FUNDAMENTALS OF ENGINEERING AND TECHNOLOGY EDUCATION (ETE)

Curriculum Content Frameworks

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Grade Levels: 9

Prerequisite: Introduction to Engineering and Technology Education

Course Code:

Course Description: This 18 week course is designed to provide 8th and 9th grade students with a more in-depth look at the fields of information and communication, construction, manufacturing, energy, power, and transportation technologies. Students will also further their understanding of technology and the use of the engineering design loop to solve technological problems. Emphasis will be placed on the further exploration of principles and concepts as well as the continued application of technological and engineering concepts and practices through the completion of experiments, learning exercises, field trips, writing activities, and design projects.

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Unit 1: Engineering and Technology Connections
Hours: 5

Terminology: technology, engineering, portfolio, technological system, goals, inputs, processes, outputs, feedback, systems thinking

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		**ACADEMIC and WORKPLACE SKILLS** What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
1.1 Define technology and engineering and describe their relationship toward one another	1.1.1 Students will participate in discussions and readings concerning technology and engineering. 1.1.2 Students will develop a Technology Portfolio that demonstrates the relationship between technology and engineering	Foundation Thinking Skills	Listening Writing Reasoning	Comprehends ideas and concepts related to technology and engineering [1.2.1] Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6] Comprehends ideas and concepts related to technology [4.5.2]
1.2 Identify the various fields of technology and engineering	1.2.1 Students will participate in discussions and readings concerning the various fields of engineering. 1.2.2 Students will work in groups to research a specific field of engineering 1.2.3 Students will develop a presentation on a field of engineering 1.2.4 Students will add their presentation to their Technology Portfolio	Foundation Thinking Skills Interpersonal Skills Personal Management Skills	Listening Writing Reading Speaking Reasoning Teamwork Responsibility	Comprehends ideas and concepts related to engineering [1.2.1] Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6] Determines what information is needed [1.3.10] Applies/Uses technical terms as appropriate to audience [1.5.2] Comprehends ideas and concepts related to engineering [4.5.2] Works effectively with others to reach a common goal [2.6.6] Describes/Explains significance of integrity, honesty, and work ethics [3.2.4]
1.3 Describe the concepts of technological systems and systems thinking	1.3.1 Students will participate in discussions and readings concerning technological systems	Foundation	Listening Reading	Comprehends ideas and concepts related to technology and engineering [1.2.1] Comprehends written information for main ideas [1.3.7]
1.4 Identify the parts of a technological system	1.4.1 Students will develop a flowchart that identifies the parts of a technological system 1.4.2 Students will add their flowchart to their Technology Portfolio	Foundation	Writing	Composes and creates documents – letters, manuals, reports, proposals, graphs, flow charts, etc. [1.6.8] Organizes information into an appropriate format [1.6.10]

Unit 2: Information and Communication Technologies
Hours: 20

Terminology: computer-aided drafting and design, coordinate system, global information system, global positioning device, longitude, latitude

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do				ACADEMIC and WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge		**Application**		**Skill Group**	**Skill**	**Description**
2.1	Define CAD/CADD - computer-aided drafting and design	2.1.1	Participate in discussions and readings concerning CAD/CADD - computer-aided drafting and design	Foundation Thinking Skills	Listening Reasoning	Comprehends ideas and concepts related to computer-aided drafting and design [1.2.1] Comprehends ideas and concepts related to computer-aided drafting and design [4.5.2]
2.2	Identify how a mathematical grid system is used to create 2-Dimensional (2D) and 3-Dimensional (3D) drawings using CAD software	2.2.1	Students will view an instructor led demonstration using CAD software and the use of a mathematical grid systems used in drawing on the computer	Foundation Thinking Skills	Listening Math Reasoning	Comprehends ideas and concepts related to CAD [1.2.1] Comprehends a mathematical ideas and concepts related to CAD [1.1.13] Comprehends ideas and concepts related to the use of CAD and a mathematical grid system [4.5.2]
		2.2.2	Students will use CAD software to plot points on an X,Y, and Z axis			
2.3	Recognize 2-Dimensional and 3-Dimensional drawings	2.3.1	Students will identify and create 2D and 3D drawings using CAD software.	Foundation Thinking Skills	Math Seeing Things in the Mind's Eye	Constructs geometric figures [1.1.15] Uses basic geometric symbols, terms, principles, and formulas [1.1.34] Visualizes a finished product [4.6.4}
2.4	Define global information and global positioning systems (GIS/GPS)	2.4.1	Participate in discussions and readings concerning global information and global positioning systems (GIS/GPS)	Foundation Thinking Skills	Writing Reasoning	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6] Uses logic to draw conclusions from available information [4.5.6]
2.5	Identify how global information and global positioning systems (GIS/GPS) are used to access and create geographic data	2.3.1	Students will identify longitude and latitude coordinates using mapping software	Foundation Thinking Skills	Writing Speaking Creative Thinking	Organizes information into an appropriate format [1.6.10] Communicates a thought, idea, or fact in spoken form [1.5.5] Combines ideas or information in a new way [4.1.2]
		2.3.2	Students access and create geographic data using mapping software			
2.5	Access and analyze specific coordinates in a global information system	2.4.1	Students will use mapping software to access and analyze longitude and latitude coordinates	Foundation Thinking Skills	Writing Science Reasoning	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6] Records data related to global information systems [1.4.21] Uses logic to draw conclusions from available information [4.5.6]

Unit 3: Construction Technologies
Hours: 20

Terminology: architecture, floor plan, elevation, schedule, commercial construction, residential construction

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		**ACADEMIC and WORKPLACE SKILLS** What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
3.1 Identify and describe common types of architectural drawings	3.1.1 Students will be presented with architectural drawings, including: floor plans, elevations, and schedules	Foundation	Listening Writing	Comprehends ideas and concepts related to construction [1.2.1] Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6]
	3.1.2 Participate in discussions about the types of drawings required for residential and commercial construction	Thinking Skills	Reasoning	Comprehends ideas and concepts related to construction [4.5.2]
3.2 Understand the importance of the planning process before construction begins	3.2.1 Participate in discussions and reading about the importance of planning before construction begins	Foundation Thinking Skills	Listening Reasoning	Comprehends ideas and concepts related to the planning process in construction [1.2.1] Comprehends ideas and concepts related to the planning process in construction [4.5.2]
3.3 Develop an architectural floor plan	3.3.1 Students will design a small residential structure, such as weekend cabin or portable disaster shelter, by sketching plan and elevation views of their design.	Foundation Thinking	Math Science Seeing Things in the Mind's Eye	Draws to scale [1.1.20] Determines quantities/measurements in English and metric units [1.4.14] Visualizes a finished product [4.6.4] Applies rules and principles to a new situation [4.5.1]
3.4 Evaluate, design, and plan a civil structure using the engineering design process	3.3.1 Students will design a scaled or full-size civil structure (such as walking bridge or walking trail in the community using recycled or free materials) with predetermined limitations and constraints	Foundation Thinking Skills	Math Science Creative Thinking	Draws to scale [1.1.20] Reads measurements from common measuring devices [1.4.20] Constructs model to depict basic concept of construction[1.4.11] Creates new design by applying specified criteria [4.1.3]

Unit 4: Manufacturing Technologies
Hours: 20

Terminology: robot, automation, pick and place, hydraulics, pneumatics, control system, open-looped system, closed-loop system, programmable logic controller

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		**ACADEMIC and WORKPLACE SKILLS** What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
4.1 Understand how robotics and automation is used to manufacture products	4.1.1 Participate in a field trip to local automated manufacturing facility	Foundation	Listening	Comprehends ideas and concepts related to robotics and automation [1.2.1]
		Interpersonal	Teamwork	Takes an interest in what others say and do [2.6.5]
4.2 Identify the parts and functions of a robotics system	4.2.1 Participate in readings and discussions about the key elements of a robotics system	Foundation	Listening	Comprehends ideas and concepts related to robotics [1.2.1]
			Reading	Applies information to new situations [1.3.5]
		Thinking Skills	Decision Making	Comprehends ideas and concepts related to manufacturing [4.2.2]
4.3 Design a robot that will solve a materials handling problem	4.3.1 Students will design and construct a robot that will perform a specific task	Foundation	Science	Applies scientific principles related to robotics [1.4.5]
			Math	Calculates different units of measurement [1.1.6]
		Thinking Skills	Creative Thinking	Creates new design by applying specified criteria [4.1.3]
			Problem Solving	Demonstrates logical reasoning in reaching a conclusion [4.4.2]
4.4 Design a product or system and document the process	4.4.1 Students will design and manufacture a product, device, or system using the engineering design process	Foundation	Science	Applies knowledge to complete a practical task [1.4.3]
				Uses equipment and techniques appropriate in the field of invention and innovation [1.4.23]
	4.4.2 Students will document their design and add this information to their portfolio	Thinking Skills	Knowing How to Learn	Applies new knowledge and skills to manufacturing [4.3.1]

Unit 5: Energy, Power, and Transportation Technologies
Hours: 20

Terminology: circuit, conductor, insulator, digital multimeter, current, voltage, resistance, fuse, ground, alternative energy, work, power

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do			ACADEMIC and WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	**Application**		**Skill Group**	**Skill**	**Description**
5.1 Understand terms associated with basic electronics	5.1.1	Participate in discussions and readings concerning electronics and electrical components	Foundation	Listening	Comprehends ideas and concepts related to energy and power [1.2.1]
				Writing	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6]
	5.1.2	Define terms associated with basic electronics, including: circuit, conduncter, insulator, current, voltage, resistance, fuse, and ground		Reading	Applies information and concepts derived from printed materials [1.3.3]
			Thinking Skills	Reasoning	Comprehends ideas and concepts related to energy and power[4.5.2]
5.2 Understand and recognize types of circuits	5.2.1	Demostrate the ability to build series and parallel circuits	Foundation	Listening	Comprehends ideas and concepts related to energy and power [1.2.1]
				Science	Performs experiment as specified [1.4.19]
			Thinking Skills	Problem Solving	Tracks and evaluates results [4.4.10]
5.3 Describe electrical measuring units and use these measuring units to describe work and/or power	5.3.1	Demonstrate an understanding and knowledge of safe practices in the classroom and laboratory	Foundation	Writing	Composes and creates documents – letters, manuals, reports, proposals, graphs, flow charts, etc. [1.6.8]
				Listening	Comprehends ideas and concepts related to energy and power [1.2.1]
	5.3.2	Demonstrate the ability to measure current, resistance, and voltage using a digital multimeter	Thinking Skills	Problem	See relationship between two or more ideas, objects, or situations [4.5.5]
5.4 Identify renewable (alternative) sources of energy and understand how they can be used to do work	5.4.1	View a presentation and participate in a discussion of renewable energy technology	Foundation	Listening	Comprehends ideas and concepts related to energy and power [1.2.1]
				Writing	Communicates thoughts, ideas, or facts in written form in a clear, concise manner [1.6.6]
5.5 Design an alternative energy device that converts wind energy into mechanical power	5.5.1	Solve design problems related to renewable energy technology	Foundation	Science	Applies scientific principles related to renewable energy [1.4.5]
				Math	Calculates different units of measurement [1.1.6]
			Thinking Skills	Creative Thinking	Combines ideas or information in a new way [4.1.2]
					Creates new design by applying specified criteria [4.1.3]

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC and WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
			Problem Solving	Demonstrates logical reasoning in reaching a conclusion [4.4.2] Draws conclusions from observations, evaluates conditions, and gives possible solutions [4.4.5]

Unit 6: Safety
Hours: As needed

Terminology: Safety procedure, OSHA, ergonomics, first aid, hazard avoidance, protective clothing, personal protection equipment, accident prevention, safety tests, materials safety

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		**ACADEMIC and WORKPLACE SKILLS** What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
6.1 Describe the need for safe work environments in the Engineering and Technology Educational classroom and laboratory	6.1.1 Maintain personal safety, workplace safety, hazard avoidance, safety information systems, protective clothing, fall protection, first aid, ergonomics, and environmental safety 6.1.2 Explore implemented safety procedures and discuss classroom and laboratory safety	Thinking	Seeing Things in the Mind's Eye	Imagines the flow of work activities from narrative descriptions [4.6.1]
			Knowing how to Learn	Applies new knowledge and skills to safety [4.3.1]
			Creative Thinking	Makes connections between seemingly unrelated ideas [4.1.6]
		Personal Management	Responsibility	Pays close attention to details [3.4.8]
6.2 Describe specific procedures such as reporting illness, injuries, safety violations, etc.	6.2.1 Demonstrate understanding of specific work procedures such as reporting illness, injuries, safety violations, etc.	Foundation	Listening	Listens and follows directions [1.2.6]
6.3 Use appropriate and required personal protection equipment (eye protection, ear protection, etc.)	6.3.1 Practice using appropriate and required personal protection equipment (eye protection, ear protection, etc.)	Thinking	Problem Solving	Devises and implements a plan of action to resolve a problem [4.4.3]
6.4 Describe machine and tool safety practices and procedures	6.4.1 Demonstrate the ability to safely use common tools and machines found in given industrial settings 6.4.2 Demonstrate the ability to pass given safety tests that show evidence of personal safety competence on given tools and machinery 6.4.3 Participate in a discussion concerning securing machinery, securing guards and safety devices, slipping hazards, eye and ear protection, adequate space around machinery, machine vibration, hand feeding and retrieval tools, power transmission parts, blade and cutter safety, worker position safety, safe procedures for adjusting or repairing	Thinking Skills	Decision Making	Demonstrates decision-making skills [4.2.4]
		Foundation Skills	Reading	Comprehends written specifications and applies them to a task [1.3.9]
				Reads and follows instructions to operate technical equipment [1.3.19]
				Uses standard occupational resource materials [1.3.22]
			Science	Follows safety guidelines [1.4.15]
			Speaking	Participates in conversation, discussion, and group presentations [1.5.8]

CAREER and TECHNICAL SKILLS What the Student Should be Able to Do		ACADEMIC and WORKPLACE SKILLS What the Instruction Should Reinforce		
Knowledge	**Application**	**Skill Group**	**Skill**	**Description**
	machinery, shear points, falling objects, flying objects, rotating parts, moving surfaces, etc. 6.4.4 Design and post a set of rules for machine safety, personal safety, hazard safety issues, rules for horseplay, materials safety, combustible materials, etc 6.4.5 Operate tools and equipment in a safe and hazard free manner to the satisfaction of the course instructor	Thinking Skills	Problem Solving	Comprehends ideas and concepts related to machine and tool safety [4.4.1]

Glossary
Unit 1: Engineering and Technology Connections

1. Technology: the modification of the natural environment in order to satisfy perceived human needs and wants
2. Engineering: the application of scientific and mathematical principles to the design and operation of structures, machines, processes, and systems
3. Portfolio: a graphic record of projects and activities completed by the student over a given period of time that illustrates how well a student has met the performance cri
4. Technological System: the systems used to make the artifacts and services that people want or need
5. Goals: the reasons for developing a system
6. Inputs: the resources the system uses to meet the identified goals in a technological system
7. Processes: the actions taken to use the inputs to meet the goals in a technological system
8. Outputs: the results obtained by operating the system
9. Feedback: the adjustments made to the system to control the outputs
10. Systems Thinking: considering how each part connects to another. This can be done by looking at individual parts as well as how the system as a whole interacts with other systems

Unit 2: Information and Communication Technologies

1. Computer-Aided Drafting and Design (CAD/CADD) - a type of design using computers to create and store technical drawings

2. Coordinate System: an arrangement of lines used to identify points in space. Points are designated by their distance along a horizontal (x) and vertical (y) axis from a reference point, the origin, designated (0, 0). A third dimension is added along a (z) axis.

3. Global Information System (GIS) - a computer application used to store, view, and analyze geographical information.

4. Global Positioning System (GPS) - A system of satellites and receivers used to determine specific logitude and latitude coordinates or locations

5. Longitude - the angular distance on the earth's surface, measured east or west from the prime meridian at Greenwich, England, to the meridian passing through a position, expressed in degrees (or hours), minutes, and seconds

6. Latitude - the angular distance on the earth's surface, measured north or south of the earth's equator, expressed in degrees (or hours), minutes, and seconds along a meridian, as seen on a map or globe

Unit 3: Construction Technologies

1. Architecture: the art and science of designing and erecting buildings or other physical structures
2. Floor Plan: is a section drawing that cuts horizontally through walls and shows room arrangements
3. Elevation: vertical projects of buildings that help define structural form and architectural style
4. Schedule: a list that defines and describes details shown by symbols on a technical drawing
5. Commercial Construction: the construction of projects such as office buildings, schools, shopping centers, sports arenas, etc
6. Residential Construction: the construction of projects in which people live

Unit 4: Manufacturing Technologies

1. Robot: a mechanical device capable of performing a variety of complex tasks while operating automatically or by remote control
2. Automation: the process of applying automatic control devices to production equipment
3. Pick and Place: term used to describe a robot that can simply pick up a part and move it to another location, typically used to transfer materials between operations
4. Hydraulics: the use of fluid power used for the generation, control, and transmission of power through the use of pressurized liquids
5. Pneumatics: the use of pressurized air or other gases to affect mechanical motion
6. Control System: contain the logic, or principles of reasoning, that is designed in an automated system. Control systems may be manual or automated.
7. Open-Looped System: attempts to meet a preset standard without monitoring the output or taking corrective action
8. Closed-Loop System: attempts to meet a preset standard while monitoring the output and providing feedback (taking corrective action)
9. Programmable Logic Controller (PLC): a small programmable control that can be used for the automation of electromechanical processes

Unit 5: Energy, Power, and Transportation Technologies

1. Circuit: a path in which current or voltage can flow.
2. Conductor: a material or object that permits electrical current to flow through
3. Insulator: a material or object that is a poor conductor of electricity
4. Digital Multimeter: A peice of test equipment used for measuring voltage, current, resistance, and possibly other electircal quantities
5. Current: the time rate of flow of electric charge, in the direction that a positive moving charge would take and having magnitude equal to the quantity of charge per unit time: measured in amperes
6. Voltage: electromotive force or potential difference expressed in volts
7. Resistance: a material's opposition to the flow of electric current; measured in ohms
8. Fuse: an electrical device that can interupt the flow of electrical current when it is overloaded
9. Alternative Energy Sources: energy sources that are currently not in mainstream use. These sources of energy may also be referred to non-renewable resources - any naturally occurring, theoretically inexhaustible source of energy, as biomass, solar, wind, tidal, wave, and hydroelectric power
10. Work: the amount of energy transferred by a force acting through a distance
11. Power: the rate at which work is done;; measured in watts (= joules/second)

Unit 6: Safety

1. Safety procedures: Proper usage techniques for a given piece of equipment or tool
2. OSHA: Occupational Safety and Health Administration. A division of the Department of Labor that sets and enforces occupational health and safety rules
3. Ergonomics: The applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort
4. First Aid: Emergency aid or treatment given to someone injured, suddenly ill, etc., before regular medical services arrive or can be reached
5. Hazard Avoidance: Systems designed to plan ahead and prevent dangerous workplace situation before they occur
6. Protective Clothing: Clothing aimed at protecting the skin from various health hazards that may be encountered in the workplace
7. Personal Protection Equipment: Includes equipment like safety glasses, gloves, hearing protection, etc. designed to protect the worker in hazardous areas
8. Accident Prevention: The practice of developing practices and habits that prevent accidents before the occur
9. Safety Test: A test designed to prove that a student has the appropriate skills and knowledge to safely operate a given tool or machine
11. Materials Safety: The act of using materials and resources in a safe and environmentally friendly manner