make efficient use of manmade and natural materials. This course will help students realize the interrelatedness of history, economics, philosophy, ethics, and writing, which will prepare them for rigorous study in any of the fields of engineering. This a full year course offered at two levels, A level and Honors level.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
2 weeks and ongoing	I	Introduction to Engineering
1 week and ongoing	II	Safety
3 weeks	III	Machines and Mechanisms
6 weeks	IV	Mass Production
6 weeks	V	Reverse Engineering
6 weeks	VI	Alternative Housing Construction
6 Weeks	VII	Ergonomic Design
6 Weeks	VIII	Musical Instrument Design

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT I: Introduction to Engineering

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
There are design tools, which can, like any other type of tool, extend and improve our ability to accomplish goals.	• What do you do when defined procedures don't work, or when there are no defined procedures to begin with?	
All real world design solutions are created in a context of parameters and special considerations: most of these concern a human element	• Under what circumstances does the human element remain indispensable to the engineering design process?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: The Engineering Design Process consists of: • Identifying a problem • Framing a Design Brief • Conducting research • Generating multiple possible solutions • Selecting a "best" solution by providing a rationale • Planning the implementation of the solution • Prototyping • Testing and evaluating Accurate recordkeeping and documentation are vital to the engineering design process. Design and engineering are disciplines, which have expectations about strong work habits, a collaborative spirit, safe work habits, a lively curiosity, and a sense of responsibility to our shared culture, planet, and resources. Design elements such as balance, harmony, color, strength, and "user-friendliness" must be given due weight. Ergonomic factors such as typical seat height, arm reach, and field of vision play a key role in virtually all designed products. Structural considerations of mass, rigidity or flexibility, ease of motion (or not), and "buildability" inhere in effective designs.	**Students will be able to:** Create sketches and drawing to accurately portray design ideas for self-designed projects. Write an accurate and organized engineering journal. Collaborate with team members to achieve specified goals. Demonstrate cooperative, productive, diligent work ethic in the completion of tasks. Employ brainstorming techniques to develop creative ideas and design solutions. Construct working models and finished projects which meet quality standards for fit and finish. Employ color, balance, and harmony as integral parts of a pleasing design. Evaluate proposed designs in terms of ergonomic comfort and efficiency. Appraise self-designed engineering solutions in terms of the application and control of forces both static and dynamic.	<u>NJCCC Science:</u> 5.1.12.C.1 5.3.12.A 5.3.12.B.1 5.4.12.C.1 <u>NJCCC Technology:</u> 8.2.12.B.1-3 8.2.12.B.5 9.4.12.0 9.4.12.(1) 9.4.12.(2) <u>Common Core Math:</u> S-1C.6 G-CO.1 G-CO.5 G-CO.12 G-MG.3 <u>Common Core ELA:</u> RST.9-10.4 RST.11-12.4 WHST.9-10-7 WHST.11-12.7

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Introduction to Engineering- 2 Weeks and Ongoing (These concepts will be continually reinforced and expanded upon and used throughout the course)		
	Personal Responsibilities in the Workplace	
	Keeping an Engineering Journal	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **SUGGESTED ACTIVITIES:** **Surface Area Development Model** **Cell Phone Holder Project** **Mechanism Model** **Automoblox** **Putt-Putt Boat** **Alternative Housing Project** **Ergonomic Furniture Design Project** **Musical Instrument Project**
	The Design Loop	
	The Artist's Toolkit: Visual Elements and Principles	
	Steps in the Design, Documentation, and Model Making Process	
	Design Considerations and Parameters	
	Sketching and Drawing	
	Working with Hand Tools	
	Working with Power Tools	
	Gluing and Adhesives	
	Characteristics of Materials	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT II: Safety

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Following proper safety measures will ensure a healthy working environment.	• In what ways has "personal safety" changed in the workplace?
Maintaining the workspace in a neat, safe condition helps to protect the user from injury and enhances the quality of the finished product.	• What is the value of responsibility?

KNOWLEDGE	SKILLS	NJCCCS
Students will know: Correct safety procedures to follow when using hand tools include wearing safety glasses, always cutting away, using two hands and making sure the tools are sharp. Correct safety procedures to follow when using power equipment include wearing safety glasses, making sure blades are sharp, and making sure areas around machines are clear. Correct safety procedures to follow when using soldering irons and electric power supplies include wearing safety glasses, having all equipment ready, and clearing work area of unneeded materials.	**Students will be able to:** Demonstrate safe practices by wearing safety glasses at all appropriate times. Use hand and power tools found in the lab safely and responsibly. Operate soldering equipment in a safe, energy-conserving manner. Understand and follow safe procedures when working with electricity.	**Science:** 5.1.12.C.1 5.1.12.C2

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Safety-1 Week and Ongoing		
	Wearing Safety Glasses	**Resources:**
	Safe use of Hand Tools	**Teacher generated handouts, demonstrations**
	Safe Use of Power Tools	
	Safe Procedures for Soldering Equipment and Electrical Power Supplies	**SUGGESTED ACTIVITIES:** **Ongoing observation of safe, responsible procedures at all times in the lab**

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT III: Machines and Mechanisms

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
There are numerous different approaches, which will work in accomplishing a given task, but some will be better than others.	• How does one decide how best to accomplish mechanized tasks?	
Energy cannot be created, but it can be accumulated, directed, and managed.	• In what ways can applying the laws of physics result in the accomplishment of an engineering goal?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: Mechanisms such as bell cranks, sliders, rack and pinion assemblies, and piston/ crank arrangements control and redirect power. The piston and cylinder arrangement is key to many of the engines in use today. Mechanisms such as gear trains are often used to provide feedback to other systems of mechanisms. Tolerance between moving parts in a mechanism, such as gear lash and bearing clearance have a profound effect on performance. Mechanisms must be built with enough structural integrity to maintain effective operating clearances, and at the same time must make efficient, cost-effective use of materials.	**Students will be able to:** Create a design for a machine, which employs multiple mechanisms. Produce and present an accurate and organized document outlining the procedures followed in designing a machine. Defend the design decisions reached in collaboration with team members to create a machine based on multiple mechanisms. Work effectively as a member of a team in the production of a prototype machine. Demonstrate a cooperative, productive, diligent work ethic in the completion of a complex arrangement of mechanisms. Formulate at least five creative design solutions for a complex machine. Construct a working model of a complex machine capable of handling applied forces both static and dynamic. Develop a working model of a device capable of redirecting, amplifying, and controlling a motive force.	<u>NJCCC Science:</u> 5.1.12.C.1 5.3.12.A 5.3.12.B.1 5.4.12.C.1 <u>NJCCC Technology:</u> 8.2.12.B.1-3 8.2.12.B.5 9.4.12.0 9.4.12.(1) 9.4.12.(2) <u>Common Core Math:</u> S-1C.6 G-CO.1 G-CO.5 G-CO.12 G-MG.3 <u>Common Core ELA:</u> RST.9-10.4 RST.11-12.4 WHST.9-10.7 WHST.11-12.7

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Machines and Mechanisms- 3 Weeks and Ongoing		
	Review of the Six Simple machines	
	Introduction to Mechanisms	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **Websites:** **http://robives.com/blog/bellcrank** **SUGGESTED ACTIVITIES:** **Mass Production Project** **Mechanism Model** **Working Model of a Self-Designed Machine Incorporating at Least 4 Different Mechanisms (Honors Credit)**
	Constructing a Model Mechanism	
	The Steam Engine and the Internal Combustion Engine	
	Characteristics of Materials: Wood, Masonite, Sheet Metal, etc	
	Metal Bending	
	Using a Jig to Produce Accurate Wheels	
	Laying Out Gear Teeth	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT IV: Mass Production

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
The great majority of the designed world depends upon the principle of standardized, interchangeable components	• In what ways can removing the human element improve the accomplishment of an engineering goal?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: The capacity to readily manufacture weapons with interchangeable parts had a profound impact on the outcome of the American Civil War. Mass production and interchangeable parts have caused sweeping changes in our society, economy, and culture; many of these changes have occurred within the last 100 years. The advent of steam power had a profound effect on our ability to work to much greater tolerance in much more stable, durable materials. Small improvements in accuracy and fit generate profound increases in the ability to produce interchangeable parts. Structural properties of mass, rigidity or flexibility, ease of motion (or not), and "buildability" are important consideration in the process of engineering design. The concept of interchangeable parts translates well into the concept of modular, adaptable designs.	**Students will be able to:** Develop a working model of a device capable of being disassembled into component parts and reassembled in a different configuration. Produce working models and finished projects with a high degree of quality, fit, and finish. Create sketches and drawing to accurately portray design ideas for a team-designed product with interchangeable parts. Present to a group of people the design work, documentation, and subsequent prototyping of a team-designed product with interchangeable parts. Defend the proposition that mass production has changed the face of the world's culture, economy, and environment. .	<u>NJCCC Science:</u> 5.1.12.C.1 5.3.12.A 5.3.12.B.1 5.4.12.C.1 <u>NJCCC Technology:</u> 8.2.12.B.1-3 8.2.12.B.5 9.4.12.0 9.4.12.(1) 9.4.12.(2) <u>Common Core Math:</u> S-1C.6 G-CO.1 G-CO.5 G-CO.12 G-MG.3 <u>Common Core ELA:</u> RST.9-10.4 RST.11-12.4 WHST.9-10.7 WHST.11-12.7

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Mass Production- 6 Weeks		
	Introduction to Mass Production	
	Samuel Colt, Eli Terry, and Simeon North	Resources:
	Automoblox: An Overview of the Idea, Design, and Realization	**Teacher generated handouts, Power Point slides, demonstrations**
	Setting a Jig to Cut to Length	**Websites:**
	The Milling Machine	**http://en.wikipedia.org/wiki/Interchangeable_parts**
	Foundry Processes	**http://www.automoblox.com/**
		http://www.core77.com/reactor/02.05_automoblox.asp
		SUGGESTED ACTIVITIES:
		Mass Production Project
		Musical Instrument Project
		30 Minute Video/Podcast (Honors Credit)

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT V: Reverse Engineering

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
A very large part of engineering is re-engineering: the first solution to a problem is rarely the best; improvements continue to suggest themselves	How does one decide when the design and redesign process has reached its ultimate goal?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: The purpose of a patent is to protect the ownership of intellectual property. Steam engines rely on the principle of expanding gases to provide motive power. Obtaining reliable performance from a simple toy like the "putt-putt" boat requires careful attention to very small details. A successful design for a vessel which floats in water depends on understanding principles of physics such as center of mass and Newton's Laws of Motion. A body floating on water displaces its weight of water; a body submerged in water displaces its volume.	**Students will be able to:** Improve an existing design with a self-designed, patentable improvement. Create sketches and drawing to accurately portray design ideas of a quality suitable for a patent application. Write an accurate description of a re-engineered article of a quality suitable for a patent application. Work effectively as a member of a team to develop a re-engineered boat capable of performing to stated criteria. Defend an explanation of the process by which a "putt-putt" boat works. Produce a working model of a re-engineered article with a high degree of quality, fit, and finish.	<u>NJCCC Science:</u> 5.1.12.C.1 5.3.12.A 5.3.12.B.1 5.4.12.C.1 <u>NJCCC Technology:</u> 8.2.12.B.1-3 8.2.12.B.5 9.4.12.0 9.4.12.(1) 9.4.12.(2) <u>Common Core Math:</u> S-1C.6 G-CO.1 G-CO.5 G-CO.12 G-MG.3 <u>Common Core ELA:</u> RST.9-10.4 RST.11-12.4 WHST.9-10-7 WHST.11-12.7

RANDOLPH TOWNSHIP SCHOOL DISTRICT
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SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Reverse Engineering- 6 Weeks		
	Introduction to the "Putt-putt" boat	
	Steam Power	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **Websites:** **http://www.sciencetoymaker.org/boat/makeBoat4_07.htm** http://www.nmia.com/~vrbass/pop-pop/ http://www.puttputtboats.com/ **SUGGESTED ACTIVITIES:** **Putt-Putt Boat** **Mass Production Project** **Musical Instrument Project** **Complete Patent Application with a Working Model for a Self-Designed Product (Honors Credit)**
	Newton's Laws of Motion and Hydrodynamics	
	Working with Epoxy and Caulk	
	Soldering Sheet Metal	
	Hardening and Annealing	
	Patents and Patent Law	
	Recycled Materials for a Toy Boat	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT VI: Alternative Housing

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
The traditional, "stick-built" houses of our recent past may well become less viable, less affordable, and less desirable as new technologies and understandings emerge.	• In what ways do changes in the environment, the availability of resources, shifting political spheres of influence, and the growth of our shared culture affect the decisions we make about the construction of our homes?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: Traditional frame houses are built on footings and foundations; they employ beams, plates, rafters, studs, headers, and sheathing. Structural integrity depends on a diagonal brace (member in tension) Structural members in a house are typically 16" on center. Buildings need to be plumb, square, and level. Geodesic domes are an economical, quickly built way to enclose space. Bermed houses and underground houses use the mass of the earth to increase thermal efficiency. Rammed earth and straw bale houses employ economical, sustainable building materials. All types and methods of housing construction suffer from the defects of their virtues.	**Students will be able to:** Develop and deliver a class presentation on urban sprawl and the Highlands Bills. Construct a model of a traditionally built cabin working at a scale of ¼"=1'. Produce research on an alternative building method, such as straw bale construction, geodesics, or cob. Create a floor plan and a scale model of a residence constructed with an alternative building method, such as straw bale construction, geodesics, or cob. Defend the use of the student's chosen method of alternative housing construction.	<u>NJCCC Science:</u> 5.1.12.C.1 5.3.12.A 5.3.12.B.1 5.4.12.C.1 <u>NJCCC Technology:</u> 8.2.12.B.1-3 8.2.12.B.5 9.4.12.0 9.4.12.(1) 9.4.12.(2) <u>Common Core Math:</u> S-1C.6 G-CO.1 G-CO.5 G-CO.12 G-MG.3 <u>Common Core ELA:</u> RST.9-10.4 RST.11-12.4 WHST.9-10-7 WHST.11-12.7

Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Alternative Housing Construction- 6 Weeks		
	Introduction to Alternative Housing methods	
	Essential Building Members and Elements	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **Websites:** **http://david.martiniii.tripod.com/index-2.html** **http://www.balewatch.com/** **http://strawbale.sustainablesources.com/** **http://www.livinginpaper.com/** **http://www.b4ubuild.com/plans/earth_sheltered_house_plans.shtml** *et al* **SUGGESTED ACTIVITIES:** **Scale Model of a Typical Frame House** **Research Paper or Presentation on Alternative Building Methods** **Architectural Plan and Model** **50 Minute Class Presentation on Current Innovations in the Field of Alternative, Resource-Conscious Housing or Other Approved Topic (Honors Credit)**
	Straight; Square; Level; Plumb	
	Working With Hand Tools	
	Working with Power Tools	
	Alternative Building Methods: Geodesics	
	Alternative Building Methods: Straw Bale Construction	
	Alternative Building Methods: Rammed earth	
	Alternative Building Methods: Bermed Houses	
	Alternative Building Methods: Underground Houses	
	Alternative Building Methods: Cob Construction	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT VII: Ergonomic Design

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
Virtually every designed object has been made with human factors in mind because the human body, while a marvel of engineering, is severely limited.	• How can the structure, abilities, and limitations of the human form be enhanced, extended, and supported through the engineering process?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: The normal curve is one of the most common patterns describing variation. The skeletal and muscular systems of the human body are essential for structure. Henry Dreyfuss was a leading figure in the development of human factors engineering. His firm, Henry Dreyfuss Associates, still plays an important role in ergonomic design. Ergonomic design came into prominence around the time of World War II. Certain design factors such as seat height are fairly constant whereas others can vary widely according to the target population.	**Students will be able to:** Defend a self-designed ergonomic project in light of the critical measurements of the expected user, or range of users. Create sketches and drawings to accurately portray design ideas for an ergonomic design project. Draft plans for and construct an articulated scale model of a human body. Develop a multi-media (e.g., Power Point or Prezi) presentation on an ergonomically designed article of interest to the student. Craft a work space or vehicular control center tailored to the needs and specifications of a typical person. Produce a working model of a workspace or vehicular control center with a high degree of quality, fit, and finish.	<u>NJCCC Science:</u> 5.1.12.C.1 5.3.12.A 5.3.12.B.1 5.4.12.C.1 <u>NJCCC Technology:</u> 8.2.12.B.1-3 8.2.12.B.5 9.4.12.0 9.4.12.(1) 9.4.12.(2) <u>Common Core Math:</u> S-1C6 G-CO1 G-CO5 G-CO12 G-MG3 <u>Common Core ELA:</u> RST.9-10.4 RST.11-12.4 WHST.9-10.7 WHST.11-12.7

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Ergonomic Design-: 6 Weeks		
	Introduction to Ergonomics	
	Henry Dreyfuss	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **Websites:** **http://www.innerbody.com/htm/body.html** **http://www.the-blueprints.com/blueprints/humans/humans/** **http://ergo.human.cornell.edu/** **http://www.everyspec.com/MIL-STD/MIL-STD-1400-1499/MIL-STD-1472F_208/** ***et al*** **SUGGESTED ACTIVITIES:** **Marionette** **¼ Scale Human Body Model** **Ergonomic Furniture Design Project** **Vehicle Control Center design Project** **Multi-media Presentation: Ergonomically Designed Sports Equipment** **50 Minute Class Presentation on Ergonomic Design (Honors Credit)**
	The Normal Curve	
	Guide to Drawing the Human Body	
	Laying out Patterns with carbon Paper	
	Researching Ergonomic Design Factors on the Web	
	Constant Factors in Vehicle Seating	
	Types of Joints in the Human Body	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Principles of Engineering
UNIT VIII: Musical Instruments

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
The principles by which musical instruments work are defined by physics (acoustics), mathematics, and an ineffable human, artistic component.	• How can one understand in a methodical, reasoned way the human element that defines the essence of music?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: Standing waves relate to the frequency of a tone. There is an inverse relationship between length and pitch of sound waves. Musical scales are contrived, not derived. Timbre is as important as any other characteristic of a musical instrument Octaves are based on the twelfth root of two. Musical frequencies can be measured and analyzed via computer software (e.g., Audacity). Every culture has its own wealth of unique instruments and musical traditions.	**Students will be able to:** Construct a musical instrument capable of producing at least three distinct tones. Create a musical instrument tuned to concert pitch (A=440 Hz). Participate as a member of a team to build a combination of musical instruments and perform with them. Demonstrate a strong working knowledge of the laws of physics as they apply to self-designed engineering solutions. Develop an appreciation for the music of other cultures by assembling a medley of "world music" pieces via computer software (e.g., iTunes).	<u>NJCCC Science:</u> 5.1.12.C.1 5.3.12.A 5.3.12.B.1 5.4.12.C.1 <u>NJCCC Technology:</u> 8.2.12.B.1-3 8.2.12.B.5 9.4.12.0 9.4.12.(1) 9.4.12.(2) <u>Common Core Math:</u> S-1C.6 G-CO.1 G-CO.5 G-CO.12 G-MG.3 <u>Common Core ELA:</u> RST.9-10.4 RST.11-12.4 WHST.9-10.7 WHST.11-12.7

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Principles of Engineering

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Musical Instrument Construction- 6 Weeks		
	Introduction to Acoustics	
	Standing Waves and Harmonics	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **Websites:** **http://www.philtulga.com/glock.html** **http://www.vintageprojects.com/woodshop/SteelGuitar.pdf** **http://www.youtube.com/watch?v=UIWUQvmY1Vo&feature=related** **http://www.youtube.com/watch?v=B4oQJZ2TEVI** *et al* **SUGGESTED ACTIVITIES:** **Musical Instrument Project** **Performing as a Trio** **30 Minute Podcast on World Music or Other Approved Topic** **(Honors Credit)**
	Strings, Pipes, and Bars	
	Vocal Music: Timbre	
	Using Audacity Software	
	Exploring World Music	
	Bass Voices: American and African Gospel	
	Tuning an Instrument to Concert Pitch	

APPENDIX A

SOFTWARE NAMES:

Total 3D Home Design
Google Sketch-Up
ImageJ
Audacity
iTunes

APPENDIX B

ASSESSMENT:

LIST OF ASSEMENT/TYPE

Assigned Projects
Optional Projects
Portfolio Assessment
Formative Assessments: designs, question/answer, writings
Performance Assessments

SUGGESTED RUBRICS TBD

APPENDIX C

SAMPLE INTERDISCIPLINARY UNITS

All topics of study will explore the connections between various disciplines within STEM education, as well as such cross-content areas as contemporary cultural issues, art topics, and global ethical issues. Students will be required to read and analyze articles thereby including a literacy component. In addition, students will be using technology in the course to construct and share their work.

APPENDIX D

PLACEMENT CRITERIA

Any high school student who has an interest in the course may enroll.