Engineering Design Technology 1

March 2008
COURSE NUMBER 791.01

TEACHERS: Mr. STEPHEN PELTIER
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Name of Course: Engineering Design Technology 1
Level of Course: Academic
Prerequisites: None
Grades Levels Offered to: 9 through 12
Course Number: 791.01
Number of Credits: 5
Length: Eighteen Week Curriculum / 90 days
Recommended class size: Maximum 18- *(Computer restrictions)*
Teacher Recommendation: One-Certified Technology Education Teacher or Industrial Arts Teacher
Revised Date and Teachers Names: **Mr. Stephen Peltier (March 2008)**

Purpose:

Engineering Design Technology I is a dynamic hands-on program of study that teaches students about the development and application of technology and the effects technology has on individuals, society, and the environment. Its goal is to develop the technological literacy and capabilities of the students so they will be better prepared for success in a highly technological society.

High Point Regional High School's curriculum and instruction are aligned to the State's Core Curriculum Content Standards and address the elimination of discrimination by narrowing the achievement gap, by providing equity in educational programs and by providing opportunities for students to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affect ional or sexual orientation, gender, religion, disability or socioeconomic status.

Method of Instruction:

Technology engages student's minds through creative problem solving and inquiry-based approaches to learning. Further, the curriculum breaks down the barriers between subject areas and acts like a "hub" uniting the core curriculum. Technology learning activities require students to apply concepts from other subjects, as well as technology content (Problem solving, design, systems, history of technology, engineering, materials and processing, research and development careers) while solving practical problems. The curriculum is delivered through an articulated series of design and problems solving activities in which students apply knowledge to solve practical problems. Activities include: robotics, fluid power, and structures.

General Objectives:

At the conclusion of this course, the students will be able to:

1. Define engineering and technology.
2. Describe engineering and technology as a system.
3. List, describe, and implement the steps in the engineering/design process.
4. Identify how different systems operate.
5. Utilize a variety of different forms of presentation techniques.
6. Work in teams for learning, problem solving, design and presentation.
7. Prepare for life-long learning by using self-management and self-assessment strategies in terms of knowledge and skills.
8. Develop careful and precise writing.
9. Explore career-specific areas.
10. Develop skills in critical thinking, analytical reasoning and logic, and the ability to establish and recognize the validity of information.
11. Understand the complex relationship of scientific, technological, social, business, legal, historical, and artistic issues in design.
12. Carry out engineering/design/problem solving projects by using established scientific principles in the creation of functional and appealing products.

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13. Become an independent leader, recognize when to follow, and know how to be a good team member.
14. Develop and apply cross-disciplinary cognitive knowledge to new problems.
15. Realize amazing feats performed by women and unique gifts women bring to the job.

Lecture/Discussion	Objectives 1, 2, 4
Class Projects/ Lab Sessions	Objectives 3, 6, 7, 12, 13, 14
Problem-Based learning	Objectives 4, 8, 10, 11,15
Computer-Base instruction	Objectives 5
Homework	Objectives 4
Mentor/Visitations	Objectives 9

Measurement of success in meeting these general objectives will be carried out through the following methods of assessment:

Classwork/Homework	Objective 4,15
Quizzes/Tests Mid Term Exam and Final Exam	Objectives 1, 2
Projects/Labs	Objectives 3, 5, 6, 8, 9, 12, 14, 15
Class Participation	Objectives 7, 10, 11, 13, 15
	Quantified by credit points on projects and labs

Standards Targeted Throughout the Curriculum

New Jersey Core Curriculum Content Standards and Cumulative Progress Indicators

- Demonstrate skills needed to effectively access and use technology-based materials through keyboarding, troubleshooting, retrieving, and managing information. (NJ CCCS 8.1.A)
- Use technology and other tools to solve problems, collect data, and make decisions. (NJ CCCS 8.1,)
- Use technology and other tools, including word processing, spreadsheet and presentation programs, and print or graphic utilities to produce products. (NJ CCCS 8.1.)
- Use technology to present designs and results of investigations. (NJ CCCS 8.1)
- Organize, synthesize, and evaluate information for appropriateness and completeness. (NJ CCCS 8.2)
- Identify and evaluate the validity of alternative solutions. (NJ CCCS 8.2)
- Apply problem solving skills to original and creative/design projects. (NJ CCCS 8.2)
- Use time efficiently and effectively. (NJ CCCS 8.2)

Source: New Jersey Department of Education Standards http://www.nj.gov/njded/stass/

New Jersey Technology Education Standards (TEANJ)

- Apply values and make rational decisions about technological issues. (8.2.A)
- Design and make devices and hybrid systems that solve complex real world problems. (8.2.C)
- Develop alternative plans for redesigning devices and systems. (8.2.B)
- Utilize and modify existing devices and systems for use in the solution of new problems. (8.2.B)
- Combine different materials in the production of products. (8.2.C)
- Create computer simulations to test and explain design concepts. (8.2.A)

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- Create multimedia presentations to inform others about design concepts, products, and events. (8.1.A)
- Access and search the Internet for relevant information while conducting research. (8.1.A)
- Use advanced publication methods. (8.1.A)
- Generate original ideas based on previous knowledge and research. (8.2.B)
- Acquire knowledge and skills that increase aesthetic awareness as it applies to technological design and ergonomics. (8.1.B)

Standards of Technological Literacy from the (TFAA) Technology for All Americans Project and the International Technology Education Association (ITEA)

- In order to comprehend the scope of technology, students should learn that technology is closely linked to creativity, which has resulted in innovation. (TFAA #1, H)
- In order to recognize the core concepts of technology, students should learn that systems thinking involves considering how every part relates to others. (TFAA #2, N)
- In order to comprehend the attributes of design, students should learn that are trade offs that are made in the design process. (TFAA #8, F)
- In order to comprehend the attributes of design, students should learn that the requirements for a design are made up of criteria and constraints. (TFAA#8, G)
- As part of learning how to apply design processes, students should be able to make two-dimensional and three-dimensional representations of the designed solution. (TFAA #11, J)
- In order to select, use, and understand information and communication technologies, students should learn that the use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas. (TFAA #17, K)

Source: International Technology Education Association (2000). Standards for Technological Literacy. Reston, VA: ITEA. ISBN 1-887101-02-0

Benchmarks of Project 2061

- Almost all control systems have inputs, outputs, and feedback. The essence of control is comparing information about what is happening to what people want to happen and then making appropriate adjustments. This procedure requires sensing information, processing it, and making changes. In almost all modern machines, microprocessors serve as centers of performance control
- Technological problems often create a demand for new scientific knowledge, and new technologies make it possible for scientists to extend their research in new ways or to undertake entirely new lines of research. The very availability of new technology itself often sparks scientific advances.
- Mathematics, creativity, logic and originality are all needed to improve technology.
- Technology usually affects society more directly than science because it solves practical problems and serves human needs (and may create new problems and needs). In contrast, science affects society mainly by stimulating and satisfying people's curiosity and occasionally by enlarging or challenging their views of what the world is like.
- Social and economic forces strongly influence which technologies will be developed and used. Which will prevail is affected by many factors, such as personal values, consumer acceptance, patent laws, the availability of risk capital, the federal budget, local and national regulations, media attention, economic competition, and tax incentives.
- Technological knowledge is not always as freely shared as scientific knowledge unrelated to technology. Some scientists and engineers are comfortable working in situations in which some secrecy is required, but others prefer not to do so. It is generally regarded as a matter of individual choice and ethics, not one of professional ethics.

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- In deciding on proposals to introduce new technologies or to curtail existing ones, some key questions arise concerning alternatives, risks, costs, and benefits. What alternative ways are there to achieve the same ends, and how do the alternatives compare to the plan being put forward? Who benefits and who suffers? What are the financial and social costs, do they change over time, and who bears them? What are the risks associated with using (or not using) the new technology, how serious are they, and who is in jeopardy? What human, material, and energy resources will be needed to build, install, operate, maintain, and replace the new technology, and where will they come from? How will the new technology and its waste products be disposed of and at what costs?
- Human inventiveness has brought new risks as well as improvements to human existence.

Source: Science For All Americans Project 2061 1990, Oxford Press, ISBN 0-19-506770-3
http://www.project2061.org/tools/benchol/bolframe.htm

Engineering activities will also stress many New Jersey and National math and science standards. Math and science applications are imperative to help solve problem solving and engineering/design activities.

Specific Behavioral Objectives and Timelines:

Current school structure: One day = One 42 minute period. Many units of study are woven together to simulate the real world.

Unit 1: Course Introduction and Safety Guidelines Time: 3 days/Ongoing

Goal:
- To introduce the students to the course expectations, discipline policy, and safety guidelines.

Objectives:

Students will be able to:
- Understand the course expectations and timeline for instruction.
- Understand the discipline policy that relates to behavior in this class.
- Outline the specific safety guidelines of the classroom and shop rules.

Assignments:
- Movie related worksheet

Lab Activities:
- None

Audio-Visual Needs:
- Overhead projector
- Movie "UVEX PPE Eyewear Training Video/Technology Department Eye Safety"

Computer Needs/Use: None
- Teacher computer with LCD projector

Assessment Method:
- Safety Quiz

Standards targeted via this unit:
- NJCCC 8.1.B
- NJCCC 8.2.C

Unit #2 Introduction to Engineering/Design/Technology Time: 3 Weeks/Ongoing

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Goal:

- Introduce the students to the systems of engineering, technology education and technological literacy.

Objectives:

Students will be able to:

- Define technology.
- Define engineering.
- List the various areas of engineering.
- Describe the difference between science, technology, and engineering.
- Describe technology as a system, and list and explain the components of these systems.
- Use various brainstorming techniques to generate ideas and solutions.
- Discuss the positive and negative impacts of different technological systems.
- Introduce the design loop and its impact on technological problem solving.
- Introduce the presentation technique of formal documentation.

Assignments:

- Homework: *The Design Loop*
- Classwork: *Creating a Design Brief/Technological Outputs/Decision making*
- Classwork: *Coloring and Shading*
- Homework: *Isometric and Orthographic Projection*
- *Great Achievements www.engineeringgirl.org/nae/cw…/cgmh4T2HYL*

Lab Activities:

- Guest speakers
- Field of Engineering Power Point Presentation
- Isometric Drawing and Orthographic drawing
- Sketching rendering demonstration and practice

Audio-Visual Needs:

- PowerPoint / Smart board technology
- Previous examples of student work
- Movie "What's Up In Technology"-
    - Produced by Thirteen-WNET - Ed. Resource Center-450 W. 33rd. Street NY, NY 1001
- Movie "Exploring The Design Process"-#V710-1994 Hearlihy & Co.
- Text: Hutchinson, J. and Karsnitz, J. (1994). *Design and Problem Solving in Technology*. Albany: Delmar Publishers, Inc. *(A good intro to technology text. Also good for middle school.)*

Computer Needs/Use:

- Internet research

Assessment Method:

- Authentic: *Teacher Observation*
- Traditional: *Introduction to Technology Test/future problem solving projects*

Standards targeted via this unit:

- NJ CCCS 5.4,
- 8.1.A,B
- 8.2.A,B,C
- TFAA #1, H
- TFAA #2, N
- STL #8, F

Unit #3 Presentations Techniques Time: 1weeks/Ongoing/Interwoven

Goal:

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- To allow students to develop their ability to effectively communicate technological information and ideas through a variety of media.

Objectives:

Students will be able to:

- Create diagrams and sketches by hand and electronically to express design ideas and solutions.
- Create multi-media presentations to inform others about design concepts, products, and events.
- Create electronic databases and spreadsheets to gather, sort, analyze, and present data.
- Communicate orally and in writing the results of their design work.
- Create two and three-dimensional technical drawings by hand and electronically to develop and express design proposals.

Assignments:

- Web Page Design
- Publication Design
- Documentation of engineering design projects
- Sketching and Rendering
- Isometric and Orthographic drawing
- CAD/Parametric introduction

Lab Activities:

- Guest speakers
- Field of Engineering Power Point Presentation
- Design a Web Page- www.engneergirl.org
- Design a publication on famous women engineers
- Documentation
- Drawings, Models, and Prototypes

Audio-Visual Needs:

- None

Computer Needs/Use:

- Computers, Smart board technology, projectors, software

Assessment Method:

- Authentic: Documentation, drawings, presentations
- Traditional: Teacher Observation

Standards targeted via this unit:

- 8.1.A,B
- 8.2.A,B,C
- NJCCCS 3.2, 3.3, 3.5
- NJCCCS WRS 1

Unit #4 Structural Systems Time: 6-7 weeks

Goal:

- For students to gain an understanding and demonstrate the use, roles and application of structural design in society.
- For students to apply structural design, materials processing, and material properties in the design and fabrication of a structure that will be tested and evaluated.
- Apply scientific principles and mathematical analysis to understand efficiency.

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Objectives:
Students will be able to:

- Identify and define human made and natural structures.
- Identify the types of structures: mass, frame and shell.
- Identify shapes that resist failure.
- Identify historical structural designs.
- Identify historical structural designs that have failed.
- Identify structural systems in our school.
- Identify types of bridges and their applications.
- Define varies forces that play a role in structures: tension, compression, shearing, torsion, and bending
- Compare and contrast internal and external forces.
- Compare and contrast static and dynamic loads.
- Identify the importance of structural analysis in structural design.
- Identify careers related to structures.
- Demonstrate aspects of structural design.
- Define reasons why structures have allowances for maintenance, alteration, and renovation.
- Demonstrate the ability to draw an orthographic view of a structure.
- Demonstrate the ability to design and fabricate and prototype bridge that is within certain design constraints.
- Demonstrate the ability to calculate the efficiency of a structure through strength to weight ratios.
- Demonstrate the ability to function positively and effectively as a group to: design, build and test a structure.
- Demonstrate the ability to test the strength of a variety of shapes and configurations in structural design.

Assignments:

- Structures research packet (various small research assignments)
- Internet Research Activity
- Technological method documentation

Lab Activities:

- Bridge design using West Point Bridge Designer
- Students will design, construct and test a bridge
- Develop a fictitious company name, slogan, logo

Audio-Visual Needs:

- Projector, presentation software.
- Smart board
- Internet
- Drafting equipment
- Structures Tester

Computer Needs/Use:

- Internet

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- MS Word, Publisher, Power Point
- Printer
- Bridge Design software
- Group file folder (to share files between groups)

Assessment Method:

- Authentic: Documentation/Presentation
- Traditional: Essay, Teacher observation, Structures Content Exam
- Craftsmanship
- Accuracy
- Group/Individual assessment

Standards targeted via this unit:

- NJ CCCS 8.1.A.,B
- NJ CCCS 8.2.A.,B,C
- TFAA #1, H
- TFAA #2, N
- TFAA #20, G
- TFAA #20, H
- TFAA #20, J
- TFAA #20, M
- TFAA #8, F
- TFAA #8, G
- TFAA #11, J
- TFAA #20, L

Unit #5: Robotics Time: 7-8 weeks

Goal:

- The study of robotics will allow the teacher to give students meaningful exercises that introduce or reinforce the following applied physics and mathematics concepts:
    - ratios;
    - diameter, radius, and circumference;
    - friction;
    - measurement of distance, time, angles, and speed;
    - basic electricity and circuits.

  At the same time students will be engaged in design activities that challenge them to develop their own original solution for each problem presented therefore developing the "out of the box" thinking that is important for innovators.

- Students will understand the basic parts and functions of modern day robots.

Objectives:

Students will be able to:

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- Identify the 4 types of industrial robots and their applications.
- To make intelligent decisions regarding the implementation of robots.
- To explain the components of an industrial robot. (End Effectors, Base, Sensor, Controller, Arm, Drive)
- Identify how different systems operate.
- Identify the 6 basic movements of a robotic arm
- Identify the six basic types of end effectors (grippers)
- Understand mechanical advantage.
- Construct a robotic arm to be used in competitions.
- Understand the use of simple machines
- Participate in a teacher led discussion contrasting robots students have seen on TV and the movies with real world robots and presentation of robotics.
- Observe a demonstration of several teacher-supplied robots.
- Discuss the sequential nature of basic programming.
- Degrees of freedom
- Applications of industrial robots

Assignments:
- Research and document fluid power technologies
- Research fluid powered robots
- Use math and scientific knowledge/skills to solve an engineering design problem.
- Develop a design portfolio for robotics (using the design loop)
- Design and develop a fluid power robotic arm that performs a specific function.

Lab Activities:
- Robotics Power Point Presentation
- Investigation and research packet
- Use computer robot arm to perform specified functions

Audio-Visual Needs:
- VCR/Tapes- Engineering Fields

Computer Needs/Use:
- Internet, Computers, Presentation Software, Projector, Smartboard

Assessment Method:
- Authentic: Documentation/Presentation
- Teacher observation
- Craftsmanship, function, performance of model.
- Unit Test

Standards targeted via this unit:
- NJ CCCS 8.1.A.,B
- NJ CCCS 8.2.A.,B,C

Unit #6: Fluid Power

Time 7-8 Weeks

Goal:

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It is our goal to increase the technological literacy of each student by teaching him or her basics of fluid controlled systems. To develop in learners a working understanding of fluid power and its role in industry as well as their everyday lives. Without a doubt, fluid power applications have become the muscles of industry—from entertainment to construction, and everything in between. Fluid power technology involves the design, service, fabrication, installation, repair, maintenance, and sale of hydraulic, pneumatic, and electro hydraulic control systems. Employers include component manufacturers, original equipment manufacturers, distributors, re-builders, and virtually all-manufacturing firms.

Theme parks rely heavily on **pneumatics**, from the opening gates, operation and safety mechanisms in the ride. As you board the roller coaster, pneumatic cylinders open the gates, with a soft hiss of compressed air. Pneumatic air brakes bring the coaster to a complete stop. And pneumatics is used in the restraint systems that keep the coaster on track as it rolls through its maneuvers. They can also provide air cushioning, to make the "free fall" rides as safe as possible. Instead of falling straight to the ground, excited kids safely drop one hundred feet through giant pneumatic airways.

Many other industries are maximizing the benefits of fluid power. Construction vehicles are using highly advanced load-sensing **hydraulic** systems to power their largest trucks and engines. The result for companies like Komatsu is high digging forces and fast cycle times. This means that excavators can lift chunks of rock or building material as big as an SUV, and do it twice as fast as before. Hydraulics also makes it easier for the operator to control the vehicle, using two small joysticks.

Objectives:

Students will be able to:

- Understanding the use of the fluid power equipment. Principles of pumps and valves.
- Understand the physical characteristics of air:
    - Air takes up space.
    - Air has mass.
    - There are spaces between air molecules.
    - Air's mass and volume determine its density.
    - Air density can change.
    - Air density is affected by changes in altitude and temperature.
    - Warm air becomes less dense and rises while cold air becomes denser and settles.

Understand the difference between pneumatics and hydraulics

Lab Activities:

- Fluid Control Power Point presentation
- Fluid Power lab act ivies
- Investigation and research packet

Audio-Visual Needs:

- VCR/Tapes-

Computer Needs/Use:

- Internet, Computers, Presentation Software, Projector, Smartboard

Assessment Method:

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- Authentic: Documentation/Presentation
- Teacher observation
- Craftsmanship, function, performance of model.
- **Unit Test**

Standards targeted via this unit:

- NJ CCCS 8.1.A.,B
- NJ CCCS 8.2.A.,B,C

Unit #7: Tool and Machine Safety

Time: 1 Week/Ongoing

Goal:

- To introduce students to the safe and proper operation of hand tools and power machines so that they may fabricate solutions to engineering problems. In the process of using these tolls, the student will view automation and operator safety as significant engineering problems to brainstorm as well as the effect of gender or hand dominance on operations.

Objectives:

Students will be able to:

- Safely operate a band saw, scroll saw, drill press, disk and belt sander, brake, metal roller, shear, soldering gun, hand drill, etc.
- Safely use hand tools- claw hammer, screw driver, hand saw, coping saw, hack saw
- Read a metric and English ruler.

Assignments:

- Tool and Machine Safety

Lab Activities:

- Safety Demonstrations/ Safety Rules

Audio-Visual Needs:

- None

Computer Needs/Use:

- None

Assessment:

- Traditional: Safety Tests

Standards targeted via this unit:

- NJ CCCS 8.1.A.,B
- NJ CCCS 8.2.A.,B,C

Assessment:

The assessment of student progress in the objectives cited on the previous pages will be primarily by, but not limited to, the following criteria.

Design Portfolios & Presentations	30%
Project Work	30%
Homework	10%
Tests	15%
Class Participation/Code of Conduct	15%

Midterm and final exams last updated 2008

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Homework, Extra Credit Policy:

Due to the periodic nature of homework in this course, homework will not be accepted late unless a legitimate excuse exists. Extra credit will be available during the design and problem solving activities in the form of additional research/development and competitive events.

Special Course Policies:

Success in this course will be based on a variety of factors, however the instructor will most directly assess the student's performance in comprehensive design and problem solving activities, teamwork performance, and class participation as the means of determining a grade. A typical week in class will consist of formal instruction on a variety of material, students working in groups to complete work pertaining to the lecture, research and development, teamwork to generate possible solutions to and solve problems, and in some cases the development of different products and prototypes. Quizzes and tests will be given to re-emphasize and assess the student's understanding of the presented information.

Periodic evaluation of objectives and this curriculum guide:

With the evaluation curriculum every five years, administration requests a curriculum re-write in the year **2009.**

Labs: **Supporting materials will b developed for all labs to help the new teacher.**

- Engineering Design Activities
- Invention and Innovation Product Design
- Area of Engineering
- Publication- Famous Women Engineers
- Power Point Presentation- Area of Engineering
- Engineering Code of Conduct
- Famous Engineers -Power Point
- Spreadsheet Analysis of design)graphing Calculator/CPU
- Word-processing
- Smart board Technology
- Publishing

Lab/Classroom set up and special needs:

The recommended maximum class size is eighteen students. This course will be taught implementing a variety of different and state of the art instructional technologies such as:

- Multiple computers- One computer for every student.
- Scanner
- Digital camera
- Multiple workbenches
- SmartBoard technology
- Projection screen and device
- Electrical outlets
- Testing area- Structure Tester
- Teamwork areas
- Table top: scroll saw, drill press, band saw, sander
- Hand tools
- Software: word processing, presentation, electronic workbench, internet digital camera, scanner, publishing, spreadsheet, Pro-DESK TOP or Inventor Parametric 3-D design software,
- Movie "What's Up In Technology"-
    - Produced by Thirteen-WNET - Ed. Resource Center-450 W. 33rd. Street NY, NY 1001
- Movie "Exploring The Design Process"-#V710-1994 Hearlihy & Co.

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Note: A current technology education lab would be suitable. School budget is used to currently fund this program. Federal Perkins funding could be used if there is an Engineering CIP coded program. This class would be considered a 1st level course. Students would then enter our Engineering Design Technology 2 and 3 programs. Gender equity funding may be another source of funding.

Materials/Resources:

Program Audio-Visual/ Computer Needs:

- Smart board technology
- Presentation techniques
- Series of videos
- Multiple models
- Previous student work

Supplementary Readings and Instructors Bibliography:

- Hutchinson, John Design and Problem Solving in Technology. (Delmar, Albany, New York). 1994. ISBN 0-8273-5244-1.
- Norman, Eddie, Advanced Design and Technology Second Addition. (Pearson Education Limited, Essex, England(, 1995. ISDN 0 582 24496 4
- Smith, Howard. Understanding Technology. (Goodheart-Wilcox Company, Tinley Park, Illinois). 1998. ISBN 1-56637-374-3.
- Todd, Ronald. Introduction to Design and Technology. (Thompson Learning Tools, Cincinnati, Ohio). 1996. ISBN 0-538-64465-6
- Wright, Thomas. Technology Systems. (Goodheart-Wilcox Company, Tinley Park, Illinois). 1966. ISBN1-56637-263-1.
- Henry Petroski's recent books on engineering.
- The Comforts of Home: The American House and the Evolution of Modern Convenience by Merritt Ierley
- Wondrous Contrivances; Technology at a Threshold by Merrit Ierley
- Open House: A guided Tour of the American Home, 1637-Present By Merritt Ierley
- The Existential Pleasures of Engineering by Samuel Florman
- INVENTING AMERICA: A History of the United States was published in 2002 by *W. W. Norton & Co.*
- Mark Devaney of Grafica. "Careers in Engineering"
- American Heritage puts out a superb magazine called Technology and Invention