

Rapid City Area Schools

**High School
Technology Education
Program**



**Approved by the Board of Education
October 21, 2010**

RAPID CITY AREA SCHOOLS
300 6TH Street
Rapid City, South Dakota 57701

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"Technology is Human Innovation in Action"

Technology for All Americans Project

Rational for Technology Education Curriculum Project

The need for technological literacy is supported by these organizations: National Academy of Science, National Academy of Engineering, Institute of Medicine, and the National Research Council.

Technological literacy is a person's ability to use, manage, and understand technology. It involves citizens having knowledge of the nature, behavior, power, and consequences of technology from a broad perspective. Technological literacy means more than the use of computers and other machines. It involves the factors used in the creation and development of technologies and the impact of technology on society, individuals, and the environment.

Today, the majority of people have few direct, hands-on connections to technology, except as users of finished consumer products. They don't manufacture the devices they use, or try to improve their performance, nor can they repair them when they break. Due to this lack of engagement, most people rarely develop a realistic, intuitive feel for technology.

Due to the fact that people have very little hands on experiences with technology, technology literacy depends essentially on what they learn in the classroom, particularly in the K-12 schools. Technological literacy depends upon active student involvement. How students are engaged within the learning process in the classroom may provide their only hands-on experiences with technology. These experiences, however limited, are enhanced when technology is integrated across the curriculum. This integrated approach promotes student success as well as self-confidence. Within the Technology Education Program, the modular curriculum approach incorporates other areas of study, including math, science and reading. This cross-curricular approach supports NCLB.

Our world is changing rapidly. We possess the knowledge and ability to understand and appreciate the many advances being made. Technology education will guide students to the level of technological literacy needed to function in today's society.

Technology Defined

The Technology Education Curriculum Development Committee for the Rapid City Area Schools, following an extensive examination of scholarly work related to technology, has adopted the following as its definition of technology:

Technology is the application of resources and systems to solve practical problems and extend human capabilities.

Introduction

The Middle School and High School Technology Education Curriculum Committee was formed in 2006. The Committee is in charge of reviewing and revising the "6-12 Technology Education Curriculum" in alignment with the South Dakota Technological Literacy Standards and the National Technological Literacy Standards. The committee used relevant research from different national organizations including International Technology and Engineering Educators, Technology for All Americans Project, the National Science Foundation and the National Aeronautics and Space Administration.

Philosophy of Technology Education

A primary goal of education is to offer a curriculum that prepares students for their effective roles in society. Because modern society is increasingly influenced by rapidly advancing technologies, it is absolutely necessary for our citizens to understand technology if they are to function as informed voters, productive workers, and wise consumers of technological products and services.

Technology education focuses on developing the technological literacy of students, regardless of their educational and career goals. All students should have access to the technology education program regardless of their sex, race, religion, disability, or national origin.

Technological problem solving is the fundamental curriculum theme. Action-based laboratory activities, as well as classroom instruction, provide students opportunities to apply the technological method by:

- designing and developing technologies
- using a wide variety of technologies
- developing sustainable green technologies
- controlling technologies
- assessing the impacts of technologies

Technology education is the "great integrator" of knowledge, providing a vital link between technology itself and science and mathematics principles. Its inter-disciplinary nature also helps students apply the social sciences and humanities.

Goals of Technology Education

Technology education is for the learner to become technologically literate and be able to:

- Develop positive strategies and citizenship roles for living in a society that is undergoing rapid technological change.
- Effectively assess and apply authentic resources of: time, people, tools and machines, capital, information, materials, and energy.
- Explore a variety of information related, physical related, and biological related systems.
- Utilize the technological method to research, design, develop, produce, utilize, control, and evaluate solutions to technological problems.
- Demonstrate the appropriate, safe, and creative use of technological tools and processes within technological systems.
- Apply science, mathematics, communications, social studies, arts and humanities to solve practical problems and extend human capabilities.
- Assess the impacts of technology and how human capabilities and environments are altered.
- Apply technological knowledge and activities to career, leisure, and consumer decisions.
- Read, write, present, and interpret technical material.

Facility Upgrade

The High School instructors are requesting a more efficient classroom to deliver instructional information to students, with the flexibility in our work centers or environment to instruct hands on skill technique and project based learning activities. The changes will improve both versatility and utility of the existing facility. Physical plant remodel needs are:

Stevens High School

Modify existing facility:

Room S205 = instructional deliver area, with computer work stations

Room S211 = restructure the shop lab into four skill development areas all in one room.

Central High School

Enhance student supervision and safety:

Room D116 = floor covering or sealant (classroom and Mini Lab)

Room D114 =

Equipment Purchasing

Delivery must take place well in advance of the start of classes to avoid confusion and disruption of student learning. All facility upgrades and equipment purchases will be made in accordance to RCAS purchasing and bid-quote practices.

In order to standardize course offerings at the Stevens and Central High Schools

Stevens High School:

Room S211 and Room S205
 Universal Laser Engraver
 CNC Plasma Cutter
 Power Drum Sander
 Vinyl Cutting machine
 Update Woodturning Lathes
 3D printer
 A Set of Construction Building Skills Units

Central High School

Rooms D16 and Room D114
 Vinyl Cutting machine
 3D printer
 To complete the Centrals HS set of Construction Building Skills Units

Evaluation Methods for Technology Education Courses

Student work in Technology Education courses is evaluated and graded according to the following components:

Knowledge	includes:	Written tests, written reports, technical vocabulary, project reports
Application	includes:	Laboratory activities and projects
Productivity	includes:	Use of time, care of facilities, laboratory safety, cooperation, following work procedures
Technology Student Portfolio:	(high school) includes:	an electronic student resumes, a personal goal statement with regard to technology study, scores and samples of the student's work, an exit statement relating completed course work to the Student's personal goals.

Articulation

The intent of articulation for this Technology education curriculum is to more fully align the High School and Middle School programs. Representatives from Post High School education have been contacted to pursue a more specific degree of articulation with Technology Education program. The cooperative articulation between Rapid City High Schools and local Post High School instructors will be in this manner.

<u>The future Career Academy</u>	--	Foundations of Technology CAD Design and Development Production Systems Energy, and Power System
<u>Black Hills State University</u>	--	Foundations of Technology CAD Design and Development Production Systems Principles of Engineering
<u>SD School of Mines and Technology</u>	--	Principles of Engineering CAD Design and Development Manufacturing Systems Energy and Power
<u>Western Dakota Technical Institute</u>	--	Production Systems Energy and Power System CAD Design and Development Manufacturing Systems

Teacher Training and In-service

This curriculum is intended to produce a teaching/learning environment that can readily accommodate change. The teaching professionals can combine their technical understanding with the quality human interaction that is needed by students. Facilitating a knowledge-intensive and diverse discipline requires that professional educators are exemplary learners. They also strive to become managers of a broad-based learning environment. Technology teachers access current information; it is crucial to have access to professional conferences dealing with technology transfer and effective teaching methods. Because technology is the integrator of knowledge; technology teachers also need access to in-service training in areas such as mathematics, science, computing, and information systems. Instructors at the High Schools will strive toward Instructor certification programs, while improving course standards for alignment with the state opportunity scholarship grant program and work toward the 2025 career cluster enhancement.

High School Technology Education Program

- Entry-level course based on the "building blocks" of technology;
 Foundations of Technology Semester or Year Grades 9-10

- Systems-level courses based on the specific technology systems;

Production Systems	Year	Grades 10-12
Intro to Energy and Power	Year	Grades 10-12
CAD Design and Development	Year	Grades 10-12

- Synthesis-level course based on design and integration of technologies;
 Introduction to Engineering Year, Grades 11-12

NOTES:

- Courses may be used for full technology.
- Semester or year courses may be expanded with new content for additional credit.
- High school courses utilize a combination delivery system:
 clustered unit activities, modular units, design and technology activities,
 individual projects, large-group and small-group projects.
- None of the high school courses have a prerequisite stipulation.
- Cluster and modular activities in the Foundations of Technology will be specifically articulated to the Systems and Synthesis level courses.

Incorporating the Technology Education Curriculum In the Overall High School Program

The Delivery Systems

This curriculum is intended to meet a wide variety of student learning needs. Methods used include: clustered unit activities, modular units, open-ended design activities and Project based learning activities. These courses are aligned to the State and national STEM standards, and also recognize Trade and Industry Standards.

The entry-level course will have all students rotate through four clustered units. Each student will have access to the same set of experiences and activities. Students will move through the activities in modular and cluster 9 week time frames.

The Systems Level courses will expose the students to: the safe and proper use of commercial and industrial equipment, materials, skill techniques, and tools. The technical aspects in the areas of study will be the main emphasis, along with avocational, consumer and vocational trends. Delivery will be through clustered units on a time frame with designated study and hands on projects. Multimedia instruction will support the laboratory experiences so students have access to remediation and enrichment activities.

The Introduction to Engineering course will use the Design and Technology approach to technological problem solving. Students will complete a variety of contextual problem-solving activities. Periodic use of modular lessons and large-group lessons will be used for information transfer. Project Based learning activities and challenges will be encouraged and incorporated into the curriculum. Delivery will be through: Product Design, Civil, Electrical, Industrial, and Mechanical Engineering.

Technology Education Course Descriptions

(Technology Education courses carry "NO" prerequisites!)

Entry Level —

Introduction of Technology Education (9-10) Semester - .5 cr Full Year - 1 cr

Technology education brings deeper meaning to core content concepts while introducing students to various technologies, technical skills, critical thinking processes, and hands-on experiences. Student activities will also help build reading skills, vocabulary, math applied science and an understanding of the materials needed for the trades.

Problem solving activities and hands-on experiences are divided into the following exploratory areas of interest that will rotate every nine weeks:

Graphic Communications: 9 wks

Design and Technology	Mechanical Design	Laser engraving
Measuring	Drafting	Graphic Production
CAD 2D and 3D	3D Modeling	

Manufacturing Cluster: 9 wks

Tool Safety	Welding	Wood Turning
Measuring	Woodworking	Sheet Metal
CNC Router	CNC Plasma Cutting	Project Building

Energy Power and Transportation Cluster: 9 wks

Tool Safety	Home Wiring	Small Gas Engines
Measuring	Vehicle Modeling	Alt Energy-related
Mechanical Systems		

Construction Cluster:

Tool Safety	Residential Structures	Measuring
Structural Design	Computerized Architecture	Block Stacking
Wall Building		

Systems Level —

Production Systems (10-11-12)

Full Year - 1 cr

Students will study the design and engineering of products along with strategies of industry. This course will provide the knowledge and technical skills that will be use full in life situations of occupational, recreational, consumer and socio-cultural significance. Modern design and production methods used will include: Computer-Aided-Design (CAD), Computer-Aided-Manufacturing (CAM) and Computer-Numerical-Controls (CNC). Student production activities will have the opportunity to design, produce, and market a final product.

Intro to Energy and Power (10-11-12)

Full Year - 1 cr

Students will be introduced to "energy" in all of its sources and forms. From there, units of study will focus on the production and utilization of energy and its systems. Class activities in: principles of electricity, Mechanical propulsion system, power transmission, guidance, and support for aerospace, land, and water transportation systems. Various supporting topics include: fuels, lubrication, alternative energy sources, mechanisms, and fluid power systems.

CAD Design and Development (10-11-12)

Full Year - 1 cr

Students will Study principles and applications of design, while applying design techniques skills with a CAD system, when working on problem-solving activities, such as: fundamentals of graphic design, 3D modeling, visualization, 2D and 3D CAD systems, CAD CAM and student design projects. Class activities include opportunities to use graphical production techniques to explore: mechanical and architecture CAD Design, integration application to CNC application with the CNC Router and CNC plasma cutting, 3D printing, as well as 3D Rendering and CAD animation.

Synthesis Level —

Introduction to Engineering (11-12)

Full Year - 1 cr

Students will learn of work done by engineers and technicians as they create and analyze designs, then produce and test their prototypes. This project based course helps students actively develop their technological problem-solving skills as they work with structural, mechanical, electrical and computer-control activities. Students activities will be worked in teams, support based on their personal interests and technical skills, while apply knowledge integrated from other academic courses, like mathematics and science.

Course Outline

Introduction of Technology Education

Semester, .5 credits -or- Year, 1 credit

Overview of Course

- Examination of management practices, safety and operation of equipment for the labs.
- General career assessment SD My life
- Cluster and modular activities specifically articulated to the Systems and Synthesis level courses.
- Origination of student learning plan

Graphic Communications Cluster – 9 weeks

- Career assessment; SD My life to investigate and understand career paths
- Multimedia overview of Graphic Com.
- Design - investigate the Graphics design loop and the principles of design
- Drafting exercises Construction of geometric Shapes, Sketching shapes, measurement applied to shapes, orthographic, isometric projections
- 3D Modeling - use Solidworks design software
- Blueprint reading - read residential, mechanical, electrical schematics
- Digital Editing - video-editing production, photo editing and processing of Images.
- Image Processing through sign building
- Electronic Publishing - calendars -greeting cards- business cards posters and banners
- Note pad production - produce graphic note tablets

Manufacturing Cluster – 9 weeks

- Career assessment; SD My life to investigate and understand career paths
- Multimedia overview of Manufacturing Systems.
- Define the Universal Systems Model in terms of resources and impacts of technology
- Measurement -
 - Linear and angular measurements
 - Quality control activity - comparative and quantitative quality measurement
 - Precision measurement - measure with micrometers and calipers
- Materials identification
- Woodworking - design and fabricate a product
- Welding - thermal fastening techniques
- CNC router and Plasma technology
- Tool Time - tool safety and operations matrix
- Sheet material fabrication - synthetic and metal
- Machining - metal lathe, wood turning, milling, CNC router and mill

Energy, Power and Transportation Cluster – 9 weeks

- Career assessment; SD My life to investigate and understand career paths
- Multimedia overview of Electrical and Energy Systems
- Measurement -
 - Understanding electronic formulas
 - Use both customary and metric units
 - Precision measurement - measure with multi-meter
- Electrical systems -
 - Identify, assemble, and test common electrical circuits
 - Solve switching circuit problems
- Mechanical systems – Internal combustion engine
- Hydraulic and pneumatic systems
- Energy and Alternative Energy Systems -
 - Thermal - test various types of building insulation
 - Fluid power - assemble and test pneumatic and hydraulic systems
 - Optical - assemble laser security system, use a laser for measurement
 - Alternative energy sources - measuring output
 - Fischertechnik Modeling - assembly of mechanical models
 - Fischertechnik CarTech - test speed and climbing ability, collect test data, report
 - Small Gas Engines - identify parts and service simple internal combustion engine

Construction Cluster – 9 weeks

- Career assessment; SD My life to investigate and understand career paths
- Multimedia overview of Construction Systems.
- Define the Universal Systems Model in terms of resources and impacts of technology
- Define the structural parts of a residential home
- Computerized Architecture - draw floor plans, plot plans, deck plans
- Materials identification related to construction
- Measurement -
 - Linear and angular measurements
 - Elevation and grade measurement - measure with Laser transit
- Block laying techniques
- Cement mixing and forming
- Structural forces - identify the forces, construct and test systems to evaluate forces
- Structure systems - design, make, predict, analyze, test, and report about a Structure

SYSTEM LEVEL CLASSES

Introduction to Energy and Power Systems

Year, 1 credit

Overview of Energy and Power Technologies

- Career assessment –
 - SD My life assessment
 - WDTI - Electrical Instructors
 - SD Tech and BHSU Electronics Instructors
- Relate the Universal Systems Model to electrical/electronic and energy applications
- Electrical and Energy Measurements and Meter Reading
- Learn how to properly connect and use a variety of meters
- Use meter readings to analyze and troubleshoot circuits and systems
- Use a software simulator for assembly and testing
- Prepare and Review student individual learning plans

Electrical

- Explore concept of "What is Electricity?" and the theory of electricity
- Learn safety procedures and attitudes relating to electricity
- Learn about the physiology of electrical shocks
- Learn technical reading and concept mapping methods
- Define terminology and describe the relationship between these terms: potential, current, coulomb, resistance, Volt, Ampere, Ohm
- Investigate the sources of electricity: friction, light, magnetism, heat pressure, and chemical action
- Make applications using the Home wiring unit
- Green construction activity using the alternative energy Unit
- Read, draw, and interpret schematic symbols of the components
 - Components included in this study -
 - passive devices: resistors
 - reactive devices: capacitors, coils, transformers
 - control devices: diodes, transistors, photonics, integrated circuits
- Use a variety of communications systems -
 - Lasers and fiber optics
 - Computerized controls
 - Satellite telecommunications
 - GPS systems and applications
 - Local-area and wide-area networks
 - Consumer electronics; assessing media programming
 - Investigate data structures -
 - Compare serial and parallel structures
 - Compare analog and digital structures

Energy

- Energy and Alt Energy
 - Defining the nature of energy
 - Solar Power
 - Wind Energy
 - Harnessing energy
 - Analyze and describe energy consumption
 - Assembly of alternative energy system kits
- Transportation Technology – recreational versus commercial use design alternative vehicle systems
 - Aeronautical
 - Use flight simulator software to learn basic flight maneuvers
 - Research contents of cross-country flight plans
 - Use flight simulator to plan and complete a cross-country flight
 - Marine
 - Investigate and construct various hull designs
 - Use of remote control navigational systems
 - Internal Combustion Engine
 - Fischertechnik Modeling - assembly of mechanical models
 - Fischertechnik CarTech - test speed and climbing ability, collect test data, report
 - Small Gas Engines - identify parts and service simple internal combustion engine

CAD Design and Drafting

Year, 1 credit

Management Overview

- Overview of technology and the process of change in graphic systems
- Career assessment;
 - SD My life assessment
 - WDTI - Graphics Instructor
 - BHSU Graphics Instructor
 - UTI Recruiter
- Guidelines for safety and equipment usage/storage
- Prepare and Review student individual learning plans

CAD for Visualization

- Development of visual processes
- Produce sketches for visual brainstorming
- Develop a sense for proportion
- Isometric / Oblique technical illustrations
- Visualize objects in 2 and 3 dimensions
- Use Solid Works 3D Modeling

CAD for Communication

- Develop ideas for communicating with others
- Conceptualize of "scale" versus "proportion"
- Demonstrate theory / principles of orthographic projection
- Produce pictorial and perspective drawings for presentation to others
- Utilize color and texture to represent Rendering solutions
- Choose appropriate scale for graphic layout of objects
- Apply principles of descriptive geometry to the production of technical drawings
- Apply industry standards of neatness, and dimensioning
- Extract technical information from drawings and blueprints
- Prepare written reports using technical style, notes, and accuracy

CAD Production Systems

- Image Processing – (Solid Works)
 - Use software to modify existing graphic images
 - Use software to create graphic images
 - Use computer and software to scan and import graphic images
- Computer-Aided-Drafting and Design (CADD)
 - Identify the components used in a CADD system
 - Recognize common input and output devices used in a CADD system
 - Use the computer to create project management documents
 - Use CADD as a tool for graphic design and drawing
 - Use of Solid Works 3D Modeling software

- Encourage students to get certifications in Solidworks
- Utilize common CADD commands:
 - create, revise, print, save, layer and retrieve drawings
- 3D Modeling -
 - Select materials appropriate to scale of project
 - Solve architectural / construction problems conceptually and in a logical manner
- CAD Integration Application
 - CNC application,
 - 3D printing, Select materials appropriate to scale of project
 - Use of digital video and photography editing procedures
 - CAD animation.
 - Compile working drawings to industry standards also process
- CAD Design and Publishing
 - Investigate the publishing and graphic arts industry
 - Learn the Elements and Principles of Design
 - Use a vinyl-cutter to produce signage
- Independent Student Project Design
 - Select interest area within graphics communication
 - Develop a collaborative project based activity with the instructor and community assistance
 - Give an oral presentation of the completed project
 - Build a scale model, of student design, to acceptable standard

Production Systems

Year, 1 credit

Management Overview

- Overview of technology and the process of change
- SD My life assessment
- WDTI - Production Instructors
- SD Tech and BHSU Industrial Instructors
- Prepare and Review student individual learning plans

Laboratory Safety

- Guidelines for safety and equipment usage/storage
- Learn safe working habits and procedures
- Learn laboratory management procedures

Production Materials

- Match materials to their applications
- Calculating and estimating materials and costs
- Analyze products and their materials
- Match products to proper material properties
- Research high-technology materials
- Lay-up composite materials

Production Tools

- Relate physics principles to tool operation
- Identification common hand tools, portable and stationary tools
- Proper Technical skills using common hand tools, portable and stationary tools

Layout and Design Processes

- Use computerized design software
- Linear measurement and layout on stock
- Locate centers for drilling applications
- Proper use of manual layout tools
- Plan a production system for a product

Separating Processes

- Set up and operate a lathe and milling machine
- Cut with oxy-acetylene and plasma-arc
- Cut internal and external threads
- Cut parts to layout marks and dimensional sizes
- Hole cutting operations -
 - Calculate drilling speeds
 - Drilling versus boring
- Sawing material Techniques
- CNC application, CNC Router and CNC Plasma Cutting

Joining Processes

- Joining via cohesion; arc and oxy-acetylene welding, solvent welding
- Joining via adhesion; brazing and soldering
- Complete a variety of structural welding joints
- Read working drawings using welding symbols
- Identify and correctly apply a wide variety of fasteners

Forming Processes

- Molding with simple and split patterns
- Cast metal into prepared molds
- Precision bend with a guided-die bender
- Cold form and thermoform sheet metals and synthetics

Fabrication Techniques

- Calculate fabrication costs using labor rates
- Use CAD system to Generate sheet metal pattern
- Read blueprinted drawings to complete a finished product
- Apply drafting techniques and create a pattern

Assembly processes

- Framing Systems
 - Assemble and dismantle framing systems
 - Conventional wood stud and plate construction
 - Structural steel beams and girders
 - Metal studs and curtain-walls
- Enclosure Systems
 - Assemble interior walls
 - Apply sheathing and underlayment
 - Apply wall materials; drywall and paneling
 - Install insulation
 - Install and attach plumbing components
 - Install electrical circuits and fixtures

Finishing and Assembly Processes

- Finish with a variety of grinding and polishing methods
- Coat materials with protective coatings
- Apply roofing and siding materials
- Use computer software to match heat-loss to insulation solutions
- Apply flooring and trim
- Prepare a final-acceptance walkthrough and relate to warranty issues

Product marketing

- Research products for production
- Produce and use market surveys
- Analyze and select production products

Automation Systems

- Integrate computerized design and manufacturing systems (CAD/CAM)
- Research trends in computer-integrated manufacturing
- Use simulation software to learn CAM coordinates and programming
- Use CADD software to design parts
- Develop a tool path program from a design
- Make a prototype part from a CADD design produced with CNC
- Produce a product using automated manufacturing environment

The Production Industry

- Relate infrastructure concepts to local community
- Relate health and safety standards to building codes
- Relate construction costs to the bidding/acceptance process
- Become familiar with the types of civil construction projects
- Preparation of Site and Foundation Systems -
 - Use a builder's level or transit to layout a building site
 - Calculate excavation costs
 - Relate structural forces to foundation needs and types
 - Prepare a concrete building foundation
 - Lay masonry
- Alternative Building Systems
 - Investigate alternative/innovative construction systems, tools, materials
 - Investigate various architectural styles and their applications
 - Investigate alternative structural systems
 - Pneumatic structures
 - Tension structures
 - Monolithic structures
 - Space-Frame structures

Introduction to Engineering

Year, 1 credit

Overview of Engineering

- Awareness of the process, impacts, and triggers of technological change
- Career assessment -
 - SD Tech Departmental Instructors: Civil, Electrical, Industrial, Mechanical
- Prepare student portfolios, SD MyLife.com

Technical Communications

- Graphic Communication -
 - Sketching designs
 - Make sketches of a redesigned product
 - Sketch a multi-view if given a pictorial view of an object; vice versa
 - Read a blueprint to obtain information
 - Use manual drafting tools to make a working drawing
 - Apply the principles and elements of graphic design
 - Make and revise drawings with CADD software
- Written Communication -
 - Use a word processor to write follow-up technical reports
 - Design an instruction manual for doing a process
 - Use a computer to produce an instruction manual with text and graphics
- Oral Communication -
 - Deliver periodic oral reports about recent developments in technology
 - Present a seminar to report project results

The Design Process

- Describe the need for problem solving in the workforce
- Learn the steps of the technological method via the Design Loop
- Practice various ideation methods such as brainstorming and clustering
- Describe and apply the concurrent and sequential engineering methods
- Evaluate existing designs in terms of effectiveness and creativity
- Follow a prepared design brief to create an engineered solution to a problem
- Use project based learning to solve and prepare solutions
- Manage technological resources during a design project

Engineering Materials

- Use multimedia software to learn the families of engineering materials
- Use multimedia software to learn the properties of engineering materials
- Use multimedia software to identify common engineering materials
- Relate atomic structure and bonding structure to properties of materials
- Test a variety of engineering materials; collect and interpret test data
- Use solid Works for sustainable design

Prototype Modeling Processes

- Use Solid Works 3D Modeling program as basic design Package.
- Solid Works Simulation when using moving parts or components.
- Process paper and card materials into conceptual models
- Use modeling components (Fischertechnik) to assemble prototypes
- Use computer spreadsheets to mathematically model testing data
- Use data-acquisition software and sensors to collect testing data
- Interpret and make conclusions from test data and mathematical models
- Use Gantt charts to model project sequences and time constraints
- Use actual tools, machines and materials to produce full-scale, operational prototypes of designs
- Demonstrate safe working practices and attitudes in the prototype laboratory

Structural Design

- Describe the structural forces of tension, shear, torsion, and compression
- Analyze a structural framework for its forces
- Use trigonometry to calculate forces within a structural system
- Use graphical solution of vectors to analyze structure forces in a system
- Predict a structural failure by using structural analysis
- Assemble structural modeling components to collect force data
- Describe the concepts of stress and strain
- Design, analyze, make, test, and redesign a structural system to specifications

Mechanical Design

- Identify the simple machines present in common technological systems
- Calculate the mechanical advantage of simple machines
- Design a mechanical system that integrates simple machines
- Assemble an integrated mechanical system to specification

Assessing Technology

- Assess technical information by summarizing technical articles
- Catalog technical articles by keyword
- Enter technical articles into a computerized database
- Search in-house and on-line databases for technical information
- Evaluate products/designs in terms of the principles of design
- Become familiar with an engineering Code of Ethics
- Discuss an ethical dilemma in the context of engineering and design
- Produce a plan of action in response to an ethical dilemma

Design Projects

- Individually solve a problem from a teacher-prepared design brief
- Work in a small design team to solve a teacher-prepared design brief
- Work in large group to solve a teacher-prepared design brief
- Seek out and select a technical problem to solve as an individual
- Participate in competitive design and assembly projects; FIRST Robotics

Introduction of Engineering

- Career assessment; SD My life to investigate and understand career paths
- Multimedia overview of Introduction to Engineering
- Develop technological problem-solving skills in work with structural, mechanical, electrical and computer-control activities
- Invention and Design -
 - Investigate the design loop and the principles of design
 - Investigate the invention processes and patent procedures
 - Research and develop a design project based on need
- Learn the steps of the technological method via the Design Loop
- Describe the structural forces of tension, shear, torsion, and compression
- Identify the simple machines present in common technological systems
- Produce a plan of action in response to an ethical dilemma
- Individually solve a problem from a teacher-prepared design brief

Technology Learning Activities

(These individual and small group activities are alternated with modular units)

- Graphic design (paper engineering; design a pop-up greeting card)
- Design activity (develop fishing lures / spoon and plug)
- Activity to design and prototype a new product
- Construction activity (plan a booth for a home-improvement show)
- Alternative energy (design a solar cooker and food item for a cookout)
- Architectural sketching (develop dream-home floor plans and plot plan)
- Wind-powered vehicle (design a wind-powered vehicle)
- Footwear design (design and promote a new style of footwear)
- Propeller design (design a propeller that optimizes power transfer)
- Boomerang research design, building and testing

Standards for Technological Literacy

Technological Literacy is for all Americans. Our professional organization, International Technology Education Association (ITEA) has developed 20 National Standards for Technological Literacy. The first 13 standards and related benchmarks apply to all disciplines. We incorporate standards 1-13 and related benchmarks into lab presentations and classroom activities. Standards 14 – 20 are application-based. We incorporate these standards in our modular learning environment. We do not prepare specific activities for the first 13 standards, but incorporate them into our lab presentations and classroom activities.

The Nature of Technology

Standard 1: Students will develop an understanding of the characteristics and scope of technology.

Benchmarks: Grades K-8

- A. Natural world and human-made world are different
- B. All people use tools and techniques to help them do things
- C. Things found in nature differ from things that are human-made in how they are produced and used
- D. Tools, materials and skills are used to make things and carry out tasks
- E. Creative thinking and economic and cultural influences shape technological development
- F. New products and systems can be developed to solve problems or to help do things that could not be done without technology
- G. The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative
- H. Technology is closely linked to creativity, which has resulted in innovation
- I. Corporations can often create demand for a product by bringing it onto the market and advertising it

Standard 2: Students will develop an understanding of the core concepts of technology.

Benchmarks: Grades K-8

- A. Some systems are found in nature, and some are made by humans
- B. Systems have parts or components that work together to accomplish a goal
- C. Tools are simple objects that help human's complete tasks
- D. Different tools are used in making things
- E. People plan in order to get things done
- F. A subsystem is a system that operates as a part of another system
- G. When parts of a system are missing, it may not work as planned

- H. Resources are the things needed to get a job done, such as tools and machines, materials, information, energy, people, capital, and time
- I. Tools are used to design, make, use, and assess technology
- J. Materials have many different properties
- K. Tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing
- L. Requirements are the limits to designing or making a product or system
- M. Technological systems include input, processes, output, and, at times, feedback
- N. Systems thinking involves considering how every part relates to others
- O. An open-loop system has no feedback path and requires human intervention, while a closed-loop system uses feedback
- P. Technological systems can be connected to one another
- Q. Malfunctions of any part of a system may affect the function and quality of the system
- R. Requirements are the parameters placed on the development of a product or system
- S. Trade-off is a decision process recognizing the need for careful compromises among competing factors
- T. Different technologies involve different sets of processes
- U. Maintenance is the process of inspecting and servicing a product or system on a regular basis in order for it to continue functioning properly, to extend its life, or to upgrade its capability
- V. Controls are mechanics or particular steps that people perform using information about the system that causes systems to change

Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Benchmarks: Grades K-8

- A. The study or technology uses many of the same ideas and skills as other subjects
- B. Technologies are often combine.
- C. Various relationships exist between technology and other fields of study.
- D. Technological systems often interact with one another
- E. A product, system, or environment developed for one setting maybe applied to another setting
- F. Knowledge gained from other fields of study has a direct effect on the development of technological products and systems

Technology and Society

Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology.

Benchmarks: Grades K-8

- A. The use of tools and machines can be helpful or harmful
- B. When using technology, results can be good or bad
- C. The use of technology can have unintended consequences
- D. The use of technology affects humans in various ways, including their safety, comfort, choices, and attitudes about technology's development and use
- E. Technology, by itself, is neither good nor bad, but decisions about the use of products and systems can result in desirable or undesirable consequences.
- F. The development and use of technology poses ethical issues
- G. Economic, political, and cultural issues are influenced by the development and use of technology

Standard 5: Students will develop an understanding of the effects of technology on the environment.

Benchmarks: Grades K-8

- A. Some materials can be reused and/or recycled
- B. Waste must be appropriately recycled or disposed of to prevent unnecessary harm to the environment
- C. The use of technology affects the environment in good and bad ways
- D. The management of waste produced by technology systems is an important societal issue
- E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems
- F. Decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another
- G. Humans can devise technologies to conserve water, soil, and energy through such techniques as reusing reducing and recycling
- H. When new technologies are developed to reduce the use of resources, considerations of tradeoffs are important

Standard 6: Students will develop an understanding of the role of society in the development and use of technology.

Benchmarks: Grades K-8

- A. Products are made to meet individual needs and wants
- B. Because people's needs and wants change, new technologies are developed, and old ones are improved to meet those changes

- C. Individual, family, community, and economic concerns may expand or limit the development of technologies
- D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies
- E. The use of inventions and innovations has led to changes in society and the creation of new needs and wants
- F. Social and cultural priorities and values are reflected in technological devices
- G. Meeting societal expectations is the driving force behind the acceptance and use of products and systems

Standard 7: Students will develop an understanding of the influence of technology on history.

Benchmarks: Grades K-8

- A. The way people live and work has changed throughout history because of technology
- B. People have made tools to provide food, to make clothing, and to protect themselves
- C. Many inventions and innovations have involved by using slow and methodical processes of tests and refinements
- D. The specialization of function has been at the heart of many technological improvements
- E. The design and structures for service or convenience have involved from the development of techniques for measurement, controlling systems, and understanding of spatial relationships
- F. In the past, an invention or innovation was not usually developed with the knowledge of science

Design

Standard 8: Students will develop an understanding of the attributes of design.

Benchmarks: Grades K-8

- A. Everyone can design solutions to a problem
- B. Design is a creative process
- C. The design process is a purposeful method of planning practical solutions to problems
- D. Requirements for a design include such factors as a desired elements and features of a product or a system or the limits that are placed on the design
- E. Design is a creative planning process the leads to useful products and systems.
- F. There is no perfect design
- G. Requirements for a design are made up of criteria and constraints

Standard 9: Students will develop an understanding of engineering design.

Benchmarks: Grades K-8

- A. The engineering design process includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others
- B. Expressing ideas to others verbally and through sketches and models is an important part of the design process
- C. The engineering design process involves defining a problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating it, and presenting the results
- D. When designing an object, it is important to be creative and consider all ideas
- E. Models are used to communicate and test design ideas and processes
- F. Design involves a set of steps, which can be performed in different sequences and repeated as needed
- G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum
- H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Benchmarks: Grades K-8

- A. Asking questions and making observations helps a person to figure out how things work
- B. All products and systems are subject to failure. Many products and systems, however, can be fixed

- C. Troubleshooting is a way of finding out why something does not work so that it can be fixed
- D. Invention and innovation are creative ways to turn ideas into real things
- E. The process of experimentation, which is common in science, can also be used to solve technological problems
- F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system
- G. Invention is a process of turning ideas and imagination into devices and systems
- H. Innovation is the process of modifying an existing product or system to improve it
- I. Some technological problems are best solved through experimentation

Abilities of a Technological World

Standard 11: Students will develop abilities to apply the design process.

Benchmarks: Grades K-8

- A. Brainstorm people's needs and wants and pick some problems that can be solved through the design process
- B. Build or construct an object using the design process
- C. Investigate how things are made and how they can be improved
- D. Identify and collect information about everyday problems that can be solved by technology, and generate ideas and requirements for solving a problem
- E. The process of designing involves presenting some possible solutions in visual form and then selecting in visual form and then selecting the best solution(s) from many
- F. Test and evaluate the solutions for the design problem
- G. Improve the design solutions
- H. Apply a design process to solve problems in and beyond the laboratory-classroom
- I. Specify criteria and constraints for the design
- J. Make two-dimensional and three-dimensional representations of the designed solution
- K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed
- L. Make a product or system and document the solution

Standard 12: Students will develop abilities to use and maintain technological products and systems.

Benchmarks: Grades K-8

- A. Discover how things work
- B. Use hand tools correctly and safely and be able to name them correctly
- C. Recognize and use everyday symbols
- D. Follow step-by-step directions to assemble a product
- E. Select and safely use tools, products, and systems for specific tasks

- F. Use computers to access and organize information
- G. Use common symbols, such as numbers and words, to communicate key ideas
- H. Use information provided in manuals, protocols, or by experienced people to see and understand how things work
- I. Use tools, materials, and machines safely to diagnose, adjust, and repair systems
- J. Use computers and calculators in various applications
- K. Operate and maintain systems in order to achieve a given purpose

Standard 13: Students will develop abilities to assess the impact of products and systems.

Benchmarks: Grades K-8

- A. Collect information about everyday products and systems by asking questions
- B. Determine if the human use of a product or systems creates positive or negative results
- C. Compare, contrast, and classify collected information in order to identify patterns
- D. Investigate and assess the influence of a specific technology on the individual, family, community, and environment
- E. Examine the trade-offs of using a product or system and decide when it could be used
- F. Design and use instruments to gather data
- G. Use data to analyze and interpret trends in order to identify the positive or negative effects to a technology
- H. Identify trends and monitor potential consequences of technological development
- I. Interpret and evaluate the accuracy of the information obtained and determine if it is useful

The Designed World

Standard 14: Students will develop an understanding of and be able to select and use medical technologies.

Benchmarks: Grades K-8

- A. Vaccinations protect people from getting certain diseases
- B. Medicine helps people who are sick to get better
- C. There are many products designed specifically to help people take care of themselves
- D. Vaccines are designed to prevent diseases from developing and spreading; medicines are designed to relieve symptoms and stop diseases from developing
- E. Technological advances have made it possible to create new devices, to repair or replace certain parts of the body, and to provide a means for mobility
- F. Many tools and devices have been designed to help provide clues about health and to provide a safe environment

- G. Advances and innovations in medical technologies are used to improve healthcare
- H. Sanitation processes used in the disposal of medical products help to protect people from harmful organisms and disease, and shape the ethics of medical safety
- I. The vaccines developed for use in immunization require specialized technologies to support environments in which a sufficient amount of vaccines are produced
- J. Genetic engineering involves modifying the structure of DNA to produce novel genetic make-ups

Standard 15: Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.

Benchmarks: Grades K-8

- A. The use of technologies in agriculture makes it possible for food to be available year round and to conserve resources
- B. There are many different tools necessary to control and make up the part of an ecosystem
- C. Artificial ecosystems are human-made environments that are designed to function as a unit and are comprised of humans, plants, and animals
- D. Most agricultural waste can be recycled
- E. Many processes used in agriculture require different procedures, products, or systems
- F. Technological advances in agriculture directly affect the time and number of people required to produce food for a large population
- G. A wide range of specialized equipment and practices is used to improve the production of food, fiber, fuel, and other products and in the care of animals
- H. Biotechnology applies the principles of biology to create commercial products of processes
- I. Artificial ecosystems are human made complexes that replicate some aspects of the natural environment
- J. The development of refrigeration, freezing, dehydration, preservation, and irradiation provide long-term storage of food and reduce the health risks caused by tainted food

Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.

Benchmarks: Grades K-8

- A. Energy comes in many forms
- B. Energy should not be wasted
- C. Energy comes in different forms
- D. Tools, machines, products, and systems use energy in order to do work
- E. Energy is the capacity to do work
- F. Energy can be used to do work, using many processes

- G. Power is the rate at which energy is converted from one form to another or transferred from one place to another, or the rate at which work is done
- H. Power systems are used to drive and provide propulsion to other technological products and systems
- I. Much of the energy used in our environment is not used efficiently

Areas of Study (Standard 16)

Fluid Power

- Pneumatics
- Hydraulics
- Single acting cylinder
- Double acting cylinder
- Pressure

Electrical/Electronic Systems

- Simple Circuit
 - Serial
 - Parallel
- Inputs
 - 12 volt
 - 120 volt
- Type
 - Alternating Current
 - Direct Current
- Controllers
 - Switches
- Out puts
 - Lights
 - Motors

Mechanical Systems

- Simple Machines
 - Lever
 - Screw
 - Incline plan
 - Wheel
 - Wedge
 - Pulley
- Gears and Pulleys
 - Direction
 - Speed
 - Power

- Rotation

Control/Management

- Inputs
- Controllers
 - Switches
 - Valves
- Outputs
- Logic Gates
 - IF
 - AND
 - OR NOT
- Check Valves

Energy/Alternative

- Wind
 - Source
 - Applications
- Water
 - Source
 - Applications
- Solar
 - Source
 - Applications
- Nuclear
 - Source
 - Applications
- Tidal
 - Source
 - Applications
- Hydro
 - Source
 - Applications

Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.

Benchmarks: Grades K-8

- A. Information is data that has been organized
- B. Technology enables people to communicate by sending and receiving information over a distance
- C. People use symbols when they communicate by technology
- D. The processing of information throughout the use of technology can be used to help humans make decisions and solve problems
- E. Information can be acquired and sent through a variety of technological sources, including print and electronic media
- F. Communication technology is the transfer of messages among people through and/or machines over distances through the use of technology
- G. Letters, characters, icons, and signs are symbols that represent ideas, quantities, elements, and operations
- H. Information and communication systems allow information to be human transferred from human to human, human to machine, and machine to human
- I. Communication systems are made up of a source, encoder, transmitter, receiver, decoder, and destination
- J. The design of a message is influenced by such factors as the intended audience, medium, purpose, and nature of the message
- K. The use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas

Areas of Study (Standard 17) Geographic Information Systems

- Global Positioning Systems
 - Concept
 - Applications
 - Operations
- Image Processing
 - Digital Mapping
 - Data Sets
 - Types
- Mapping
 - Scale
 - Interpret
 - Type
- Surveying
 - Elevations
 - Equipment

Graphic Design

- Mechanical
 - 2 Dimensional
 - 3 Dimensional
 - Pattern Development
- CADD
 - 2 Dimensional
 - 3 Dimensional
 - Modeling

Multimedia

- Video/TV Production
 - Editing
 - Recording/Mixing
 - Format
 - Script Presentation
- Radio Production
 - Editing
 - Recording/Mixing
 - Format
 - Script Presentation
- Tele-communications
 - Satellite
 - Land Line
 - Microwave
- Computer Applications
 - Desktop Publishing
 - Word Processing
 - Spread Sheet
 - Data Base
 - Presentation
 - Animation
 - WEB Design
 - Digital Imaging

Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.

Benchmarks: Grades K-8

- A. A transportation system has many parts that work together to help people travel
- B. Vehicles move people or goods from one place to another in water, air, or space and on land
- C. Transportation vehicles need to be cared for to prolong their use
- D. The use of transportation allows people and goods to be moved from place to place
- E. A transportation system may lose efficiency or fail if one part is missing or malfunctioning or if a subsystem is not working
- F. Transporting people and goods involves a combination of individuals and vehicles
- G. Transportation vehicles are made up of subsystems, such as structural, propulsion, suspension, guidance, control, and support; they must function together for a system to work effectively
- H. Governmental regulation often influences the design and operation of transportation systems
- I. Processes, such as receiving, holding, storing, loading, moving, unloading, delivering, evaluating, marketing, managing, communicating, and using conventions are necessary for the entire transportation system to operate efficiently

Areas of Study (Standard 18)**Land**

- Vehicular
 - Structural
 - Propulsion
 - Suspension
 - Control
 - Support

- Aerodynamics
 - Speed
 - Friction
 - Fuel efficiency
 - Design

Water

- Buoyancy
 - V hull
 - Flat hull
 - Tri hull

- Propulsion
 - Wind
 - Mechanical

Air/Space

- Air subsystems
 - Structural
 - Propulsion
 - Suspension
 - Control
 - Support

- Guidance
 - Lift
 - Drag
 - Thrust
 - Gravity

- Principles
 - Bernoulli's
 - Newton's 3rd Law

Standard 19: Students will develop an understanding of and be able to select and use manufacturing technologies.

Benchmarks: Grades K-8

- A. Manufacturing systems produce products in quantify
- B. Manufactured products are designed
- C. Processing systems convert natural materials into products
- D. Manufacturing processes include designing products, gathering resources, and using tools to separate, form, and combine materials in order to produce products
- E. Manufacturing enterprises exist because of a consumption of goods
- F. Manufacturing systems use mechanical processes that change the form of materials through the processes of separating, forming, combing, and conditioning them
- G. Manufactured goods may be classified as durable and non-durable
- H. The manufacturing process includes the designing, development, making, and servicing of products and systems
- I. Chemical technologies are used to modify or alter chemical substances
- J. Materials must first be located before they can be extracted from the earth through such processes as harvesting, drilling, and mining
- K. Marketing a product involves informing the public about it as well as assisting in selling and distributing it

Areas of Study (Standard 19)

Product Development

- Design
 - Structural
 - Aesthetics
 - 3D CAD
- Marketing
 - Target group
 - Advertisement
- Resources
 - Time
 - People
 - Information
 - Materials
 - Energy
 - Tools/Machines
 - Capital

Fabrication

- Casting/Molding
 - Injection
- Forming
 - Vacuum
 - Scroll
- Separating
 - Shearing
 - Thermo
 - Mechanical
- Conditioning
 - Chemical
 - Thermo

- Assembly
 - Fasteners
 - Order
- Finishing
 - Staining
 - Painting
 - Waxing

Production

- Select Operations
 - Drilling
 - Cutting
 - Shearing
- Sequence Operations
 - Flow Chart
- Select Equipment
 - Tools
 - Machines
- Design Tooling
 - Jigs
 - Fixtures
- Quality Control
 - Check off list
- Testing the System
 - Trial Run
 - Adjust System

Standard 20: Students will develop an understanding of and be able to select and use construction technologies.

Benchmarks: Grades K-8

- A. People live, work, and go to school in buildings, which are of different types:
houses, apartments, office buildings, and schools
- B. The type of structure determines how the parts are put together
- C. Modern communities are usually planned according to guidelines
- D. Structures need to be maintained
- E. Many systems are used in buildings
- F. The selection of designs for structures is based on factors such as building laws and codes, style, convenience, cost, climate, and function
- G. Structures rest on a foundation
- H. Some structures are temporary, while others are permanent
- I. Buildings generally contain a variety of subsystems

Areas of Study (Standard 20)

Basic Construction Principles

- Materials
 - Types
 - Properties
- Loads
 - Natural
 - Man Made
- Force
 - Sequencing
 - Stretching
 - Bending
 - Shoring
 - Twisting
- Shapes
 - Squares
 - Triangles
 - Domes

Types of Construction

- Residential
 - Single Dwelling
 - Multiple Dwelling
- Commercial
 - Business
 - Institution
 - Industrial
 - Entertainment

- Civil
 - Bridges
 - Tunnels
 - Dams
 - Towers
- Infrastructure
 - Utilities
 - Transportation

Construction Systems

- Input
 - Information
 - People
 - Materials
- Process
 - Planning
 - Funding
 - Design
 - Contracting
- Output
 - New or Improved Structures
- Feedback
 - Change Orders
 - Maintenance
 - Future Expansion

Technology Education's Links To Rapid City's District-wide Indicators of Student Achievement (Grade 12 Graduation Standard Indicators)

A. Acquisition of functional communication skills

Modular lessons emphasize reading of process instructions

Technical vocabulary is challenging

Reading teachers are asked to evaluate modules for their readability

Student use of technical writing and use electronic publishing to report project results

Technical papers completed using traditional and online research

Students write instruction manuals to communicate procedures to others

Students orally present reports of project results

Students are introduced to techniques of reading technical material

Students are taught listening skills to be courteous to project reporters

Students are introduced to interactive skills to create a comfortable environment for idea-generation sessions

B. Development of problem solving skills

Students are made aware of the need for problem solvers in technology

The discipline of Technology Education is based on students applying the "Technological Method" of problem solving to real situations

The conceptual framework of Technology Education emphasizes problem solving by applying the resources of time, people, information, tools and machines, capital, energy, and materials

Students are taught techniques for divergent thinking to generate ideas

Students are taught optimization techniques for selecting solutions

Students have many opportunities to design solutions with respect to constraints, then they evaluate and redesign the results

Students are led through a continuum from increasingly challenging problem solving through to student's "problem finding"

C. Mastery of an essential core of knowledge

Technologies designed to expand basic technological skills and knowledge

Problem solving activities are based on applying appropriate resources

Technology activities include a wide range of mathematical applications ranging from measurement and arithmetic to applied trigonometry

Technology activities include a wide range of scientific principles supporting scientific inquiry

Technology activities often incorporate artistic expression as part of product design and graphic communications

Life-long learning is emphasized in Technology Education

D. Development of citizenship skills

One of the goals of Technology Education is to develop technological literacy; the knowledge, attitudes, and skills needed by citizens in a world increasingly influenced by technology

Because of the demands of the technological workplace, emphasis is placed on developing teamwork and cooperation while completing tasks

Technology Education activities are created for students to explore contexts of the past, present, and the future applications of technology

Students are made aware of how technology influences society, values, politics, history, and the process of change

E. Development of vocational and employment skills

Technology Education classes are some of the few places in schools that students actually experience the roles of the work force

By their nature, Technology Education activities are not contrived, they are real situations and real resources are used to solve problems

Transferable work skills and productivity measures are an integral part of Technology Education activities and their evaluation

Many Technology Education activities directly include research into careers and the application of careers to the things learned and experienced

F. To plan and secure a future career

Technology Education classes are a direct path into most of the newly emerging career fields

Technology Education activities offer experiences that transfer directly into future work opportunities; many students have based their own business ventures and their eventual occupations on what they have learned in Technology Education courses

Technology Education activities relate directly to work force issues such as intellectual property protection, professional communications, and teamwork

Technology Education activities permit student's opportunities to actually experience a wide variety of occupational activities

G. Skills necessary to maintain a healthy body

Safety is an integral part of instruction for using tools and materials

Ergonomics is an integral topic in Technology; students experience actual activities in matching products and processes to the human body

Technology Education activities transfer directly into an immense variety of hobbies and other leisure activities

Bio-related Technology Education activities directly increase the health and medical awareness of students

Applications of Computer Sciences in Technology Education

All Technology Education courses will utilize fundamental computer skills to access, collect, document, record and present data. Students will be required to properly implement tasks ranging from simple word processing, databases, spreadsheets and drawings to developing interactive design and modeling projects. Students will get a basic understanding and application with different computer systems (PC, Mac and alternative). The use of the Internet websites and research engines will provide an immediately current information and knowledge base.

Introduction of Technology Education

Computer Assisted Instruction:

- Drafting measurement software
- Safety
- Get wired residential wiring
- Amatol Structural
- CNC Mill level software
- Machine Shop safety software
- Wood shop safety software

Technical Data:

- Internet research for activities
- Reports
- Spreadsheet documents
 - Calculate and charting graphs
 - Collect test data and draw conclusions
 - Material list/parts list

Simulation:

- Interactive Flight Simulators
- “Get wired sim” / residential wiring

Production:

- Architecture 3D Design
- Landscape 3D Design
- Cad drawing programs
- “Get wired” / residential wiring
- Interactive Flight Simulators
- NASA Aircraft design website
- ProDESKTOP 3D Modeling
- Machine shop safety software
- Structural testing data Mr. Buster
- Pattern development drawings
- Choices Career Software

Electrical and Energy Systems

Computer Assisted Instruction:

- “Get Wired” / residential wiring Lesson

Technical Data:

- Internet research for activities
- Reports
- Spreadsheet Documents
- Calculate and charting graphs
- Collect test data and draw conclusions
- Material List/parts list

Simulation:

- “Get Wired” / residential wiring simulation
- Car Builder software

Graphic Communications

Computer Assisted Instruction:

- Solid Professor Instruction

Technical Data:

- Internet research for activities
- Reports
- Spreadsheet Documents
 - Calculate and charting graphs
 - Collect test data and draw conclusions
 - Material List/parts list

Simulation:

- Solid Works 3D Modeling Simulation
- Visualize and transfer data from 3D full-sized objects to scaled 2D drawings

Production:

- Cad solid Works
- Rhino 2D 3D CAD
- Digital Video production (Final Cut)
- Electronic Publishing
- Digital Photography and Editing (Adobe Photo)
- Pattern development drawings
- Color Cam Design and Production
- CNC Milling and Routing
- CNC Plasma
- Paint Program
- Power point presentations

Manufacturing Systems

Computer Assisted Instruction:

- Wood Shop safety software
- Machine shop safety software
- Internet self help instruction

Technical Data:

- Internet research for activities
- Product development reports
- Reports
- Spreadsheets Documents
 - Calculate and charting graphs
 - Collect test data and draw conclusions
 - Material List/parts list
 - Use charts to convert between decimal, fractional, letter, and number drill sizes

Simulation:

- ProDESKTOP 3D Animation

Production:

- ProDESKTOP 3D Modeling
- Structure Buster compression tester
- Pattern development drawings
- Digitize parts for manufacturing CNC
- CNC Milling and Routing
- CAD Pattern Development

Construction Systems

Computer Assisted Instruction:

- Chief Architectural 3D model and Instruction
- Measurement Software
 - Shop Safety

Technical Data:

- Internet research for activities
- Reports
- Spreadsheet Documents
 - Calculate and Charting graphs
 - Collect test data and draw conclusions
 - Material List/parts list
 - Calculate beam load forces

Production:

- CAD Pattern Development
- City Planning
 - Arc View imaging city planning
 - Sim City

Applications of Mathematics in Technology Education

Introduction of Technology Education

- Calculate the force produced by a fluid system cylinder when input pressure and piston size are given; requires:
 - estimation of values
 - calculation of piston area
 - conversion to specified units ·solving equations
- Using drafting tools to do geometric constructions:
 - bisecting lines, angles, and arcs
 - copying angles and arcs
 - producing polygons
 - constructing tangents to circles
- Drawing to scale
- Determining sizes and positions from blueprints
- Reading and interpreting orthographic and isometric drawings
- Reading and interpreting pattern development drawings
- Calculate gear ratios, and chain and sprocket ratios
- Collect test data and draw conclusions regarding drive ratios and vehicle performance
- Read meters and scales to collect structural data
- Learn measurement unit prefixes that pertain to light waves; nanometer, milliwatt
- Collect test data to compare divergence of laser light compared to normal light
- Use ratios and proportions to measure extremely small distances with a laser and a beam-type laser micrometer.
- Use estimation skills to reason the laser micrometer results
- Calculate cutting RPM by solving equations
- Measure linear distances with customary and metric scales
- Measure to 0.01mm and 0.001" accuracy with micrometers and vernier caliper
- Measure angles with a protractor head
- Estimate angles by reasoning difference between acute and obtuse angles
- Relate exponential change to the number and spacing of technological events

Electrical and Energy Systems

- Read digital, standard analog, and logarithmic meter scales
- Relate measured values to derived, calculated values
- Relate concept of significant figures to meter-reading skills
- Become familiar with electronics-related measurement units and their prefixes (e.g. micron, nanometer, microvolt, milliamp, megawatt, kilohm)
- Relate electron flow rates to derived values for electronic components
- Relate variables of current, potential, and time to derived electrical measuring units
- Calculate flux density for magnetic fields

- Use formulas and equations to solve for current, voltage, resistance, and power with Ohm's Law, Kirchoff's Law, and Watt's Law
- Calculate time delay within communication systems
- Calculate frequencies from oscilloscope time-base data
- Use tables to determine values of electronic components
- Calculate voltage step-up and step-down of transformers by using wire-turn ratios and proportions
- Calculate conversions between decimal, binary, hexadecimal, octal number systems
- Relate binary number data to digital logic truth tables
- Relate binary number data to communication codes
- Relate scanning data to position of video images
- Use numerical coding systems to communicate information
- Use estimation of meter values to troubleshoot circuits
- Calculate resonance frequencies from capacitor, resistor, inductor values
- Calculate antenna lengths from transmit/receive frequencies
- Calculate costs from bill of materials
- Calculate percentages when analyzing radio and television programming plans
- Relate values of frequencies to sound intensity and structure
- Using trig functions to explain instantaneous and peak AC voltage
- Estimate distances, times, weights, costs
- Measure in customary and metric units using rules, gages, micrometers, and calipers
- Solve equations to determine engine displacement
- Use ratios to compare internal engine volumes to determine compression ratio
- Solve equations to calculate horsepower of an engine

Graphic Communications

- Use architectural scale to measure distances and to make drawings to scale
- Calculate centering of objects within given areas using rules and scales
- Using drafting tools to do geometric constructions:
 - bisecting lines, angles, and arcs
 - copying angles and arcs
 - producing polygons
 - constructing tangents to circles
- Construct and verify geometric objects using the Pythagorean theorem
- Estimate and measure ratios and proportions of objects to make technical sketches
- Calculate ratios and proportions using a calculator
- Accurately transfer data by use of scales and dividers
- Determine the proper sequencing of events for making detailed technical drawings
- Visualize and transfer data from 3D full-sized objects to scaled 2D drawings
- Visualize and transfer data from 2D drawings to scaled or full-sized 3D objects

- Calculate measurements in whole numbers and fractions or decimal equivalents
- Measure accurately in decimal-inch and fractional-inch systems
- Reduce/enlarge objects in proportion
- Convert mathematical solutions of problems into descriptive geometry
- Estimate and calculate costs of housing according to standard guidelines
- Use Cartesian coordinates to locate and produce technical drawings
- Locate points and objects using absolute, incremental, and polar coordinates
- Calculate income/price relationships for housing
- Calculate principal and interest payments using amortization tables and a computer
- Analyze cost factors and determine the appropriate type of housing mortgage loan
- Scale and record topographical features of maps
- Discern the difference between size and scale
- Locate specific points using triangulation
- Locate/discern geographical areas by the use of bearing angle and coordinates
- Calculate beam loading forces
- Triangulate forces for the design of beam and truss supports
- Perform stair calculations
- Determine heating/cooling loss of a dwelling
- Measure distances in both customary inch and metric units
- Calculate roof slope using rise/run
- Calculate compound angles for rough carpentry
- Calculate electrical circuit requirements for a building
- Compile an electrical load chart
- Calculate drainage field requirements
- Record and analyze data in tabular forms

Manufacturing Systems

- Calculate RPM by solving formulas
- Calculate machine movements using cutter offsets and diametric size changes
- Measure in customary and metric units using rules, scales, and micrometers
- Determine sizes and distances from blueprints and technical drawings
- Relate decimal and fractional measurements to American Standard Sheet Gage #
- Read and interpret scales for pressures, flow rates, and current settings
- Calculate labor charges for welding jobs; use time, labor, consumables data
- Use a multi-variable nomograph to determine welding job costs
- Estimate distances and angles for structural weld fit-up
- Estimate and measure angles to compensate for thermal distortion during welding
- Estimate and adjust compound angles to develop proper manipulative skills
- Use charts and tables to determine machine settings for specific applications
- Calculate the consumption rate of welding electrodes

Construction Systems

- Estimate distances, times, weights, costs
- Measure in customary and metric units using rules, scales, micrometers, and calipers
- Make geometric constructions of ellipses, hexagons, octagons, etc. to use as patterns
- Calculate locations for centering geometric constructions to compensate for waste
- Solve an equation for board foot and material cost calculations
- Use layout and marking tools for square ness and angularity
- Calculate cutting depth and cutting distances to make accurate cuts
- Use accurate cutting tool calculations to compensate for cutter kerf while machining
- Transfer dimensions from blueprints to products
- Solve equations to calculate rim speeds, pulley speeds, cutter speeds
- Use charts to convert between decimal, fractional, letter, and number drill sizes
- Principles of Engineering
- Estimate distances, times, weights, costs
- Learn difference between actual and derived units
- Use calculators, computers, and tables for calculations
- Calculate RPM by solving formulas
- Calculate machine movements using cutter offsets and diametric size changes
- Calculate machine positions within Cartesian coordinates
- Measure in customary and metric units using rules, scales, micrometers, and calipers
- Record measurements into tables
- Collect testing data and report it in technical reports (use appropriate units)
- Enter measurements and set up computer spreadsheets for data representation
- Use charting software to create graphs that represent collected data
- Create control charts to represent variations in quality control data
- Calculate mechanical advantage of gears, pulleys, screws, incline planes, and levers
- Calculate movement distances and angles of linkages using trig functions
- Calculate costs from bill of materials
- Calculate work times after making project-management Gantt charts
- Graphically add force vectors to determine structural stresses
- Relate structural forces to various geometric shapes
- Analyze the transfer of structural forces through load-paths of geometric shapes
- Use triangulation for pattern development for designing structural members
- Use graphical methods to determine the center of gravity of structural members
- Change the code in computer programs to operate programmable control systems
- Determine sizes and distances from blueprints and technical drawings

- Use architect's scale to make technical drawings to scale
- Use proportions to determine sizes when making technical sketches
- Draw conclusions from the manipulations of mathematical variables in computer models dealing with heat-loss and urban planning

Applications of Science in Technology Education

Introduction of Technology Education

- Describe the atomic structure of electrical insulators and conductors
- Assemble, test, analyze the characteristics of the types of electrical circuits
- Investigate the operation of common electrical and electronic components
- Investigate the relative compressibility of liquids and gases in fluid systems
- Investigate the concept of pressure in fluid systems as described by Pascal's Law
- Calculate system pressures in a fluid system
- Calculate output force of linear actuators from system pressure and piston sizes
- Assemble fluid systems to investigate conversion of pressure to work and motion
- Trace the transfer of power through simple machines, compound machines, and various mechanical systems
- Calculate gear/pulley ratios and relate to vehicle design
- Test vehicles with various drive systems; collect and interpret testing data
- Describe how a laser produces light
- Characteristics of laser light related to applications in technology
- Explore relationship between incident and reflective angles in laser/optical systems
- Compare light conduction through optical fibers and air
- Modulate a communication signal over a carrier wave
- Test physical properties engineering materials; hardness, toughness, brittleness, thermo conductivity, electro conductivity, color, and weight
- Investigate how various engineering materials interact with cutting tools
- Relate the size and speed of cutting tool to material properties
- Identify and analyze the structural forces of compression, tension, torsion, and shear
- Describe the difference between static vs. dynamic loading
- Assemble structures with geometric shapes and conclude which is the strongest
- Collect thermal transfer data and relate data to insulation qualities

Electrical and Energy Systems

- Relate concept of current flow to potential difference
- Relate concept of current flow to resistance
- Describe the atomic structure of electrical insulators and conductors
- Complete activities to investigate the conversion of electrical energy to heat energy
- Observe and identify electrical energy and its relationship to work
- Observe and record the effects of magnetism on various materials
- Describe the domain theory of magnetism
- Complete an activity to verify the inverse-square law of magnetism
- Produce static electricity from mechanical/frictional means

- Describe the Law of Charges after static electricity experiments
- Produce electricity from heat, pressure, light, and electromagnetic induction
- Relate the structure of piezoelectric crystals and their ability to produce electricity
- Describe how a thermocouple produces electrical potential
- Relate n-type and p-type semiconductor materials to their photovoltaic properties
- Produce electricity from chemical action of dissimilar materials and electrolyte
- Collect test data to verify the characteristics between the types of Electrical circuits
- Investigate and describe the operation of electrical and electronic components
- Test circuits and make calculations to investigate the relationship between current, potential, power, and resistance via Ohm's Law, Kirchoff's Law, and Watt's Law
- Analyze electrical and electronic waveforms in terms of time and signal intensity
- Analyze waveforms in terms of their ability to communicate information
- Experiment to verify the dispersion and directional nature of various frequencies
- Test range of hearing of humans with an audio frequency oscillator
- Relate operation of oscillator circuits to waveform propagation
- Relate concept of wave resonance to the processes of signal tuning and rejection
- Relate properties of semiconductor materials to operation of integrated circuits
- Relate optical principles to production of integrated circuit chips
- Relate optical principles to the function of fiber optics
- Relate the active medium of a laser to its light output
- Describe how a laser produces light
- Investigate the properties of laser light (convergence, monochromaticity, intensity) and relate them to technological applications of measurement, holography
- Compare the ground tracks of geostationary and polar satellite orbits
- Relate satellite orbits to their respective signal footprints
- Investigate the effects of center of gravity and center of pressure on aircraft stability
- Relate airfoil function to Bernoulli's Principle
- Relate angle of attack, thrust, and drag to aerodynamic performance
- Relate navigation principles to the components of vectors
- Identify each of the simple machines and provide an example of each
- Analyze a complex machine in terms of its constituent simple machines
- Trace the path of force transfer through simple and compound machines
- Calculate mechanical advantages of mechanical systems
- Incorporate concepts of mechanical advantages into mechanical system designs
- Determine power and torque values from engine tests
- Plot power and torque curves from engine tests
- Relate the heat content of various fuels to their respective power output
- Describe the operation of internal and external combustion heat engines
- Describe conversion of forces and motions by engine and power-transfer systems
- Produce a device that operates using a renewable/alternative energy source

Graphic Communications

- Relate optical characteristics of the human eye to how 3D graphics are interpreted
- Observe, measure, and apply analog and digital signals in communication systems
- Locate/discern geographical areas by the use of bearing angle and coordinates
- Conceptualize of "scale" versus "proportion"
- Coordinate and calculate production time and data storage requirements
- Use image processing software to derive information and data from:
 - medical, biological, geological, forensic, and geographical images
- Make ergonomic measurements of products and places
- Extract geographical and geological information from remote sensing images
- Relate scale distances to geographical features

Construction Systems

- Investigate the structural stability of triangles related to truss and frame construction
- Relate the actions of cutting tools to properties of various building materials
- Relate the bonding of adhesives to the properties of a variety of substrates
- Relate the design of various types of joinery to structural stability
- Relate hydraulic principles to plumbing system assembly
- Assemble identify the various types of electrical circuits

Manufacturing Systems

- Explore various types of materials and their physical properties
- Compare how thermo conductivity of various materials relates to weld ability
- Relate the difference between intensity of heat and quantity of heat
- Process materials to compare applications of cohesion and adhesion
- Process materials to investigate altering properties by thermal and chemical means
- Describe the chemical production of acetylene gas
- Describe the production of oxygen and other industrial gases from liquid air process
- Chemistry of the oxy-acetylene flame; its chemical reaction and its characteristics
- Relate oxidation reactions and their relationship with cutting and with weld quality
- Relate capillary action and its effect on weld strength
- Relate chemical reactions that affect scavenging action of welding fluxes
- Investigate current flow/welding heat/weld fluidity relationships
- Compare molten weld puddle action with various arc welder current waveforms
- Relate eye safety practices to the wavelength of arc light and flame light
- Test for changes in metallic structure due to heating and cooling effects
- Relate the flow rates of gases related to orifice size and pressures
- Describe the difference between ionic, covalent, and metallic bonding

- Relate the properties of materials to their type of bonds and atomic structure
- Identify common engineering materials by analyzing physical properties
- Properly apply engineering materials to products and designs by analyzing physical properties of the materials
- Research engineering materials databases for needed technical data
- Relate material properties to the methods selected to process the materials
- Process a wide variety of materials to become familiar with their behavior
- Collect material testing data to arrive at application decisions
- Relate structural forces and stability to the processing of fiber composite structures

Principles of Engineering

- Solid works testing and analysis
- Describe the differences between science and technology
- Describe the differences between the scientific and technological method
- Identify the scientific principles and the technological principles present in a design
- Physical properties engineering materials
- Properties of engineering materials and their effects on tool interactions
- Identify the structural forces of compression, tension, torsion, and shear
- Analyze a frame structure in terms of its structural forces
 - predict action, reaction, and failure due to structural forces
- List the components of a force vector
- Graphically and mathematically solve force vector systems to assist in design
- Design a structure using force analysis as a design tool
- Describe the difference between static and dynamic loading
- Identify each of the simple machines and provide an example of each
- Analyze a complex machine in terms of its constituent simple machines
- Trace the path of force transfer through simple and compound machines
- Calculate mechanical advantages of mechanical systems
- Apply principles of Pascal's Law to distribution of forces in pneumatic systems
- Describe the difference between ionic, covalent, and metallic bonding
- Relate the properties of materials to their type of bonds and atomic structure
- Identify common engineering materials by analyzing physical properties
- Properly apply engineering materials to products and designs by analyzing physical properties of the materials
- Research engineering materials databases for needed technical data
- Relate material properties to the methods selected to process the materials process a wide variety of materials to become familiar with their behavior in use
- Collect material testing data to arrive at application decisions examine weathered materials to observe physical changes in the materials
- Predict effects of weathering on materials; compare test results to prediction
- Use computer modeling and simulation to investigate heat loss and insulation effects

- Relate concepts of current, voltage, and resistance to electrical circuits
- Relate electrical concepts to digital logic circuit applications
- Collect anthropometric data and relate human body measurements to ergonomics
- Design an ergonomic product using anthropometric measurements as a basis
relate the structural and mechanical principles to the structure of the human body