

Invention and Innovation
A Standards-Based Middle School Model Course Guide, Updated Edition

Unit Overview

Unit 1: Introduction to Invention and Innovation

Nils Bohlin recently died at the age 82 in Sweden. Most people have never heard of him. However, the technology he invented has saved millions of lives worldwide. Who was he? He was the inventor of the car lap-and-shoulder belt that was introduced by carmaker Volvo in 1959. Today, the law in many countries requires the seatbelt.

Unit 1 - Big Idea

**Invention and innovation
are creative ways to turn
ideas into real things.**

The main goal of this unit is to introduce students to the key concepts associated with technology, invention, innovation, and to have them “invent something.” Students must learn the basics associated with technology and how inventions and innovations lead to new technology and how technology influences innovations and inventions. Students must also develop an understanding to the problem solving process and learn that invention and innovation are types of problem solving.

Standards:

- Students will develop an understanding of the influence of the characteristics and scope of technology. (ITEA/STL-1)
- Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study. (ITEA/STL-3)
- Students will develop an understanding of role of society in the development and use of technology. (ITEA/STL-6)
- Students will develop an understanding of the influence of technology on history. (ITEA/STL-7)
- Students will develop an understanding of engineering design (ITEA/STL-9)
- Students will develop an understanding of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. (ITEA/STL-10)
- Students will develop the abilities to apply the design process. (ITEA/STL-11)
- Students will develop the abilities to use and maintain technological products and systems. (ITEA/STL-12)
- Students will develop an understanding of and be able to select and use information and communications technologies. (ITEA/STL-17)

Benchmarks:

ITEA – Benchmarks for Technological Literacy

- New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. (1-F)
- The development of technology is a human activity and is the result of individual or collective needs and the ability to be creative. (1-G)
- Technology is closely linked to creativity, which has resulted in innovation. (1-H)
- Throughout history, new technologies have resulted from the demands, values, and interests of individuals, industries, and societies. (6-D)
- Meeting societal expectations is a driving force behind the acceptance and use of products and systems. (6-G)
- Many inventions and innovations have evolved by using slow and methodical processes of tests and

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refinements. (7-C)

- The specialization of function has been at the heart of many technological improvements. (7-D)
- In the past, an invention or innovation was not usually developed with the knowledge of science. (7-F)
- Design involves a set of steps that can be performed in different sequences and repeated when needed. (9-F)
- Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it. (10-G)
- Apply a design process to solve problems in and beyond the laboratory-classroom. (11-H)
- Use computers and calculators in order to achieve a given purpose. (12-J)
- Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human. (17-H)
- The use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas. (17-K)

AAAS-Benchmarks for Science Literacy

- Throughout history, people have carried out impressive technological feats, some of which would be hard to duplicate today even with modern tools.
- Engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems.
- Mathematics is helpful in almost every kind of human endeavor - from laying bricks to prescribing medicine or drawing a face. In particular, mathematics has contributed to progress in science and technology for thousands of years and still continues to do so.
- The level of skill a person can reach in any particular activity depends on innate abilities, the amount of practice, and the use of appropriate learning technologies.
- Locate information in reference books, back issues of newspapers and magazines, compact disks, and computer databases.
- The human ability to shape the future comes from a capacity for generating knowledge and developing new technologies - and for communicating ideas to others.
- Use calculators to compare amounts proportionally.
- Read simple tables and graphs produced by others and describe in words what they show.

NCTM-Standards for School Mathematics

- Recognize and apply mathematics in contexts outside of mathematics.
- Create and use representations to organize, record, and communicate mathematical ideas.
- Develop, analyze, and explain methods for solving problems involving proportions, such as scaling and finding equivalent ratios.
- Select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision.
- Recognize and use connections among mathematical ideas.

Unit Objectives: At the completion of this unit, students will:

1. Define the terms invention and innovation.
2. Identify inventions and innovations that have impacted our lives.
3. Explain that new products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.
4. Identify famous inventors and their inventions.
5. Explain that the development of technology is a human activity and is the result of individual or collective needs and the ability to be creative.
6. Identify, explain, and discuss the history of various inventions and innovations.
7. Explain that technology is closely linked to creativity, which has resulted in innovation.
8. Explain how societal expectations impact the acceptance and use of products and systems.

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9. Explain why, that in the past, an invention or innovation was not usually developed with the knowledge of science.
10. Explain that the use of symbols, measurements, and drawings promotes clear communication by providing a common language to express ideas.
11. Define and explain the role that technology and society play in the invention and innovation process.
12. Contribute to a group endeavor by offering useful ideas, supporting the efforts of others, and focusing on the task.
13. Research and report on a selected information and communication technology.
14. Organize and present research findings effectively.
15. Work safely and accurately with a variety of tools, machines, and materials.
16. Design and make a simple invention.

Unit 1 Content Outline	
<p>I. Definitions</p> <p>A. Technology – Human innovation in action that involves the generation of knowledge and processes to develop systems that solve problems and extend human capabilities. The innovation, change, or modification of the natural environment to satisfy perceived human needs and wants.</p> <p>B. Science – The study of the natural world through observation, identification, description, experimental investigation, and theoretical explanations.</p> <p>C. Engineering – The profession or work performed by an engineer. Engineering involves the knowledge of the mathematical and natural sciences (biological and physical) gained by study, experience, and practice that are applied with judgement and creativity to develop ways to utilize the materials and forces of nature for the benefit of humankind.</p> <p>D. Invention – A new product or system or process that has never existed before, created by study and experimentation.</p> <p>E. Innovation – An improvement of an existing technological product, system, or method of doing something.</p> <p>F. Serendipity – An accidental discovery.</p> <p>G. Artifact – A human-made object.</p> <p>H. Creative Thinking – The ability or power used to produce original thoughts or ideas based upon reasoning and judgement.</p> <p>II. Scope of Technology</p> <p>A. Technology provides new products and systems.</p> <p>B. Humans have needs and wants—they invent or innovate a new technology to satisfy their needs and wants.</p> <p>C. Creativity is an important ingredient to technology.</p> <p>D. Advertising helps create demand for new or improved technology.</p> <p>III. Society Influences Technology and Technology Influences Society</p> <p>A. People have invented and innovated since the beginning of humankind.</p> <p>B. Technology is continually changing.</p> <p>C. Technology influences the needs and wants of people.</p> <p>D. People and culture influence technology.</p> <p>E. Societies' acceptance of technology is important.</p>	<p>F. Inventions and innovations can have both positive and negative impacts.</p> <p>IV. History of Technology</p> <p>A. Studying the history of technology provides people a way to learn from the successes and failures of their predecessors.</p> <p>B. Invention and innovation typically take time and involve patience.</p> <p>C. Specialized functions of a product or system can lead to technological improvements.</p> <p>D. Technology of the times influences the way in which people live and work.</p> <p>E. Early inventions and innovations were not developed with the knowledge of science.</p> <p>V. Design</p> <p>A. It is the creative planning process that leads to useful products and systems.</p> <p>B. There is no perfect design.</p> <p>C. Design has criteria and constraints.</p> <p>VI. Engineering Design</p> <p>A. Engineering design consists of basic steps.</p> <ol style="list-style-type: none"> 1. Identify the problem or need. 2. Brainstorm a solution. 3. Determine an appropriate solution. 4. Select a solution to solve the problem or meet the need. 5. Implement the solution (e.g., build a model or prototype). 6. Test and evaluate the solution. <p>VII. Famous Inventors and Their Inventions</p> <p>A. Leonardo da Vinci – made the first real studies of flight (1480s)</p> <p>B. Alexander Graham Bell – telephone (1870s)</p> <p>C. Levi Strauss – blue jeans (1873)</p> <p>D. Thomas Edison – lightbulb (1879)</p> <p>E. Gottlieb Daimler – invented a gas engine (1885)</p> <p>F. George Eastman – photographic film (1888)</p> <p>G. Marie Curie – together with her husband, she discovered two new elements—radium and polonium (1890s)</p> <p>H. Ole Evinrude – outboard boat motor (1907)</p> <p>I. George Washington Carver – industrial applications for agricultural products (1910s)</p> <p>J. Henry Ford – assembly line (1913)</p> <p>K. Garrett Morgan – traffic light (1923)</p> <p>L. Philo T. Farnsworth – electronic television (1927)</p> <p>M. Buckminster Fuller – geodesic dome (1950)</p> <p>N. Nolan Bushnell – video game (1971)</p> <p>O. Steve Wozniak – personal computer (1976)</p>

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Student Assessment Criteria – Introduction to Invention and Innovation			
Achievement Level Sub-concept	Above Target 3	At Target 2	Below Target 1
Concepts and Terms	Can define and describe all terms and concepts related to Invention and Innovation.	Can define and describe most terms and concepts related to Invention and Innovation.	Can define and describe a few concepts and terms related to Invention and Innovation.
Technology and Society	Can describe, explain, and evaluate the role that technology and society play in the invention and innovation process.	Can describe and explain the role that technology and society play in the invention and innovation process.	With assistance, can describe the role that technology and society play in the invention and innovation process.
History of Invention and Innovation	Can identify, explain, and discuss the history of various inventions and innovations.	Can identify and explain various historical inventions and innovations.	With assistance, can identify and explain various historical inventions and innovations.
The Design Process	Can explain, analyze, and apply the design process in the development of a simple invention.	Can explain and apply the design process in the development of a simple invention.	With assistance, can use and apply the design process in the development of a simple invention.

Student Learning Experiences

Our First Invention
The Most Important Invention or Innovation of All Time
Introduction to Invention and Innovation

As a set of learning experiences, the following *STL* content standards and corresponding benchmarks are addressed: **Standard 1**, Benchmarks F, G, H, and I; **Standard 3**, Benchmark F; **Standard 6**, Benchmarks D, E, F, and G; **Standard 7**, Benchmarks C, D, E, and F; **Standard 8**, Benchmarks E, F, and G; **Standard 9**, Benchmarks F, G, and H; **Standard 10**, Benchmark G; and **Standard 17**, Benchmark H. However, if you choose to use only a specific activity, please refer to Appendix B to determine exactly which standards and benchmarks are being addressed by that learning experience. See **Appendix B** for a complete listing of the *STL* content standards.

Acceptable Evidence of Student Understanding

The items listed below reflect a set of tasks that students should be able to demonstrate as evidence that the standards have been met. This will require that a variety of learning experiences are completed and assessment is conducted throughout the unit.

1. Define the following: technology, science, engineering, invention, innovation, and creativity.
2. Discuss the roles that technology and society play in the invention and innovation processes.
3. Identify an important invention or innovation from the past and give a presentation on it.
4. Research one artifact related to information and communication technology that is at least 20 years old and report on its origins and impacts.
5. Design and make a simple invention.
6. Explain the basic steps of the engineering design process.

Special note: Please keep in mind that criteria must be developed to measure the evidence that students provide in demonstrating their levels of understanding—what are we looking for and how will we know it when we see it? For example, if students are asked to build a model, how will we know if it's a good one?

When considering achievement levels and helping students to understand how they might improve, it will be necessary to know what we mean by terms such as effectively, efficiently, adequately, creatively, thoughtfully, mostly, clearly, minimally, marginally, correctly, safely, systematically, randomly, logically, thoroughly, introspectively, insightfully, and meaningfully. (See **Appendix D, Acceptable Evidence Glossary**, for definitions.)

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Pre-Test

Directions: Circle the T or F in the column to the left of each true (T) or false (F) statement.

T	F	1.	Societal expectations have little to do with the acceptance and use of products and systems.
T	F	2.	New products and systems are developed to do things that could not be done without the help of technology.
T	F	3.	Science endeavors are based on individual or collective needs and the ability to be creative.
T	F	4.	Technology is dependent on human mobility.
T	F	5.	Innovation is a process of turning ideas and imagination into devices and systems.
T	F	6.	Invention is the process of modifying an existing product or system to improve it.
T	F	7.	Throughout history, new technologies have resulted from the demands, values, and interests of individuals, industries, and societies.
T	F	8.	Many inventions and innovations have evolved quickly without using the slow and methodical processes of tests and refinements.
T	F	9.	In the past, an invention or innovation was not usually developed with the knowledge of science.
T	F	10.	Information and communication systems allow information to be transferred from human to human, human to machine, and machine to human.

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Unit 1: Introduction to Invention and Innovation **Unit Test**

Place the letter of the best answer in the box at left of statement.

1.	<p>The development of technology is a human activity and is the result of individual or collective needs and the ability to _____.</p> <p>A. memorize B. draw C. be creative D. build structures</p>
2.	<p>Technology is closely linked to creativity, which has resulted in _____.</p> <p>A. computers B. advertising C. scientific knowledge D. innovation</p>
3.	<p>New products and systems can be developed to solve problems or to help to do things that could not be done without the help of _____.</p> <p>A. friends B. technology C. animals D. marketing</p>
4.	<p>Meeting societal expectations is a driving force behind the _____ and use of products and systems.</p> <p>A. application B. rejection C. acceptance D. determination</p>
5.	<p>In the past, an invention or innovation was usually developed without knowledge of _____.</p> <p>A. science B. technology C. materials D. processes</p>
6.	<p>Information and _____ systems allow information to be transferred from human to human, human to machine, and machine to human.</p> <p>A. transportation B. biotechnology C. communication D. renewable</p>
7.	<p>The use of symbols, measurements, and drawings promotes clear communication by providing a common _____ for expressing ideas.</p> <p>A. language B. starting point C. technology D. structure</p>
8.	<p>Design involves a set of _____ that can be performed in different sequences and repeated when needed.</p> <p>A. answers B. constraints C. criteria D. steps</p>

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9.	<p>Invention is a process of turning ideas and imagination into devices and systems. _____ is the process of modifying an existing product or system to improve it.</p> <p>A. Experimentation B. Modeling C. Innovation D. Brainstorming</p>
10.	<p>Throughout history, new technologies have resulted from the, _____, values, and interests of individuals, industries, and societies.</p> <p>A. equations B. demands C. hardiness D. interface</p>
11.	<p>Throughout history, people have carried out impressive _____, some of which would be hard to duplicate today even with modern tools.</p> <p>A. technological feats B. scientific studies C. athletic endeavors D. artistic initiatives</p>
12.	<p>Engineers, architects, and others who engage in design and technology use _____ to solve practical problems.</p> <p>A. timetables B. random order C. scientific knowledge D. students</p>
13.	<p>Many inventions and innovations have evolved by using slow and methodical processes of tests and _____.</p> <p>A. measures B. quizzes C. edits D. refinements</p>
14.	<p>The _____ has been at the heart of many technological improvements.</p> <p>A. scientific method B. age of exploration C. use of language D. specialization of function</p>
15.	<p>The _____ a person can reach in any particular activity depends on innate abilities, the amount of practice, and the use of appropriate learning technologies.</p> <p>A. classification B. propriety C. level of skill D. acceptance</p>