

Engineering By Design
Advancing Technological Literacy
A Standards-Based Program Series

MS - 2

INVENTIONS & INNOVATIONS

A Standards-Based Middle School Course Guide



Technology Engineering Education Grade 7



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INVENTIONS AND INNOVATIONS

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Description:	<p>In this course, students learn all about invention and innovation. They will have opportunities to study the history of inventions and innovations, including their impacts on society. They will learn about the core concepts of technology and about the various approaches to solving problems, including engineering design and experimentation.</p> <p>Students will apply their creativity in the invention and innovation of new products, processes, or systems. Finally, students learn about how various inventions and innovations impact their lives. Students participate in engineering-design activities to understand how criteria, constraints, and processes affect designs.</p> <p>Students are involved in activities and experiences where they learn about brainstorming, visualizing, sketching, modeling, constructing, testing, experimenting, and refining designs. Students also develop skills in researching for information, communicating design information, completing engineering portfolios, developing a cost analysis, working with time studies and reporting their results.</p> <p>Students learn how Technology, Innovation, Design, and Engineering interrelate and are interdependent. This middle school course and provide the foundation for future studies in a Technology Engineering Education sequence.</p>
Pre-requisites	Exploring Technology
Recommended Credits:	Inventions and Innovations
Recommended Grade Levels:	7th

It is strongly recommended that administration and guidance follow the scope and sequence course recommendations as listed.

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Standard 1.0

Demonstrate leadership, citizenship, and teamwork skills required for success in the school, community and workplace.

Standard 2.0

Safely use tools, materials, equipment and other technology resources.

Standard 3.0

Students will develop an understanding of how to turn ideas into products using invention, innovation, and inquiry.

Standard 4.0

Students will use, manage and assess the engineering design process as they apply STEM to create solutions to a problem.

Standard 5.0

Students will use design and creativity concepts to improve the daily lives of other through invention and innovation.

Standard 6.0

Students will understand the effects technology and inventions and innovations have on the environment.

Standard 7.0

Students will identify and research a Space Exploration Infrastructure problem or issue that has been influenced by advancements in technology.

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STANDARD 1.0

Demonstrate leadership, citizenship, and teamwork skills required for success in the school, community and workplace through Technology Student Association.

LEARNING EXPECTATIONS

The student will be able to:

- 1.1 The creed, purposes, motto, and emblem of Technology Student Association is directly related to personal and professional development.
- 1.2 Makes decisions and assumes responsibilities.
- 1.3 Respect the opinions, customs, and individual differences of others.
- 1.4 Build personal career development by identifying career interests, strengths, and opportunities.
- 1.5 Demonstrate the ability to work cooperatively with others in a professional setting.
- 1.6 Cooperates with peers to select and organize a community service project.
- 1.7 Interacts respectfully with individuals of different cultures, gender and backgrounds.
- 1.8 Resolves conflicts and differences to maintain a smooth workflow and classroom

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student should know and be able to:

- Create a leadership inventory and use it to conduct a personal assessment.
- Recite the TSA Motto and Creed.
- Design and produce a cover letter and a chronological or skills resume based on research of a selected technology-related career
- Participates and conducts meetings and other business according to accepted rules of parliamentary procedure.
- Demonstrate character and leadership using creative and critical thinking skills.
- Participate in a mock interview.
- Participates in a community service project
- Implement an annual program of work.
- Evaluate an activity within the school, community, and/or workplace and project effects of the project.

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STANDARD 2.0

Safely use tools, materials, equipment and other technology resources.

LEARNING EXPECTATIONS

The student will be able to:

- 2.1 Understand general laboratory safety rules and regulations when using tools, equipment and performing processes.
- 2.2 Successfully pass a test on general laboratory safety and regulations with 100% accuracy.
- 2.4 Successfully pass a safety test on power tools used in the classroom with 100% accuracy.
- 2.5 Successfully pass a written or oral test on the chemical, electrical and fire safety hazards that exist in a Technology Engineering classroom and their school.
- 2.6 Understand safety, nomenclature and usage of all hand tools used in this course.
- 2.7 Demonstrate a positive attitude regarding safety practices and issues.
- 2.8 Demonstrate continuous awareness of potential hazards to self and others and respond appropriately.

PERFORMANCE INDICATORS: EVIDENCE STANDARDS IS MET

The student should know and be able to:

- Is attentive during safety discussions.
- Actively seeks information about safe procedures.
- Responds positively to instruction, advice, and correction regarding safety issues.
- Does not deliberately create or increase hazards, such as by horseplay, practical jokes, or creating distractions.
- Is observant of personnel and activities in the vicinity of the work area.
- Warns nearby personnel, prior to starting potentially hazardous actions.
- Provides and activates adequate ventilation equipment as required by the task.
- Reports all injuries to self to instructor.
- Reports observed unguarded hazards to their immediate supervisor.
- Complies with personal assignments regarding emergency assignments.
- List all safety rules required when performing TSA competitive events.

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STANDARD 3.0

Students will develop an understanding of how to turn ideas into products using invention, innovation, and inquiry.

LEARNING EXPECTATIONS

The student will be able to:

- 3.1 Discuss how inventors and innovators use the design process to solve problems.
- 3.2 Identify, explain, and discuss important inventions and innovations that have impacted our lives.
- 3.3 Develop a new product using invention and innovative processes.
- 3.4 Understand and practice brainstorming to help find solutions to a problem.
- 3.5 Understand and use freehand technical sketching.
- 3.6 Students will read, analyze, and interpret technical sketching.
- 3.7 Students will create an engineering portfolio and record information, time-study, cost analysis, and a material list.
- 3.8 Students will calculate and interpret measurements.
- 3.9 Define related invention and innovation terms
- 3.10 Compare invention to innovation
- 3.11 Identify an important past invention or innovation
- 3.12 Research an artifact related to Engineering and Technology that is at least 25 years old

PERFORMANCE STANDARDS:

The student should know and be able to:

- Define a simple invention or innovation.
- Evaluate a simple invention or innovation.
- Apply a design process in the invention or innovation of a product or system.
- Demonstrate appropriate safety in the invention or innovation of a product or system.
- Define brainstorming techniques.
- Identify the sketches in an orthographic projection.
- Identify sketching views in an orthographic projection.
- Sketch an isometric drawing.
- Create 3D solid model of various objects.
- Read technical illustrations.
- Read dimensions.
- Create technical drawing with dimensions.
- Define and describe terms and concepts related to invention and innovation.

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Standard 4.0

Students will use, manage and assess the engineering design process as they apply STEM to create solutions to a problem.

LEARNING EXPECTATIONS (BENCHMARKS)

The student will be able to:

- 4.1 Understand inventions and innovation in the designed world.
- 4.2 Affectively read and interpret an engineering problem and list possible solutions.
- 4.3 Use the design process to develop a solution to the problem.
- 4.4 Understand the brainstorming and how it helps in the design and solution to a problem.
- 4.5 Create a series of thumbnail sketches and submit them to the team for evaluation.
- 4.6 Design sketches using isometric or perspective sketches.
- 4.7 Understand why isometric sketching is an essential skill for the designer.
- 4.8 Define the difference between and isometric, perspective and orthographic projection.
- 4.9 Draw and identify and submit orthographic projection of the design
- 4.10 List the advantages of computer-aided designs.
- 4.11 Understand, use and apply dimensions and measurement to sketches and technical drawing.
- 4.12 Create, test, and evaluate the mockup or prototype of your engineering design and have a design team check the specification using measuring devices.

PERFORMANCE STANDARDS:

The student should know and be able to:

- Apply a design process to solve problems in and beyond the laboratory-classroom.
- Applies the appropriate technical solution to complete tasks.
- Understands the use of 3D models in product invention, design and development.
- Identify and describe the major steps in the engineering design process.
- Design and make a simple invention and report on a selected information and communication technology.
- Explain how new products and systems can be developed to solve problems.
- Identify an important invention or innovation from the past and give a presentation on it.
- Inputs data and information accurately for the course requirements.
- Explain 2-dimensional and 3-dimensional drawings
- Uses appropriate time management to achieve goals.
- Students will understand relationships between two variables.
- Plot points on a coordinate plane.
- Explain 2-dimensional and 3-dimensional drawings.
- Define the difference between and isometric, perspective and orthographic projection.
- Draw and identify and submit orthographic projection of the design.
- List the advantages of computer-aided designs.
- Understand, use and apply dimensions and measurement to sketches and technical drawing.

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STANDARD 5.0

Students will use design and creativity concepts to improve the daily lives of other through invention and innovation.

LEARNING EXPECTATIONS

The student will be able to:

- 5.1 Identify and research a specific problem or issue you can improve with an innovative design and creativity.
- 5.2 Select, research and use one of the following (Environment Issues, Medical Technology Issue, Green Technology Issues, Hydroponics or Wind Energy) to help your team invent or innovate a product that will assist or extend life.
- 5.3 Identify the criteria clearly and precisely and the constraints and issue that need to be improved.
- 5.4 Explore, design and analyze the pros and cons of a variety of possible solutions.
- 5.5 Submit technical sketches, a bill of materials, cost analysis and a time study for your prototype.
- 5.6 Produce a model or prototype that meets the task criteria in creative insightful ways.
- 5.6 Test and evaluate the design using mathematical, scientific, and engineering specification.
- 5.7 Show significant improvement in refining their design based on prototype testing and evaluation.
- 5.8 Explain that design is a creative planning process that leads to useful products and systems.
- 5.9 Develop a design and creative proposal that is accurate and comprehensive.

PERFORMANCE STANDARDS:

The student should know and be able to:

- Define your problem or issue as a creative challenge.
- Identify the major categories of the design world.
- List and describe the types of technological design.
- Use appropriate resources to troubleshoot a product or a system.
- Explain that design is a creative planning process that leads to useful products and systems.
- Explain that modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.
- Explain that requirements for a design are made up of criteria and constraints
- Generates the best ideas to solve your problem.
- Work safely and accurately with a variety of tools, machines, and materials.
- Create a troubleshooting chart.
- Communicate the design process and present with clarity and accuracy the final solution.
- Submit the teams engineering portfolio along with all sketches, drawing, and documentation which will be duplicated by another team based on the proposal submitted.
- Discuss the many interpretations association with the word design.
- Describe the elements associated with the engineering design process.
- Troubleshoot a product or device that is not working.

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STANDARD 6.0

Students will understand the effects technology and inventions and innovations have on the environment.

LEARNING EXPECTATIONS

The student will be able to:

- 6.1 Research design alternatives for products that may be manufactured from recycled or reused materials.
- 6.2 Identify and research a specific environmental problem or issue that has been influenced by advancements in technology.
- 6.3 Design and manufacture a product using recycled or reused materials.
- 6.4 Conduct research on a contemporary agriculture or biotechnology issue of their choosing, document their research, and create a display.
- 6.4 Demonstrate an understanding of the issue through research and effective presentation.
- 6.5 Gather information, analyze data, develop strategies and submit conclusions relative to the specific problem or issue and its impact/s on society and the environment.
- 6.6 Present their findings in a multimedia presentation and interview.
- 6.7 Create a model or prototype depicting some aspect of the issue may be included in the displays.

PERFORMANCE STANDARDS:

The student should know and be able to:

Market a product and inform the public about it as well as assist in selling and distributing of the product.

- Properly secure recycled or reused materials that could be used for student-designed and manufactured products.
- Explain that corporations can often create demand for a product by bringing it onto the market and advertising it.
- Explain that technological ideas are sometimes protected through the process of patenting.
- Submit two-dimensional and three-dimensional sketching of the recycled or reused product.
- Develop a personnel plan with assigned responsibilities and tool up for production.
- Manufacture several products using line production techniques.
- Conduct a survey to measure potential marketability.
- Generate a marketing plan that includes some tangible advertising pieces.
- Maintain an inventor's notebook (portfolio) that details and invention or innovation.
- Research and develop a presentation on a new invention (cool gadget).
- Create, test, and evaluate the mockup or prototype of your engineering design and have a design team check the specification using measuring devices.
- Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task.

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STANDARD 7.0

Students will identify and research a Space Exploration Infrastructure problem or issue that has been influenced by advancements in technology. Research with the reasons for establishing a lunar outpost and with what explorers will do on the Moon.

LEARNING EXPECTATIONS

The student will be able to:

- 7.1 Research, assess, and develop strategies in *Establishing a Lunar Outpost*
- 7.2 *Research and identify possible solutions to Launch Vehicles and Early Departure Stages*
- 7.3 Identify, explain, and evaluate what explorers will do on the Moon and the scientific and economic reasons for establishing a lunar outpost.
- 7.4 Explain that all technologies have effects other than those intended by the design, some of which may have been predictable and some not.
- 7.5 Describe, analyze, and evaluate the impacts that inventions and innovations have had on humans.
- 7.6 Identify and describe the reasons for further exploration of the Moon.
- 7.7 Identify, explain, and evaluate what explorers will do on the Moon and the scientific and economic reasons for establishing a lunar outpost.
- 7.8 Describe, analyze, and evaluate the impacts that inventions and innovations have had on humans.
- 7.9 Identify and describe the reasons for further exploration of the Moon.

PERFORMANCE STANDARDS:

The student should know and be able to:

- Select an invention and discuss how it has impacted society.
- Describe important invention and innovations in medical technologies that have impacted our lives.
- Describe the life cycle of a product.
- Discuss the importance of using data in making meaningful decisions.
- Research and record information on three waste materials. Create a display board using your research.
- Compare technological decisions about products or systems that have had both desirable and undesirable consequences.
- Explain that systems fail because they have faulty or poorly matched parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with.
- Defend the ethical issues related to the development and use of technology
- Identify and describe examples of how technology affects humans.
- Support an economic, political or cultural issue that is influenced by the development and use of technology.
- Explain that the development and use of technology poses ethical issues.
- Describe, analyze and evaluate the impacts that inventions and innovations have had on humans.
- Identify advances and innovation in future space travel.
- Explain how economic, political, and cultural issues are influenced by the development and use of technology.
- Discuss the impacts of “waste materials” on the environment.
- Describe how various “waste materials” can be recycled, reused, or re-manufactured into new products.

Note: Teachers may research any problem or issue that has been influenced by advancements in technology. You are not limited to Space Research only. The research can be in Ag Biotechnology, Assistive Technologies, Communications, Construction, Information Technology, Medical Technology, Manufacturing and Production, Power and Energy, Transportation, and Career in STEM. Make sure you follow the standards and substitute the area of research you and your students would like to pursue.