2007 Mississippi Curriculum Framework

Secondary Technology Applications

(Program CIP: 21.0101 – Technology Applications)

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Standards in this document are based on information from the following organizations:

International Technology Education Association STL Content Standards	Reproduced with permission of the International Technology Education Association
Academic Standards	Mississippi Department of Education Subject Area Testing Program
21st Century Skills	Reproduced with permission of the Partnership for 21st Century Skills. Further information may be found at www.21stcenturyskills.org

Preface

Secondary Technology Applications Research Synopsis

Articles, books, Web sites, and other materials listed at the end of each unit were considered during the revision process. These references are suggested for use by instructors and students during the study of the topics outlined.

Industry advisory team members from schools throughout the state were asked to give input related to changes to be made to the curriculum framework. Specific comments related to soft skills needed in this program included an understanding of 21st Century Skills, a solid foundation in basic science and mathematical skills, a solid foundation in using the writing process to produce a piece of writing, and being able to read and comprehend information. Occupation-specific skills stated included learning Computer Aided Drafting and Design.

Curriculum

The following state/national standards were referenced in each course of the curriculum.

- *Mississippi Department of Education Subject Area Testing Program Academic Standards*
- *21st Century Skills*
- *International Technology Education Association STL Content Standards*

Industry and instructor comments, along with current research, were considered by the curriculum revision team during the revision process; and changes were made as needed and appropriate. Many of the skills and topics noted in the research were already included in the curriculum framework. Specific changes made to the curriculum at the April 5–7, 2006, curriculum revision meeting included:

- Competencies and objectives were reviewed to ensure accuracy and appropriateness.
- A 21st Century Skills Unit that emphasizes teambuilding skills, conflict resolution skills, interpersonal skills, and leadership skills was added.
- The Recommended Tools and Equipment list was updated.

Assessment

Students will be assessed using the *Technology Applications MS-CPAS2 Test*.

Professional Learning

It is suggested that instructors participate in professional learning related to the following concepts:

- 21st Century Skills
- How to integrate the Blackboard Learning System® into instruction
- Using the Rigor and Relevance Framework
- Integrating reading and writing into teaching and assessment strategies
- How to use the program Technology Applications B.R.I.D.G.E. site on Blackboard®
- Differentiated instruction – To learn more about differentiated instruction, please go to http://www.paec.org/teacher2teacher/additional_subjects.html and click on Differentiated Instruction. Work through this online course and review the additional resources.

Foreword

Secondary vocational-technical education programs in Mississippi are faced with many challenges resulting from sweeping educational reforms at the national and state levels. Schools and teachers are increasingly being held accountable for providing true learning activities to every student in the classroom. This accountability is measured through increased requirements for mastery and attainment of competency as documented through both formative and summative assessments.

The courses in this document reflect the statutory requirements as found in Section 37-3-49, Mississippi Code of 1972, as amended (Section 37-3-46). In addition, this curriculum reflects guidelines imposed by federal and state mandates (Laws, 1988, ch. 487, §14; Laws, 1991, ch. 423, §1; Laws, 1992, ch. 519, §4 eff. from and after July 1, 1992; Carl D. Perkins Vocational Education Act III, 1998; and No Child Left Behind Act of 2001).

Each secondary vocational-technical course consists of a series of instructional units which focus on a common theme. All units have been written using a common format which includes the following components:

- Unit Number and Title
- Suggested Time on Task - An estimated number of clock hours of instruction that should be required to teach the competencies and objectives of the unit. A minimum of 140 hours of instruction is required for each Carnegie unit credit. The curriculum framework should account for approximately 75-80 percent of the time in the course.
- Competencies and Suggested Objectives
  - A competency represents a general concept or performance that students are expected to master as a requirement for satisfactorily completing a unit. Students will be expected to receive instruction on all competencies.
  - The suggested objectives represent the enabling and supporting knowledge and performances that will indicate mastery of the competency at the course level.
- Suggested Teaching Strategies - This section of each unit indicates strategies that can be used to enable students to master each competency. Emphasis has been placed on strategies which reflect active learning methodologies. Teachers should feel free to modify or enhance these suggestions based on needs of their students and resources available in order to provide optimum learning experiences for their students.
- Suggested Assessment Strategies - This section indicates strategies that can be used to measure student mastery. Examples of suggested strategies could include rubrics, class participation, reflection, and journaling. Again, teachers should feel free to modify or enhance these suggested assessment strategies based on local needs and resources.

- Integrated Academic Topics, Workplace Skills, Technology Standards, and Occupational Standards - This section identifies related academic topics as required in the Subject Area Assessment Program (SATP) in Algebra I, Biology I, English II, and U. S. History from 1877, which are integrated into the content of the unit. It also identifies the 21st Century Skills, which were developed by the Partnership for 21st Century Skills, a group of business and education organizations concerned about the gap between the knowledge and skills learned in school and those needed in communities and the workplace. A portion of the 21st Century Skills addresses learning skills needed in the 21st century, including information and communication skills, thinking and problem-solving skills, and interpersonal and self-directional skills. The need for these types of skills has been recognized for some time and the 21st Century Skills are adapted in part from the 1991 report from the U.S. Secretary of Labor's Commission on Achieving Necessary Skills (SCANS). Another important aspect of learning and working in the 21st century involves technology skills, and the International Society for Technology in Education, developers of the National Educational Technology Standards (NETS), were strategic partners in the Partnership for 21st Century Skills.
- References - A list of suggested references is provided for each unit. The list includes some of the primary instructional resources that may be used to teach the competencies and suggested objectives. Again, these resources are suggested and the list may be modified or enhanced based on needs and abilities of students and on available resources.

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Program Description

Technology Applications is a program in "pre-engineering" for high school students. Successful completion of Algebra I and an overall C average is a prerequisite for enrollment in this program. The purpose of the program is to provide students with expanded knowledge of the use of technological skills and to enable them to solve problems by applying knowledge in a technological context. The program is designed to provide students with "hands-on" experiences related to the application of technology education and engineering concepts in the workplace. Students will develop academic and technical skills, 21st Century skills, and human relations competencies which accompany technical skills for job success and life-long learning. Students who complete the program will be better prepared to enter and succeed in engineering programs offered by Mississippi community and junior colleges and institutions of higher education.

Industry standards referenced are from the *International Technology Education Association STL Content Standards*.

COURSE GOALS

1. Develop Science, Technology, Engineering, and Mathematical (STEM) skills.
2. Improve recruitment among students into science, technology, engineering and mathematics fields.
3. Utilize technological systems to solve problems related to predictable and unpredictable, real-world situations.
4. Establish a comprehensive course that includes academic competencies, career and technical topics, the International Technology Education Association (ITEA) standards, and 21st Century Skills.
5. Implement a state of the art, secondary pre-engineering program.

Course Outline

Technology Applications I
Course CIP Code: 48.0202

Course Description: Technology Applications I is a course designed to introduce students to Science, Technology, Engineering, and Mathematical concepts. Problems will be solved using 21st Century, technology, academic, and investigative skills. Applications of science, technology engineering, and mathematics will be demonstrated in technical communication technology, computer aided design and drafting technology, manufacturing (CAD/CAM) technology, fluid systems technology, thermal systems technology, electrical systems technology, and mechanical systems technology. (2-2½ Carnegie Units, depending upon time spent in the course)

Unit	Title	Hours
1	Orientation and Safety	5
2	Preparing for a 21st Century Workforce	15
3	Introduction to Science, Technology, Engineering, and Mathematics	15
4	The Design Process	10
5	Technical Communication	25
6	Computer Aided Design and Drafting (CADD)	25
7	Manufacturing (CAD/CAM) Technology	25
8	Fluid Systems Technology	25
9	Thermal Systems Technology	25
10	Electrical Systems Technology	25
11	Mechanical Systems Technology	25

Technology Applications II
Course CIP Code: 48.0203

Course Description: Technology Applications II will permit second year students to expand and deepen their knowledge related to Science, Technology, Engineering, and Mathematics skills. Students will apply concepts related to computer assembly technology, computer networking technology, computer programming technology, geographic information systems technology, programmable logic control technology, electronic control systems technology, and computer integrated manufacturing technology. (2-2½ Carnegie Units, depending upon time spent in the course)

Unit	Title	Hours
1	Orientation & Safety Review	3
2	Computer Assembly Technology	25
3	Computer Networking Technology	25
4	Computer Programming Technology	25
5	Geographic Information Systems (GIS) Technology	25
6	Programming Logic Control	10
7	Electronic Control Systems Technology	25
8	Computer Integrated Manufacturing Technology	60
9	Directed Individual Project	22

Technology Applications I
Unit 1: Orientation and Safety **(5 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify course expectations, school policies, and program policies related to Technology Applications. a. Give a brief overview of the course. Explain to students what Technology Applications is, why it is important, and how it will be delivered. b. Preview the school handbook, the technology acceptable use policy, and all other safety procedures for the classroom and building level. c. Preview course objectives, program policy, and the ITEA standards.	**Teaching:** • Cover one or more bulletin boards with paper and trim. Leave it bare and tell students that this is where their high-quality work will be displayed. • Display the classroom discipline plan, procedures, calendar, and emergency information, etc. in a prominent place. Review these important documents with students. Make sure students understand the proper emergency procedures. • Post examples of tests students will complete; assignments they will turn in; and projects students will complete throughout the year. Allow students to review these samples and ask questions. • Designate one area of the classroom to list daily objectives and weekly assignments and/or expectations of students. Encourage students to write the weekly assignments in their Technology Applications notebook/portfolio. • Using guided prompts, have students write a reflection describing their history, experience, and feelings about using technology. Sample prompts can include: o What is technology? o When was the first time you used a computer? o Do you use the Internet? If so, how do you use it? o What is the one kind of technology you could not live without? o What would life be like without technology? • Have students write a journal entry about the following topic: o Describe in detail a normal day without technology. • Have students write a 2nd journal entry about the following topic: o You are the world's richest

	man/woman. You have any and all types of technology at your disposal. What would a normal day be like? • Using presentation equipment, provide the course goals, objectives, ITEA standards, and student expectations. • Using a multimedia presentation, discuss the school handbook, the technology acceptable use policy, classroom procedures, and all safety procedures for the classroom level and building level. • Read and discuss with students the school acceptable use policy. Have students and parents sign a district approved Technology Acceptable Use Policy. • Discuss the course objectives, program policies, etc. • Discuss classroom rules and procedures. Have students use a graphic organizer, such as a Venn Diagram, to compare and contract the classroom/school rules and workplace skills. • Create a separate directory for student assignment and a resource notebook at each computer station. Teachers will share this information with students and make sure they know how to use the directories and notebooks. • Have students complete a pretest on technology literacy skills; Science, Technology, Engineering, and Mathematics; 21st Century Skills and Information and Communication Technologies; and Career Pathways to determine what current knowledge they have in these areas. • Have students interview 3 engineers or other professionals related to the course and determine how Science, Technology, Engineering, and Math work together to enhance every day life in their community, state, nationally, and globally. • Using bulletin board paper, construction papers, and tape, have students work in collaborative groups to create a classroom bar chart of the quantitative data they

	received for their engineer interviews. Allow students to discuss their findings and expectations for the course. • As an extension, have students input data into a spreadsheet application program. Have student create graphs and charts related to the data. Have students integrate the graphs and charts into a word processing or a multimedia presentation program and use the writing process to summarize their findings. **Assessment:** • Provide teacher assessment according to local policy. • Evaluate with a checklist for interviews and group project using the Group Participation Assessment Rubric located in Appendix D.
2. Demonstrate proper use and care for laboratory equipment related to the Technology Applications laboratory (ongoing). a. Identify and describe the use of safety equipment and other safety precautions in the laboratory. b. Describe operating procedures for the course including the roles and responsibilities of teachers and students in a modular instructional laboratory. c. Introduce the modular workstations and the instructional resources provided in the Technology Applications laboratory. d. Compare and contrast safety issues in the Technology Applications classroom to safety issues related to career fields in science, technology, and engineering.	**Teaching:** • Invite a local engineer to be a guest speaker and discuss workplace safety issues and how it impacts the business/industry economically. Use a multimedia presentation, safety videos, the Internet, or the marker board to provide a few examples of safety hazards and lead a class discussion on prevention and/or solutions. • Have students use the writing process to develop three safety hazards or violations that might occur in the workplace and describe solutions. • Have students work in teams to use the Internet to locate and print safety data sheets related to technology, science, engineering, and mathematics. Have student teams create a graphic organizer; a multimedia presentation using graphics and charts; a song or cheer; or a role play to present their research to the class. • Provide students with case studies or scenarios which describe various safety violations and situations related to the use of resources in the laboratory. Students will work in teams of three or four to analyze the case studies or scenarios,

	applying the appropriate rules and procedures and developing ways to prevent workplace hazards. • At the end of the unit, divide students into teams. Make sure teams have members with different learning styles. Give each member of a team a different candy bar and have the team work together to create a paragraph describing key points related to safety in the Technology Applications laboratory. An example for this might be: "If you want to reach PayDay®, you need to turn all Butterfinger® moves into Smarties® with safety in mind." **Assessment:** • Have students complete a written safety test at 100% success rate. On the written safety test, provide a case study or scenario for students to analyze. File the completed test to document student mastery of safety rules. • Monitor students as they work together on the case studies. • Have students use a peer evaluation rubric or checklist to evaluate other teams as they present their research about safety issues related to science, technology, engineering, and mathematics using the Group Presentation Rubric located in Appendix D. • Monitor and reinforce student safety habits throughout the year.

STANDARDS

ITEA Standards

Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationship among technologies and the connection between technology and other fields of study.
Standard 4	Students will develop and understanding of the cultural, social, economic, and political effects of technology.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
H3 Describe the relationship of people, places, and environments through time.

21st Century Skills

CS1 Global Awareness
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

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Technology Applications I
Unit 2: Preparing for a 21st Century Workforce **(15 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Explore personality development and the classroom environment in relation to interpersonal skills, others, and the world of work. a. Identify forces that shape personality development including personality traits, heredity, and environment. b. Complete a learning style inventory. c. Develop a report on how personality traits affect teamwork and leadership skills. d. Write an autobiography.	• Have students research the different types of personality traits (definitions, Gordon Allport: Father of personality theory, Cattell's 16 personality factors, Three personality super traits: Hans Eysenck, The big Five Personality factors, etc.). Once students learn about personalities, have students complete a learning styles inventory. • Gather a collection of different shoes that represent different walks of life. You might borrow shoes from family, friends, or neighbors. Make sure there is a pair of shoes for each student. Ask students to pick one pair of shoes. • Place this quote on the board, "You never really understand a person until you consider things from his point of view… until you climb into his skin and walk around in it." Ask students to consider what the quotation means – what is the speaker trying to explain? What does the speaker mean by the term *point of view*? How does perspective view come into working in teams? • Ask students to privately brainstorm details of their first impressions of the shoes in their notebooks. Ask students to examine the shoes in more detail and envision the owner of the shoes and answer the following questions (ask students to be creative): o Describe the shoe that you're using for this activity. o Give the owner's first, middle, and last name. o How old is the owner? o What does the owner look like (be very descriptive)? o What does the owner do for a living? o Where does the owner live and with whom?

	o List three personality traits of the owner. o What does the owner do in his or her spare time? o What is the owner's favorite food, book, or movie? o Name one bad habit that the owner has? o How do other people feel about the owner? o Name an accomplishment that the owner has made that few people know about. o Could you work with the owner of these shoes? Why or why not? o How is your personality like the personality of the owner? How is it different? • Ask for volunteers to share their answers. Have students discuss the importance of understanding different personality and learning styles to effectively work in a team setting. • Have students use the writing process to write a summary report about their previous knowledge, personality skills, and learning styles. Require students to include a section in the summary report that gives the teacher tips on how to individualize instruction to fit their personality and learning style. Have students identify the purpose and audience for this activity. Also, have students include their understanding of how to effectively work with different personalities and learning styles in a team environment. • Prepare an anticipation guide for the book *7 Habits of Highly Effective Teens* or *7 Habits of Highly Effective People*. Sample questions may include: o Looking at the cover, what do you think this book is about? o What do you already know about the book? o What do you expect to learn from reading this book?

	○ How do you think the content of this book will help you throughout this course, college, and life? • Assign students to read one to two chapters per week until the book is complete. Present the first chapter to students. Each week, assign all students chapters to read. Divide students into groups using the results of the learning styles inventory to present a chapter to the whole class. As a part of their presentation, have students select terminology to teach the class. Have students use a peer and self evaluation for each chapter presentation. As a part of the evaluation, have students address individual and group strengths and weaknesses, group dynamic structures, and personality traits. **Assessment:** • Use the Written Report Writing Rubric located in Appendix D to grade the written summary report for organization, audience, and voice. • Have a written, weekly spelling, and terminology test related to the book.
2. Develop leadership skills. a. Describe the qualities of an effective leader including positive attitude, image, decision making, communication skills, and knowledge. b. Identify opportunities in the local community that develop leadership skills. c. Dramatize effective leadership skills. d. Practice effective leadership skills. e. Prepare a project management methodology and use it consistently.	**Teaching:** • Read the following scenario to your students: ○ Passengers are free to do a lot of things the driver cannot do. As a driver, your focus needs to be on the road and not on the distractions. As a driver, you no longer have the right to "mess around" – like listening to music – even though it seems okay to do that as a passenger. The same principle applies when you become a leader. You are no longer a passenger; you become the driver. Even though your responsibilities increase when you become a leader, you lose some of the rights or freedom you may have enjoyed in the past. For instance, if you want to be successful as a leader, you don't have the right to join employee pity partiers and talk about your upper

	school/district administration. You lose the right to blame others for a problem in your center when you are a leader. You are the person responsible for everything that happens in your center, and that can be pretty hard to swallow. What type of driver are you? • Have students use technology productivity tools, the writing process, and graphics to describe the type of "driver" they see themselves as. • Find two or three journal or internet articles that have information related to different leadership styles, the importance of positive attitudes, decision making skills, and communication skills, etc. Divide students into home-base groups of three to five members depending on the number of texts to be read. Assign each student to a base group and a section of the article(s) to read (10 to 15 minutes of independent reading). Have students who have read the same section form small expert groups to discuss key aspects from their portion of the article (15 – 20 minutes). Have student experts return to their base groups and invite each person to share the key points from their reading and discussion with others of the group (20 – 30 minutes). Then, facilitate a large group discussion identifying key concepts from the information that was read. • Have students brainstorm to identify local community activities that provide leadership opportunities. Also, have students research and join different student organizations, such as the Technology Student Association and Mississippi Technology Teens. • Have students work in groups to research, write, and present a dramatization about world leaders that they will study in their History classes. Their script and dramatization should highlight their world leaders' leadership qualities including positive attitude, image, decision making,

	communication skills, and knowledge. • Have students use electronic sources, textbooks, and research articles to develop a strong understanding of project management. • Lead a class discussion about the project manager's role, the importance of planning projects, good and bad organizational structures and how project management will impact their success in class and the world of work. • Have students work individually to develop a project management philosophy and methodology. Throughout the year, assign "project managers" on group projects. Allow that student to implement their project management methodology and reflect upon the process. • As an extension, allow students to select an autobiography of a leader that they respect and admire. Have students read the autobiography and develop a presentation about their leader. Allow students to select their presentation media. Students can present their information via a bulletin board display, multimedia presentation, newsletter, newspaper article, etc. **Assessment:** • Monitor participation in class discussion. • Give a written test that incorporates personality skills, learning style, and leadership skills. • Use the Dramatization Teacher Evaluation Rubric and the Dramatization Peer Evaluation Rubric located in Appendix D to evaluate the world leader project. • Evaluate the presentation of an autobiography using a checklist or rubric.
3. Exercise sound reasoning in understanding and making complex choices about working in teams. a. Demonstrate an appreciation and respect for diversity. b. Apply the components of good teamwork including team dynamics, status of team growth, and working	**Teaching:** • Divide students into groups with a set of index cards. Students will use the index cards to create the tallest tower without using verbal communications. • Lead students in listing and evaluating effective and ineffective teamwork skills. • Have students return to their groups to read

through team problems. c. Apply conflict resolution skills	the "Three's a Crowd" case study. Have students discuss and come to a solution to each of the questions listed below the case study. • Teams will use the writing process to report their solutions by writing a newspaper article. The article will retell the story and explain the solutions to the projected audience. **Assessment:** • Monitor classroom participation. • Use the self evaluation rubric to evaluate newspaper article. • Use the Newspaper Article Rubric located in Appendix D to evaluate the newspaper article for grammar and content.
4. Apply appropriate skills and techniques for resolving conflict among peers. a. Learn technical terms related to conflict resolution. b. Introduce problem solving procedures. c. Practice resolving conflict.	**Teaching:** • Find a soft ball. Have the class stand in a circle. Select one student to begin by completing the sentence, "I feel angry when ..." Ask for a volunteer who is willing to restate what they just said. Toss that student the ball. That student restates what you said, then completes the sentence for himself/herself. He/she then tosses the ball to someone else, which repeats what she said, then completes the sentence for himself/herself, and so on. • Use a multimedia presentation to explain terminology related to conflict resolution (for example, communicate, negotiate, mediate, arbitrate, litigate, legislate). Explain that when there is a conflict, there is a problem. When trying to resolve conflicts, it helps to have a way to think about the problem and to attempt to solve it. Place the following steps on the board or create a multimedia presentation slide that displays them: o Define the problem. o Brainstorm solutions. o Choose a solution and act on it. • Go over each step with the class. Point out that before the problem solving begins; the people in the conflict have to agree to work it out. In order for problem solving to

	work, they have to agree to really try to work it out, and not yell or call names. Emphasize that in step two they want to come up with many possible solutions as they can. In step three, they want to choose a win-win solution. Encourage students to define problems in a way that does not affix blame. • Divide students into groups based on their learning style. Have each group create and act out a skit that presents a conflict with a co-worker or peer. When each group is finished, have the class brainstorm solutions to the conflict. When the class decides which solution is best, have the actors act it out. • Once the skits have been performed, conduct a class discussion using the following probes: o What makes the conflicts in the skits escalate? o What words can people say to indicate that they want to stop the fight and try to solve the problem? o Have you ever had a conflict like this one? How did you resolve it? • Have students write a reflective journal discussing a time that they had a problem and used effective conflict resolution skills to solve it. • Throughout the year, have students read and discuss Project Management and conflict resolution case studies. **Assessment:** • Use a written spelling and vocabulary test to evaluate vocabulary terminology. • Use a classroom participation rubric to evaluate skits. • Use the Reflective Journal Rubric located in Appendix D to evaluate reflective journal discussions.
5. Develop effective written, oral, and nonverbal communication skills. a. Define effective written, oral, and nonverbal communication skills. b. Identify the impact of effective	**Teaching:** • Tell students to imagine that a new book has just been written about them. It is titled, "(Student name): Star Communicator." Allow each student to

communication. c. Analyze personal strengths/weaknesses in communication. d. Develop a plan to improve written, oral, and nonverbal communication.	select a piece of construction paper. Ask student to fold their piece of construction paper to look like a hardback book cover, with a front, back, spine, front inside flap, and back inside flap. Have each student create cover art for their front cover and spine. On the back cover, ask students to write a few promotional reviews, such as those seen on many books. In these reviews, state why this book and the student are so fabulous at written, oral, and nonverbal communication. Give students about fifteen minutes to complete this activity. • Ask students to pair up with someone in the class that they usually do not sit with. Ask pairs to share the contents of the book jackets with each other, explaining the meaning behind the quotes and what they expect readers to gain from reading their book. Explain that, after five minutes, they will have to introduce one another to the class. Give students five minutes to share information. • Tell students that it is now time to introduce all of the communication stars that will be appearing on today's episode of "Oprah's Book Club." Have students pretend they are Oprah and give a brief introduction of their partner, using the information they have learned about him/her. Encourage students to remember that they want to get the audience pumped up about this marvelous guest! • Divide students into four groups. Assign each group an article related to effective communication skills (nonverbal, verbal, written, body language, etc.). Give each group a set of markers and chart/bulletin board paper. Have each group read their article and present the information to the class using the markers and chart/bulletin board paper. Ask students not to use works, but to use pictures on their chart/bulletin board paper. Have students work as a whole group to create a single

	list combining elements from all of the articles. • Based on the information from the articles, have students create a survey that evaluates their communication skills. Ask students to use the survey to evaluate their personal communication skills. Ask students to give the survey to peers, family members, and teachers. Have students input data into a spreadsheet application program. Have students compare and contrast their personal evaluation to the evaluation from peers, family members, and teachers. • Have students develop a plan to improve written, oral, and nonverbal communication skills. **Assessment:** • Evaluate students using a classroom participation checklist. • Evaluate improvement plan for grammar and content.
6. Utilize effective time management techniques. a. Understand the purpose and process of developing a semester, weekly, and daily calendar. b. Set semester, weekly, and daily priorities. c. Create semester, weekly, and daily calendars.	**Teaching** • Have the word "priority" listed on the board or on a multimedia presentation slide. Ask students to give their definition of priority. Ask students to list their priorities. • Explain to students that scheduling and managing time wisely are important for students and employees. If an important appointment and/or deadline is missed, if feelings of anxiety, frustration, and guilt occur. • Explain to students that before they manage their time, they need a better understanding of how they use their time. Have students calculate time available to study and study time required for each course by using the Time Management Formula and the Study Hour Formula activities. Have students convert their findings into percentages and plug values into a pie chart using the tools in a spreadsheet application program or other software program. Have students measure

	the angles of the pie chart using a protractor. • Have students use a word processing program to create a school calendar. Have students use this calendar for the remaining school year as a time management tool. Have the students record: o Weekly, semester, and yearly goals related to personal and academic projects. o Projects, homework, tests and other dates (for all classes) in calendar/planner with a self-developed color coding/organization system. o All other events (academic, extra-curricular, personal, social) should be recorded for time management. • Discuss the importance of the daily To-Do list that should be completed at the end of day for the next day's activities and the concept of procrastination. Have students share their own battles about procrastination and the impact it had on them. • Display the type of notebook and organization of the notebook or electronic portfolio required for the course. Provide teacher-made checklist of all the necessary notebook or electronic portfolio elements. • Have students use the internet to research "Tips for Saving Time." Have students create a brochure or newsletter for middle school students with this information. **Assessment:** • Use the Calendar/Planner and Notebook Checklist. • Assess the Time Management Calculation Activity. • Use the Student Brochure Rubric located in Appendix D to evaluate the brochure or newsletter for ideas, organization, and voice.

STANDARDS

ITEA Standards

Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.

Academic Standards

E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and
E5	Complete oral and written presentations which exhibit interaction and consensus within a group.
E8	Read, discuss, analyze, and evaluate literature from various genres and other written material.
E10	Use language and critical thinking strategies to serve as tools for learning.

21st Century Skills

CS4	Information and Communication Skills
CS5	Thinking and Problem-Solving Skills
CS6	Interpersonal and Self-Directional Skills

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Technology Applications I
Unit 3: Introduction to Science, Technology, Engineering, and Mathematics (15 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Use the scientific method to identify the components, characteristics, and scope of mathematics, science, technology, and engineering. a. Utilize the components, characteristics, and scope of science and technology (make the science and technology relevant to students). b. Observe a problem related to mathematics, science, technology, and engineering. c. Gather data and information about the problem. d. Form a hypothesis based upon the information and data. e. Design an experiment to test the hypothesis. f. Collect data from the experimentation. g. Analyze the data. h. Form conclusions or inferences based upon the data. i. Communicate the results via publications and presentations.	**Teaching:** • Have students complete a KWL chart regarding information related to the scientific method. • Ask students to raise their hands if they use or depend on the following: o Computer chips used in personal computers (video games) o Golf, Tennis, Archery (graphite epoxy materials) o CDs or DVDs o Automatic doors (for example, shopping centers, garage doors, etc.) • If students raised their hands, tell them that they depend on unique tools and measurements related to science, technology, engineering, and mathematics. • Have students refer back to the KWL chart and add information to any of the columns. • Have students write their thoughts about the scientific method or inquiry. • Ask students if they have any idea where the scientific method originated. Explain to students that the idea originated from Greek and Latin. Have students use the Internet to research more about the origination of the Scientific method. • Gather items that are oddly shaped and that may be difficult for students to identify. Place items on students' desks prior to their arrival to class. When students arrive, instruct them to write as much as they can to describe the object that they have on their desk. When finished, ask students to fold the paper into quarters and turn in their descriptions. Take the papers and hand them out at random. Students must wonder around and try to match the description to the object. Discuss with students the importance of observations when implementing the scientific method.

	• Use a multimedia presentation or a Web quest to teach students basic components of the scientific method. • Divide students into four groups. Give each group a scenario from the Identify Controls and Variables Activity. Have groups read the scenario, analyze the information, answer questions regarding the information, and present their information to the class. • Have students work individually to select a problem related to mathematics, science, technology, and engineering. • Have student gather data and research about the problem. • Have students form a hypothesis based on the information and data. • Have students design and experiment to test the hypothesis. • Have students collect, graph, and analyze the data. • Have students form conclusions or inferences based on the data. • Have students use the writing process to create a summary report and a multimedia presentation to communication the results. **Assessment:** • Use a presentation rubric or checklist to evaluate the presentation. • Use the Written Report Writing Rubric located in Appendix D to evaluate the written report.
2. Apply science, technology, engineering, and mathematical concepts to solve real-world problems related to science, technology, and engineering. a. Analyze general problem solving strategies. b. Develop critical thinking skills in solving problems. c. Utilize various aspects of "best" engineering solutions. d. Analyze moving objects and explain their motion in relation to Newton's Laws of Physics. e. Apply Newton's Laws of Physics as	**Teaching:** • Divide students into groups of three – five. Give students six blocks that are the same size (cardboard boxes, building blocks, etc.). Give students the following problem: o Arrange six blocks so that each block touches three-and only three-others. • Allow students to come up with a solution. One possible solution may be:  • Have groups share with the class the

they relate to problem solving strategies.	strategies that they use to solve the problem. • Compose five to eight charts that summarize problem solving strategies (http://www.une.edu.au/psychology/staff/malouff/problem.htm#clarify). Each chart should have content material, photographs, quotes from the text, or other means to convey one idea per chart. • Post the charts around the classroom and number each chart. Divide students into "touring groups" to fit the class space. • Assign one group per chart as a starting point. Allow groups to spend two to five minutes at that chart, take notes on, and/or discuss the ideas presented. • Rotate the groups until all groups have "toured" each chart. When students return to their seats, allow some time for discussion and reaction. • Have students define and illustrate terminology related to Newton's Laws of Motion. Terms can include, but are not limited to motion, inertia, force, mass, acceleration, friction, gravity, speed, and velocity. • Post the following statement in the classroom: o *Engineers need to learn how to apply the right solution at the right time in the right way for the right reason with the right customer.* • Lead a classroom discussion about the quote. • Have students select one problem solving strategy that appeals to them. Next, have students compare and contrast their problem solving strategy to the scientific method. • Write this law on the board and read it to students: o *1st Law of Motion: Objects in motion stay in motion, objects at rest stay at rest, until a force changes their speed or direction.* • Explain that this law can be demonstrated

	by a top. Distribute tops to all students. Have each student lay their tops on the table. Ask if the tops are at rest or in motion? (Answer: at rest) • Ask what is needed to make the tops move? (Answer: a force) • Ask students to apply a force to the top. Restate the 1st law, and then ask what should happen according to the first law. (Answer: Tops should stay moving forever) • As the tops begin to slow, ask the students what force is acting on the top? (Answer: Friction) • Ask students to predict what would happen if they could spin the tops in outer space? (Answer: The tops do not stop because friction is eliminated in space) • Write this law on the board and read it to students: o *2nd Law of Motion: Changes in motion are equal to the applied force and in the direction of the applied force. Mathematically described as Force = Mass x Acceleration.* • Have one student help with the Swinging Wonder Demonstrator. Have the student pull one steel marble back and hold it while you ask, "If one marble is dropped, predict what will happen to the other four marbles?" (Answer: Only one marble will move in the direction of the applied force. Continue predictions with 2, 3, and 4 marbles pulled back. • Write this law on the board and read it to students: o *3rd Law of Motion: For every action there is an equal and opposite reaction.* • Have one student drop a basketball and another drop a tennis ball. Ask why the ball bounces back? As the ball hits the floor with force, the floor pushes back with the same force in the opposite direction. Therefore, the ball bounces up. • Now, place the tennis ball on top of the

	basketball. Ask the students to predict, then observe and explain what happens in terms of Newton's Laws of Motion. Drop the combination. (Answer: The tennis ball is launched to the ceiling because it absorbs both the force of the floor pushing up on the basketball and the floor pushing up on the tennis ball.) • Divide students into groups of four or five. Assign a project manager for each group. Give each group a box containing the following: one car, two washers, two rubber bands, one balloon, and a PVC pipe elbow. • Ask students, "How can you make the car move with these materials?" Have them discuss the question within their groups. • Have students use problem solving strategies and information learned from Newton's Laws of Motion to achieve the following: o Design a car that can travel longer than other cars built by other groups in the class. o Design a car that can carry the greatest amount of weight the entire length of the track. Use a Hot Wheels Track for the cars to travel on and use washers to add weight to the cars. • Allow 15 – 20 minutes for the students to experiment with their car designs. After all groups have their cars running, as a review, discuss, and demonstrate Newton's Laws of Motion. **Assessment:** • Evaluate completed Web quest or online testing. • Evaluate term definitions and illustration project. • Evaluate the project with a checklist or rubric. • Evaluate group work using the Teamwork Rubric located in Appendix D. • Use a written test that contains case studies and questions about Newton's Laws of Motion.

3. Create a statistical analysis of different engineering fields, work experiences, and responsibilities. a. Compare and contrast the modern world of engineering and the ancient world of engineering. b. Research different engineering fields, job opportunities, salaries, licensure, degree requirements, and college programs of studies. c. Research safety issues related to the field of engineering. d. Present the statistical analysis.	**Teaching:** • Use the results from the learning style inventory to group students. Have students use the Internet (http://www.bls.gov/), Career Choices, and interviews from local engineers to research the questions listed below. Student results should include data from the past 30 – 50 years to present date. o How many people study engineering on a yearly basis? o What are their majors? o What is the job market for engineers like? o How much do engineers earn? o How many women and minorities are studying engineering? o How many practicing engineers are there in the U.S.? o How does that number compare to other countries? o What is the percentage of people who hold engineering degrees who are unemployed or in graduate school? o What do employers expect from engineers? o What types of technology do engineers use? • Have students compile this information into a spreadsheet application program and make predictions and give explanations about the following: o How many people will be studying engineering on a yearly basis in five years, 10 years, 20 years, 30 years, etc.? o What is the job market for engineers like? o How much do engineers earn in five years, 10 years, 20 years, 30 years, etc.? o How many women and minorities are studying engineering in five years, 10 years, 20 years, 30 years, etc.? o How many practicing engineers are there in the U.S. in five years, 10 years, 20 years, 30 years, etc.?

	○ How does that number compare to other countries in five years, 10 years, 20 years, 30 years, etc.? ○ What is the percentage of people who hold engineering degrees who are unemployed or in graduate school in five years, 10 years, 20 years, 30 years, etc.? ○ What factors do you think contribute to the fact that entry level engineering salaries are usually higher than any other major on campus? ○ What types of technology do engineers use? • Discuss the engineering licensure procedures in Mississippi and other states. Also, share information about the National Academy of Engineering (http://www.nae.edu/). • Have students use the writing process, a word processing application program, and a spreadsheet application to create an engineering recruitment public relations document (brochure, newsletter, Web site, etc.). **Assessment:** • Have students peer review document using a rubric. Allow students to make revisions to their document before submitting the final product. • Use a rubric such as the Student Brochure Rubric located in Appendix D to evaluate the final product.
4. Utilize proper measurement tools and attributes of objects, units, systems, and processes related to science, technology, engineering, and mathematics. a. Identify examples of measurable attributes for objects, units, systems, and processes. b. Summarize measurable attributes of objectives and the units, systems, and processes or measurement. c. Apply appropriate techniques, tools, and formulas to determine measurement.	**Teaching:** • Ask students the following question: ○ How good is your eye for measurement? • Give students the following scenario: ○ The distance from your nose to the outside of your finger tips is about one meter. Estimate the distance between you and three objects in the room. Have each member in the class make a data table and record their estimates. Have each student verify his or her estimation and compare it to the real

d. Calculate mass of objects. e. Convert units of the English system of measurement to the Standard International units. f. Convert units extensively (i.e., meters/sec. to min./hr. to cubic inches/day to liters/min.) g. Use technology to predict changes in measurement over time related to science, technology, mathematics, and engineering. h. Convert units of measurement from one system to another. i. Solve linear sets of equations for unknowns. j. Use measurement systems to solve problems.	measurement. • Lead a class discussion using the following prompts: o Were the estimates reasonably close? o Did one person consistently make accurate estimates? • Use a KWL chart to determine students' previous knowledge of measurement in the field of science, technology, engineering, and mathematics. Have students formulate ideas that they already know about each topic and that they want to learn about the topic. • Have students define and illustrate measurement terminology. • Hold up a meter stick and a yard stick and ask students which system is more accurate. To their surprise, neither system is more accurate. Remind students that certain industries in Mississippi, such as Nissan, Northrop Grumman, etc. use the English system. The value of the metric system is that it is easier to change from one metric measurement to another metric measurement. Have students practice converting measurements. • Have the following materials displayed on a table. o Inertial balance o 6 - C clamps o 3 beakers – 1000 ml, 500 ml, 100 ml o Very large sponge o Ball of string o 6 - Ring stands o Box of small washers o Small box of beads (or small box of sand) o Stop watches o Meter stick o Metric scale • Use the following process to demonstrate the concept of atoms and density: • Use the small beads to simulate atoms of matter in mass. Ask a class member to measure the mass of an empty 100 ml beaker and then again after it has been

	filled with beads. Ask another student to subtract the masses of the full beaker from that of the empty beaker and divide it into the mass. This procedure will be repeated for the 200 ml and 1000 ml beakers. Lead a class discussion about the demonstration and findings. • Divide the class into groups of four. Have students work in groups to find the density of all three beakers and compare them using technology productivity tools. Have students summarize their views on weight and mass and find references from the Internet that supports their position. • Use a string, four washers, ring stand, stopwatch, and meter stick, have each group construct and test a pendulum that has one washer for the pendulum bob and string for the pendulum arm. Have group members count the number of oscillations made by the pendulum in 30 seconds. Have students repeat this process by adding one washer at a time and counting the number of oscillations with up to four washers. • Have students use a spreadsheet application program to graph their findings or the number of oscillations made by the pendulum in 30 seconds. • Have students use research to determine similarities and differences between systems of measurement. Convert units of English system of measurement to Standard International units. Have students practice converting units of the English system of measurement to Standard International units. • Use a class lecture to demonstrate and discuss measurement units. Have students practice converting units extensively (i.e. meters/sec. to min./hr., cubic in./day to liters/min.). **Assessment:** • Monitor student participation in activities using the Group Participation Assessment Rubric located in Appendix D.

	• Evaluate completed assignments and converted measurements.
5. Utilize relevant chemical, mechanical, biological, electrical, and physical properties of material used in engineering projects. a. Define and identify examples of force, work, rate, resistance, energy, and power in mechanical, fluid, electrical, and thermal systems. b. Summarize the role of force, work, rate, resistance, energy, and power in mechanical, fluid, electrical, and thermal systems. c. Apply appropriate measurement techniques related to force, work, rate, resistance, energy, and power.	**Teaching:** • Divide students into six groups. Assign each group one of the following topics: o Force in mechanical, fluid, electrical, and thermal systems. o Work in mechanical, fluid, electrical, and thermal systems. o Rate in mechanical, fluid, electrical, and thermal systems. o Resistance in mechanical, fluid, electrical, and thermal systems. o Energy in mechanical, fluid, electrical, and thermal systems. o Power in mechanical, fluid, electrical, and thermal systems. • Have each group use the Internet and classroom resources to prepare a presentation that will teach their topic to the class. Require each group to have the following in their presentation: o A PowerPoint presentation related to their topic. o A "tips" sheet related to their topic. This sheet should have basic information related to their topic along with Internet and text references. o A "hands-on" lab activity related to their topic. o A list and graphical example of technologies used related to their topic. o Examples of measurement techniques related to their topic. o Applications of how their topic relates to medical technologies, agricultural and related biotechnologies, energy and power technologies, information and communication technologies, transportation technologies, manufacturing technologies, and construction technologies. **Assessment:** • Use the Group Presentation Assessment Rubric located in Appendix D to evaluate group presentation.

	• Give students a written test that will evaluate their knowledge of force, work, rate, resistance, energy, and power in mechanical, fluid, electrical, and thermal systems.

STANDARDS

ITEA Standards

Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A5	Utilize various formulas in problem-solving situations.
A6	Communicate using the language of algebra.
A7	Interpret and apply slope as a rate of change.
B1	Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4	Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.

E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.
H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

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Technology Applications I
Unit 4: The Design Process **(10 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Explain the components of the design process. a. Define the design process. b. Identify items that have been designed by engineers and items that have not been designed by engineers. c. Apply concepts of planning, design, building, testing, quality assurance, and customer needs. d. Conduct research, development, experimentation, and application. e. Practice invention and innovation. f. Summarize the design process.	**Teaching:** • Using a multimedia presentation, define all components of the design process. o Stage 1: Identify the problem/product innovation. o Stage 2: Define the working criteria/goals. o Stage 3: Research and gather data. o Stage 4: Brainstorm/generate creative ideas. o Stage 5: Analyze potential solutions. o Stage 6: Develop and test models. o Stage 7: Make the decision. o Stage 8: Communicate and specify. o Stage 9: Implement and commercialize. o Stage 10: Perform post-implementation review and assessment. • Have students work in groups to identify three items designed by engineers. Have students investigate the following: o What did these items do that was new and innovative at the time of their creation? o What items did these new creations replace? o How is the world a better place because of these designs? • Have groups identify three items that they suspect were not developed by engineers. Have students write or discuss how these items differ from those designed by engineers. • As an independent assignment, have students compare the engineering design process to one of the following processes: o Making the family dinner o Creating new laws o Treating illness in a patient • Have students be specific about each stage of the design process. Have students use the writing process and a word processing

	application program or multimedia presentation program summarize each stage of the process. **Assessment:** • Monitor classroom participation. • Use the Compare and Contrast Summary Rubric located in Appendix D to evaluate the summary.
2. Apply the components of the design process. a. Identify components of the design process.	**Teaching:** • Divide students into groups based on their learning style. • Have groups disassemble one of the devices listed below and put it back together. o Flashlight o Lawn sprinkler o Skin faucet o Stapler o Toaster o Computer mouse • Using poster board, butcher paper, markers, colored pencils, tape, and other creative materials, have groups sketch a diagram of all parts and illustrate how they fit together to make the device operate. Have students list three ways they think the design could be improved. • Have students present their information to the class. **Assessment:** • Use a checklist such as the Group Presentation Assessment Rubric located in Appendix D to evaluate student presentations.
3. Create a product using the design process. a. Identify a problem or design objective. b. Define the goals and identify the constraints. c. Research and gather information. d. Create potential design solutions. e. Analyze the viability of solutions. f. Choose the most appropriate solution. g. Build or implement the design. h. Test and evaluate the design.	**Teaching:** • Divide students into groups based on their learning styles. • Have students use the 10-stage design process to build the tallest possible tower that can support at 12-oz can of soda. • Have students use the following materials to accomplish this task: o One roll of masking tape o One package of straws o One can of soda • Have students work with the following

	constraints: o The tower must be free standing. o The base must fit on a plate. o The tower must stand for five seconds under load for measurement. • After the design is complete, allow students 30 minutes for tower construction. • Have students test and evaluate their design. • Have students work in groups and select one of the following: o Medical technology o Agricultural and related biotechnologies o Energy and power technology o Information and communication technology o Transportation technology o Manufacturing technology o Construction technology • Have each group research their selected topic. • Have groups use technology productivity tools and the writing process to create a product such as a newsletter, brochure, newspaper article, Web page, etc. that summarizes how their selected technologies offer solutions to potential problems related to the respective career field. Also, have students summarize how their selected topic impacts the global, national, and regional environment. **Assessment:** • Invite local engineers or industry members to judge student designs. • Use a rubric to evaluate students following the design process and teaming skills. • Use the Written Report Writing Rubric located in Appendix D to evaluate group writing products.

STANDARDS

ITEA Standards

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

Secondary Technology Applications

Standard 9	Students will develop an understanding of engineering design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11	Students will develop abilities to apply the design process.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A5	Utilize various formulas in problem-solving situations.
A6	Communicate using the language of algebra.
B1	Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4	Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5	Complete oral and written presentations which exhibit interaction and consensus within a group.
E9	Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10	Use language and critical thinking strategies to serve as tools for learning.
H1	Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
H2	Describe the impact of science and technology on the historical development of the United States in the global community.

H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

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Technology Applications I
Unit 5: Technical Communication **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe basic concepts and proper use of the Internet. a. Give a brief overview of the history of the Internet. b. Review the key parts of the Internet Browser application software c. Explain the importance of the Internet, what it is used for, and how it will be used in the Technology Applications classroom. d. Identify the various parts of a URL. e. Research top-level domain names, how their status is determined, and which are more useful for particular situations. f. Implement rules and proper online behavior. g. Understand the consequences of not using the Internet properly.	**Teaching:** • Have students define and illustrate terms related to technology communication tools. Terms should include, but are not limited to access protocols, architecture, Arpanet, blogs (Web logs), chat, client/server, directory, discussion groups, Domain Name System (DNS), electronic mail, file transfer protocol (FTP), graphical browser, GUI, home pages, HTML, HTML tags, HTTP, hypertext, instant messaging, Internet, multimedia, plug-ins, TCP/IP, technical writing, Telnet, text browser, URL, Usenet News Groups, Web pages, WWW, WWW Consortium. • Using presentation software, demonstrate how to use an Internet browser to allow access to Internet sites, save favorites, travel Back and Forward, print files, etc. • Divide students into six groups. Write the following questions on strips of paper: o How did the Internet begin? o Who has access to the Internet? o Who controls the Internet? o Are there any standards that users should follow when using the Internet? o What are the dangers of the Internet? o What are the benefits of the Internet? • Fold the strips up and allow one group member to select a question. Give each group 5 – 10 minutes to use Internet search tools to find the answers to the question. After groups have the answer, allow one person from each group to teach the information to the whole group. • Working in groups, have students use a Web quest or teacher created activity to research the Internet and find important facts about the Internet. Using bulletin board paper stretched across a long wall, have students create a timeline of the history of the Internet and place

	appropriate highlights in order of appearance, from earliest to latest. • Have students complete a Web quest to explore the various top-level domain names, and present their findings to the class. • Allow groups of students to prepare posters explaining a URL (Universal Resource Locator) address and its different sections. Assign each group of students a different top-level domain name to allow them to compare content. • Show students video clips about Internet safety for teens from http://www.netsmartz.org/resources/reallife.htm#realamy. Divide students into groups of four. Assign a project manager to each group. Have each group visit http://www.getnetwise.org/ to research one of the following topics: o Keeping children safe online o Stopping unwanted e-mail and spam o Protecting your computer from hackers and viruses o Keeping your personal information private • Ask each group to become experts on their assigned topic. Have each group teach the class about their topic. • As a whole group, have students brainstorm guidelines for teen safety on the Internet. Share with students the Web site http://www.missingkids.com and http://www.getnetwise.org/. Have students complete a teen safety reference sheet that includes information about the following: o Internet safety guidelines for teens o Strategies to enhance their ability to recognize dangers on the Internet o Information about how to report victimizations to a trusted adult • Have students take their teen safety reference sheet home and discuss it with their parents/guardians. **Assessment:** • Monitor student participation in timeline

	activity. • Evaluate Web quest for content. • Assess URL group project posters for content and appearance. • Evaluate definitions of terms for accuracy.
2. Describe basic concepts of appropriate Internet communications. a. List and discuss netiquette as it applies to Internet communication. b. Generate asynchronous communication such as e-mail, blogs, discussion boards, wikies, etc. c. Generate synchronous communication sessions such as chat rooms and interactive whiteboards.	**Teaching:** • Using presentation software, share netiquette expectations for Internet communications. o Using poster board and markers, have students prepare posters of acceptable rules of behavior while using Internet communications of any variety. o Using technology applications tools, have students prepare a slide for each of the acceptable rules of Internet behavior. • Using presentation software, describe and demonstrate the use of asynchronous communications tools. • Using http://www.gaggle.net have a sample e-mail message available as a handout for discussion of various sections of e-mail message: To, From, CC, BCC, Attachments, Forward, Reply, and Message. • Using a printout of a blank e-mail message, have students compose an e-mail message to the instructor, including an image attachment. • Using a sample blog page obtained from the Internet, allow the students to discuss what is included and brainstorm to develop content guidelines as to blog content, as well as some advantages and disadvantages to using blogs. Have students complete a writing activity to explain their findings. • Using http://rcu.blackboard.com, guide the students in a discussion board posting of a topic of interest. Have students reply to a pre-planned message on the classroom Blackboard® account. Have students post information to the Blackboard® Discussion Board throughout the year. • Using presentation software, describe and demonstrate the use of synchronous

	communications tools. • Using Blackboard®, allow students to participate in a chat room discussion. After experimenting in the chaos of uncontrolled chat room entries, group students and allow them to develop guidelines for the successful use of a chat room. Use presentation software to report their findings to the rest of the class. • Use the Interactive Whiteboard feature of Blackboard® to demonstrate some topic to students. • Allow students to research information regarding taking a class online. Have students compare and contrast online education to traditional, face-to-face education. Allow students to complete components of the Technology Applications course in an online environment using Blackboard®. **Assessment:** • Have students complete an interactive Netiquette Quiz found at http://www.albion.com/netiquette/netiquiz.html • Use the Group Presentation Assessment Rubric located in Appendix D to evaluate student presentations. • Use the Blackboard® Discussion Board and chat room throughout the school year to check for student understanding of other competencies.
3. Evaluate research from the Internet. a. Distinguish between personal Web pages, commercial Web pages, and information pages, and research pages. b. Compare search engines, mega search engines and meta search engines. c. Use Boolean search techniques to perform an advanced search. d. Discuss plagiarism and other copyright issues related to research, writing, and electronic sources. e. Cite Internet resources using the	**Teaching:** • Using the Internet with pre-determined Web sites, display various types of Web pages. Allow students to distinguish between the personal pages, commercial pages, information pages, and research pages. • Divide the students into groups based on learning styles and assign them a type of Web page to examine further. Have students design, develop, and present a presentation on characteristics of their assigned type of Web page. • Have students read a case study regarding

APA or MLA format.	copyright issues. Lead a classroom discussion about the dangers of plagiarism and not following copyright rules. • Using presentation software, deliver a lecture regarding the different types of search engines, using Boolean search for advanced searching, and copyright information regarding using electronic sources. Have students take notes throughout your lecture. Give students time to organize their notes and ask questions about topics that are unclear to them. • Using the Internet, have students perform searches using the different search engines for terms or information as listed on a teacher-made activity. • Using the Internet and advanced search techniques, have students search for a particular term or information as given by the instructor. • Have students select a topic of interest. Have students use the writing process and technology application tools to write a five paragraph, informative essay related to their topic. Require students to integrate and cite five high-quality references using APA or MLA format. As an extension of the writing assignment, have students include illustrations throughout their essay. **Assessment:** • Observe students as they use search techniques to find information on the Internet. • Use the Written Report Writing Rubric located in Appendix D to evaluate student essays.
4. Create a Web page using technology productivity tools and concepts of practical Web design. a. Differentiate between designing in HTML and a WYSIWYG environment. b. Incorporate the essential HTML tags to complete a basic personal Web page. c. Develop a basic Web page using text	**Teaching:** • Using multimedia presentation equipment and Web page samples, explain to students the differences of developing Web pages in HTML and WYSIWYG application software. Include information on benefits of working in HTML, such as all Web pages are based on HTML and this is free online for anyone to use. Also, include information about the benefits of working

formatting tags, image tags, hyperlink tags and their necessary tag attributes. d. Design a Web page related to a topic of interest. e. Create a Web page related to a topic of interest. f. Evaluate a created Web page related to a topic of interest.	in WYSIWYG application software, such as the developer can see the design as he/she is developing and that no coding is necessary. • Using the Blackboard® Discussion Board, have students reply to a message about the different types of Web design software, HTML coding, and WYSIWYG application software. • Using presentation software or a marker board, explain HTML tags and attributes. Establish the required HTML tags for Web pages. <HTML> <HEAD> <TITLE> </TITLE> </HEAD> <BODY> </BODY> </HTML> • Have students use Notepad® to type in the basic HTML tags and save the file to use as a template. • Using presentation software, walk students through viewing the file in an Internet browser. • Using an Internet browser, have students view their basic Web page as developed earlier. (NOTE: nothing will show in the browser.) • Using presentation equipment, demonstrate adding content to the <TITLE> tag and resaving the file. • Have students use Notepad® to edit their own files. Have students add their name as the page title (between the <TITLE> and </TITLE> tags). Have students save the file under another name in order to preserve the original file. Allow students to use their browser to view the file. Students may need to click the Refresh button. Ask students why nothing is showing in the page body. Point out their name in the blue title bar of the browser window. • Using presentation equipment, demonstrate adding page content to a Web page by having students add a sentence in Notepad® to their new file in between the <BODY> and </BODY> tags. Ask students to save the file and preview it again using their Internet browser. Students may be

	required to click the Refresh button. • Using Notepad® and an Internet browser, have students add a sentence to their basic Web page, resave it, and preview it again. Allow students to share their excitement of developing their Web page using HTML coding. Allow students to practice adding content to their basic Web page. • Allow students to research HTML Web sites and tutorials, such as http://www.htmlgoodies.com, to learn more about tags and attributes necessary for text formatting, (bold, italics, underline), adding images, adding hyperlinks, background colors, text colors, page alignment, etc. • Using Notepad® and an Internet browser, have students add content to their basic Web page, save it, and view it in their browser. • Use guided practice teaching instruction to show students how to develop a Web page using Web authoring software. Have students select a topic of interest. Next, have students develop, create, combine, edit, and link multiple Web pages to create a Web page. Instruct students to remember copyright and plagiarism information learned in previous instruction. • Have students search the Internet for Web page evaluation tools. Have students work in groups to develop their own Web page evaluation tool. Have groups peer evaluate each other's Web page using the newly created Web page evaluation tool. Have each student present their created Web page to the class. Have groups submit their evaluation tool and their Web site for evaluation. **Assessment:** • Use the student-created evaluation tools to evaluate their Web sites. • Use the Group Participation Assessment Rubric located in Appendix D to evaluate student group work. • Administer a written test to evaluate

	student knowledge of HTML tags and screen components of the Web page authoring software. • Have students begin an electronic portfolio using HTML or Web page authoring software.
5. Create effective technical writing documents. a. Define technical writing as "writing that explains technology to various technical, organizational and societal audiences." b. Explore technical writing skills and use these skills to produce effective technical documents.	**Teaching:** • Using a teacher-made survey; have students explore their own attributes about writing. • Lead a classroom discussion and show examples of different types of writing such as informative, creative, descriptive, technical, etc. • Using multimedia presentation equipment, introduce technical writing skills to the students. Include a discussion on attitudes about writing as determined in previous survey. Introduce a list of six recommended techniques for success: o Define expected terminology. o Use short, well-written sentences. o Use brief paragraphs. o Strive for coherence. o Interpret all data presented. o Employ frequent closure by summarizing what has been written to allow the readers to comprehend a little at a time. • Distribute multiple examples of some technical writing documents and discuss as a class the sections found above. • Distribute samples to groups of three to four students and allow them to determine if they are effective technical writing documents. • Using presentation techniques, present to the students Five C's of Report Writing: o Concise o Complete o Concrete o Correct o Coherent. • Distribute individual topics to the students and allow them to practice technical writing skills by creating an electronic

	document. **Assessment:** • Use the Technical Writing Rubric located in Appendix D. • Administer a written quiz to students to evaluate their knowledge of technical writing.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5	Students will develop an understanding of the effects of technology on the environment.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influences of technology on history.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Academic Standards

E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4	Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5	Complete oral and written presentations which exhibit interaction and consensus within a group.
H4	Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Estrin, H. A., & Eliot, N. (1990). *Technical writing in the corporate world.* Lanham, MD: Crisp.

Flynn, N., & Flynn, T. (2003). *Writing effective e-mails: Improving your electronic communication*. Lanham, MD: Crisp.

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Technology Applications I
Unit 6: Computer Aided Design and Drafting (CADD) (25 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Explain basic concepts of computer aided drafting and design technology. a. Trace the history of drafting and design. b. Identify applications in business and industry. c. Identify terms and concepts of drafting and design. d. Demonstrate the proper use of scales, including engineers, architects, and metric scale. e. Distinguish between the types of drawing views.	**Teaching:** • Using a multimedia presentation trace the history of drafting and design in engineering and architecture. • Have students use technology research tools and communication tools, such as the Blackboard® Discussion Board, to research and discuss the applications of computer aided drafting and design technology in engineering and architectural fields. • Have students define and illustrate terms related to computer aided drafting and design technology. • Demonstrate to students the differences in the type of scales. Demonstrate how to use each scale: the civil engineer, mechanical engineer, architectural, and metric. As an activity, have reproductions of different scales with predetermined measurements and have the students determine the readings. Give the students a reproduction of a mechanical drawing and use the civil or mechanical engineer's 1:1 (10) scale to determine the dimensions at various locations on the part. Give the students a floor plan drawn 1/4″ = 1′-0″ scale and determine the dimensions at various locations. • Compare the various types of views and discuss the use of each. Views are orthographic, isometric, and perspective. • Using multimedia technology to demonstrate the proper setup for an orthographic drawing. Create an assignment for students to sketch an orthographic drawing with the top, front and right side views properly aligned. Provide images of isometric drawings and have students sketch the orthographic drawings. Cut out basic shapes of Styrofoam and have students produce the

	orthographic drawing on paper. **Assessment:** • Use the Blackboard® Assessment System to give students a quiz on history, applications, and terms in drafting and design. • Evaluate students' orthographic multiview sketches using a checklist or a rubric.
2. Demonstrate applications of computer aided drafting and design 2D. a. Identify major commands of computer aided drafting and design 2D software. b. Identify and design an engineering type drawing. c. Identify and design an architectural type drawing.	**Teaching:** • Have students produce single view drawings using the following basic CAD commands: line, erase, move, circle, arc, copy, trim, fillet, dimension, and text. Students should also learn to make use of zoom commands, snap, and grid. A suggested advanced activity would have students make use of inserting blocks, creating layers, using different linetypes, creating construction lines, and creating hatch patterns. • Have students produce an engineering type drawing (mechanical drawing) creating the orthographic views of top, front, and right side (properly aligned). Have students make proper use of hidden lines and center lines. Have students properly dimension the drawing part. Have students create a border and a title block and plot or print the drawing. • Have students produce an architectural type drawing. Give students a floor plan and have them reproduce it. Have the students make use of inserting blocks such as kitchen and bathroom fixtures, doors, furniture, lights, etc. Have the students properly dimension and to insert text naming the rooms with dimensions. • Have students produce a front elevation drawing of their floor plans. Have students make use of hatch patterns in their elevations. **Assessment:** • Assess students' single view drawings, engineering drawings, and architectural drawings for accuracy and appearance.
3. Demonstrate applications of computer	**Teaching:**

aided design 3D. a. Identify major commands of 3D drawing software. b. Identify and design a 3D engineering drawing. c. Identify and construct a 3D engineering assembly drawing. d. Demonstrate the animation of a 3D engineering drawing. e. Identify and design a 3D architectural type drawing.	• Using multimedia technology, discuss 3D design technology. Have students use a Venn Diagram to compare and contrast 2D and 3D drawings. • Discuss the major commands of 3D drawing software. Include workplanes (front, top, right), sketch (lines, rectangles, circles, arcs, etc.), dimension, extrude, revolve, modify, etc. • Have students produce a 3D engineering drawing (mechanical). • Have students create and assemble an engineering drawing consisting of at least two parts. • Have students animate a drawing. Students could show the animation of an assembly process or show the rotation of a part. • Using 3D architectural software, have students create a 3D home based on a previously designed floor plan. **Assessment:** • Use a rubric for scoring students 3D engineering and 3D architectural drawings for content and appearance.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 9	Students will develop an understanding of engineering design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11	Students will develop abilities to apply the design process.
Standard 12	Students will develop abilities to use and maintain technological products and systems.
Standard 13	Students will develop abilities to assess the impact of products and systems.

Academic Standards

A1 Recognize, classify, and use real numbers and their properties.
A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
A5 Utilize various formulas in problem-solving situations.
A6 Communicate using the language of algebra.
A7 Interpret and apply slope as a rate of change.
A8 Analyze data and apply concepts of probability.
B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
E10 Use language and critical thinking strategies to serve as tools for learning.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.
H3 Describe the relationship of people, places, and environments through time.
H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS1 Global Awareness
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Cram, C. M. (2007). *Communicating in business with technology*. New York: Delmar.

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Technology Applications I
Unit 7: Manufacturing (CAD/CAM) Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe basic concepts of CAD/CAM technology. a. Identify applications of CAD/CAM technology. b. Identify terms related to CAD/CAM technology. c. Explain the XYZ coordinating relationships.	**Teaching:** • Using multimedia technology, discuss with students the applications of CAD/CAM technology. Have students view video clips from www.unitedstreaming.com that show how CAD/CAM technology is used in the workforce. • Discuss terms such as CAD, CAM, CNC, points, lines, arcs, planes, geometry, Cartesian coordinates system, polar coordinate system, absolute coordinates, incremental coordinates, polar arcs, polar lines, toolpaths, chaining, controller, NC code, post processor, PRZ, etc. • Using multimedia technology, explain 2D Cartesian coordinates. Explain 3D Cartesian coordinates in an isometric view. Explain the XYZ coordinate relationships and demonstrate the use of the "right hand rule" to demonstrate the positive direction of the axes. • Have students research the use of CAD/CAM technologies in a global, national, and regional environment. **Assessment:** • Use the Blackboard® Assessment System to quiz students on terms. Include a check on the students understanding of the Cartesian coordinate system.
2. Perform applications of CAD/CAM technology. a. Identify major commands of CAD/CAM software. b. Create a 2D and 3D wireframe drawing. c. Create a 3D wireframe drawing complete with toolpaths and generated NC code. d. Design a part that will be produced on a milling machine.	**Teaching:** • Discuss with the students the major commands of CAD/CAM software. Be sure to include the following: various tools to create the geometry, a discussion on types of toolpaths and chaining, types of endmills, backplotting and verifying, and generating NC codes. Also include a section on safety in using the milling machine to include proper use of safety glasses, handling endmills, and safety precautions when running a milling machine.

	• Introduce students to using CAD/CAM software by having them create a 2D wireframe drawing. • Have students create a 3D wireframe drawing. Have students go through the steps of creating the geometry, toolpath creation, including defining the stock, choosing the contour and chaining, setting the tool parameters, backplotting and verifying, and posting the NC code. • Have students complete a project. Go to http://www.mastercam.com/TeachersStudents/InstructorsCorner/Projects/Default.aspx and download for sample name plate project. o *Project description:* Designed to be cut out of wood, each student can individualize this project with their own name or clip-art images. Step-by-step instructions and illustrations are included in the PowerPoint file. This is great for beginners and includes pocketing and projecting a toolpath onto a surface. • Refer to the *Learning Series: Mill Projects and Applications* book for the appropriate version of Mastercam® if using Mastercam® software. If Quickpart® is available, have students learn to engrave to produce various products. **Assessment:** • Observe student participation in work. • Evaluate drawings and projects using a rubric or checklist for proper components.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 9	Students will develop an understanding of engineering design.

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

Academic Standards

A1 Recognize, classify, and use real numbers and their properties.
A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
A5 Utilize various formulas in problem-solving situations.
A6 Communicate using the language of algebra.
B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

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Technology Applications I
Unit 8: Fluid Systems Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Determine how force affects fluid systems. a. Differentiate between hydraulic and pneumatic systems. b. Define buoyant force. c. Define pressure, both in words and in equation form. d. Explain where atmospheric pressure comes from. State the sea level standard value for atmospheric pressure in the appropriate system of measure. e. Describe the difference between absolute and gage pressure. f. Explain how pressure in a fluid depends on depth of fluid. g. Given a fluid system with two connected reservoirs, describe fluid levels in each reservoir that will cause fluid motion between reservoirs, or that will cause no action. h. Explain how manometers are used to measure pressures.	**Teaching:** • Before students enter the class, create a Cartesian Diver using a squeeze condiment packet (ketchup, soy sauce, etc.); an empty, clear 2-liter clear bottle; and water. Fill the empty, clear plastic bottle to the top with water. Place the condiment packet into the bottle. Replace the bottle cap. Test your Cartesian Diver by squeezing the bottle to make the condiment packet sink, and release to make the packet rise. When students enter the class, display the Cartesian Diver. Squeeze the bottle to make the diver sink. Release the bottle to make the diver rise. Ask students, "What is going on here?" Explain to students that many sauces are denser than water, but it is the air bubble at the top of the sauce that determines whether the packet will sink or swim. Squeezing the bottle causes the bubble to shrink. This smaller bubble is less buoyant and the packet sinks. • Show students the video "Pressure in Fluid Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). Before the video, ask students: o Why might a technician need to understand how pressure acts in a fluid system? • After the video, lead a class discussion using the following questions: o What are the two kinds of fluid systems? o What is the relationship between force, pressure and area in a fluid system? o Why do Bob Burnham and the other technicians at the bottling plant need to understand how pressure acts in a fluid system?

	• Using presentation software, explain and demonstrate information related to force in fluid systems. • Using technical writing skills, allow students to explain the difference between a hydraulic and a pneumatic system, and give a common example of each. • After reading articles related to buoyant force, have the students compose a one- or two-sentence definition of buoyant force to share with the rest of the class. • Have students use technology productivity tools or classroom resources to explain and illustrate where atmospheric pressure comes from, state the sea level standard value for atmospheric pressure in the appropriate system of measure and how pressure in a fluid depends on depth of fluid. • Have students use a Venn Diagram to describe the differences and similarities between absolute and gage pressure, and explain it to the rest of the class using presentation software. • Using materials found in the lab, demonstrate how pressure causes fluids to move, how pressure increases with the depth of the fluid and, how pressure and flow rate in a fluid circuit are proportional. **Assessment:** • Observe students working in groups on fluid activities. • Evaluate group presentations using the Group Presentation Assessment Rubric located in Appendix D. • Evaluate students' understanding of force in fluid systems using a quiz.
2. Determine how work affects a fluid system. a. Describe how open and closed fluid systems are different. b. Explain the relationship between work and pressure in a fluid system by the equations: Work = constant pressure x fluid volume moved	**Teaching:** • Use this experiment to show students the effects of high pressure versus low pressure: o Display the following materials on a table in front of the class: one hard-boiled egg with the shell off, one glass gallon jar with a small neck (about 1½″ in diameter), and matches.

$W = p \times (\Delta V)$ And Work = pressure difference x volume moved $W = (\Delta p) \times V$	○ Light a match and immediately place in jar. Quickly put egg lightly on the opening and watch. As the flame uses up the oxygen inside the jar, the air pressure in the jar will decrease causing a vacuum to develop. ○ The low air pressure in the jar will cause a pressure difference with the outside air. The high air pressure on the outside will push the egg through the small opening and into the jar. ○ Ask students, "How do you get the egg out?" ○ Hold the jar upside-down so the egg is pointed out the opening. ○ Create a high air pressure inside the jar by blowing hard into it. The high air pressure inside the jar will push the egg back out the small opening. • Using a classroom lecture and a multimedia presentation, explain the concept that work is done when a pressure difference causes liquids or gases to move. Include an explanation of how air pressure difference causes movement of particles. The amount of pressure is determined by the difference of pressure in the air and the amount of area affected. Have students take notes from the lecture and presentation. • Divide students into three groups. Give each group one of the following assignments: ○ Group 1: How does a tire pressure gauge work? (http://www.howstuffworks.com/pressure-gauge.htm) ○ Group 2: What are the principles behind hydraulic machines from log splitters to heavy equipment? (http://www.howstuffworks.com/hydraulic.htm) ○ Group 3: How is the human cardiovascular system similar to a fluid system?

	(http://www.rwc.uc.edu/koehler/biophys/3a.html) • Have students teach their assigned topic/question to the class. • Using a marker board, demonstrate how to solve fluid work problems. Have students work individually to calculate fluid problems. **Assessment:** • Use the Group Presentation Assessment Rubric located in Appendix D to evaluate student presentations. • Evaluate completed fluid problems.
3. Determine how rate affects fluid systems. a. Describe a volume flow rate (Q_v) as volume of fluid (V) moved per unit time (t), or $Q_v = v/t$. b. Describe a mass-flow rate (Q_m) as mass of fluid (m) moved per unit time (t), or $Q_m = m/t$. c. Explain the meaning of the fluid rate equations. d. Use rate equations to find an unknown.	**Teaching:** • Show students the video, "Rate in Fluid Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o How can you calculate the rate at which gas is pumped into a gas tank? • After video discussion questions: o How do you calculate rate in a fluid system? o Why, in some cases, is the mass of fluid used to calculate rate, rather than volume? o What is the importance of knowing how to calculate rate in fluid systems? • Using presentation software, explain volume-flow rate and mass-flow rate. Use hands on demonstrations to demonstrate rate in fluid systems. • Have students complete individual projects and experiments to demonstrate their knowledge of how rate affects fluid systems. **Assessment:** • Evaluate student knowledge using a written or electronic quiz (Blackboard® Learning System) • Assess individual projects for content.
4. Determine how resistance affects fluid systems. a. Describe resistance in fluid systems.	**Teaching:** • Show students the video "Resistance in Fluid Systems" or a video related to

b. Distinguish between streamlined and turbulent flows. c. Identify sources of resistance for a fluid moving through a pipe. d. Identify the effects of resistance in a fluid flowing through a pipe. e. Explain how fluid resistance in a pipe depends on pipe area, pipe length and type of fluid. f. Describe how to reduce fluid resistance in a system.	electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o Why might you want to use a lighter weight (less viscous) oil in your car in the winter? • After the video, use the following discussion questions to facilitate a large group discussion: o How is resistance calculated in a fluid system? o What relationship is there between resistance and viscosity? o What are some variables that can influence fluid resistance? • Using presentation software, explain and demonstrate concepts of resistance in fluid systems. In the presentation and discussion, describe and illustrate the difference between streamlined and turbulent flows. • Have students work in groups of three-four to: o Brainstorm to predict some sources of resistance in a fluid flowing through a pipe. o Use the research to discover actual sources of resistance. o Choose two to research the effects they would have on the fluid flowing through the pipe. o Use technology application tools to present their findings to the whole group. • Using presentation software, describe and illustrate the factors that affect fluid resistance 1) pipe area, 2) pipe length, and 3) type of fluid**.** • Have students read Internet articles on factors that affect fluid resistance. Next, have them develop a list of three ways to reduce resistance in a fluid system. Then, have students use technical writing skills to explain why these methods would be effective.

	• Distribute the following articles to students: o Why does a Curve Ball Curve? o Why does a Curve Ball Curve? – the Physics Concepts • Divide students into groups of four – five. Assign a project manager for each group. Have the groups work together, use the writing process, and use technology productivity to create a children's book on why curve balls curve. The book should explain the physics concepts and should be written in a way that children can understand. • As an extension, have students design a kite. Visit http://www.grc.nasa.gov/WWW/K-12/airplane/kitedrag.html and http://www.grc.nasa.gov/WWW/K-12/airplane/kiteprog.html to learn how resistance affects kites. Have students design a kite. **Assessment:** • Observe students as they work in groups on resistance problems. • Assess presentations using the Group Presentation Assessment Rubric located in Appendix D. • Assess a quiz on resistance.
5. Determine how energy affects fluid systems. a. Describe the characteristics of fluids. b. Describe and illustrate how energy is used in fluid systems. c. Differentiate between hydraulic and pneumatic systems. d. Illustrate how to find the kinetic energy of fluids. Calculate fluid energy using the following formula: $E_k = ½ (^w/_g) v^2$ E_k = kinetic energy in foot pounds w = weight of fluid in pounds g = acceleration due to gravity (32 ft/sec ^{2}) e. Illustrate how to determine the potential energy stored in a fluid by	**Teaching:** • Show students the video "Energy in Electrical Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). Before the video, ask students: o Why might a technician need to understand how energy acts in fluids system? o Using a multimedia presentation or the Internet, explain the concepts of fluid. • Have students use classroom resources and the Internet to research characteristics of fluids and how energy affects fluid systems. • Have students use technology application

using a formula.	tools and the writing process to create a flow-chart, brochure, newsletter, etc. to summarize their conclusions of how energy is used in fluid systems **Assessment:** • Use a rubric to assess the students flow chart, brochure, newsletter, etc.
6. Determine how power affects fluid a. Define power in a fluid system as work divided by time: $P = \frac{(\Delta p)v}{t}$, or $P = \frac{p(\Delta v)}{t}$ b. Explain why power in a fluid system obeys the unifying principle of work divided by time, or "force" times a rate. c. Define the units of fluid power. d. Use the equation for power in a fluid system to solve for an unknown. e. Examine workplace applications where technicians measure or control power in fluid systems.	**Teaching:** • Present video "Power in Fluid Systems" or a video related to fluid systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, distribute an anticipation reaction guide that contains true and false statements related to the video. Before the video, have students respond to each statement. After students have an opportunity to view the video, have them respond again to each statement. Have students rewrite the statements that are false so that they are true. • Using a lecture and multimedia presentation or the internet, explain the concepts of power in fluid systems. Have students take notes from the lecture and summarize the information using technology productivity tools. • Using a marker board, demonstrate the process of solving problems using the equations for power. • Have students complete work in groups of two to solve the unknown using the equation of power. Have one student complete a problem and verbally explain it to their partner. Have the second student solve a problem and give an explanation to the first student. After students grasp the concept of using the equation for power, have students summarize the process of using the equation of power. **Assessment:** • Monitor student participation in activities. • Evaluate a paper or electronic quiz on fluid power in electrical systems.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 9	Students will develop an understanding of engineering design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11	Students will develop abilities to apply the design process.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A2	Recognize, create, extend, and apply patterns, relations, and functions and their applications.
A3	Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.
A4	Explore and communicate the characteristics and operations of polynomials.
A5	Utilize various formulas in problem-solving situations.
A6	Communicate using the language of algebra.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.

E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.
H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

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Ewen, P., Schurter, N., & Gundersen, E. P. (2005). *Applied physics*. Upper Saddle River, NJ: Prentice Hall.

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Secondary Technology Applications

Orsak, G. C., Wood, S. L., Douglas, S. C., Munson, D. C. Jr., Rauindra, A., & Yoder, M. A. (2004). *The infinity project: Engineering our digital future.* Upper Saddle River, NJ: Prentice Hall.

Technology Applications I
Unit 9: Thermal Systems Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Analyze work done in a thermal system. a. Identify the direction of movement of heat energy in a thermal system when temperature information is known. b. Describe the "forcelike" quantity in a thermal system. c. Define temperature. d. Describe the relationship between heat energy and molecular motion. e. Given Celsius or Fahrenheit temperatures and the formula for the conversion, find the equivalent temperature on the alternate scale.	**Teaching:** • Show the students the video, "Temperature in Thermal Systems" or similar video on www.unitedstreaming.com • Using a multimedia presentation or the Internet, explain the concept that heat flows from an area of high temperature to an area of lower temperature. Discuss how the temperature difference is the "forcelike" quantity in thermal systems. • Give students the following materials: o 2 cups of lukewarm water o 2 cups of hot water o Bowl o Food coloring o Ruler o Clear glass soda bottle o Clear plastic straw o Play-Doh o A marker o Thermometer o A large pan • Have students use the following procedures to build a calibrated thermometer from the materials listed above. o Put two cups of lukewarm water into the bowl and stir in six or seven drops of food coloring. Fill the soda bottle with the colored water. Mold Play-Doh around the straw, about two inches (5 cm) from one end. Insert the straw into the bottle. Mold the Play-Doh around the top of the bottle to seal the straw. Do not let the straw touch the bottom of the bottle. o Let the bottle sit for a while at room temperature. Then use the marker to mark the water level on the straw. Take the temperature of the room with a real thermometer and write that number next to the mark.

	○ Now set the bottle into a pan filled with two cups of hot water. Once the water level in the bottle has stopped rising, mark the new level on the straw. Take the temperature of the water in the pan and label that number next to the mark. ○ You now have a high temperature and a low temperature. Mark equally spaced tics between the two numbers onto the straw. For example, let's say your low and high temperatures are 65 °F and 80 °F and the distance between the two marks is 1.5″ inches. Measure at 0.5″ increments between the low and high marks, adding five degrees to each mark. So you'd have something like this: ▪ Degrees: 65°, 70°, 75°, 80° ▪ Measure: 0″, 0.5″, 1″, 1.5″ ○ Now you have a calibrated thermometer. ○ Have students complete lab sheets that calculate temperature conversion problems. ▪ °C = (°F - 32) * 5/9 ▪ °F = (°C * 1.8) + 32 • Have students use the writing process to summarize work done in a thermal system. **Assessment:** • Monitor student participation in activities. • Use the Written Report Writing Rubric located in Appendix D to evaluate student summaries.
2. Determine how rate affects fluid systems. a. Describe heat-flow rate (Q_H) as heat energy (H) moved per unit time (t), or $Q_H = H/t$. b. Define rate units for thermal systems, using both English and SI measure. c. Define heat capacity and specific heat. d. Explain the meaning of the equation for thermal system rate. e. Use this equation to find an unknown value.	**Teaching:** • Show students the video, "Rate in Thermal Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: ○ What phenomenon allows heat exchange to occur? • After video discussion questions: ○ How do you calculate rate in thermal systems?

f. Explain the difference between sensible and latent heat.	o What's the importance of controlling rate in a thermal system? o Name the four elements that affect the rate at which heat energy will move through a thermal system. • Using presentation software, explain and demonstrate how heat-flow rate (Q_H) as heat energy (H) moved per unit time (t), or $Q_H = H/t$; how rate units for thermal systems, using both English and SI measure; how to use the equation for thermal system rate to find an unknown value, and the differences between sensible and latent heat. • Have students take notes during the presentation. Give students time to ask questions from the presentation. • Have students use technology productivity tools to create a graphic organizer, such as a Venn Diagram to compare and contrast sensible and latent heat. Have students use the writing process and technology productivity tools to summarize their graphic organizer. **Assessment:** • Administer a written or electronic quiz to students to assess their knowledge of how rate affects fluid systems.
3. Determine how resistance affects thermal systems. a. Describe resistance in thermal systems. b. Identify the effects of resistance in a thermal system. c. Define thermal conductivity. d. Explain the relationship between resistance, temperature difference, and heat-flow rate. e. Show that thermal resistance obeys the unifying principle of a "force" divided by rate. f. Explain the meaning of the R-factor as a measure of relative thermal resistance of insulation. g. Identify what can be done to reduce or increase thermal resistance.	**Teaching:** • Show students the video "Resistance in Thermal Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o What is thermal resistance? • After the video, use the following questions to facilitate a class discussion. o How is resistance calculated in a thermal system? o What factors influence thermal resistance of a material? • Using presentation software, explain and demonstrate the lesson on resistance in thermal systems. • Have students illustrate a graph of data to

	show the relationship between resistance, temperature difference and heat-flow rate. • Have students work in groups of three-four. o Brainstorm to predict how thermal resistance can be lowered. o Research the Internet and lab resources to discover four actual sources of insulating. o Choose the best insulator, and the worst insulator, and why this is so. o Use technology application tools to present their findings to the whole class. • Using the data from the above group results, lead a group discussion about the R-factor and how it is used to determine effective insulation for home. • Have students read material on applications of low thermal resistance. Using technical writing skills, explain these applications. • Have students read material on applications of high thermal resistance. Using technical writing skills, explain these applications. **Assessment:** • Observe students as they work in groups on thermal resistance problems. • Use the Group Presentation Assessment Rubric located in Appendix D to evaluate group presentations. • Administer a written or electronic quiz to assess student knowledge of how resistance affects thermal systems.
4. Determine how energy affects thermal systems. a. Describe the relationship between thermal energy and work. b. Define the mechanical equivalent of heat. c. Use the equation, $H = mc\Delta T$, to find how much heat energy is transferred between two objects at different temperatures. d. Describe three ways to transfer heat energy. e. Describe how heat energy changes	**Teaching:** • Show students the video "Resistance in Thermal Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o What is thermal resistance? • Video Discussion Questions: o How is resistance calculated in a thermal system? o What factors influence thermal resistance of a material?

states—from solids to liquids to gases, and back again. f. Describe the role of heat energy in the Law of Conservation of Energy. g. Measure the transfer of heat energy. h. Identify work place applications where technicians measure or control energy in thermal systems.	• Using presentation software, explain and demonstrate the lesson on energy in thermal systems. Include the relationship between thermal energy and work, define the mechanical equivalent of heat, and demonstrate how to find how much heat energy is transferred between two objects at different temperatures using the formula. • Students will work in groups of three-four. o In textbook reading, discover three ways to transfer heat energy. o Using presentation software, describe how heat energy changes states from solids to liquids to gases and back again. o Using the Internet or classroom resources, describe the role of heat energy in the Law of Conservation of Energy. o Each group will then use technology application tools to present their findings to the whole group. • Using the Internet and classroom resources, the students will brainstorm to identify workplace applications where technicians measure or control energy in thermal systems. Have students use technical writing skills to explain and summarize details of their choice of workplace applications. • Using equipment from the lab, have students measure the transfer of heat energy. Have students write a descriptive paragraph about the process of transfer of heat energy that they observe. **Assessment:** • Observe students as they work in groups on thermal problems. • Assess group presentations using the Group Presentation Assessment Rubric located in Appendix D. • Evaluate students' descriptive writing for content.
5. Determine how power affects thermal systems.	**Teaching:** • Present the video "Power in Thermal

a. Define power in a thermal system as work (energy) divided by time. b. Relate power in a thermal system to rate. c. Identify the units of thermal power. d. Use the equation for power in a thermal system to solve for an unknown.	Systems" or a video related to power systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video ask the question, "What is the general qualifying equation for power?" Hand out activity sheets of discussion questions to watch for after the video and then discuss. • Using a multimedia presentation or the internet, explain the concepts of power in thermal systems. • Demonstrate the solving of problems using the equations for power. Have students work in groups and individually to solve equations for power. **Assessment:** • Observe student participation in activities. • Evaluate equations. • Assess a written quiz related to power in thermal systems.

STANDARDS

ITEA Standards

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A4	Explore and communicate the characteristics and operations of polynomials.
A5	Utilize various formulas in problem-solving situations.
A6	Communicate using the language of algebra.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
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E9	Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
H2	Describe the impact of science and technology on the historical development of the United States in the global community.
H4	Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS4	Information and Communication Skills
CS5	Thinking and Problem-Solving Skills
CS6	Interpersonal and Self-Directional Skills

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Technology Applications I
Unit 10: Electrical Systems Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Determine how force affects electrical systems. a. Define and illustrate basic electrical energy terms. b. Differentiate between AC and DC current. c. Demonstrate the sequence for connecting a DC circuit in series. d. Demonstrate how different voltages add up in a circuit. e. Read schematic drawings of simple circuits. f. Identify source, load, and conductor of a circuit and their symbols. g. Explain how frequency and hertz relate to AC current. h. Briefly describe how voltage acts as a force in an electrical system. i. Explore the uses of a multimeter as a measuring tool. j. Explore careers related to electrical systems.	**Teaching:** • Use a 3-volt light bulb and connect it to a 1.5-volt battery. Next, use two 1.5-volt batteries in a series to connect to a second 3-volt light bulb. Have students infer why one light bulb is brighter than the other. Demonstrate the measurement of the voltage flowing through the simple circuit using a multimeter. • Show students the video "Voltage in Electrical Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o Why might a technician need to understand how voltage acts in an electrical system? • Have students use technology application tools to define and illustrate using a graphical representation terms associated with electrical systems technology. Terms may include, but are not limited to, alternating current, ampere, capacitance, conductance, coulomb, direct current, electrical circuit, electrical loads, electrical rate, electrical systems, electricity, electrodes, electron, farad, hertz, in parallel, in series, inductance, insulators, joule, multimeter, ohm, resistance, voltage, wattage, etc. • Using a multimedia presentation or the Internet, explain the concepts of AC and DC currents, including frequency and hertz. • Invite a guest speaker from a local power company or engineering firm. Have the guest speaker discuss the following with students: o What safety issues should be addressed when working with AC or DC currents?

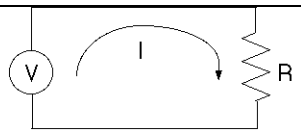
	○ What are the differences between AC and DC currents? ○ How many batteries would it take to operate an appliance? ○ What careers are related to electrical systems? • Display electrical symbols used in schematic drawings on note cards. Distribute one card to each student. Have that student use classroom resources or the Internet to determine what that symbol represents in the real world. Have each student present their symbol and the symbol explanation. Divide students in groups of three – four depending on their learning styles. Allow groups to design and construct a circuit and challenge other groups to prepare the matching schematic drawing. • Have students use classroom resources and the Internet to research how voltage in a circuit moving electrons through wire is like pressure in a city water system moves water through pipes. Have students use the writing process and technology productivity tools to create a product that compares and contrasts the two. • Give students the following materials: ○ Wire ○ Battery ○ Switch ○ Load (for example, light bulb or a small fan) • Have students setup a simple series circuit. • Have students use technology application tools and the writing process to create a flowchart, brochure, newsletter, etc. to explain their conclusions of how force affects electrical systems. **Assessment:** • Have students complete a vocabulary test where they are required to spell the term correctly, write the definition, and use the term correctly in a sentence. • Use the Compare and Contrast Summary Rubric located in Appendix D to evaluate

	the product that compares and contrasts the pressure in the city water system to voltage in a circuit. • Use the Written Report Writing Rubric located in Appendix D to evaluate the product that explains student conclusions of how force affects electrical systems.
2. Identify the effects of work done in electrical systems. a. Determine how work done by voltage affects an electrical system. b. Solve electrical work problems, given voltage and electrical charge information. Work = Voltage x Electrical Charge Moved $W = V \times q$ c. Explain the relationship between work and voltage in an electrical system, as given by the following equation: Current = charge/time $I = q/t$	**Teaching:** • Use chart paper or a marker board to create a three column chart. In the first column, have students brainstorm and write information that they already know about how work affects an electrical system. In the second column, brainstorm and record information that students want to learn about how work affects an electrical system. During the brainstorming phase, emphasize getting lots of ideas rather than debating or discussing the ideas as they are generated. Debates, clarifications, and discussions of ideas occur once the brainstorming is over. Do not clarify any confusion or react in any way other than to record the data. Conflicting data may be recorded. Throughout the teaching of how work affects an electrical system, address any misconceptions, confusion, or curiosity. • Use the results of the learning style inventory to divide students into groups of two – four. Give each group different printed articles from the Internet related to the concept that voltage moves electrical charge to produce work. Have each group read and summarize their article using bulletin board paper and markers or a multimedia presentation. In the summary, require students to use graphics instead of words. • Using a multimedia presentation, give students a detailed explanation of how work done in an electrical system cannot be seen but the results of work can be observed (light from a bulb, turning of a motor, etc.). Use multiple graphical representations throughout the

	presentation. Have students take notes from the presentation using notebooks or a word processing application program. • Have students work in small groups to classify how electrical work found in their home or classroom has been converted to other forms of energy that can be observed. • Using a multimedia presentation or a marker board demonstrate how to solve electrical work problems by going over examples. o Example: A "dead" 12-volt automobile battery can store 8000 coulombs of electrical charge. How much electrical work must be done to recharge the battery? • Have students practice calculating work problems using lab sheets. • Return to the three column chart. Have students brainstorm and record information that they learned about how work affects an electrical system. **Assessment** • Grade completed three-column charts.
3. Determine how rate affects electrical systems. a. Explain the meaning of rate in electrical systems. b. Use rate equations to find an unknown. c. Describe charge-flow rate (I) as quantity of charge moved (q) per unit time (t), or I = q/t. d. Distinguish between frequency and period.	**Teaching:** • Show students the video, "Rate in Electrical Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o What is the relationship of amperes to rate in electrical systems? • After the video, divide students into groups of 2. Have each group read a question and take 1 – 2 minutes to think quietly about possible answers to the question. Next, have students work with their partner to discuss their thinking. Allow 2 – 3 minutes for each pair to discuss. After students share with their partner, have students share their responses with the whole group. Use the following discussion questions to lead this think-pair-share activity: o How do you measure rate in an

	electrical system? o What is an ampere? o What might be the result of uncontrolled rate in an electrical system? o How does alternating current differ from direct current? • Using presentation software, explain and demonstrate specific skills and concepts related to rate in electrical systems. Have students take notes from the presentation. Encourage students to leave blank spaces between notes to make them more readable and easier to organize. After the presentation, have students review their notes and mark ideas that are unclear. Give students time to ask questions about unclear items. As a follow-up activity, have students keyboard and/or color code their notes to increase memory. • Have students use classroom resources and the Internet to research the difference between frequency and period. Have students complete a Venn Diagram that compares and contrasts the frequency and period. Have students use the writing process and technology productivity tools to create a product that compares and contrasts frequency and period. • Have students work in groups and individually to solve equations and problems related to rate and electrical systems. **Assessment:** • Use the Group Presentation Assessment Rubric located in Appendix D to evaluate student presentations. • Evaluate equations and problems related to electrical systems.
4. Determine how resistance affects electrical systems. a. Describe resistance and resistivity in electrical systems. b. Illustrate that the unifying principle of resistance is force divided by rate. c. Use a graph to explain the	**Teaching:** • Show students the video "Resistance in Electrical Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students:

relationship between resistance, voltage and current (Ohm's Law). d. Show how resistance in a wire depends on the length of the wire, the cross-sectional area of wire, and the material the wire is made of. e. Distinguish between conductors, semiconductors, and insulators. f. Use the equation $R_E = (\Delta V)/I$ to solve for an unknown. g. Find total resistance of two or more resistors in parallel hookups and in series hookups. h. Measure resistance in electrical systems.	○ Why does a wire get hot when current flows through it? • After the video, use the following probes to facilitate discussion: ○ In what ways is resistance useful in an electrical system? ○ What is the formula for calculating resistance in an electrical system? ○ What causes resistance in an electrical system? • Compose four to five charts that represent how resistance affects electrical systems with content material, pictorially, or verbally. Charts can include photographs and explanations, direct quotes from classroom resources, or other means to convey one idea per chart. Post the charts around the classroom and number each chart. Divide students into groups of three – four. Assign one group per chart as a starting point. Allow groups to spend two to five minutes at each assigned chart. Encourage students to take notes and discuss the ideas presented on each chart. When time is up, rotate the groups until all groups have taken notes and discussed information from each chart. When students return to their seats, lead a whole group discussion about the content learned from each chart. • Use technology application tools or a graphing calculator and presentation equipment to enter data related to various voltages and currents. Graph the resulting resistances to demonstrate the relationship between them. (Ohm's Law) • Have students use the Internet or classroom resources to gain a basic understanding of Ohm's Law. Have students write the formula and sketch the drawing that represents the formula in their notebooks. ○ *Ohm's Law: V = I x R* *V = Voltage* *I = Current* *R = Resistance*



- Allow students to work in small groups to solve the following problem:
  - Problem: A nine volt battery supplies power to a cordless curling iron with a resistance of 18 ohms. How much current is flowing through the curling iron?
  - Solution: Visit http://www.grc.nasa.gov/WWW/K-12/Sample_Projects/Ohms_Law/ohmslaw.html for the solution and more problems for students to solve.
- Discuss "resistivity" and demonstrate the relationship of electrical resistance to Ohm's law. Use four wires and a multimeter. One wire should be your "standard" with a specific length, diameter and material. Each of the other three wires has ONE parameter changed. Use this strategy to show the change in resistance of path of the three wires with respect to the "standard" wire.
- Have students use technology application tools to define and illustrate what they discovered by watching the demonstration explaining Ohm's Law.
- Have students use the electrical trainer or other devices to setup electrical experiments demonstrating resistance in Ohm's Law.
- Using technology application tools, groups of three to four students will use the Internet to research the differences between conductors, semiconductors, and insulators. Have students create a product such as a Web page, brochure, news paper, technical report, etc. to explain and illustrate conductors, semiconductors, and insulators.

Assessment:

- Observe students as they work in groups on resistance problems
- Evaluate group presentations on

	conductors, semiconductors and insulators using the Group Presentation Assessment Rubric located in Appendix D. • Evaluate quiz on Resistance.
5. Determine how energy affects electrical systems. a. Describe and illustrate how potential energy is stored in electrical systems. b. Differentiate between batteries, capacitors, and inductors. c. Demonstrate how capacitors oppose changes in voltage. d. Determine the electrical energy stored in a capacitor and use the formula to calculate electrical potential energy stored in fixed and variable capacitors. e. Demonstrate how inductors oppose changes in current in a circuit. f. Determine the electrical energy stored in an inductor by using a formula.	**Teaching:** • Demonstrate the measurement of the voltage flowing through the simple circuit using a multimeter. • Show students the video "Energy in Electrical Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o Why might a technician need to understand how energy acts in an electrical system? o Using a multimedia presentation or the Internet, explain the concepts of capacitance and inductance. • Have students use classroom resources and the Internet to research how potential energy is stored and utilized in a circuit. Have students use a Venn Diagram to compare and contrast capacitance and inductance. • Have students use a wire, a battery, a switch, a capacitor, and a load (for example, light bulb or a small fan) to setup a simple series circuit. • Have students use technology application tools to create a flow chart. Have students use technical writing skills to present their conclusions of how potential energy is used in electrical systems. **Assessment:** • Use a rubric to assess the student product.
6. Determine how power affects electrical systems. a. Define power in an electrical system as work divided by time $P = \frac{V \times q.}{t}$ b. Explain why power in an electrical system can also be described as voltage multiplied by a current, i.e. a	**Teaching:** • Present video "Power in Electrical Systems" leading question "What is the formula for work in an electrical system?" Hand out worksheet of discussion questions to watch for after video and discuss. • Using a multimedia presentation or the Internet, explain the concepts of power in

force multiplied by a rate: P = V x I c. Define the units of electrical power. d. Use the equation for power in an electrical system to solve for an unknown. e. Examine workplace applications where power is measured or controlled in electrical systems.	electrical systems. • Demonstrate the solving of problems using the equations for power. • Have students complete a worksheet of problem solving for an unknown in the equation power. • Have students determine an electric bill by using readings from kilowatt-hour readings. • Have students use the electrical trainer or other devices to setup electrical experiments demonstrating the calculation of power. **Assessment:** • Give students a written quiz related to power in electrical systems.
7. Calculate energy usage in kilowatt hours. a. Solve electrical energy problems for capacitance, given voltage, capacitance information in farads, and stored energy in joules. b. Solve electrical energy problems for inductance, given voltage, inductance in henries, and current in amperes flowing through the inductors.	**Teaching:** • Have students use classroom resources and the Internet to define kilowatt hours. • Using some demonstration technique, work example equations/problems related to power in electrical systems. Review the role of capacitors and inductors in controlling energy in electrical systems. • Have students work in groups and individually to solve equations/problems related to electrical systems. • Invite a guest speaker from the local power/electric company to visit the classroom and discuss the topic of power in electrical systems. Ask the guest speaker to show students how to read a kilowatt-hour meter. Also, ask the guest speaker to discuss the business and finance aspect of power/electric companies. **Assessment:** • Evaluate student equations/problems related to power in electrical systems.

STANDARDS

ITEA Standards

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

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

Secondary Technology Applications

Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 9	Students will develop an understanding of engineering design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11	Students will develop abilities to apply the design process.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A2	Recognize, create, extend, and apply patterns, relations, and functions and their applications.
A3	Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.
A4	Explore and communicate the characteristics and operations of polynomials.
A5	Utilize various formulas in problem-solving situations.
A6	Communicate using the language of algebra.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4	Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5	Complete oral and written presentations which exhibit interaction and consensus within a group.
E8	Read, discuss, analyze, and evaluate literature from various genres and other written material.

E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.
H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

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Technology Applications I
Unit 11: Mechanical Systems Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Determine how force affects mechanical systems. a. Define the concept of force in one or two sentences. b. Identify a common device that's used to measure force. c. Name the units of force used in the English measuring system. d. Describe what happens when forces on an object are balanced. e. Describe what happens when forces on an object are unbalanced. f. Briefly define the following: scalar, vector, weight, mass, and torque. g. Describe torque's relationship to clockwise and counterclockwise movement. h. Solve torque problems, given force and lever arm information.	**Teaching:** • Show students the video "Force in Mechanical Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video, ask students: o Why might a technician need to understand how force acts in a mechanical system? • Video Discussion Questions: o What is net force? o What happens when the forces in a system are unbalanced? o Why does Tom Jenner, who is an electrician, need to understand mechanical force? • Using presentation software, explain and demonstrate the lesson on force in mechanical systems: include the concept of force in mechanical systems, a common device that is used to measure force, common English units of force, what happens when forces on an object are balanced and unbalanced, and define scalar, vector, weight, mass, and torque. • Using reading material and presentation software, allow students to work in groups of three-four: o Define and illustrate torque's relationship to clockwise and counterclockwise movement. • Using presentation software, demonstrate how to solve torque problems, given force and lever arm information. • Using notes taken during demonstration, allow students to work in groups of two to work practice problems on solving torque problems. • Give students a worksheet on solving torque problems, given force and lever arm information.

<table>
<tr>
<td></td>
<td>Assessment:
• Observe students working in groups on activities.
• Administer a written quiz related to force in mechanical systems.</td>
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<tr>
<td>2. Analyze work affects mechanical system.
a. Identify the effects of work done by a force in a mechanical system.
b. Define/calculate work done by a force in a mechanical system using the formula:
W = F x D
Work = force applied x distance object moves while force applied
c. Explain how efficiency relates to input work and output work for a mechanical system.
d. Calculate efficiency using the formula:
work x 100
Efficiency (%) = output work/input
e. Define radian measures of angles. Solve rotational work problems using torque.
W = T x θ
Work = torque applied x angle moved through</td>
<td>Teaching:
• Using a multimedia presentation or the Internet, explain the concept that work is done when a force or torque causes an object to move.
• Demonstrate work done on an object by applying force to an object and the object moving along the direction of that force. Explain that once the force is removed from that object work is no longer being done.
• Using a multimedia presentation or the Internet, demonstrate how to solve mechanical work problems by going over examples. For radian measurement, consider the unit circle (a circle of radius 1) whose center is the vertex of the angle in question. Then the angle cuts off an arc of the circle, and the length of that arc is the radian measure of the angle. It is easy to convert between degree measurement and radian measurement. The circumference of the entire circle is 2π (π is about 3.14159), so it follows that 360° equals 2π radians. Hence, 1° equals π/180 radians, and 1 radian equals 180/π degrees. Give students the common radian measurement chart.
<table>
<tr><th>Angle</th><th>Degrees</th><th>Radians</th></tr>
<tr><td></td><td>90°</td><td>π/2</td></tr>
<tr><td>  </td><td>60°</td><td>π/3</td></tr>
<tr><td>  </td><td>45°</td><td>π/4</td></tr>
<tr><td>  </td><td>30°</td><td>π/6</td></tr>
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• Have students complete lab sheets that calculate work mechanical work problems.
• Have students set up mechanical work projects.
Assessment:
• Observe students while working in groups on activities.</td>
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	• Evaluate lab sheets and projects for accuracy.
3. Determine how rate affects mechanical systems. a. Define speed, velocity, and acceleration. b. Explain the difference between speed and velocity. c. Explain the differences between velocity and acceleration. d. Use speed, velocity, and acceleration to solve problems involving linear motion. e. Compare and contrast angular speed and angular acceleration. f. Solve equations/problems related to rate in mechanical systems.	**Teaching:** • Have students complete a KWL chart about how rate affects mechanical systems. • Using presentation software, explain and demonstrate information related to rate in mechanical systems. • Have students use the Internet and other classroom resources to summarize speed, velocity, and acceleration. Have students complete a Venn Diagram to compare and contrast the three. • Using guided practice, show students how to solve equations for speed, velocity, and acceleration. • Have students solve real world problems with equations and problems related to rate in thermal systems. **Assessment:** • Evaluate student equations and problems related to rate in mechanical systems. • Administer a written test related to rate in mechanical systems.
4. Determine how resistance affects mechanical systems. a. Review Newton's laws of motion and solve problems involving force, mass, and acceleration. b. Calculate the weight and mass of objects. c. Compare and contrast static and kinetic friction. d. Calculate the force of friction between two surfaces.	**Teaching:** • Show students the video, "Resistance in Mechanical Systems" or a video related to electrical systems technology from United Streaming (http://www.unitedstreaming.com). • Using presentation software, explain and demonstrate the lesson on resistance in mechanical systems. • Using presentation software, explain and demonstrate information related to resistance in mechanical systems. • Have students use the Internet and other classroom resources to summarize weight and mass. Also, have students use the Internet and other classroom resources to summarize static and kinetic friction. Have students complete a Venn Diagram to compare and contrast. • Using guided practice, show students how to solve equations related to resistance and mechanical systems. Discuss the effect that

	lubrication has on resistance in mechanical systems. • Have students solve real world problems with equations and problems related to resistance in thermal systems. **Assessment:** • Evaluate student equations and problems related to resistance in mechanical systems. • Administer a written test related to resistance in mechanical systems.
5. Determine how energy affects mechanical systems. a. Describe and illustrate how potential and kinetic energy are used in mechanical systems. b. Differentiate between gravitational potential energy and elastic potential energy. c. Illustrate how gravitational potential energy equals the work done to lift an object to a higher position and use the formula to calculate gravitational potential energy: $E_p = w \times h$. d. Illustrate how elastic potential energy equals the work done to stretch or compress elastic objects and use the formula to calculate elastic potential energy : $E_p = ½ \times kd^2$. e. Differentiate between linear kinetic energy and rotational kinetic energy. f. Illustrate how kinetic energy involves mass and linear motion and use the formula $E_k = ½ mv^2$. g. Illustrate how kinetic energy involves the moment of inertia and rotational motion and use the formula $E_k = ½ I \omega^2$. h. Describe conversion between types of energy in mechanical systems	**Teaching:** • Show students the video "Energy in Mechanical and Fluid Systems" or a video related to mechanical systems technology from United Streaming (http://www.unitedstreaming.com). Before the video, ask students: o Why might a technician need to understand how energy acts in a mechanical system? o Using a multimedia presentation or the Internet, explain the concepts of gravitational and elastic potential energy. • Demonstrate that gravitational potential energy of an object depends on its weight and height above a reference point. • Demonstrate an example of gravitational potential energy. • Demonstrate how a spring scale compresses and stretches, returning to its original shape, and how the scale has assigned values for the spring constant. • Introduce terms to include fluid, hydraulic, pneumatic, reference point. • Use the activity "Determining a Spring Constant" at "Physics in Context" Web site. (http://www.learningincontext.com/PiC-Web/chapt05.htm) • Have students use classroom resources and the Internet to research how potential energy is stored and utilized in mechanical systems. • Have the students use a mechanical trainer

	or other devices to setup simple mechanical energy experiments. • Have students use technology application tools and the writing process to create a flowchart, brochure, newsletter, etc. to explain their conclusions of how potential energy is used in mechanical systems. **Assessment:** • Use a rubric such as the Student Brochure Rubric located in Appendix D to assess the student product. • Administer a written test related to energy in mechanical systems.
6. Determine how power affects mechanical systems. a. Define power in a linear mechanical system as work divided by time: $P = \frac{W}{t}$, or $P = \frac{F \times D}{t}$ b. Explain why power in a linear mechanical system also can be described as force times a rate: $P = F \times \frac{D}{t}$, or $P = F \times v$ c. Define power in a rotational mechanical system as work divided time: $P = \frac{W}{t}$, or $P = \frac{T \times ø}{t}$. d. Explain why power in a rotational mechanical system also can be described as a force times a rate: $P = T \times \frac{ø}{t}$, or $P = T \times \omega$ e. Identify the units of fluid power. f. Define efficiency as output power divided by input power. g. Use equations for power in a mechanical system to solve for an unknown.	**Teaching:** • Present the video "Power in Mechanical Systems" or a video related to mechanical systems technology from United Streaming (http://www.unitedstreaming.com). • Before the video ask the question, "What is meant by power in a mechanical system?" Lead a class discussion related to information learned from the video. • Using a multimedia presentation or the Internet, explain the concepts of power in mechanical systems. • Demonstrate the solving of problems using the equations for power. • Have students complete an activity sheet of real world problems solving for an unknown in the equation for power. **Assessment:** • Monitor student participation in activities. • Administer a written test related to power in mechanical systems.

STANDARDS

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Standard 9	Students will develop an understanding of engineering design.
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A1	Recognize, classify, and use real numbers and their properties.
A2	Recognize, create, extend, and apply patterns, relations, and functions and their applications.
A3	Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.
A4	Explore and communicate the characteristics and operations of polynomials.
A5	Utilize various formulas in problem-solving situations.
A6	Communicate using the language of algebra.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.

E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.
H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Ewen, P., Schurter, N., & Gundersen, E. P. (2005). *Applied physics*. Upper Saddle River, NJ: Prentice Hall.

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Technology Applications II
Unit 1: Orientation & Safety Review **(3 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe general policies and procedures for participating in the Technology Applications II course. a. Identify policies and procedures for instruction in the course. b. Demonstrate understanding of safety rules. c. Recognize classroom materials and resources that students will use in the course. d. Describe and apply principles of teamwork as related to the course and to careers.	**Teaching:** • Explain and discuss rules and procedures related to instruction in the class, including attendance policy, module schedules and rotations, inventory procedures, grading policies, classroom behavior, etc. • Provide each student with a written list of safety rules for the laboratory. Have students and parent/guardian to sign a contract agreeing to abide by these rules at all times. • Provide students with an overview of the equipment, materials, and other resources in the Technology Applications II lab. • Discuss workplace skills related to team building. Have students participate in team building activities and critique their roles and actions within the team. **Assessment:** • Observe students activity on a continuing basis. • Evaluate a written safety test (100% accuracy required) and signed contracts. • Observe role-playing activity and student's critique. Continue to observe teamwork throughout the year and critique as needed.
2. Investigate career and workplace skills. a. Discuss employer expectations of employees. b. Complete a personal interest profile. c. Demonstrate basic communication/presentation skills. d. Identify critical occupational safety skills.	**Teaching:** • Invite a guest speaker to discuss employer expectations with the class. (Videotape the presentation for use at other times.) Refer to the "What Employers Expect" poster available from MDE. • Have students complete the personal interest profile found in the Choices career software package. Review results of the profile with students. • Discuss basic oral and written communications skills as they will apply to the Technology Applications II course. This could include basic guidelines for journaling, demonstrations to teacher or other students, oral presentations with

	visual aids, etc. • Discuss occupational safety rules including rules related to signage and color coding, hazardous occupations, hazardous materials, ladders and scaffold, barriers, proximity work, etc. Show a video on industrial safety or invite an industrial safety specialist to speak to the class. **Assessment:** • Monitor students during a question and answer session with a guest speaker. • Review completed profile. • Observe student oral communication skills and documentation of written communication skills throughout the course. • Assess written documentation (essay, poster, presentation, test) on occupational safety skills for content and presentation.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.

Academic Standards

E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.

21st Century Skills

CS3	Civic Literacy
CS4	Information and Communication Skills
CS5	Thinking and Problem-Solving Skills
CS6	Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Ewen, P., Schurter, N., & Gundersen, E. P. (2005). *Applied physics*. Upper Saddle River, NJ: Prentice Hall.

Lima, M., & Oaks, W. (2006). *Service-learning engineering in your community.* Wildwood, MO: Great Lakes Press.

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Technology Applications II
Unit 2: Computer Assembly Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify basic concepts of computer assembly technology. a. Identify terms related to computer assembly technology. b. Identify the major components of a typical PC. c. Describe the power-on sequence of a typical PC. d. Explain how major components interact with each other. e. Identify common tools used to service a PC. f. Explain how to install a printer.	**Teaching:** • Have students use technology productivity tools and a digital camera to define and illustrate terms related to computer assembly technology. Terms can include but are not limited to input, output, processing, storage, disk drives, cables, cards, motherboard, hard disk, floppy disk, CD ROM drives, power cables, ribbon cables, panel cables, video cards, sound cards, network, sockets, slots, and ports. • Deliver a multimedia presentation on the basics of computing with time for students to ask questions throughout. Bring attention to the following during the presentation: o Input – Have students brainstorm all of the ways information can get into a computer and then allow students to pick their top three. Explain why the keyboard, mouse, and network interface cards are so important. Share with students basic troubleshooting techniques with input devices. o Output – Have students brainstorm all of the ways the computer can display information to the users. Allow students to pick their top three. Explain basic troubleshooting techniques with output devices such as a monitor, speaker, and printer. o Processing – Explain that data gets processed by a computer. o Storage – Explain that data inside a computer must be stored for a certain amount of time. Explain the concept of RAM and show students a sample of a memory chip. Also, explain that there are multiple types of storage devices such as floppy disks, compact disks, zip disk, jazz disk, and flash drives. Show examples of different types of

	storage devices and explain how the devices have evolved over time. o Computers and Numbers – Explain to students that computers only really understand one language – Mathematics. All computer programs are compiled data into mathematical machine language that the computer understands. Share with students that computers process numbers differently. Binary is a math with only 1's and 0's. Each 1 or 0 is called a bite. A total of 8 bites together is a byte. Have students practice counting in binary. • Demonstrate computer setup and Windows navigation. Observe students using basic windows operations such as navigating, copying files, finding files, viewing the control panel, etc. • Disassemble a standard desktop of tower PC, identifying the major components. Demonstrate the removal of covers from a variety of PC models. Have students use a Venn Diagram to compare and contrast an old computer system to a new computer system. • Have a dissembled computer on a table at the front of the classroom. Discuss each part of the computer and assemble the computer in front of students. • Have students work in pairs to practice setting up a computer system. Emphasize careful and neat setup. • Have students research the history of computer technology. Allow each student to select a leader in the field, such as Bill Gates, Steve Wozniak, Steve Jobs, Paul Allen, etc. Require students to read an autobiography about the leader they selected and create a report and presentation. The report and presentation should include but should not be limited to the person's leadership qualities, contributions to the field of technology, and hardships that were overcome by the leader.

	Assessment: • Have students take a written test on computer assembly technology terms. • Observe students setting up a computer system. Ask questions while students are setting up the system. • Evaluate report and presentation about the leader for content and presentation.
2. Perform applications of computer assembly technology. a. Identify each of the common types of Intel processors and demonstrate how to upgrade a system. b. Assemble a computer. c. Install print driver software. d. Complete printer setup and installation. e. Create a presentation demonstrating how to assemble a computer.	• Show the students the processors and let them handle the processors as the teacher discusses each one. • Deliver a multimedia presentation discussing the Pentium Motherboards – The Pentium motherboard has built-in hard disk auto detection. Demonstrate a machine upgrade. • Have students work in teams of three to remove a motherboard. Have students upgrade the processor and memory. Next, have students reassemble the unit and troubleshoot until it works. When the machine is working properly, give students hypothetical problems and allow them to discuss possible solutions. • Have students develop a presentation, brochure, newsletter, or reference sheet discussing basic troubleshooting techniques that teachers in the district can use before they call for technology support. • As an extension, have students work individually to disassemble and assemble old computers. Gather old computers from classrooms in the district. Dissemble the computers. Have all of the dissembled parts on a table for students to use while working. Have students work individually or in a group to assemble the computer. Be sure to include hardware and software components. **Assessment:** • Observe students as they disassemble and assemble computers. • Evaluate project about troubleshooting for content and presentation.
3. Solve problems related to computer	**Teaching:**

assembly technology. a. Investigate commonly practiced troubleshooting steps. b. Recognize common startup problems and understand their causes. c. Restart a PC in a variety of troubleshooting modules. d. Step through a PC's boot sequence. e. Explain how to access, repair, and back up files. f. Explain basic data recovery methods. g. Identify and diagnose common laser printer faults.	• Have students complete the Troubleshooting for Teachers Web quest (http://pangea.tec.selu.edu/~rbradburn/finalwebquest.html). • Give students sample scenarios of computer problems and have them use troubleshooting techniques to solve the problem. Sample scenarios may include but are not limited to the following: o To simulate a power problem, unconnect all power to the PC at the circuit breaker panel. Have students check the outlet for power. If this is not practical, modify a plug-in power strip so it will not function. Unplug and open the power strip, disconnect one of the hot wires, and tape up or cap off the end of the wire to prevent any chance of electrical shock. o To simulate a keyboard failure, unplug the keyboard and then reinsert far enough that it looks attached but is not electrically connected. o To restore a PC, restore the original autoexec.bat file. If the student runs or boots the computer more than once, the computer will boot into Safe Mode. • As a school service project, have Technology Applications second year students help teachers and students throughout the school with troubleshooting PC problems. **Assessment:** • Evaluate a written vocabulary test on terms related to computer assembly technology. • Observe students as they work on computers.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.

Secondary Technology Applications

Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5	Students will develop an understanding of the effects of technology on the environment.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influences of technology on history.

Academic Standards

E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4	Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5	Complete oral and written presentations which exhibit interaction and consensus within a group.
H2	Describe the impact of science and technology on the historical development of the United States in the global community.
H4	Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS1	Global Awareness
CS2	Financial, Economic, and Business Literacy
CS3	Civic Literacy
CS4	Information and Communication Skills
CS5	Thinking and Problem-Solving Skills
CS6	Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Lima, M., & Oaks, W. (2006). *Service-learning engineering in your community.* Wildwood, MO: Great Lakes Press.

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Roberts, R. M. (2005). *Lab manual to accompany computer service and repair: A guide to upgrading, configuring, troubleshooting, and networking personal computers.* Tinley Park, IL: The Goodheart-Wilcox.

Technology Applications II
Unit 3: Computer Networking Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify applications of computer networking technology a. Identify terms related to networking including but not limited to network, server, client, LAN, WAN, MAN, Network Interface Card (NIC), hub, switch, Cat5 Cable, fiber optic cable, and bandwidth. b. Describe a typical network and advantages of using a network. c. Identify different types of networks: client-server, peer-to-peer. d. Identify the geography of networks: LAN and WAN. e. Illustrate network topologies.	**Teaching:** • Use multimedia presentation equipment to introduce terminology related to networking and to discuss a typical network and the advantages of using a network. • Use presentation equipment to introduce, explain, and discuss the types of networks. Divide students into groups according to results of a learning style inventory. Have one group list characteristics and advantages of a P2P network, and the other list characteristics and advantages of a client-server network. • Tour the network in your lab and building, and/or district. Have students prepare a visual aid to demonstrate the connections in your lab, building, or district. After the tour, have students illustrate a LAN or WAN using technology productivity tools or bulletin board paper and markers. • Have students work in teams to create a concept map or flow chart of star, bus, and ring topologies. Have teams present and describe their illustrations to the class. **Assessment:** • Use a written test to evaluate student knowledge of terminology and general understanding of networking. • Assess visual aids for accuracy and neatness. • Evaluate team presentations using the Group Presentation Assessment Rubric located in Appendix D.
2. Perform applications of computer networking technology. a. Design a simple LAN. b. Set up network hardware. c. Install and configure server and client operating systems. d. Solve problems related to networking.	• Have students design a simple LAN for a given, chosen, or student-developed business/industry. Have students draw a simple floor plan of the business/industry and design the layout for the server and clients. Have students present and explain the designs to the class. • Have students connect power and

	peripherals for the server and the client, make patch cable(s), install punch down equipment, and connect the server and the client through a hub/switch. • Give students scenarios or case studies of possible problems related to networks. Have students determine solutions to the networking problems. Have students use the writing process to summarize the scenario or case study and the solution. **Assessment:** • Use a checklist or rubric to evaluate student networks. • Evaluate scenarios or case studies using the Written Report Writing Rubric located in Appendix D..

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5	Students will develop an understanding of the effects of technology on the environment.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influences of technology on history.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.

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

Academic Standards

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
E6 Explore cultural contributions to the history of the English language and its literature.
E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills

SUGGESTED REFERENCES

Lima, M., & Oaks, W. (2006). *Service-learning engineering in your community.* Wildwood, MO: Great Lakes Press.

Oaks, W. C., Leone, L. L., & Gunn, C. J. (2004). *Engineering your future: A comprehensive approach* (4th ed.). Wildwood, MO: Great Lakes Press.

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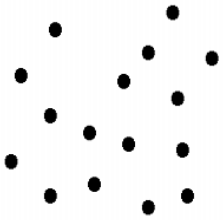
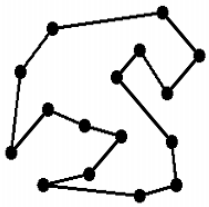
Technology Applications II
Unit 4: Computer Programming Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify applications of computer programming technology. a. Define terms associated with computer programming technology. b. Construct an algorithm for computer programming technology. c. Develop a basic understanding of the C++ programming language.	**Teaching:** • Display five to eight appropriate cartoons related to Computer Programming. Number each cartoon. Divide students into "touring groups" to fit the classroom space. Assign one group per cartoon as a starting point. Allow groups to spend two to five minutes at each cartoon, discussing the idea presented in the cartoon. Rotate the groups until all groups have "toured" each chart. When students return to their seats, allow time for a classroom discussion and reaction. • Using a multimedia presentation or the Internet, explain the following to the students: o Terms associated with computer programming technology that include but are not limited to binary, numbers, data types, loops, election, structure, functions, data, source code, algorithm, syntax error, run-time error, debugging, executable file, and complier. o How data are represented in bits and how numbers are converted to binary. o Differences between a high level and a low o Level language. o Base 2 numbering system. • Explain that everywhere, except for computer-related operations, the main system of mathematical notation today is the decimal system, which is a base-10 system. As in other number systems, the position of a symbol in a base-10 number denotes the value of that symbol in terms of exponential values of the base. That is, in the decimal system, the quantity represented by any of the ten symbols used (0, 1, 2, 3, 4, 5, 6, 7, 8, and 9) depends on its position in the number.

- Unlike the decimal system, only two digits (0, 1) suffice to represent a number in the binary system. The binary system plays a crucial role in computer science and technology. The first 20 numbers in the binary notation are 1, 10, 11, 100, 101, 110, 111, 1000, 1001, 1010, 1011, 1100, 1101, 1110, 1111, 10000, 10001, 10010, 10011, 10100, the origin of which may be better understood if they are rewritten in the following way.

1: 00001	11: 01011
2: 00010	12: 01100
3: 00011	13: 01101
4: 00100	14: 01110
5: 00101	15: 01111
6: 00110	16: 10000
7: 00111	17: 10001
8: 01000	18: 10010
9: 01001	19: 10011
10: 01010	20: 10100

- Any decimal number can be converted into the binary system by summing the appropriate multiples of the different powers of two. For example, starting from the right, 10101101 represents (1 x 20) + (0 x 21) + (1 x 22) + (1 x 23) + (0 x 24) + (1 x 25) + (0 x 26) + (1 x 27) = 117. This example can be used for the conversion of binary numbers into decimal numbers.
- For the conversion of decimal numbers to binary numbers, the same principle can be used, but the other way around. Thus, to convert, first find the highest power of two that does not exceed the given number, and place a 1 in the corresponding position in the binary number. For example, the highest power of two in the decimal number 519 is 29 = 512. Thus, a one can be inserted as the 10th digit, counted from the right: 1000000000.
- In the remainder, 519 - 512 = 7, the highest power of 2 is 22 = 4, so the third zero from the right can be replaced by a 1:

	1000000100. The next remainder, 3, consists of the sum of two powers of 2:21 + 20, so the first and second zeros from the right are replaced by 1:519 = 10000001112. Have the students calculate their age, their parent's age, and the amount of money they would like to earn as an adult as binary numbers. • Explain to the students that algorithms are already familiar to them in recipes for cooking, instructions for assembling a bicycle, etc. They are in anything that requires a sequential set of instructions. • Distribute the traveling salesman activity found at http://www.cs.sunysb.edu/~algorith/files/traveling-salesman.shtml to help explain algorithms. Have students connect the businesses in the shortest path possible to eliminate cost for the traveling salesman. Explain that gas and time have a significant cost to a traveling salesman. UPS uses an algorithm that is similar to this for their drivers to follow for deliveries Problem:  Solution:  • Have the students write an algorithm that details the shortest route possible from their house to the local shopping center. **Assessment:** • Monitor student participation in activities. • Evaluate student algorithms.

2. Perform applications of programming networking technology. a. Research careers related programming technology. b. Research and complete tutorials related to programming networking technology.	**Teaching:** • Have students use Web sites such as http://www.developers.net to find research, tutorials, and information related to careers in the programming area. • Have students visit sites such as http://www.cprogramming.com/tutorial.html#c++tutorial and complete the Learning to Program C++ tutorials and quizzes related to the following topics: o Introduction to C++ o If statements o Loops in C++ o Functions o Switch case o Pointers o Structures o Arrays o Strings o File I/O o Typecasting o Classes o Inline functions o Command line arguments o Linked lists o Inheritance o Inheritance continued o Initialization lists and inheritance o Templates in C++ **Assessment:** • Evaluate completed tutorials for accuracy.
3. Solve problems related to computer programming. a. Select a problem related to a career of interest that can be solved by using programming technology. b. Produce a solution to the problem using programming technology.	**Teaching:** • Have students select a problem related to a career of interest that can be solved by using programming technology. Have students use knowledge from the completed tutorials to create a program that solves the problem. • Have an expert from the programming field review the student's work and give feedback. • Have students improve their program based on the expert's input. • Have students present their program to the class. **Assessment:**

	• Use a presentation rubric to evaluate student presentations.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5	Students will develop an understanding of the effects of technology on the environment.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influences of technology on history.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A2	Recognize, create, extend, and apply patterns, relations, and functions and their applications.
B1	Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.

E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a group.

21st Century Skills

CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

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Technology Applications II
Unit 5: Geographic Information Systems (GIS) Technology (25 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe applications of geographic information systems technology. a. Define terms associated with GIS systems. b. Discuss how GIS relates to the environment.	**Teaching:** • Use the following to begin a classroom discussion: o When you flip on a local television station to find out what tomorrow's weather will be, you'll probably see photos of clouds taken from satellites in orbit around Earth. Satellites also make it possible for what other activities? • Using the proper resources, have students research the following connections between the four topics: o Electromagnetic spectrum Communications satellite o Weather satellite o Global Positioning Satellites (GPS). • If appropriate, have students discuss their experiences with Hurricane Katrina. Explain that many rescue efforts during Hurricane Katrina would have been impossible without GIS technology because of the destructions and distortions among the Barrier Islands and Mississippi and Louisiana Gulf Coast. Ask students to list other ways in which GIS benefits society today during the 21st century era. • Divide students into groups and have them compile a visual aid presentation or collage that reflects the evolutionary history of GIS. • Using the computer-generated images from Landsat have students calculate the intensity of two wavelengths for the purpose of explaining clarity and distortion. • Have students draw a map of the world on the paper provided. Have students use a graphic organizer to explain how their perspective of the world has changed as a result of the work they have done so far. **Assessment:**

	• Monitor student participation in discussions. • Assess student research of the connections of terminology. • Use the Group Presentation Assessment Rubric located in Appendix D to evaluate the visual aid and/or collage and graphic organizer.
2. Apply concepts of geographic information technology and environmental technology. a. Research possible problems that GIS can be used to help solve.	**Teaching:** • Provide each learner or group of learners with a piece of fruit. Oranges or grapefruits make excellent choices. Using a permanent marker have student to add major grid lines to project the Equator, Prime Meridian, and Tropics of Capricorn and Cancer. Using the best available map as a reference, reproduce the map on the globed fruit surface. When the maps are completed, use a camera to capture a close-up of the fruit resting on a black construction paper (background). Let the orange sit in a cool place over night. Have students to make cross sections in certain places, such as, the Equator. Thus, allowing them to simulate the GIS as a system selected data and geographical overlays. • Using the cross sections, the students can demonstrate distortions by applying pressure to the fruit upon a flat surface like a table top. Have students create distortions and then discuss how these distortions can cause major flaws in mapping systems. • Have students use the writing process to compile a written/oral report on geographic information systems and its uses. Encourage students to use the fruit demonstration as part of their report. • Have students reflect upon the terms longitude and latitude and demonstrate the term on paper. • Using a grid, have students demonstrate longitude and latitude. • Using hurricane tracking sheet and data from http://www.nhc.noaa.gov/ have

	students plot hurricane positions using longitude and latitude. **Assessment:** • Use a rubric such as the Group Presentation Assessment Rubric located in Appendix D to assess the fruit lab presentations and oral or written report. • Use a rubric or checklist to grade map drawings of longitude and latitude.
3. Infer the results of accumulated data using geographical information systems technology. a. Use GIS technology to solve problems.	**Teaching:** • Have students complete and Internet search to determine what the USGS represents? o Answer: United States Geological Survey • In groups allow students to complete a written/oral presentation that will outline the following about the USGS: o History. o Organization within the federal government. o Responsibilities of the agency. • Have students use GIS to examine the Earth in new ways using three dimensional analyses. • Using free software from the USGS, have students select a major GIS project that relates to the accumulation of data toward solving or examining an environmental problem. Sample projects may include but are not limited to: o Economic impacts of rivers in there communities. o Map alternative sites for local land field. o Examining the history of mining and the location of cemeteries in a community. o Earthquake locations as relating to fault lines. • Have students use the writing process and technology productivity tools to present the solution to their selected problem. **Assessment:** • Have students use auditory reflective responses and/or oral feedback.

	• Use a rubric or checklist such as the Written Report Writing Rubric located in Appendix D to evaluate oral or written report. • Use a presentation rubric to evaluate the environmental GIS project.

STANDARDS

ITEA Standards

Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influences of technology on history.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 13	Students will develop abilities to assess the impact of products and systems.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

B7	Investigate the interdependence and interactions that occur within an ecosystem.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4	Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
H4	Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).
H5	Analyze the contributions of Americans to the ongoing democratic process to include civic responsibilities.

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

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Technology Applications II
Unit 6: Programming Logic Control **(10 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Identify applications of programmable logic control (PLC) technology. a. Trace the history of the development of programmable logic control technology, including programmable automation controllers. b. Describe the purpose and applications of programmable logic control. c. Define terms related to programmable logic control technology. d. Explain ladder logic programming and how it differs from other types of programming. e. Explain the difference between microprocessors and personal computers	**Teaching:** • Utilizing multimedia, explain the origins and development of programmable logic control. • Illustrate how PLC devices are used to control devices in society. • Have students use technology productivity tools to research and illustrate terms associated with programmable logic control to include but are not limited to PLC, ladder logic, input terminals, output terminals, etc. • Using symbols on poster board simulate simple ladder logic programs with students acting as inputs and outputs (switches, relays, lights, buzzers, etc.). • If equipment and technology is available, give students problems to solve using ladder logic diagrams and illustrate the solutions. Have students summarize the programming faults and solutions. **Assessment:** • Give students a vocabulary test where they are required to spell the term correctly, write the definition, and use the term correctly in a sentence.
2. Create a statistical analysis of careers related to PLC. a. Compare and contrast the modern world of PLC and the ancient world of PLC. b. Research different careers, salaries, degree requirements, and possible college programs related to PLC. c. Research safety issues related to PLC. d. Present a statistical analysis.	**Teaching:** • Take students on an industry tour that uses PLC technology. • Have students use information from the Industry tour and research from the Internet to complete a statistical analysis report that summarizes and presents the following: o What industries in your area use PLC technologies? o How many people study PLC technologies? o What is the job market for PLC technologies? o How much do people who work with PLC technology earn?

	○ How many women and minorities work with PLC technology? **Assessment:** • Use a writing rubric to evaluate student reports.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5	Students will develop an understanding of the effects of technology on the environment.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influences of technology on history.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A2	Recognize, create, extend, and apply patterns, relations, and functions and their applications.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.

E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
H2 Describe the impact of science and technology on the historical development of the United States in the global community.
H3 Describe the relationship of people, places, and environments through time.

21st Century Skills

CS1 Global Awareness
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills

SUGGESTED REFERENCES

Gomez, A. G., Oakes, W. C., & Leone, L. L. (2004). *Engineering your future.* Wildwood, MO: Great Lakes Press.

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Technology Applications II
Unit 7: Electronic Control Systems Technology **(25 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Describe applications of electronic control systems technology. a. Trace the nature and evolution of electronic control systems technology. b. Identify terms related to electronic control systems technology. c. Explore logic gate characteristics - examine the types of logic gates and identify the gates: AND, NAND, NOT, NOR, OR.	**Teaching:** • Using Internet sources and class resources, have students research the nature and evolution of electronic control technology. • Define and illustrate the following words, including, but not limited to, alarm, analog electronics, AND gate, closed switch, digital electronics, input, logic gate, NAND gate, NOR gate, NOT gate, open switch, OR gate, output, process, relay, signal, and truth table. • Using technology applications tools and technical writing skills, the students will examine and explain in detail analog and digital electronics, and discuss the question, "Is there a reason to use one over the other?" • Using presentation software, the students will choose one of the logic gates (AND, NAND, NOT, NOR, OR), discuss its inputs and outputs, display its symbol, and prepare its truth table. **Assessment:** • Assess a vocabulary test that requires students to list, spell, define, and use appropriate terms in a sentence. • Evaluate logic gate presentations using a rubric such as the Group Presentation Assessment Rubric located in Appendix D.
2. Apply concepts of electronic control systems technology. a. Conduct a practical exercise to identify components of electronic control systems technology. b. Construct truth tables associated with each of the gates: AND, NAND, NOT, NOR, OR. c. Engage in a practical exercise to construct and demonstrate projects that will utilize light sensors, proximity sensors, infrared sensors, touch sensors, speed controls, relays	**Teaching:** • Using their notes, have students complete a real-world activity to identify the logic gate symbols and truth tables associated with each logic gate. • Using lab equipment, have students complete exercises to determine the input, process, and output of an analog system. • Using lab equipment, have students complete an exercise to determine the input, process, and output of a digital system. **Assessment:**

and solenoids.	• Evaluate lab activities. • Have students complete a written test related to electronic control technology.

STANDARDS

ITEA Standards

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.

Academic Standards

A1	Recognize, classify, and use real numbers and their properties.
A2	Recognize, create, extend, and apply patterns, relations, and functions and their applications.
E1	Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2	Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3	Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4	Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.

21st Century Skills

CS4	Information and Communication Skills
CS5	Thinking and Problem-Solving Skills
CS6	Interpersonal and Self-Directional Skills

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Technology Applications II
Unit 8: Computer Integrated Manufacturing Technology (60 hours)

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Design a robotics program. a. Identify safety measures for robotics and materials handling. b. Identify robotic system components. c. Identify the components of a robotic software program. d. Design, program and execute a robotics application.	**Teaching:** • Have students research Computer Integrated Manufacturing and its impact at a regional, state, national, and global level. Have students use the writing process and technology productivity tools to present their writing product. Have students include a timeline of the progression of Computer Integrated Manufacturing. • Have students learn the safety measures for robotics and material handling systems. • Have students identify hardware components and software. • Have students learn to activate the robotic control software, home the robot, move the robot joints, operate the gripper, and set and use different speeds of motion. • Have students learn to record absolute positions, list and delete positions, save and load positions, and move the robot to recorded positions. • Have students write and edit a simple robot program, load and save a robot program file, run the robot program, learn how to abort the program execution. • Have students define and use pick and place positions and use intermediate positions; then, have them program the robot for a pick and place task. • Have students define inputs and outputs, learn to use unconditional and conditional jump commands, and then enable the robotic system to read and respond to input signals. • Have students define outputs, produce output signals, and then include output commands in a robotic program. • Have students define joint and Cartesian (XYZ) coordinate systems, instruct the robot to move according to joints and XYZ axes, and instruct the robot to move in linear movements.

	• Have the students define relative positions and program robot tasks using relative positions. • Have students create program loops using counters/variables, and create conditional program loops. • Have students create program subroutines, and to use additional programming commands such as Remarks and RingBell. • Have students integrate a contact sensor (microswitch) in the robot workcell, integrate a noncontact sensor (photoelectric sensor) in the workcell, program the robot for a horizontal approach to a pick position, and use a "drop-off" position in a robotic program. • Have students record conveyor positions, use the conveyor to deliver materials, and use the movement commands to operate the conveyor as a servo axis. • Have the students learn to use commands to start and stop continuous motion of the conveyor and use conditional input commands for controlling conveyor operation. • Assign a final robotic programming project which has student design an application which involves using the parts feeder, conveyor, and microswitch box. **Assessment:** • Monitor student participation in activities. • Evaluate final project using a rubric such as the Directed Individual Project Checklist located in Appendix D. • Evaluate posttest quiz on robotics and materials handling.
2. Construct a computer numerical control program (CNC). a. Identify safety rules for operating a machining center. b. Identify machining center hardware components. c. Identify the components of a CNC software program. d. Identify and create an NC (numerical control) part program.	**Teaching:** • Have students learn all safety rules for operating the machining center. • Have students identify all machining hardware components. • Have students start the control program and learn all program screens, inputs and outputs, and to be able to jog the machining center x, y, and z axes. • Have students learn to mount the

e. Verify and run a numerical control program in a machining center. f. Develop an NC part program from a part drawing.	workpiece in the machining center vice, home the machine, and set stock parameters. • Have students learn to install and mount a tool and define the tool in the control program. • Discuss with students the difference between machine coordinates and machine zero with work coordinates (workpiece origin or PRZ). • Have students load a program, adjust the verification settings, and verify, then dry run the program. • Have students mount a workpiece, install the appropriate tool, set the workpiece origin, verify, and then run the run program. • Discuss with students how to create an NC program. Discuss how to write a typical block of NC code. Discuss all individual parts that make up the block. Provide activities for writing correct NC part programs. • Discuss and review with students coordinate geometry in two and three-dimensional systems. Describe absolute and incremental programming • Have students develop an NC part program from a part drawing. Have students create a part drawing and plot the coordinates for the part program on graph paper. Have students determine the best cutting sequence. Then have students construct the NC program to machine the part. Have students enter the program in the control program. Have students verify and run the program. **Assessment:** • Evaluate safety test for a score of 100%. • Assess student worksheets for each unit that correlate to each activity in the CNC. • Monitor student participation in activities. • Evaluate parts generated using a rubric. • Assess posttest quiz on CNC programming.
3. Setup a computer integrated	**Teaching**

manufacturing cell (CIM) which will enable handshaking between a robot and a milling machine. a. Identify the components of a CIM cell. b. Develop a program for moving the robot to all positions in the CIM cell and synchronizes the robot's movements with mill's operations. c. Develop an NC program to make a part, and have the mill synchronize with the robot.	• Review safety rules with students for all components within the CIM cell. • Have students record absolute and relative robot positions for parts handling at each component within the CIM cell, including the parts feeder, for mill tending, and the parts bin. • Have the students write a robot program for moving the robot to all positions in the CIM cell. Run the program with and without the robot handling work pieces. Control and test program flow by simulating input signals. • Have students measure the time it takes to complete the production cycle. Determine ways to optimize production time. • Discuss with students robot digital inputs and outputs and mill inputs and outputs to ensure understanding. Have students write the NC program for input/output communication with the robot. • Have students write the robot program which synchronizes the robot's movement with the mill's operation. Then complete the program which synchronizes the mill with the robot. • Have students execute a dry run of the complete CIM production cycle, the have them execute an actual productions cycle. • As a final advanced project, have students design their own production cycle within the CIM cell. Students could alter their original robot program to take parts to different compartments in the sorting bin, and/or the conveyor belt. Students could alter their original NC codes to engrave a different part. **Assessment:** • Assess student worksheets for each unit that correlate to each activity in the CNC Technology student activities book. • Monitor participation in activities. • Assess final advanced project with a rubric. • Assess posttest quiz on CIM production.

STANDARDS

ITEA Standards

HCS1 Health care workers will know the academic subject matter required for proficiency within their area. They will use this knowledge as needed in their role.
HCS4 Health care workers will understand how employability skills enhance their employment opportunities and job satisfaction. They will demonstrate key employability skills and will maintain and upgrade skills, as needed.
HCS8 Health care workers will understand the roles and responsibilities of individual members as part of a health care team, including their ability to promote the delivery of quality health care. They will interact effectively and sensitively with all members of the health care team.

Academic Standards

A1 Recognize, classify, and use real numbers and their properties.
A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

21st Century Skills

CS1 Global Awareness
CS2 Financial, Economic, and Business Literacy
CS3 Civic Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Gomez, A. G., Oakes, W. C., & Leone, L. L. (2004). *Engineering your future.* Wildwood, MO: Great Lakes Press.

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Technology Applications II
Unit 9: Directed Individual Project **(22 hours)**

Competencies and Suggested Objectives	Suggested Strategies for Competencies
1. Use science, technology, engineering, and mathematical principles and concepts to create solutions for real-world problems related to a career of interest. a. Identify a problem related to a career of interest. b. Gather research related to the problem. c. Analyze potential solutions for the problem. d. Develop and test models related to the solution. e. Present the best solution related to the problem. f. Perform post-implementation review and assessment of the solution.	**Teaching:** • Have students work individually to identify a problem related to a career of interest. • Have students use all resources and tools available to gather research related to the problem. • Have students brainstorm possible solutions for the problem. Have students select the best solution to the problem. • Using technology application tools develop a plan for inventing the solution to the problem. Develop a scale model and/or prototype related to the solution. The model and/or prototype must include the use of at least three different types of materials. • Have students develop a marketing plan for their invention. The plan can include but is not limited to: o Cost of development o Cost of production o Advertisement and/or public relations material o Benefits to the consumer • Using technology resource tools, have students create a design portfolio that includes the following: o Summary of important design constraints and the problem solving steps and an organizational/flow chart describing the title and responsibility of each step of the solution. o Research conducted by the designer. o Documentation of brainstorming possible solutions. o Documentation of a minimum of three possible solutions with a brief evaluating each solution. o Details about the solution including a 3D-technical drawing or rendering. o Summary of how science,

	mathematical, and technology skills and concepts are part of the solutions. o An explanation of the evaluation of how well the final solution meets the design brief and explanation of the possible impact the solution will have on society and the environment. • Have students present their product to a panel of industry and community members. **Assessment:** • Use the Directed Individual Project Checklist located in Appendix D to evaluate student projects.

STANDARDS

ITEA Standards

Standard 8	Students will develop an understanding of the attributes of design.
Standard 9	Students will develop an understanding of engineering design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11	Students will develop abilities to apply the design process.
Standard 12	Students will develop abilities to use and maintain technological products and systems.
Standard 13	Students will develop abilities to assess the impact of products and systems.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

Academic Standards

A1 Recognize, classify, and use real numbers and their properties.

A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
E5 Complete oral and written presentations which exhibit interaction and consensus within a

21st Century Skills

CS2 Financial, Economic, and Business Literacy
CS4 Information and Communication Skills
CS5 Thinking and Problem-Solving Skills
CS6 Interpersonal and Self-Directional Skills

SUGGESTED REFERENCES

Gomez, A. G., Oakes, W. C., & Leone, L. L. (2004). *Engineering your future.* Wildwood, MO: Great Lakes Press.

Katz, J. R. (2000). *Keys to science success.* Upper Saddle River, NJ: Prentice Hall.

Oaks, W. C., Leone, L. L., & Gunn, C. J. (2004). *Engineering your future: A comprehensive approach* (4th ed.). Wildwood, MO: Great Lakes Press.

Oaks, W. C., Leone, L. L., & Potter, M. C. (2003). *Engineering your future: A problem-oriented approach.* Wildwood, MO: Great Lakes Press.

Oaks, W. C., Leone, L. L., & Potter, M. C. (2003). *Engineering your future: A short course.* Wildwood, MO: Great Lakes Press.

Oaks, W. C., Leone, L. L., & Potter, M. C. (2003). *Engineering your future: A student's guide.* Wildwood, MO: Great Lakes Press.

Orsak, G. C., Wood, S. L., Douglas, S. C., Munson, D. C. Jr., Rauindra, A., & Yoder, M. A. (2004). *The infinity project: Engineering our digital future.* Upper Saddle River, NJ: Prentice Hall.

Recommended Tools and Equipment

CAPITALIZED ITEMS

1. Color Inkjet Printer (1)
2. Computer Power/Surge Suppressor (10)
3. Display Device - VGA to NTSC TV Scan (1)
4. File Server (Personal Computer) with internal tape back-up drive (2)
5. Headphones with Adapters and Cords (10)
6. Instructional Modules and Equipment (1 of each):
    a. Computer Aided Drafting and Design (CADD) Technology
    b. Computer Aided Drafting/Computer Aided Manufacturing (CAD/CAM) Technology
    c. Computer Assembly Technology
    d. Electronic Control Systems Technology
    e. Electrical Systems Technology
    f. Fluid Systems Technology
    g. Geographic Information Systems Technology
    h. Mechanical Systems Technology
    i. Programmable Logic Control (PLC) Technology
    j. Computer Integrated Manufacturing (CIM) Technology
7. Laser Printer with I/O Cable (1)
8. Network Smart Hub, Including Wiring and Installation (1)
9. Optical Scanner, Full Page Color (1)
10. Personal Computer with Modem (2)
11. Personal Computer (6)
12. Software, Operating System (Site license and workstation licenses) (1)
13. Training Network (Includes mini hub and category 5 installation kit (1)
14. Uninterruptible Power Supply (1)

NON-CAPITALIZED ITEMS

1. Copy holder (25)
2. Disk holders (25)

RECOMMENDED INSTRUCTIONAL AIDS

It is recommended that instructors have access to the following items:

1. Data projector with screen (1)
2. Access to a digital video camera (1)
3. Access to a digital camera (1)
4. Access to a copier (1)
5. Teacher workstation with CD-RW, DVD+/-RW (1)

ASSESSMENT

BLUEPRINT

This program is assessed using the MS-CPAS. The following blueprint summary contains the competencies that are measured when assessing this program. Competencies are grouped into *clusters* and a weight is given to each cluster to determine the number of items needed from each cluster. The numbers of C1s and C2s (item difficulty levels) are also indicated on the blueprint.

Title of Program: Technology Applications 30LL Program Level: Secondary

Cluster/Competency	**Level 1 (C1)**	**Level 2 (C2)**	**TOTAL**	**%**
	Number	Number		
Cluster 1: **PRINCIPLES OF ENGINERING** Tech I, Units 2, 3, 4	8	3	11	11%
Cluster 2: **TECHNOLOGY OPERATION & APPLICATIONS** Tech I, Units 5 Tech II, Units 2, 3, 4, 5	20	9	29	29%
Cluster 3 : **MANUFACTURING** Tech I, Units 6, 7 Tech II, Units 6, 8	21	9	30	30%
Cluster 4: **SYSTEMS TECHNOLOGY** Tech I, Units 8, 9, 10, 11 Tech II, Units 7	21	9	30	30%
Total Questions:	70	30	100	100%

Appendix A: International Technology Education Association (ITEA) Study of Technology Literacy Content Standards[1]

Standard 1	Students will develop an understanding of the characteristics and scope of technology.
Standard 2	Students will develop an understanding of the core concepts of technology.
Standard 3	Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
Standard 4	Students will develop an understanding of the cultural, social, economic, and political effects of technology.
Standard 5	Students will develop an understanding of the effects of technology on the environment.
Standard 6	Students will develop an understanding of the role of society in the development and use of technology.
Standard 7	Students will develop an understanding of the influences of technology on history.
Standard 8	Students will develop an understanding of the attributes of design.
Standard 9	Students will develop an understanding of engineering design.
Standard 10	Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Standard 11	Students will develop abilities to apply the design process.
Standard 12	Students will develop abilities to use and maintain technological products and systems.
Standard 13	Students will develop abilities to assess the impact of products and systems.
Standard 14	Students will develop an understanding of and be able to select and use medical technologies.
Standard 15	Students will develop an understanding of and be able to select and use agricultural and related biotechnologies.
Standard 16	Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17	Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 18	Students will develop an understanding of and be able to select and use transportation technologies.
Standard 19	Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20	Students will develop an understanding of and be able to select and use construction technologies.

[1] International Technology Education Association. (n.d.). *Listing of STL content standards*. Retrieved December 6, 2006, from http://www.iteaconnect.org/TAA/PDFs/ListingofSTLContentStandards.pdf

Appendix B: Academic Standards

Algebra I[2]

Competencies and Suggested Objective(s)

A1 Recognize, classify, and use real numbers and their properties.
- a. Describe the real number system using a diagram to show the relationships of component sets of numbers that compose the set of real numbers.
- b. Model properties and equivalence relationships of real numbers.
- c. Demonstrate and apply properties of real numbers to algebraic expressions.
- d. Perform basic operations on square roots excluding rationalizing denominators.

A2 Recognize, create, extend, and apply patterns, relations, and functions and their applications.
- a. Analyze relationships between two variables, identify domain and range, and determine whether a relation is a function.
- b. Explain and illustrate how change in one variable may result in a change in another variable.
- c. Determine the rule that describes a pattern and determine the pattern given the rule.
- d. Apply patterns to graphs and use appropriate technology.

A3 Simplify algebraic expressions, solve and graph equations, inequalities and systems in one and two variables.
- a. Solve, check, and graph linear equations and inequalities in one variable, including rational coefficients.
- b. Graph and check linear equations and inequalities in two variables.
- c. Solve and graph absolute value equations and inequalities in one variable.
- d. Use algebraic and graphical methods to solve systems of linear equations and inequalities.
- e. Translate problem-solving situations into algebraic sentences and determine solutions.

A4 Explore and communicate the characteristics and operations of polynomials.
- a. Classify polynomials and determine the degree.
- b. Add, subtract, multiply, and divide polynomial expressions.
- c. Factor polynomials using algebraic methods and geometric models.
- d. Investigate and apply real number solutions to quadratic equations algebraically and graphically.
- e. Use convincing arguments to justify unfactorable polynomials.
- f. Apply polynomial operations to problems involving perimeter and area.

A5 Utilize various formulas in problem-solving situations.
- a. Evaluate and apply formulas (e.g., circumference, perimeter, area, volume, Pythagorean Theorem, interest, distance, rate, and time).
- b. Reinforce formulas experimentally to verify solutions.

[2] *Mississippi mathematics framework—Algebra I*. (2003). Retrieved September 10, 2003, from http://www.mde.k12.ms.us/curriculum/index_1.htm

c. Given a literal equation, solve for any variable of degree one.
d. Using the appropriate formula, determine the length, midpoint, and slope of a segment in a coordinate plane.
e. Use formulas (e.g., point-slope and slope-intercept) to write equations of lines.

A6 Communicate using the language of algebra.
a. Recognize and demonstrate the appropriate use of terms, symbols, and notations.
b. Distinguish between linear and non-linear equations.
c. Translate between verbal expressions and algebraic expressions.
d. Apply the operations of addition, subtraction, and scalar multiplication to matrices.
e. Use scientific notation to solve problems.
f. Use appropriate algebraic language to justify solutions and processes used in solving problems.

A7 Interpret and apply slope as a rate of change.
a. Define slope as a rate of change using algebraic and geometric representations.
b. Interpret and apply slope as a rate of change in problem-solving situations.
c. Use ratio and proportion to solve problems including direct variation (y=kx).
d. Apply the concept of slope to parallel and perpendicular lines.

A8 Analyze data and apply concepts of probability.
a. Collect, organize, graph, and interpret data sets, draw conclusions, and make predictions from the analysis of data.
b. Define event and sample spaces and apply to simple probability problems.
c. Use counting techniques, permutations, and combinations to solve probability problems.

Biology I[3]

Competencies and Suggested Objective(s)

B1 Utilize critical thinking and scientific problem solving in designing and performing biological research and experimentation.
a. Demonstrate the proper use and care for scientific equipment used in biology.
b. Observe and practice safe procedures in the classroom and laboratory.
c. Apply the components of scientific processes and methods in the classroom and laboratory investigations.
d. Communicate results of scientific investigations in oral, written, and graphic form.

B2 Investigate the biochemical basis of life.
a. Identify the characteristics of living things.
b. Describe and differentiate between covalent and ionic bonds using examples of each.
c. Describe the unique bonding and characteristics of water that makes it an essential component of living systems.

[3] *Mississippi science framework—Biology I.* (2003). Retrieved September 10, 2003, from http://www.mde.k12.ms.us/curriculum/index-1.htm

d. Classify solutions using the pH scale and relate the importance of pH to organism survival.
e. Compare the structure, properties and functions of carbohydrates, lipids, proteins and nucleic acids in living organisms.
f. Explain how enzymes work and identify factors that can affect enzyme action.

B3 Investigate cell structures, functions, and methods of reproduction.
a. Differentiate between prokaryotic and eukaryotic cells.
b. Distinguish between plant and animal (eukaryotic) cell structures.
c. Identify and describe the structure and basic functions of the major eukaryotic organelles.
d. Describe the way in which cells are organized in multicellular organisms.
e. Relate cell membrane structure to its function in passive and active transport.
f. Describe the main events in the cell cycle and cell mitosis including differences in plant and animal cell divisions.
g. Relate the importance of meiosis to sexual reproduction and the maintenance of chromosome number.
h. Identify and distinguish among forms of asexual and sexual reproduction.

B4 Investigate the transfer of energy from the sun to living systems.
a. Describe the structure of ATP and its importance in life processes.
b. Examine, compare, and contrast the basic processes of photosynthesis and cellular respiration.
c. Compare and contrast aerobic and anaerobic respiration.

B5 Investigate the principles, mechanisms, and methodology of classical and molecular genetics.
a. Compare and contrast the molecular structures of DNA and RNA as they relate to replication, transcription, and translation.
b. Identify and illustrate how changes in DNA cause mutations and evaluate the significance of these changes.
c. Analyze the applications of DNA technology (forensics, medicine, agriculture).
d. Discuss the significant contributions of well-known scientists to the historical progression of classical and molecular genetics.
e. Apply genetic principles to solve simple inheritance problems including monohybrid crosses, sex linkage, multiple alleles, incomplete dominance, and codominance.
f. Examine inheritance patterns using current technology (gel electrophoresis, pedigrees, karyotypes).

B6 Investigate concepts of natural selection as they relate to diversity of life.
a. Analyze how organisms are classified into a hierarchy of groups and subgroups based on similarities and differences.
b. Identify characteristics of kingdoms including monerans, protists, fungi, plants and animals.
c. Differentiate among major divisions of the plant and animal kingdoms (vascular/non-vascular; vertebrate/invertebrate).
d. Compare the structures and functions of viruses and bacteria relating their impact on other living organisms.

e. Identify evidence of change in species using fossils, DNA sequences, anatomical and physiological similarities, and embryology.
f. Analyze the results of natural selection in speciation, diversity, adaptation, behavior and extinction.

B7 Investigate the interdependence and interactions that occur within an ecosystem.
a. Analyze the flow of energy and matter through various cycles including carbon, oxygen, nitrogen and water cycles.
b. Interpret interactions among organisms in an ecosystem (producer/consumer/decomposer, predator/prey, symbiotic relationships and competitive relationships).
c. Compare variations, tolerances, and adaptations of plants and animals in major biomes.
d. Investigate and explain the transfer of energy in an ecosystem including food chains, food webs, and food pyramids.
e. Examine long and short-term changes to the environment as a result of natural events and human actions.

English II[4]

Competencies and Suggested Objective(s)

E1 Produce writing which reflects increasing proficiency through planning, writing, revising, and editing and which is specific to audience and purpose.
a. Produce individual and/or group compositions and/or projects to persuade, tell a story, describe, create an effect, explain or justify an action or event, inform, entertain, etc.
b. Produce writing typically used in the workplace such as social, business, and technical correspondence; explanation of procedures; status reports; research findings; narratives for graphs; justification of decisions, actions, or expenses; etc.
c. Write a response, reaction, interpretation, analysis, summary, etc., of literature, other reading matter, or orally presented material.
d. Revise to ensure effective introductions, details, wording, topic sentences, and conclusions.

E2 Communicate ideas for a variety of school and other life situations through listening, speaking, and reading aloud.
a. Listen to determine the main idea and supporting details, to distinguish fact from opinion, and to determine a speaker's purpose or bias.
b. Speak with appropriate intonation, articulation, gestures, and facial expression.
c. Speak effectively to explain and justify ideas to peers, to inform, to summarize, to persuade, to entertain, to describe, etc.

E3 Read, evaluate, and use print, non-print, and technological sources to research issues and problems, to present information, and to complete projects.
a. Read, view, and listen to distinguish fact from opinions and to recognize persuasive and manipulative techniques.

[4] *Mississippi language arts framework—English II*. (2003). Retrieved September 10, 2003, from http://www.mde.k12.ms.us/curriculum/index_1/.htm

b. Access both print and non-print sources to produce an I-Search paper, research paper, or project.
c. Use computers and audio-visual technology to access and organize information for purposes such as resumes, career search projects, and analytical writings, etc.
d. Use reference sources, indices, electronic card catalog, and appropriate research procedures to gather and synthesize information.

E4 Work individually and as a member of a team to analyze and interpret information, to make decisions, to solve problems, and to reflect, using increasingly complex and abstract thinking.
a. Interact with peers to examine real world and literary issues and ideas.
b. Show growth in critical thinking, leadership skills, consensus building, and self-confidence by assuming a role in a group, negotiating compromise, and reflecting on individual or group work.

E5 Complete oral and written presentations which exhibit interaction and consensus within a group.
a. Share, critique, and evaluate works in progress and completed works through a process approach.
b. Communicate effectively in a group to present completed projects and/or compositions.
c. Edit oral and written presentations to reflect correct grammar, usage, and mechanics.

E6 Explore cultural contributions to the history of the English language and its literature.
a. Explore a variety of works from various historical periods, geographical locations, and cultures, recognizing their influence on language and literature.
b. Identify instances of dialectal differences which create stereotypes, perceptions, and identities.
c. Recognize root words, prefixes, suffixes, and cognates.
d. Relate how vocabulary and spelling have changed over time.

E7 Discover the power and effect of language by reading and listening to selections from various literary genres.
a. Listen to and read aloud selected works to recognize and respond to the rhythm and power of language to convey a message.
b. Read aloud with fluency and expression.
c. Analyze the stylistic devices, such as alliteration, assonance, word order, rhyme, onomatopoeia, etc., that make a passage achieve a certain effect.
d. Demonstrate how the use of language can confuse or inform, repel or persuade, or inspire or enrage.
e. Analyze how grammatical structure or style helps to create a certain effect.

E8 Read, discuss, analyze, and evaluate literature from various genres and other written material.
a. Read and explore increasingly complete works, both classic and contemporary, for oral discussion and written analysis.
b. Read, discuss, and interpret literature to make connections to life.
c. Read from a variety of genres to understand how the literary elements contribute to the overall quality of the work.

d. Identify qualities in increasingly complex literature that have produced a lasting impact on society.
e. Read for enjoyment, appreciation, and comprehension of plot, style, vocabulary, etc.

E9 Sustain progress toward fluent control of grammar, mechanics, and usage of standard English in the context of writing and speaking.
a. Infuse the study of grammar and vocabulary into written and oral communication.
b. Demonstrate, in the context of their own writing, proficient use of the conventions of standard English, including, but not limited to, the following: complete sentences, subject-verb agreement, plurals, spellings, homophones, possessives, verb forms, punctuation, capitalization, pronouns, pronoun-antecedent agreement, parallel structure, and dangling and misplaced modifiers.
c. Give oral presentations to reinforce the use of standard English.
d. Employ increasingly proficient editing skills to identify and solve problems in grammar, usage, and structure.

E10 Use language and critical thinking strategies to serve as tools for learning.
a. Use language to facilitate continuous learning, to record observations, to clarify thought, to synthesize information, and to analyze and evaluate language.
b. Interpret visual material orally and in writing.

U. S. History from 1877[5]

Competencies and Suggested Objective(s)

H1 Explain how geography, economics, and politics have influenced the historical development of the United States in the global community.
a. Apply economic concepts and reasoning when evaluating historical and contemporary social developments and issues (e.g., gold standard, free coinage of silver, tariff issue, laissez faire, deficit spending, etc.).
b. Explain the emergence of modern America from a domestic perspective (e.g., frontier experience, Industrial Revolution and organized labor, reform movements of Populism and Progressivism, Women's Movement, Civil Rights Movement, the New Deal, etc.).
c. Explain the changing role of the United States in world affairs since 1877 through wars, conflicts, and foreign policy (e.g., Spanish-American War, Korean conflict, containment policy, etc.).
d. Trace the expansion of the United States and its acquisition of territory from 1877 (e.g., expansionism and imperialism).

H2 Describe the impact of science and technology on the historical development of the United States in the global community.
a. Analyze the impact of inventions on the United States (e.g., telephone, light bulb, etc.).
b. Examine the continuing impact of the Industrial Revolution on the development of our nation (e.g., mass production, computer operations, etc.).

[5] *Mississippi social studies framework—U.S. History from 1877*. (2003). Retrieved September 10, 2003, from http://www.mde.k12.ms.us/curriculum/index_1.htm

c. Describe the effects of transportation and communication advances since 1877.

H3 Describe the relationship of people, places, and environments through time.

a. Analyze human migration patterns since 1877 (e.g., rural to urban, the Great Migration, etc.).

b. Analyze how changing human, physical, geographic characteristics can alter a regional landscape (e.g., urbanization, Dust Bowl, etc.).

H4 Demonstrate the ability to use social studies tools (e.g., timelines, maps, globes, resources, graphs, a compass, technology, etc.).

a. Interpret special purpose maps, primary/secondary sources, and political cartoons.

b. Analyze technological information on graphs, charts, and timelines.

c. Locate areas of international conflict (e.g., Caribbean, Southeast Asia, Europe, etc.).

H5 Analyze the contributions of Americans to the ongoing democratic process to include civic responsibilities.

a. Examine various reform movements (e.g., Civil Rights, Women's Movement, etc.).

b. Examine the government's role in various movements (e.g., arbitration, 26th Amendment, etc.).

c. Examine the role of government in the preservation of citizens' rights (e.g., 19th Amendment, Civil Rights Act of 1964).

d. Examine individuals' duties and responsibilities in a democratic society (e.g., voting, volunteerism, etc.).

Appendix C: 21st Century Skills[6]

CS1 Global Awareness

- Using 21st century skills to understand and address global issues
- Learning from and working collaboratively with individuals representing diverse cultures, religions, and lifestyles in a spirit of mutual respect and open dialogue in personal, work, and community contexts
- Promoting the study of non-English language as a tool for understanding other nations and cultures

CS2 Financial, Economic, and Business Literacy

- Knowing how to make appropriate personal economic choices
- Understanding the role of the economy and the role of business in the economy
- Applying appropriate 21st century skills to function as a productive contributor within an organizational setting
- Integrating oneself within and adapting continually to our nation's evolving economic and business environment

CS3 Civic Literacy

- Being an informed citizen to participate effectively in government
- Exercising the rights and obligations of citizenship at local, state, national, and global levels
- Understanding the local and global implications of civic decisions
- Applying 21st century skills to make intelligent choices as a citizen

CS4 Information and Communication Skills

- Information and media literacy skills: Analyzing, accessing, managing, integrating, evaluating, and creating information in a variety of forms and media; understanding the role of media in society
- Communication skills: Understanding, managing, and creating effective oral, written, and multimedia communication in a variety of forms and contexts

CS5 Thinking and Problem-Solving Skills

- Critical thinking and systems thinking: Exercising sound reasoning in understanding and making complex choices, understanding the interconnections among systems
- Problem identification, formulation, and solution: Ability to frame, analyze, and solve problems
- Creativity and intellectual curiosity: Developing, implementing, and communicating new ideas to others, staying open and responsive to new and diverse perspectives

CS6 Interpersonal and Self-Directional Skills

- Interpersonal and collaborative skills: Demonstrating teamwork and leadership, adapting to varied roles and responsibilities, working productively with others, exercising empathy, respecting diverse perspectives
- Self-direction: Monitoring one's own understanding and learning needs, locating appropriate resources, transferring learning from one domain to another
- Accountability and adaptability: Exercising personal responsibility and flexibility in personal, workplace, and community contexts; setting and meeting high standards and goals for one's self and others; tolerating ambiguity

[6] *21st century skills.* (n.d.). Washington, DC: Partnership for 21st Century Skills.

- Social responsibility: Acting responsibly with the interests of the larger community in mind; demonstrating ethical behavior in personal, workplace, and community contexts

Group Participation Assessment Rubric

	Beginning	Developing	Accomplished	Exemplary	Score
	1 point	2 points	3 points	4 points	
Group Discussions	Rarely contributed to discussions of the group	Contributed good effort to discussions of the group	Contributed great effort to discussions of the group	Contributed exceptional effort to discussions of the group	
On-task Behavior	Exhibited on-task behavior inconsistently	Exhibited on-task behavior some of the time	Exhibited on-task behavior most of the time	Exhibited on-task behavior consistently	
Helping Others	Did not assist other group members	Seldom assisted other group members	Occasionally assisted other group members	Assisted other group members	
Listening	Ignored ideas of group members	Seldom listened to ideas of group members	Occasionally listened to ideas of group members	Always listened to ideas of group members	

Group Presentation Assessment Rubric

	Exemplary 4 points	**Accomplished** 3 points	**Developing** 2 points	**Beginning** 1 point	**Score**
Content	Clear, appropriate, and correct	Mostly clear, appropriate, and correct	Somewhat confusing, incorrect, or flawed	Confusing, incorrect, or flawed	
Clarity	Logical, interesting sequence	Logical sequence	Unclear sequence	No sequence	
Presentation	Clear voice and precise pronunciation	Clear voice and mostly correct pronunciation	Low voice and incorrect pronunciation	Mumbling and incorrect pronunciation	
Visual Aids	Attractive, accurate, and grammatically correct	Adequate, mostly accurate, and few grammatical errors	Poorly planned, somewhat accurate, or some grammatical errors	Weak, inaccurate, or many grammatical errors	
Length	Appropriate length	Slightly too long or short	Moderately too long or short	Extremely too long or short	
Participation	Well-balanced participation by all group members	All group members have significant participation	Most group members participate	One main speaker with little participation from other group members	
Eye Contact	Maintains eye contact, seldom looking at notes	Maintains eye contact most of time but frequently returns to notes	Occasionally uses eye contact but reads most of information	No eye contact because reading information	

Written Report Writing Rubric

5	3	1
Ideas: The heart of the message, the content of the piece, the main theme, with details that enrich and develop that theme.		
This paper is clear and focused. It holds the reader's attention. Relevant anecdotes and details enrich the central theme. A. The topic is narrow and manageable. B. Relevant, telling, quality details go beyond the obvious. C. Reasonably accurate details. D. Writing from knowledge or experience; ideas are fresh and original. E. Reader's questions are anticipated and answered. F. Insight.	The writer is beginning to define the topic, even though development is still basic or general. A. The topic is fairly broad. B. Support is attempted. C. Ideas are reasonably clear. D. Writer has difficulty going from general observations to specifics. E. The reader is left with questions. F. The writer generally stays on topic.	The paper has no clear sense of purpose or central theme. The reader must make inferences based on sketchy or missing details. A. The writer is still in search of a topic. B. Information is limited or unclear or the length is not adequate for development. C. The idea is a simple restatement or a simple answer to the question. D. The writer has begun to define the topic. E. Everything seems as important as everything else. F. The text may be repetitious and disconnected, containing too many random thoughts.
Organization: The internal structure, the thread of central meaning, the logical and sometimes intriguing pattern of ideas.		
The organizational structure of this paper enhances and showcases the central idea or theme of the paper; it includes a satisfying introduction and conclusion. A. An inviting introduction draws the reader in; a satisfying conclusion leaves the reader with a sense of closure and resolution. B. Thoughtful transitions. C. Sequencing is logical and effective. D. Pacing is well controlled. E. The title, if desired, is original. F. Flows so smoothly, the reader hardly thinks about it.	The organizational structure is strong enough to move the reader through the text without too much confusion. A. The paper has a recognizable introduction and conclusion. B. Transitions often work well. C. Sequencing shows some logic, yet structure takes attention away from the content. D. Pacing is fairly well controlled. E. Organization sometimes supports the main point or story line. A title, if desired, is present.	The writing lacks a clear sense of direction. A. No real lead. B. Connections between ideas are confusing. C. Sequencing needs work. D. Pacing feels awkward. E. No title is present (if requested). F. Problems with organization make it hard for the reader to get a grip on the main point or story line.
Voice: The heart and soul, magic, wit, feeling, and conviction of the writer coming out.		
The writer of this paper speaks directly to the reader in a manner that is individual, compelling, engaging, and has personality. The reader feels a strong interaction with the writer. A. The writer takes a risk. B. The tone and voice give flavor and texture to the message and are appropriate for the purpose and audience. C. Narrative writing seems honest and personal. Expository or persuasive writing reflects a strong commitment to this topic.	The writer seems sincere, but not fully engaged or involved. The result is pleasant or even personable, but not compelling. A. The writing communicates in an earnest, pleasing manner. B. Only one or two moments here are there surprise, delight, or move the reader. C. Writer weighs ideas carefully and discards personal insights in favor of safe generalities. D. Narrative writing seems sincere; expository or persuasive writing lacks consistent engagement. E. Emerges strongly at some places, but is often obscured behind vague generalities.	The writer seems indifferent, uninvolved, or distanced from the topic and/or the audience. Writer speaks in a kind of monotone. A. Writing is humdrum and "risk free." B. Writing is not concerned with the audience; writer's style is a complete mismatch for the intended reader. C. Writing is lifeless or mechanical. D. No point of view is reflected.

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Dramatization Teacher Evaluation Rubric

	Excellent 4	Good 3	Satisfactory 2	Needs Improvement 1
Research of Events				
	The student uses a word processing program to produce a script and biography (APA style). A script with a biography is submitted to the teacher. The script is free of errors.	The student uses a word processing program to produce a script and biography (APA style). A script with a biography is submitted to the teacher.	The student submits a handwritten script and biography (APA style) to the teacher.	The student submits a handwritten script and biography (APA style) to the teacher. A script is submitted to the teacher. No biography is included.
Characters				
	The student uses a word processing program to produce a summary and historical account of each character in the script. A narrator gives a brief description to the audience members before the dramatization begins.	The student submits a handwritten summary and historical account of each character in the script. A narrator gives a brief description to audience members before the dramatization begins.	The student submits a handwritten summary and historical account of each character in the script.	A summary or historical account of each character is not submitted.
Content				
	The story is retold completely with all major events included. A problem and a solution are included in the content.	Most events are dramatized. The story is easy to follow. A problem and a solution are included in the content.	The story events are not in sequence and are hard to follow. A problem is included in the content.	The story events are not in sequence and are hard to follow.
Dramatizations				
	All actors and actresses act out the script with proper volume and expression. Relevant props and costumes are used.	All actors and actresses act out the script. Props and costumes are used.	All actors and actresses act out the script. Props and costumes are lacking.	All actors and actresses read the script to the audience. There are no props or costumes.
Participation				
	All participants are actively involved in the dramatization.	Most participants are actively involved in the dramatization.	Many participants are not actively involved in the dramatization.	Some people in the group do not involve themselves in the dramatization.

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Dramatization Peer Evaluation Rubric

Directions: Write Yes or No in the blank before each statement.

_____ A narrator gives a brief description of each character to audience members before the dramatization begins.

_____ I can follow the story's events.

_____ I can identify the story's problem.

_____ I can identify the story's solution.

_____ The actors spoke loud enough.

_____ The actors spoke with expression.

_____ The props and costumes fit the play.

_____ All students were actively involved in the play.

Group Member Names:

_____

_____

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Evaluator(s):

_____

_____

Compare and Contrast Summary Rubric

4	3	2	1
Purpose & Supporting Details			
The paper compares and contrasts items clearly. The paper points to specific examples to illustrate the comparison. The paper includes only the information relevant to the comparison.	The paper compares and contrasts items clearly, but the supporting information is general. The paper includes only the information relevant to the comparison.	The paper compares and contrasts items clearly, but the supporting information is incomplete. The paper may include information that is not relevant to the comparison.	The paper compares or contrasts, but does not include both. There is no supporting information or support is incomplete.
Organization and Structure			
The paper breaks the information into whole-to-whole, similarities-to differences, or point-by-point structure. It follows a consistent order when discussing the comparison.	The paper breaks the information into whole-to-whole, similarities-to-differences, or point-by-point structure but does not follow a consistent order when discussing the comparison.	The paper breaks the information into whole-to-whole, similarities-to-differences, or point-by-point structure, but some information is in the wrong section. Some details are not in a logical or expected order, and this distracts the reader.	Many details are not in a logical or expected order. There is little sense that the writing is organized.
Transitions			
The paper moves smoothly from one idea to the next. The paper uses comparison and contrast transition words to show relationships between ideas. The paper uses a variety of sentence structures and transitions.	The paper moves from one idea to the next, but there is little variety. The paper uses comparison and contrast transition words to show relationships between ideas.	Some transitions work well; but connections between other ideas are fuzzy.	The transitions between ideas are unclear or nonexistent.
Grammar and Spelling			
Writer makes no errors in grammar or spelling that distract the reader from the content.	Writer makes 1–2 errors in grammar or spelling that distract the reader from the content.	Writer makes 3–4 errors in grammar or spelling that distract the reader from the content.	Writer makes more than four errors in grammar or spelling that distract the reader from the content.

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Newsletter Rubric

	Awesome	Clever	Satisfactory	Acceptable	Total Points
Completed article on time.	10	9	8	7	
Wrote newsworthy article on a topic of interest.	20	19	18	17	
Added digital photograph that complemented article well.	20	19	18	17	
Formatted article using desktop publishing software.	20	19	18	17	
Organized presentation of article and photograph in a unified whole.	10	9	8	7	
Wrote well-developed descriptive paragraph for written assessment.	20	19	18	17	

Student Brochure Rubric

CATEGORY	20	18	16	14
Content - Accuracy	All facts in the brochure are accurate.	90-99% of the facts in the brochure are accurate.	80-89% of the facts in the brochure are accurate.	Fewer than 80% of the facts in the brochure are accurate.
Spelling	No spelling errors occur.	No more than three spelling errors occur.	No more than six spelling errors occur.	Several spelling errors occur and make meaning for the reader difficult.
Sources	Careful and accurate records are kept to document the source of 95-100% of the facts and graphics in the brochure.	Careful and accurate records are kept to document the source of 85-94% of the facts and graphics in the brochure.	Careful and accurate records are kept to document the source of 75-84% of the facts and graphics in the brochure.	Sources are not documented accurately or are not kept on many facts and graphics.
Knowledge Gained	All students in the group can accurately answer all questions related to facts in the brochure and to technical processes used to create the brochure.	All students in the group can accurately answer most questions related to facts in the brochure and to technical processes used to create the brochure.	Most students in the group can accurately answer most questions related to facts in the brochure and to technical processes used to create the brochure.	Several students in the group appear to have little knowledge about the facts or technical processes used in the brochure.
Attractiveness & Organization	The brochure has exceptionally attractive formatting and well organized information.	The brochure has attractive formatting and well organized information.	The brochure has well organized information.	The brochure's formatting and organization of material are confusing to the reader.

Newspaper Article Rubric

Element	Possible Points	Earned Assessment	
		Self	Teacher
The headline of the article catches the attention of the reader and relates well to the topic.			
The *lead* (or first sentence) captures the attention of the reader and sums up the focus of the story.			
The introductory paragraph tells the most important facts and answers the questions: who, what, where, when, why, and how.			
Details and elaboration are evident in the body of the news story and flow smoothly from the lead.			
Quotes are used to add interest and support to the story.			
The piece is a **factual** account of a newsworthy event.			
The writer is objective and shows all sides to an issue.			
The subject chosen by the student is timely, important, and/or interesting.			
The sources for this news story are identified and are reliable.			
The vocabulary is correct. The student uses words carefully to show exact meaning and is careful not to show bias through his/her choice of words.			
The article is mechanically correct.			
The work is neat and presentable.			
Total:			

Reflective Journal Rubric

Idea Development:

___ (3) Well-developed writing which contains idea density and analytical thinking about the assigned topic;
___ (2) Developing writing which contains some idea density and analytical thinking about the assigned topic;
___ (1) Poorly developed writing which contains little idea density and analytical thinking about the assigned topic;
___ (0) Not completed enough for scoring or off topic.

Relationship to Classroom Instruction or Student Learning:

___ (3) Writing shows clear and compelling relationship between ideas and their application to classroom instruction and/or student learning;
___ (2) Writing shows some relationship between ideas and their application to classroom instruction and/or student learning;
___ (1) Writing shows little relationship between ideas and their application to classroom instruction or student learning;
___ (0) Writing shows no relationship between ideas and their application to classroom instruction and/or student learning. Or writing is off topic.

Submitted on Time:

___ (2) Journal submitted on or before due date;
___ (1) Journal submitted late;
___ (0) Journal not submitted

Teamwork Rubric

CATEGORY	4	3	2	1
Contributions	Routinely provides useful ideas when participating in the group and in classroom discussion. A leader who contributes a lot of effort.	Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard.	Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required.	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Problem solving	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems. Lets others do the work.
Attitude	Is never publicly critical of the project or the work of others. Always has a positive attitude about the task(s).	Is rarely publicly critical of the project or the work of others. Often has a positive attitude about the task(s).	Is occasionally publicly critical of the project or the work of other members of the group. Usually has a positive attitude about the task(s).	Is often publicly critical of the project or the work of other members of the group. Is often negative about the task(s).
Focus on the task	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on the task and what needs to be done most of the time. Other group members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on-task.	Rarely focuses on the task and what needs to be done. Lets others do the work.
Working with Others	Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together.	Usually listens to, shares, with, and supports the efforts of others. Does not cause “waves” in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.

Technical Writing Rubric

Ideas/Content (Development)

Rating of 5 (Strong):
The writing is clearly focused which leads to achieving a well defined goal.

- The purpose is clearly defined.
- The writing supports the purpose with concise, logical details that meet the reader's informational needs.
- Sources, if used, are acknowledged.

Rating of 3 (Developing):
The writing addresses an identifiable goal by offering the reader general basic information. The development is limited, sketchy, and/or general.

- The purpose can be identified.
- The writing sometimes supports the purpose with concise, logical details that meet the reader's informational needs.
- Sources, if used, are sometimes acknowledged.

Rating of 1 (Beginning):
The writing has not clarified the selected goal. The text has no clear sense of purpose.

- The purpose is not identifiable.
- The writer does not support the purpose with concise, logical details that meet the reader's information needs.
- Sources, if used, are not acknowledged.

Technical Writing Rubric (Continued)

Organization

Rating of 5 (Strong):
The organization enhances and showcases the purpose. The sequence, structure, and presentation are compelling and move the reader through the text.

- Information is arranged in a format that is logical and effective and meets the reader's needs.
- The writing is a comprehensive piece with a constructive introduction, a body that provides relevant information, and a suitable conclusion that reinforces the purpose and leaves the reader with a sense of completion.
- Transitions are appropriate and connect the ideas.
- Information is organized within each section, paragraph, list, or graphic in a logical and effective sequence to meet the reader's needs.

Rating of 3 (Developing):
The organizational structure is strong enough to move the reader from point to point without undue confusion.

- Information is sometimes arranged in a format that is logical and effective, which does not always meet the reader's needs.
- The writing is beginning to develop as a comprehensive piece that includes a functional introduction, body, and conclusion.
- Transitions are usually appropriate.
- Information is sometimes organized within each section, paragraph, list, or graphic in a logical and effective sequence to meet the reader's needs.

Rating of 1 (Beginning):
The text lacks a clear sense of direction. Ideas and details seem strung together in a random fashion.

- Information is not arranged in a format that is logical and effective.
- The writing is not comprehensive and does not include a clear introduction, body, and conclusion.
- Transitions are not used.
- Information in each section, paragraph, list, or graphic is not organized in a logical or effective sequence.

Technical Writing Rubric (Continued)

Voice

Rating of 5 (Strong):
The writer speaks directly to the reader in a way that is individualized, expressive, and engaging. Clearly, the writer is involved in the text and is writing for an audience.

- The text and/or graphics are appropriate for the audience and purpose. (for example, letter, complex reports, directions, brochures, electronic presentations, newsletters, memos, e-mails, fliers, Web pages, charts, maps, tables, pictorials, and resumes)
- Writes with authority so the voice is not distracting.

Rating of 3 (Developing):
The writing seems sincere, but not genuinely engaged, committed, or involved. The result is pleasant and sometime even personable, but short of compelling.

- The text and/or graphics sometimes are appropriate for the audience and purpose. (for example, letter, complex reports, directions, brochures, electronic presentations, newsletters, memos, e-mails, fliers, Web pages, charts, maps, tables, pictorials, and resumes)
- Writes with authority but sometimes voice is distracting.
- Rating of 1 (Beginning): The writer seems indifferent, uninvolved, or distanced from the topic and/or audience.

Rating of 1 (Beginning):
The writer seems indifferent, uninvolved, or distanced from the topic and/or audience.

- The text and/or graphics are not appropriate for the audience and purpose. (for example, letter, complex reports, directions, brochures, PowerPoint®, newsletters, memos, e-mails, fliers, Web pages, charts, maps, tables, pictorials, and resumes)
- Writes without authority and the voice is distracting.

Directed Individual Project Checklist

	Description
	Cover page includes a team logo and the problem design brief
	Introductory pages that list important design constraints and the problem solving steps, and that provides an organizational chart describing the title and responsibility of each team member
	Research conducted by design team, two or more pages
	One or more pages of documentation of brainstorming
	One or more pages documenting consideration of a minimum of three possible solutions with a brief evaluation of each team's merit
	Details about the solution including a 3D-technical drawing or rendering, one or more pages
	One page describing math and science concepts involved in the final solution
	Explanation of the areas of technology that are a part of the solution (as many areas that apply)
	One or more pages explaining the evaluation of how well the final solution meets the design brief and explains the possible impact of the solution on society and the environment