

**NEW YORK STATE EDUCATION DEPARTMENT
MIDDLE LEVEL CAREER AND TECHNICAL EDUCATION
PROBLEM SOLVING AND INNOVATION THEME MODULE
UPDATED JUNE 2023**

MODULE DESCRIPTION

This module introduces students to problem-solving methods and research. Problem solving can be proactive through design or reactive through troubleshooting. This module will relate invention and innovation to problem solving processes. Students will learn to acquire, critically evaluate, and apply the products of research to make informed problem-solving decisions. Problem-solving skills are essential for all students to develop; they can use formal, iterative, and systemic approaches to solve real-world problems. Current issues related to problem-solving processes, research processes, information access, and information literacy will be examined. Students will have the opportunity to explore the wide variety of career options related to technological invention, innovation, and research and identify the knowledge, skills, education, and training necessary for success within these fields.

GUIDING QUESTION

What knowledge and skills are necessary to demonstrate introductory understanding of the application of problem-solving processes and the acquisition, evaluation, and application of the products of research for informed decision making?

MODULE CONTENT

1. PROBLEM SOLVING

Students will:

- a. Describe the scientific method of inquiry as it relates to real-world problem solving
- b. Define technological problem solving in the context of design and troubleshooting
- c. Define invention as new designs for technologies and systems
- d. Define innovation as new applications for existing technologies and systems
- e. Demonstrate personal development of problem-solving skills through practice of these skills in a variety of classroom applications

2. DESIGN PROCESS (PROACTIVE)

Students will:

- a. Implement a formal design process to solve a given problem by:

1. Define the problem (1-3.4 (n)g (t)2.5 (i)3. (h)4. (e)4.2 (o)1.3 (t)-5.9 (i)-3.3 (n)t6 (e)4.9 (m)Tt.2 (5 (oc52 (o).8 (e)-6 (62

5. CAREERS IN PROBLEM SOLVING, INVENTION, AND INNOVATION

Students will:

- a. Investigate knowledge, skills, and practices needed for a career utilizing problem solving, invention, and innovation skills
- b. Analyze career paths requiring skills for problem solving, invention, and innovation
- c. Evaluate personal skills, abilities, and interests for employment opportunities utilizing skills for problem solving, invention, and innovation

ILLUSTRATIVE ACTIVITIES BY CTE CONTENT AREA

AGRICULTURAL EDUCATION

FAULTY SYSTEM

Students identify a system that is not functioning properly. Students observe, identify and document the individual system components, how they operate, and how they interact. Students locate the system component that is not functioning, implement a change or repair, and evaluate the system to ensure that it is functioning properly. Students document the repair and propose preventive maintenance solutions.

BUSINESS AND MARKETING EDUCATION

COMMON COMPUTER PROBLEMS

Prepare a list of the most common computer and technology problems students encounter in class daily. Divide the class into small teams. Pass out copies of the common problems. Have each team complete a troubleshooting process and prepare a write-up showing how to solve one of the common problems. Have a different team apply the solution to determine whether the corrective action solved the problem and led to the desired outcome.

COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

INQUIRY BASED DATA INVESTIGATION

Students will engage in the problem-solving process by collecting and analyzing data to develop an informed solution to be demonstrated through an artifact such as a flowchart or coding.

FAMILY AND CONSUMER SCIENCES EDUCATION

REWORKING SPACES

Students work with the school leaders to identify areas in their school that are not functioning well due to space issues. Examples might be slow-moving cafeteria lines, overcrowded storage areas for sports,

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COMMON CAREER TECHNICAL CORE STANDARDS

Career Ready Practices

1. Act as a responsible and contributing citizen and employee
2. Apply appropriate academic and technical skills
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
11. Use technology to enhance productivity
12. Work productively in teams while using cultural global competence

CONTENT AREA STANDARDS

NATIONAL AGRICULTURAL EDUCATION STANDARDS

<https://thecouncil.ffa.org/afnr/>

PST.01 Apply physical science principles and engineering applications to solve problems and improve performance AFNR power, structural, and technical systems

CRP.02 Apply appropriate academic and technical skills

CRP.06 Demonstrate creativity and innovation

CRP.07 Employ valid and reliable research strategies

CRP.08 Utilize critical thinking to make sense of problems and persevere in solving them

CRP.11 Use technology to enhance productivity

Note: National Agricultural Education Standards CRP .01-.12 coincide with Common Core Technical Core Standards

NATIONAL BUSINESS EDUCATION STANDARDS

<https://nbea.org/general/custom.asp?page=BusinessEdStandards>

Computation

I. Mathematical Foundations Achievement Standard

Apply basic mathematical operations to solve problems

II. Number Relationships and Operations Achievement Standard

Solve problems involving whole numbers, decimals, fractions, percents, ratios, averages, and proportions

III. Patterns, Functions, and Algebra

Use algebraic operations to solve problems

V. Measurements Achievement Standard

Use common international standards of measurement when solving problems

V. Statistics and Probability Achievement Standard

Analyze and interpret data using common statistical procedures

VI. Problem-Solving Applications Achievement Standard

Use mathematical procedures to analyze and solve business problems

NATIONAL FAMILY AND CONSUMER SCIENCES STANDARDS

<http://www.leadfcsed.org/national-standards.html>

3.0 Consumer Services

Integrate knowledge, skills, and practices needed for a career in consumer services

3.5 Demonstrate skills needed for product development, testing, and presentation

3.5.1 Conduct market research to determine consumer trends and product development needs

3.5.2 Design or analyze a consumer product

3.5.3 Analyze features, prices, product information, styles, and performance of consu.1

- E. Design is a creative planning process that leads to useful products and systems
- F. There is no perfect design
- G. Requirements for a design are made up of criteria and constraints
- 9. Students will develop an understanding of engineering design
 - F. Design involves a set of steps which can be performed in different sequences and repeated as needed
 - G. Brainstorming is a group problem-solving design process in which each person in the group presents his or her ideas in an open forum
 - H. Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions
- 10. Students will develop an understanding of the role of troubleshooting, research and development, invention, innovation, and experimentation in problem solving
 - F. Troubleshooting is a problem-solving method used to identify the cause of a malfunction in a technological system
 - G. Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it
 - H. Some technological problems are best solved through experimentation

Abilities for a Technological World

- 11. Students will develop abilities to apply the design process
 - H. Apply a design process to solve problems in and beyond the laboratory-classroom
 - I. Specify criteria and constraints for the design
 - J. Make two-dimensional and three-dimensional representations of the designed solution
 - K. Test and evaluate the design in relation to pre-established requirements, such as criteria and constraints, and refine as needed
 - L. Make a product or system and document the solution

USDOE EMPLOYABILITY SKILLS

http://cte.ed.gov/employability_skills/

Applied Knowledge: Applied Academic Skills, Critical Thinking Skills

The thoughtful integration of academic knowledge and technical skills put to practical use

Effective Relationships: Interpersonal Skills, Personal Qualities

The skills that enable individuals to interact effectively with clients, coworkers, and supervisors

Workplace Skills: Resource Management, Information Use, Communication Skills, Systems Thinking, Technology Use

RESOURCES

UNITED STATES DEPARTMENT OF EDUCATION GREEN STRIDES: ENVIRONMENT, HEALTH, AND FACILITIES AT ED STEM PROGRAMS AT ED

<https://www2.ed.gov/about/inits/ed/green-strides/stem.html>

Federal resources are helping to assist educators in implementing effective approaches for improving STEM teaching and learning; facilitating the dissemination and adoption of effective STEM instructional practices nationwide; and promoting STEM education experiences that prioritize hands-on learning to increase student engagement and achievement.

BROOKINGS INSTITUTE TEACHING PROBLEM SOLVING: LET STUDENTS GET 'STUCK' AND 'UNSTUCK'

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