Engineering & Technology

PROGRAM CONCENTRATION: Engineering & Technology
COURSE TITLE: Invention and Innovation, Grade 7

COURSE DESCRIPTION:

Invention and Innovation is designed to introduce students to the world of invention and innovation along with the Engineering Design Process. They will examine the impacts of invention and innovation on society and solve problems through research, design, and experimentation in one or more of the areas of Engineering and Technology. Students will work individually and in groups to investigate solutions to technological problems, using research, data collection, design, prototype development, and working models. Invention and Innovation reinforces the areas of math, science, social studies, and language arts through practical application and/or hands on activities.

At the end of this course, students will be able to evaluate products and systems that they encounter in their daily lives and choose appropriate technologies to solve a variety of tasks. Students will be able to produce a functional invention/innovation.

ENGR-II-1: Students will learn the concept of invention and innovation.

a) Define related invention and innovation terms
b) Compare invention to innovation
c) Examine the role that Engineering & Technology and society play in the invention and innovation process
d) Identify an important past invention or innovation
e) Research an artifact related to Engineering and Technology that is at least 25 years old

ACADEMIC STANDARDS:

ELA7LSV1 – The student participates in student-to-teacher, student-to-student, and group verbal interactions.

ELA7LSV2 – The student listens to and views various forms of text and media in order to gather and share information, persuade others, and express and understand ideas.

ELA7RC3 – The student acquires new vocabulary in each content area and uses it correctly.

ELA7W3 – The student uses research and technology to support writing.

STANDARDS FOR TECHNOLOGY LITERACY:

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

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 influence of technology on history.

STEM STANDARDS:

ENGR-STEM 2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.

ENGR-STEM 3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

ENGR-STEM 6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

SAMPLE TASKS:

- Brainstorm famous inventors and inventions
- Discuss the differences between invention & innovation
- Research various inventions (who, what, where, when, & why)
- Create poster of an inventor/invention
- Develop a timeline of inventions
- Graphic organizer (C-maps.com, Inspiration)

ENGR-II-2: Students will examine the core concepts of engineering and technology.

a) Identify one or two major inventions or innovations related to each Engineering and Technology pathway
b) Construct a simple technological system
c) Explain how your technological system operates
d) Reverse engineer a consumer product

ACADEMIC STANDARDS:

M7P4 – Students will make connections among mathematical ideas and to other disciplines.

M7P5 – Students will represent mathematics in multiple ways.

S7CS2 – Students will use standard safety practices for all classroom laboratory and field investigations.

S7CS4 – Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities.

S7CS5 – Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

ELA7LSV1 – The student participates in student-to-teacher, student-to-student, and group verbal interactions.

ELA7LSV2 – The student listens to and views various forms of text and media in order to gather and share information, persuade others, and express and understand ideas.

ELA7RC3 – The student acquires new vocabulary in each content area and uses it correctly.

STANDARDS FOR TECHNOLOGY LITERACY:

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

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 the abilities to apply the design process.

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

STEM STANDARDS:

ENGR-STEM 1 – Students will recognize the systems, components, and processes of a technological system.

ENGR-STEM 3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

ENGR-STEM 4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.

ENGR-STEM 5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

ENGR-STEM 7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.

SAMPLE TASKS:

- Research inventions in energy systems, electronics, manufacturing, and engineering
- Student presentation of an invention
- Modeling/testing
- Solving a design brief
  - Candy dispenser
  - Marble maze/roller coaster
  - Rube Goldberg device
- Reverse engineering
  - Toy autopsy
  - Simple machines
  - Examine existing designs

ENGR-II-3: Students will demonstrate engineering design and problem solving skills.

a) Define the designed world and its connotations
b) Examine the steps of the Technological Design Process
c) Describe the steps of the Engineering Design Process
d) Compare the Technological Design Process, the Engineering Design Process, and the Scientific Method

e) Troubleshoot a product or system

ACADEMIC STANDARDS:

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S7CS4 – Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities.

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ELA7LSV2 – The student listens to and views various forms of text and media in order to gather and share information, persuade others, and express and understand ideas.

STANDARDS FOR TECHNOLOGY LITERACY:

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 the abilities to apply the design process.

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

STEM STANDARDS:

ENGR-STEM 1 – Students will recognize the systems, components, and processes of a technological system.

ENGR-STEM 3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

ENGR-STEM 4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.

ENGR-STEM 5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

ENGR-STEM 6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

ENGR-STEM 7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.

SAMPLE TASKS:

- Research inventions in energy systems, electronics, manufacturing, and engineering
- Student presentation of an invention
- Modeling/testing
- Solving a design brief
  - Candy dispenser
  - Marble maze/roller coaster
  - Rube Goldberg device
- Reverse engineering
  - Toy autopsy
  - Simple machines
  - Examine existing designs

ENGR-II-4: Students will invent or innovate a technological product.

a) Apply a design process in the invention or innovation of a product or system

b) Design a simple invention or innovation
c) Construct a simple invention or innovation
d) Demonstrate appropriate safety in the invention or innovation of a product or system
e) Maintain a portfolio of the invention process
f) Demonstrate the use and/or operation of the invention or innovation
g) Evaluate the invention or innovation

ACADEMIC STANDARDS:

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M7P5 – Students will represent mathematics in multiple ways.

S7CS2 – Students will use standard safety practices for all classroom laboratory and field investigations.

S7CS4 – Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities.

S7CS5 – Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

ELA7LSV1 – The student participates in student-to-teacher, student-to-student, and group verbal interactions.

ELA7LSV2 – The student listens to and views various forms of text and media in order to gather and share information, persuade others, and express and understand ideas.

STANDARDS FOR TECHNOLOGY LITERACY:

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 the abilities to apply the design process.

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

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

STEM STANDARDS:

ENGR-STEM 3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.

ENGR-STEM 4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.

ENGR-STEM 5 – Students will select and demonstrate techniques, skills, tools, and understanding related to energy and power, bio-related, communication, transportation, manufacturing, and construction technologies.

ENGR-STEM 7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.

SAMPLE TASKS:

- Research inventions in energy systems, electronics, manufacturing, and engineering
- Student presentation of an invention
- Modeling/testing
- Create a design portfolio
- Create an engineering notebook
- Solving a design brief
    - Candy dispenser
    - Marble maze/roller coaster
    - Rube Goldberg device
- Reverse engineering
    - Toy autopsy
    - Simple machines
    - Examine existing designs

ENGR-II-5: Students will examine the impacts of inventions and innovations on society.

a) Discuss the societal impacts of a specific invention or innovation
b) Investigate important inventions or innovations related to Engineering and Technology and how they have impacted our lives
c) Describe the life-cycle of a product
d) Analyze positive and negative effects of inventions and innovations

ACADEMIC STANDARD:

ELA7LSV1 – The student participates in student-to-teacher, student-to-student, and group verbal interactions.

ELA7LSV2 – The student listens to and views various forms of text and media in order to gather and share information, persuade others, and express and understand ideas.

ELA7RC3 – The student acquires new vocabulary in each content area and uses it correctly.

ELA7W3 – The student uses research and technology to support writing.

STANDARDS FOR TECHNOLOGY LITERACY:

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 influence of technology on history.

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

STEM STANDARDS:

ENGR-STEM 2 – Students will identify the impact of engineering and technology within global, economic, environmental, and societal contexts.

ENGR-STEM 6 – Students will enhance reading by developing vocabulary and comprehension skills associated with text materials, problem descriptions, and laboratory activities associated with engineering and technology education.

SAMPLE TASKS:

- Research inventions in energy systems, electronics, manufacturing, and engineering
- Student presentation of an invention

ENGR-II-6: Students will develop leadership skills and work ethics.

a) Demonstrate work ethics within the classroom and lab environment
b) Investigate leadership skills through co-curricular activities

ACADEMIC STANDARDS:

M7P3 – Students will communicate mathematically.

S7CS6 – Students will communicate scientific ideas and activities clearly

ELA7LSV1 – The student participates in student-to-teacher, student-to-student, and group verbal interactions.

STEM STANDARDS:

ENGR-STEM 7 – Students will develop leadership and interpersonal problem-solving skills through participation in co-curricular activities associated with the Technology Student Association.

SAMPLE TASKS:

- Modular Activities
- Whole group activities
- Small group activities
- TSA
- Robotics competition (i.e. First Lego League, etc.)

READING STANDARD COMMENT:

After the elementary years, students are seriously engaged in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal learning. Students encounter a variety of informational as well as fictional texts, and they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas *in context.*

Beginning with the middle grade years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

CTAEMRC-1: Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas.
- Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
- Read both informational and fictional texts in a variety of genres and modes of discourse.
- Read technical texts related to various subject areas.

b. Discussing books.
- Discuss messages and themes from books in all subject areas.
- Respond to a variety of texts in multiple modes of discourse.
- Relate messages and themes from one subject area to messages and themes in another area.
- Evaluate the merit of texts in every subject discipline.
- Examine author's purpose in writing.
- Recognize the features of disciplinary texts.

c. Building vocabulary knowledge.
- Demonstrate an understanding of contextual vocabulary in various subjects.
- Use content vocabulary in writing and speaking.
- Explore understanding of new words found in subject area texts.

d. Establishing context.
- Explore life experiences related to subject area content.
- Discuss in both writing and speaking how certain words are subject area related.
- Determine strategies for finding content and contextual meaning for unknown words.

WRITING:

The student writes clear, coherent text. The writing shows consideration of the audience and purpose. The student progresses through the stages of the writing process (e.g., prewriting, drafting, revising, and editing successive versions).

CTAEW-1: The student demonstrates competence in a variety of genres.

The student produces technical writing (business correspondence: memoranda, emails, letters of inquiry, letters of complaint, instructions and procedures, lab reports, slide presentations) that:

a) Creates or follows an organizing structure appropriate to purpose, audience, and context.
b) Excludes extraneous and inappropriate information.
c) Follows an organizational pattern appropriate to the type of composition.
d) Applies rules of Standard English.

CTAEW-2: The student uses research and technology to support writing.

The student:

a) Identifies topics, asks and evaluates questions, and develops ideas leading to inquiry, investigation, and research.
b) Uses organizational features of electronic text (e.g., bulletin boards, databases, keyword searches, e-mail addresses) to locate relevant information.
c) Includes researched information in different types of products (e.g., compositions, multimedia presentations, graphic organizers, projects, etc.).
d) Uses appropriate structures to ensure coherence (e.g., transition elements).
e) Supports statements and claims with anecdotes, descriptions, facts and statistics, and specific examples.
f) Gives credit for both quoted and paraphrased information in a bibliography by using a consistent and sanctioned format and methodology for citations.

CTAEW-3: The student consistently uses the writing process to develop, revise, and evaluate writing.

The student:

a) Plans and drafts independently and resourcefully.

b) Uses strategies of note taking, outlining, and summarizing to impose structure on composition drafts.
c) Edits writing to improve word choice after checking the precision of the vocabulary.

ENTREPRENEURSHIP:

MKT-EN-1: Understands concepts and processes associated with successful entrepreneurial performance.

a) Define entrepreneurship.
b) Identify and analyze characteristics of a successful entrepreneur.
c) Identify the reasons for planning in entrepreneurial businesses.
d) Discuss the entrepreneurial discovery processes.
e) Assess global trends and opportunities.
f) Determine opportunities for business creation.
g) Generate ideas for business.
h) Determine feasibility of ideas.
i) Determine the major reasons for business failure.

ACADEMIC STANDARDS:

ELA8W1 – The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA8W3 – The student uses research and technology to support writing.

SSEF6 – The student will explain how productivity, economic growth and future standards of living are influenced by investment in factories, machinery, new technology and the health, education and training of people.

SSEIN1 – The student will explain why individuals, businesses and governments trade goods and services.

MKT-EN-2: Explain the fundamental concepts of business ownership.

a) Determine the relationship of competition to our private, free enterprise system.
b) Explain the effects of competition on buyers and sellers.
c) Identify the common types of business ownership.
d) Compare and contrast the advantages and disadvantages of each type of ownership.

e) Explain relevant government regulations relating to the operation of a business.
f) Discuss the types of risks that businesses encounter.
g) Explain how businesses deal with the various types of risks.
h) Identify the market segment for the business.
i) Formulate a marketing mix designed to reach a specific market segment.
j) Utilize the marketing functions to determine the competitive advantage of the proposed business.

ACADEMIC STANDARDS:

ELA8W1 – The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA8W3 – The student uses research and technology to support writing.

SSEF5 – The student will describe the roles of government in a market economy.

CTAE FOUNDATION SKILLS:

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U.S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.