

CTE CONTENT AREA: Technology Education

CONTENT MODULE TITLE: Abilities for a Technological World

MODULE DESCRIPTION

Technological developments are becoming more powerful and more complex as our tools and ability to design them improves. Modern technologies may be developed by teams of specialized engineers and designers who focus on system components that will be integrated into more complex systems. As these technologies become more complex, our ability as end users to troubleshoot and repair them decreases where specialists with specialized equipment and tools are required.

A technologically literate person should understand how advanced technologies are developed, how they work, how they interrelate, and how to make informed decisions about them. The Standards for Technological Literacy identify that having the ability to use, manage, assess, and understand technological systems requires foundational skills including problem solving, critical thinking, and reasoning. These skills can be accomplished through design, troubleshooting, modeling, and other applied activities.

In this module, students will develop abilities for thriving in a technological world which include applying the design process, using and maintaining technological products and systems, and assessing products and systems.

This module is intended as the fourth of five modules that can be completed in sequence or integrated with content with the other technology modules through laboratory activities and problem-based assignments.

GUIDING QUESTION

What do students need to understand to be able to use, manage, assess, and create technological products and systems in a rapidly changing technological world?

MODULE CONTENT

Abilities for a Technological World

1. Applying the Design Process

Students will

- a) Identify and define information about a given problem to generate constraints and criteria for solving the problem
- b) Develop and present possible solutions to a problem in visible (2-D or 3-D) form to aid in selecting the best solution from many
- c) Create or model the product or solution and document the results
- d) Test and evaluate solutions from a given design problem against design criteria and constraints to validate function
- e) Derive improvements for design solutions to produce an optimized product or system

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2. Use and Maintain Technological Products and Systems

Students will

- a) Use information resources, manuals, documents, or experienced people to describe how systems work
- b) Utilize tools, materials, and machines to diagnose, adjust, and repair a system
- c) Utilize computer and information resources to operate and maintain a system

3. Assess the Impact of Products and Systems

Students will

- a) Utilize instruments to measure and gather data
- b) Identify trends or patterns in data to be applied toward decision making and identify positive and negative effects of technologies
- c) Interpret and evaluate accuracy of information to determine the quality of products and systems

4. Career Pathways

Students will

- a) Explain roles and functions of individuals engaged in technical careers involving problem solving and troubleshooting
- b) Investigate education, training requirements and opportunities for career paths in involving problem solving and troubleshooting
- c) Assess personal employability skills for technical careers and evaluate personal suitability for such careers

ILLUSTRATIVE ACTIVITIES by Theme Module

Career and Community Connections

Technology Repair and Maintenance Career Exploration

Students research a repair and maintenance occupation that includes systems engineers, building maintenance workers, mechanics, computer programmers, network technicians, or other workers who maintain and repair technological systems. In a prepared report, students identify and report on the training, education, skills, and aptitudes necessary to enter a chosen occupation along with reporting the benefits of that occupation to self and society.

Communication and Interpersonal Relationships

Computer Program Development

Students write a computer program for a given task, such as navigating a robot through a maze or slalom course. In groups, students develop a basic algorithm or program design to plan the program that includes a sequence of events and decision making. Students write the prototype code to complete the task based on their plan and document the program components. Students test and optimize the program.

Financial and Consumer Literacy

True Cost of Ownership

Students develop a spreadsheet to discover the total cost of ownership for an automobile

over five years that includes the cost of the vehicle with registration, taxes, and insurance. If the vehicle is financed, students include the cost of the loan and interest. Based on 12,000 miles a year, students determine the cost of oil changes and servicing every 3,000 miles; calculate fuel costs based on the fuel economy of the chosen vehicle; and determine what the actual monthly and yearly costs are and the total cost of ownership for the five-year period. Variations include comparing the costs of natural/synthetic blend oil and full synthetic oil or the costs of gasoline with different octane levels.

Health, Safety, and Wellness

Survival Shelter

Students design a survival shelter made of sheet materials that include cloth, plastic, or cardboard. Students design the shelter to be easily folded for storage and to be transported by a hiker, traveler, or emergency personnel. Students model the shelter using paper materials to show how it can be made from multiple sheet components. Alternative activities include designs for Tiny Houses, off grid cabins, shelters from shipping containers, or emergency response housing.

Problem Solving and Innovation

Race Car Design

Students design a rubber band powered speed racing vehicle using design, drawing, and fabrication skills. Students utilize the scientific method to develop basic experiments to measure the vehicle's performance, modifying their vehicle for performance by altering weight distribution, airfoils, and fins. Students then measure multiple distances that the vehicle travels with each modification, record the data, and determine averages for each modification. Students analyze the statistical calculations to determine optimal design. Alternative activities include designing and testing air racers, catapult designs, water rockets, or CO₂ powered dragsters.

Sustainability

Design a Solar Heater

Using concepts of light collection, focusing, and absorption, students design a solar collector that captures solar energy to heat water for human use. Students develop a prototype to heat 50 mL of water and test the prototype on a sunny day. Students measure the temperature increases every minute for a 20-minute period and then remove the prototype from the sun. Students measure the heat loss every minute for a 20-minute period and graph the resulting temperature data as a function of time. Variations of this activity include a solar cooker or a window solar heater for a bedroom.

STANDARDS ADDRESSED

New York State Career Development and Occupational Studies (CDOS) Standards

Intermediate Level

<http://www.p12.nysed.gov/cte/>

Standard 1: Career Development

Students will be knowledgeable about the world of work, explore career options, and relate personal skills, aptitudes, and abilities to future career decisions.

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Standard 2: Integrated Learning

Students will demonstrate how academic knowledge and skills are applied in the workplace and other settings.

Standard 3a: Universal Foundation Skills

Students will demonstrate mastery of the foundation skills and competencies essential for success in the workplace.

Common Career Technical Core Standards

Career Ready Practices - www.careertech.org/career-ready-practices

1. Act as a responsible and contributing citizen and employee
2. Apply appropriate, academic, and technical skills
3. Attend to personal health and financial well-being
4. Communicate clearly and effectively and with reason
5. Consider environmental, social, and economic impacts of decisions
6. Demonstrate creativity and innovation
7. Employ valid and reliable research strategies
8. Utilize critical thinking to make sense of problems and persevere in solving them
9. Model integrity, ethical leadership, and effective management
10. Plan education and career paths aligned to personal goals
11. Use technology to enhance productivity
12. Work productively in teams while using cultural global competence

International Technology and Engineering Education Association

Standards for Technological Literacy

<http://www.iteea.org/39197.aspx>

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.

RESOURCES

International Technology and Engineering Educators' Association

www.iteea.org

ITEEA is the international organization that represents technology and engineering educators. The organization supports an annual conference and publishes two journals, *Technology and Engineering Educator* and *Journal of Technology Education*. Many resources are available for classroom teachers including Engineering by Design. ITEEA developed and maintains the Standards for Technological Literacy.

New York State Department of Labor

New York State Career Zone

<https://www.careerzone.ny.gov>

Career Zone is a no-cost online career exploration and planning tool developed by the New York State Department of Labor. It offers career and education information on thousands of careers, as well as, self-assessment and career planning tools. Career

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Zone is appropriate for users from middle school through adult.

United States Department of Labor

CareerOneStop

<https://www.careeronestop.org>

CareerOneStop is the career, training, and job search website for the U.S. Department of Labor. The website serves job seekers, businesses, students, and career advisors with a variety of free online tools, information, and resources.

Association of Career and Technical Education

Career Planning Guide

https://www.acteonline.org/wp-content/uploads/2018/02/ACTE_CC_Paper_FINAL.pdf

Research has identified middle school as a time when students can benefit the most from career exploration, a process of building self-awareness, learning about potential careers, and developing a plan for reaching future goals.

AdvanceCTE

Middle Level Career Interest Inventory

<https://cte.careertech.org/sites/default/files/StudentInterestSurvey-English.pdf>

AdvanceCTE provides a Career Interest inventory worksheet to use with students in helping them identify potential matches to the 16 career clusters available to them.

New York State Technology and Engineering Educators' Association

www.nysteea.org

NYSTEEA represents Technology and Engineering Educators across New York State. The website has important information on technology content, current developments in Technology and Engineering Education, professional development opportunities, and other resources important to technology educators.

Career and Technical Education Technical Assistance Center of New York (CTE TAC)

<http://nyctecenter.org/>

The Career and Technical Education Technical Assistance Center (CTE TAC) operates under a state contract to assist the New York State Education Department (NYSED) in carrying out its mission of improving the quality, access, and delivery of career and technical education through research-based methods and strategies resulting in broader CTE opportunities for all students.

Code.org®

www.code.org

Code.org is a nonprofit organization that promotes computer science education and supports increased participation in computer sciences for underrepresented populations. The website contains online activities and resources for teachers and students appropriate from elementary to high school levels.

NASA Jet Propulsion Laboratory – Problem Solving

<https://www.jpl.nasa.gov/edu/teach/tag/topic/Problem+Solving>

The NASA Jet Propulsion Laboratory at the California Institute of Technology supports teaching problem solving and engineering through classroom STEM activities.

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Activities are organized by age and STEM area and include downloadable worksheets, resource lists, instructional plans, and assessments.