
Invention and Innovation Curriculum Standards

The Background:

Curriculum frameworks are mandated by Rules, Regulations, and Minimum Standards of the State Board of Education (Section 0520-01-03-.05, State Curriculum, Requirement D).

The course Inventions and Innovations prepares students with opportunities to apply the design process in the invention or innovation of a new product, process, or system. It provides for increased integration of math, science, and technology—critical components of Science, Technology, Engineering, and Math (STEM), which will provide for increased alignment with the common core.

Students will participate in engineering-design activities to understand how criteria, constraints, and processes affect designs. They will be involved in activities and experiences where they learn about brainstorming, visualizing, modeling, constructing, testing, experimenting, and refining designs. Students also develop skills in researching for information, communicating design information, and reporting results.

This course, designed for seventh grade students, will replace an existing course currently entitled Inventions and Innovations. The new curriculum standards align to revisions at both the national and international levels.

Changes since first reading include:

- Cosmetic formatting changes to reflect new course description document format. This new format includes additional information about the course to assist school leadership in implementing the course, including pre-requisites, as requested by the Board on first reading. This format has been reviewed by division and department leadership.
- Learning expectations and performance indicators have been combined with duplicate performance indicators (competencies) removed.
- Specific performance indicators that were possible but not necessary demonstrations of professional skills competencies have been removed (i.e. recitation of the TSA creed), as requested by the Board on first reading.

The Recommendation:

The Department of Education recommends adoption of the standards on final reading.
The SBE staff concurs with this recommendation.



TENNESSEE DEPARTMENT OF

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Inventions & Innovations

Primary Career Cluster:	Science, Technology, Engineering, and Mathematics (STEM)
Consultant:	Marty Willis, (615) 741-8836, Marty.Willis@tn.gov
Course Code(s):	Awaiting approval
Prerequisite(s):	Exploring Technology
Credit:	None
Grade Level:	7 th
Graduation Requirement Substitution:	None
Programs of Study and Sequence:	While not a part of a formal program of study, this course is a great foundation for future STEM programs of study.
Necessary Equipment:	None
Aligned Student Organization(s):	TSA http://www.tntsa.org/
Coordinating Work-Based Learning:	Instructors are encouraged to become certified in work-based learning for mentorship and job shadowing opportunities. http://www.state.tn.us/education/cte/wb/index.shtml
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	None
Teacher Endorsement(s):	Any TEE endorsement OR 007, 013, 014, 015, 016, 017, 018, 105, 210, 211, 212, 213, 214, 407, 413, 414, 415, 416, 417, 418, 460, 461, 480, 481, 482, and 483 OR Any T&I teacher who holds a Bachelor's.
Additional Required Teacher Certifications/Training:	State approved STEM training session
Teacher Resources:	http://www.state.tn.us/education/cte/index.shtml

Course Description

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.

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. 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.

Program of Study Application

Inventions and Innovations is a middle school course meant to provide students with a foundational understanding of important math, science, technology, and engineering concepts that will benefit them in their choice of a variety of programs at the high school level.

Course Standards

Standard 1.0

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

Learning Expectations and Performance Indicators:

- 1.1 Cultivate positive leadership skills. Take part in opportunities to practice and demonstrate personal leadership skills. For example, taking advantage of opportunities provided by a career and technical student organization (CTSO), such as the Technology Student Association (TSA).
- 1.2 Assess situations, apply problem-solving techniques and decision-making skills within the school, community, and workplace.
- 1.3 Participate as a team member in a learning environment.
- 1.4 Respect the opinions, customs, and individual differences of others.
- 1.5 Build personal career development by identifying career interests, strengths, and opportunities.

Standard 2.0

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

Learning Expectations and Performance Indicators:

- 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.
- 2.3 Successfully pass a safety test on power tools used in the classroom with 100% accuracy.



- 2.4 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.
- 2.5 Demonstrate continuous awareness of potential hazards to self and others and respond appropriately.

Standard 3.0

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

Learning Expectations and Performance Indicators:

- 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.

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 and Performance Indicators:

- 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.



Standard 5.0

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

Learning Expectations and Performance Indicators:

- 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 engineering categories – 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.
- 5.7 Test and evaluate the design using mathematical, scientific, and engineering specification.
- 5.8 Show significant improvement in refining their design based on prototype testing and evaluation.
- 5.9 Explain that design is a creative planning process that leads to useful products and systems.
- 5.10 Develop a design and creative proposal that is accurate and comprehensive.

Standard 6.0

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

Learning Expectations and Performance Indicators:

- 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, including submitting two and three dimensional sketches of the product, developing a personnel plan with assigned responsibilities and tools for production, manufacturing the product using line production techniques, conducting a survey to measure potential marketability, and generating a marketing plan.
- 6.4 Conduct research on a contemporary agriculture or biotechnology issue of their choosing, document their research, and create a display.
- 6.5 Demonstrate an understanding of engineering issues through research and effective presentation, including both multimedia and interview.
- 6.6 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 and maintain an inventor's portfolio.
- 6.7 Create a model or prototype depicting some aspect of the issue may be included in the displays by creating, testing, and evaluating the mockup or prototype of your engineering design and have a design team check the specification using measuring devices.



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:

- 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.

Note: Teachers may research any problem or issue that has been influenced by advancements in technology. You are not limited to Space Research only, as seen above in Standard 7. The research can be in Agricultural Biotechnology, Assistive Technologies, Communications, Construction, Information Technology, Medical Technology, Manufacturing and Production, Power and Energy, Transportation, and/or Careers in STEM. Make sure you follow the standards and substitute the area of research you and your students would like to pursue. Sample performance indicators for use with other subject areas are below.

Performance Indicators:

- Describe the life cycle of a product.
- Compare technological decisions about products or systems that have had both desirable and undesirable consequences.
- Discuss the importance of using data in making meaningful decisions.
- Research and record information on “waste materials.” Discuss the impacts of “waste materials” on the environment. Describe how various “waste materials” can be recycled, reused, or re-manufactured into new products.
- 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.
- Explain that the development and use of technology poses ethical issues. Defend the ethical issues related to the development and use of technology
- Identify and describe examples of how technology affects humans. Describe, analyze and evaluate the impacts that inventions and innovations have had on humans. Explain how economic, political, and cultural issues are influenced by the development and use of technology. Support an economic, political or cultural issue that is influenced by the development and use of technology.

