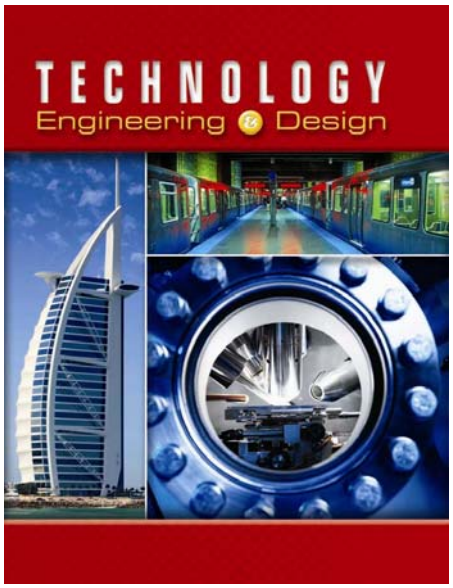
Glencoe

Technology/Engineering, High School Learning Standards for a Full First-Year Course

Massachusetts



TECHNOLOGY Engineering & Design

STANDARDS		PAGE REFERENCES
I. Content Standards		
1. Engineering Design *Central Concepts*: Engineering design involves practical problem solving, research, development, and invention/innovation, and requires designing, drawing, building, testing, and redesigning. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge.		
1.1	Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.	**Student Edition:** 43, 59, 66-69, 75, 93, 113, 133, 161, 185, 205, 233, 245, 265, 297, 319, 337, 357, 389, 407, 427, 447, 471, 489, 509, 529, 549 *STEM Handbook* 595 **Teacher Annotated Edition:** TM-11, TM-15-TM-16

STANDARDS	PAGE REFERENCES
1.2 Understand that the engineering design process is used in the solution of problems and the advancement of society. Identify examples of technologies, objects, and processes that have been modified to advance society, and explain why and how they were modified.	**Student Edition:** 87-88, 107-109, 128-129, 195-201, 314-315, 431-432, 452-458, 466-467, 514-515, 542-545 *Evolution of Bio-Related Technology* 496-497 *Evolution of Communication Technology* 80-81 *Evolution of Construction Technology* 324-325 *Evolution of Energy & Power Technology* 166-167 *Evolution of Manufacturing Technology* 228-229 *Evolution of Technology* 28-29 *Evolution of Transportation Technology* 418-419 **Teacher Annotated Edition:** TM-19, TM-23-TM-24
1.3 Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques.	**Student Edition:** 152-157, 254-255, 300-301, 348 *STEM Handbook* 591-594 **Teacher Annotated Edition:** TM-23-TM-25
1.4 Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g., ¼" = 1'0", 1 cm = 1 m).	**Student Edition:** 151, 153-154, 385 *Math Application* 349, 536 *STEM Handbook* 591 **Teacher Annotated Edition:** TM-18-TM-19
1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models.	**Student Edition:** 68, 151, 156-157, 254-256, 300-302, 348 *Activity* 405-407 *STEM Handbook* 591-594 **Teacher Annotated Edition:** TM-18-TM-19, TM-23-TM-24

STANDARDS	PAGE REFERENCES
2. Construction Technologies *Central Concepts:* The construction process is a series of actions taken to build a structure, including preparing a site, setting a foundation, erecting a structure, installing utilities, and finishing a site. Various materials, processes, and systems are used to build structures. Students should demonstrate and apply the concepts of construction technology through building and constructing either full-size models or scale models using various materials commonly used in construction. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in construction technology.	
2.1 Identify and explain the engineering properties of materials used in structures (e.g., elasticity, plasticity, R value, density, strength).	**Student Edition:** 349-353 *Evolution of Construction Technology* 324-325 *Science Application* 251 *STEM Handbook* 576-577 **Teacher Annotated Edition:** TM-25
2.2 Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in structures.	**Student Edition:** 379, 391-392 *Science Application* 251 *STEM Handbook* 576-577 **Teacher Annotated Edition:** TM-27
2.3 Explain Bernoulli's principle and its effect on structures such as buildings and bridges.	**Student Edition:** 395, 572 **Teacher Annotated Edition:** TM-27
2.4 Calculate the resultant force(s) for a combination of live loads and dead loads.	**Student Edition:** 392 **Teacher Annotated Edition:** TM-27
2.5 Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.	**Student Edition:** 32, 342-343 *Activity* 387-389 *Safety First* 551, 553-557 *Science Application* 277 **Teacher Annotated Edition:** TM-14, TM-22

STANDARDS	PAGE REFERENCES
2.6 Recognize the purposes of zoning laws and building codes in the design and use of structures.	**Student Edition:** 341 **Teacher Annotated Edition:** TM-25
3. Energy and Power Technologies—Fluid Systems *Central Concepts*: Fluid systems are made up of liquids or gases and allow force to be transferred from one location to another. They can also provide water, gas, and/or oil, and/or remove waste. They can be moving or stationary and have associated pressures and velocities. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in a fluid system.	
3.1 Explain the basic differences between open fluid systems (e.g., irrigation, forced hot air system, air compressors) and closed fluid systems (e.g., forced hot water system, hydraulic brakes).	**Student Edition:** 171, 196-200, 213-216 **Teacher Annotated Edition:** TM-19, TM-20
3.2 Explain the differences and similarities between hydraulic and pneumatic systems, and explain how each relates to manufacturing and transportation systems.	**Student Edition:** 171, 214-215, 460 **Teacher Annotated Edition:** TM-19, TM-20, TM-29
3.3 Calculate and describe the ability of a hydraulic system to multiply distance, multiply force, and effect directional change.	**Student Edition:** 171, 214-215 *STEM Handbook* 571 **Teacher Annotated Edition:** TM-19, TM-20
3.4 Recognize that the velocity of a liquid moving in a pipe varies inversely with changes in the cross-sectional area of the pipe.	This standard can be met during teacher/class discussion.
3.5 Identify and explain sources of resistance (e.g., 45º elbow, 90º elbow, changes in diameter) for water moving through a pipe.	This standard can be met during teacher/class discussion.
4. Energy and Power Technologies—Thermal Systems *Central Concepts*: Thermal systems involve transfer of energy through conduction, convection, and radiation, and are used to control the environment. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in a thermal system.	
4.1 Differentiate among conduction, convection, and radiation in a thermal system (e.g., heating and cooling a house, cooking).	**Student Edition:** 195 **Teacher Annotated Edition:** TM-19

STANDARDS	PAGE REFERENCES
4.2 Give examples of how conduction, convection, and radiation are considered in the selection of materials for buildings and in the design of a heating system.	**Student Edition:** 349-353, 381 *Activity* 355-357 *Science Application* 33 **Teacher Annotated Edition:** TM-25, TM-26
4.3 Explain how environmental conditions such as wind, solar angle, and temperature influence the design of buildings.	**Student Edition:** 346-347 **Teacher Annotated Edition:** TM-25
4.4 Identify and explain alternatives to nonrenewable energies (e.g., wind and solar energy conversion systems).	**Student Edition:** 187-201 *Activity* 203-205 *STEM Handbook* 573-574 **Teacher Annotated Edition:** TM-20
5. Energy and Power Technologies—Electrical Systems *Central Concepts*: Electrical systems generate, transfer, and distribute electricity. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in an electrical system.	
5.1 Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.	**Student Edition:** 179-180, 218 *Activity* 183-185 *STEM Handbook* 578-579 **Teacher Annotated Edition:** TM-19, TM-20
5.2 Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.	**Student Edition:** 218-219 **Teacher Annotated Edition:** TM-20
5.3 Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.	**Student Edition:** 180 *STEM Handbook* 579 **Teacher Annotated Edition:** TM-19
5.4 Recognize that resistance is affected by external factors (e.g., temperature).	This standard can be met during teacher/class discussion.

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5.5 Compare and contrast alternating current (AC) and direct current (DC), and give examples of each.	**Student Edition:** 216-218 **Teacher Annotated Edition:** TM-20
6. Communication Technologies *Central Concepts*: Applying technical processes to exchange information can include symbols, measurements, icons, and graphic images. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in a communication technology.	
6.1 Explain how information travels through the following media: electrical wire, optical fiber, air, and space.	**Student Edition:** 84-86, 115-119, 123-126 *Science Application* 86 **Teacher Annotated Edition:** TM-16, TM-17
6.2 Differentiate between digital and analog signals. Describe how communication devices employ digital and analog technologies (e.g., computers, cell phones).	**Student Edition:** 83-88, 102-103, 115-129, 146-147 **Teacher Annotated Edition:** TM-16, TM-17-TM-18
6.3 Explain how the various components (source, encoder, transmitter, receiver, decoder, destination, storage, and retrieval) and processes of a communication system function.	**Student Edition:** 84-86, 116, 118-119 **Teacher Annotated Edition:** TM-16, TM-17-TM-18
6.4 Identify and explain the applications of laser and fiber optic technologies (e.g., telephone systems, cable television, photography).	**Student Edition:** 116-117, 342-343, 467 *Science Application* 144 **Teacher Annotated Edition:** TM-17-TM-18, TM-25
6.5 Explain the application of electromagnetic signals in fiber optic technologies, including critical angle and total internal reflection.	**Student Edition:** 116-117 **Teacher Annotated Edition:** TM-17-TM-18

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7. Manufacturing Technologies *Central Concepts*: Manufacturing processes can be classified into six groups: casting/molding, forming, separating, conditioning, assembling, and finishing. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge in a manufacturing technology.	
7.1 Describe the manufacturing processes of casting and molding, forming, separating, conditioning, assembling, and finishing.	**Student Edition:** 237-238, 268-269 **Teacher Annotated Edition:** TM-20-TM-21, TM-22
7.2 Identify the criteria necessary to select safe tools and procedures for a manufacturing process (e.g., properties of materials, required tolerances, end-uses).	**Student Edition:** 267-275 *Activity* 279-281 *Science Application* 33, 277 *STEM Handbook* 557 **Teacher Annotated Edition:** TM-22
7.3 Describe the advantages of using robotics in the automation of manufacturing processes (e.g., increased production, improved quality, safety).	**Student Edition:** 306-309, 314-315 *Math Application* 309 **Teacher Annotated Edition:** TM-23-TM-24