Randolph Township Schools
Randolph High School

TECHNOLOGY AND DESIGN
Curriculum

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

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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.

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Technology and Design

Course Introduction:

Technology and Design is a survey course intended to give the learner an opportunity to see how the design process is applied to simple problems like creating an attractive package for a toy or making a simple device work better, longer, or more smoothly. It is designed to actively involve the student in the solution of technological problems in the areas of systems, formulation technology, construction, and manufacturing. In addition to developing critical thinking skills, an interdisciplinary approach to problem solving will be used throughout the course. Students will be involved in both the designing and the hands-on building of solutions. This is a one semester course.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Technology and Design

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
1 week and ongoing	I	Safety
2 Weeks	II	The Design Loop
4 Weeks	III	The Human Factor
4 Weeks	IV	Physics in Action

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Technology and Design
UNIT I: 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.	• How can someone demonstrate responsibility?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: When using hand tools: • maintain them in sharp, usable condition • cut away from oneself • hold the tool in both hands • employ clamping devices where feasible • wear safety glasses When using power tools: • wear safety glasses • keep all body parts a safe distance from moving parts • keep hair and clothing out of the way • work carefully and without distraction	**Students will be able to:** Demonstrate safe practices by wearing safety glasses at all appropriate times. Operate soldering equipment in a safe, energy-conserving manner. Use hand and power tools found in the lab safely and responsibly. Practice safe procedures when working with electricity.	<u>Science:</u> 5.1.8.C1-.2 5.1.12.C.1

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Technology and Design

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

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Technology and Design
Unit II: The Design Loop

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 the rules run out, or when there are no rules in the first place?
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 good design? Why?
A very large part of designing is re-designing: 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 Design Loop consists of stating a problem, gathering information and resources, brainstorming solutions, choosing and creating the "best" solution, evaluating results, and feeding back to the initial step. Accurate recordkeeping and documentation are vital to the engineering 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. Structural considerations of mass, rigidity or flexibility, ease of motion (or not), and "buildability" inhere in effective designs. There is a strong connection and correlation between engineering and physical science.	**Students will be able to:** Create sketches and drawing to accurately portray design ideas for all self-designed projects. Employ brainstorming techniques to develop creative ideas and design solutions. Select viable design solutions from a list of student- or team-generated possibilities. Defend a chosen design solution. Write and organize an accurate, complete engineering journal. Work effectively as a member of a team to achieve specified goals. Demonstrate a cooperative, productive, diligent work ethic in the completion of assigned projects and activities. Demonstrate a working knowledge of the laws of physics as they apply to self-designed engineering solutions for a real world problem.	<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
Technology and Design

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
The Design Loop-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:** **Cube Project** **Marble Roller Coaster** **Crane Strain** **Trebuchet** **Rube Goldberg Device** **Mobiles** **Dream House SAD**
	The Design Loop	
	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
Technology and design
UNIT III: The Human Factor

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS	
Many design solutions are centered around pleasing the senses.	Why do some designed objects seem to attract the eye and invite the user to handle them?	
KNOWLEDGE	**SKILLS**	**NJCCCS**
Students will know: Design elements such as balance, harmony, color, strength, and "user-friendliness" must be used appropriately in a product. Design can be dynamic as well as static: how things move, and when and where, can be very important. Successful designs for the marketing of products rely on product packaging, and advertising through a variety of media; these elements should harmonize with and complement each other.	**Students will be able to:** Create a design for a package or container based on a theme, which harmonizes with the object contained. Formulate a presentation on a successful advertising logo and campaign of the student's choice. Apply color, balance, and harmony as integral parts of a pleasing design. Create a work of kinetic art. Design a two dimensional layout which can be developed into a three dimensional object (surface area development).	<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
Technology and Design

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
The Human Factor-4Weeks		
	Packaging Design	
	Color as a Design Element	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **Websites:** **http://www.artsconnected.org/toolkit/index.html** **SUGGESTED ACTIVITIES:** **Packaging Project** **Marble Roller Coaster** **Rube Goldberg Device** **Mobiles** **Dream House SAD**
	Balance and Harmony, Static and Dynamic Balance	
	Surface Area Development	
	Alexander Calder: Mobiles	
	Choosing a Theme for a Mobile	
	Using a Computer to Work with Graphics and Patterns	
	Mobile Construction and Balancing	

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Technology and Design
Unit IV: Physics in Action

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Real world design solutions often involve structures that need to sustain loads over a distance; knowledge of material properties and structure to creating these solutions.	How can a specification be translated into three dimensional structures?
Designed solutions to real world problems often involve combining elements from several core technologies in one unified design.	How can we combine simple machines and core technologies to provide solutions for real world problems?

KNOWLEDGE	SKILLS	NJCCCS
Students will know: The type of materials chosen for a given design, as well as structural elements like diagonal bracing, have a profound effect on the success of that design. Rigidity becomes progressively harder to maintain as a structure gets taller/longer. Velocity, momentum, inertia, mass, center of mass, and equilibrium can be manipulated in order to achieve designed goals. It is often harder to make things happen slowly than it is to make them happen quickly. Accuracy and attention to detail are vital to making structures strong. Every system and product is made up of one or more of the nine core technologies: bio-, electrical, electronic, fluid, material, mechanical, optical, structural, and thermal technology.	**Students will be able to:** Create a device which will perform a specified task, such as keeping a ball rolling for the longest possible time, or supporting the greatest mass possible given teacher-directed design constraints. Evaluate a designed solution to a problem in terms of the core technologies used and how they interact. Write and maintain an accurate, complete record of the performance achieved by a student-designed device. Create a video which illustrates the construction and testing of a design solution. Defend the design for a structure or device by citing appropriate laws of physics as they apply to structure and 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
Technology and Design

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
Physics in Action-4Weeks		
	The Six Simple Machines	
	The Trebuchet	
	Introduction to Physics in Action	
	Review of Newton's Laws of Motion	Resources: **Teacher generated handouts, Power Point slides, demonstrations** **Websites:** **http://www.youtube.com/watch?v=TDGezfCemtA&feature=endscreen&NR=1** **http://www.pennridge.org/works/brbeam.html** **http://www.faculty.fairfield.edu/jmac/rs/bridges.htm** **http://estemonline.net/pages/resources/fotunit3lesson1/HondaTheCog.mp4** **http://www.youtube.com/watch?v=qybUFnY7Y8w** **http://www.rubegoldberg.com/?page=link_item&NewsID=2134595342&Press_Page_Width=750&last_page=links** *et al* **Videos:** ***Medieval Siege*** **SUGGESTED ACTIVITIES:** **Marble Roller Coaster**
	Building a Tower: Rigidity and Structural Integrity	
	Hot Glue *vs* White Glue	
	Shooting Video with a Smart Phone	
	The Funnel: A Study in Angular Acceleration	

		Trebuchet **Crane Strain Project** **Rube Goldberg Device** **Multi-media (e.g., Prezi, Video) Presentation of Completed Work**

APPENDIX A

SOFTWARE NAMES:
Google Sketch-Up
ImageJ

SUGGESTED WEBSITES:
www.thedesignloop.org
www.fearofphysics.com
www.shermanlab.com
www.aplusphysics.com
www.cswright.edu
www.thehumanfactorblog.com

APPENDIX B

ASSESSMENT:

LIST OF ASSEMENT/TYPE

Assigned Projects
Optional Projects
Portfolios and Journals
Formative Assessments such as drawings, discussions, question/answer
Performance Assessments

SUGGESTED RUBRICS TBD

APPENDIX C

SAMPLE INTERDISCIPLINARY UNITS

All topics of study will explore the connections between various disciplines within STEM education. Students will be required to read and write within a technical subject, 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.