

# INVENTION PROJECT III™ STANDARDS

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## KEY CONCEPTS

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- Marine biology is the study of organisms in saltwater environments (e.g., the ocean).
- Marine researchers refer to the zone between 500 to 1,500 feet in the open ocean as the Twilight Zone.
- Invention and innovation play a critical role in exploring unknown territory.
- Science research can be costly; scientists are often called upon to be innovative and resourceful, in order to conduct research.
- Intellectual Property refers to creations of the mind.
- Design patents protect the design or appearance of an invention, while utility patents protect their functionality.
- The Intellectual Property of inventions can be highly secured through the triangulated approach of a trademark, along with a design and utility patent.
- Invention can help enhance, improve, and save lives.
- Elastic properties can be found in many inventions and the human body.
- Elastic materials return to their original shape when stretched and deformed.
- Inventions are often a result of individuals empathizing with others' challenges.
- Critically thinking about issues or problems can lead people to think of a solution.
- Innovative solutions are often a result of critical thinking and creative thinking.
- Branding is a way to get people to associate a logo or images of a product and/or service with particular desired qualities that are portrayed as superior to other brands.
- Advertising is a way of communicating the exciting features and benefits of an idea or product.
- Biomedical innovations help veterinarians cure animal illnesses.
- Pets can suffer from similar ailments to humans including bladder infections, diabetes, dehydration, and kidney stones.
- Urinalysis can be used to detect medical problems in animals.
- Production is the process of manufacturing a product in order to be sold in the marketplace.
- A Manufacturing Resource Plan is a system used to determine what materials to use, how to obtain them, and how much they will cost.
- There are several methods for producing a product that range from low risk to high risk and low investment to high investment.
- Hover technology was once a part of science fiction. It has been around, however, for almost 50 years and continues to evolve for transportation, entertainment, and even biochemistry.
- Levitation is when an object is held in their air without physical support and can be achieved using air pressure or magnetism.
- Sustainable agriculture is the ability to grow and rotate crops with minimal nutrient loss.
- Crop rotation is a strategic plan for arranging and rearranging crops in fields.
- Creativity and invention can be expressed by using materials for purposes other than what they were intended.
- Code is a creative tool that inspires critical thinking and enables people to communicate ideas in new and innovative ways.
- Building codes are regulations that must be met to ensure the structural integrity of the building and safety of its occupants.
- Structural loads are forces applied to a structure including environmental, live, and dead loads.
- Loads can cause stresses and deformations leading to structural failure.
- Dynamite was invented by Alfred Nobel and has made demolition quicker, easier, safer, and cheaper.
- A building code is a set of rules that outline the minimum standards for the construction and occupancy of structures, existing to protect the health and safety of individuals.

- The Cost of Goods Sold is the total direct cost a company incurs from the production of their product. It includes material costs in addition to the costs of labor to produce the item.
- An income statement is the summary of a company's profitability over a certain period of time.
- Revenue is the amount of money a company receives for goods and/or services sold.
- Expenses are the costs incurred by a company.
- The break-even point helps a company determine how many goods or services it needs to sell in order to begin making a profit.
- A franchise is a long-term relationship between a franchiser, the owner, and several franchisees, the partners. A franchisee receives a license to provide the goods and/or services of the owner.
- Creativity involves the novel (original) production of ideas to solve a challenge.
- Innovation is the process of introducing new ideas, products, systems, and processes.
- Mirrors reflect light and can be used to redirect laser light at varying angles.
- National Inventors Hall of Fame Inductees George Alcorn and Roger Angel created inventions that help study space.
- Rovers are deployed to collect samples and record data from planetary bodies.
- Terraforming is the act of transforming the physical characteristics of a planet to make it habitable.
- Thick layers of carbon dioxide in the atmosphere increase a planet's temperature.
- It is theoretically possible to terraform a planet, changing physical characteristics such as the atmosphere, soil composition, and temperature.
- Trademarks, copyrights, and patents protect different types of intellectual property.
- A patent protects an invention. A patent is an intellectual property right issued to an inventor by the U.S. government.
- A trademark is generally a word, phrase, symbol, or design, or a combination of these, that identifies and distinguishes the source of the goods of one business from those of others. A trademark typically protects brand names, taglines, and logos used on goods and services.
- A copyright protects an original artistic or literary work.
- Obtaining background information on a person can form positive or negative first impression.
- Fingerprints are unique in each individual and can most often be categorized under one of three fingerprint patterns.
- Water-based markers each have their own unique color components depending on the manufacturer.
- Modifying a product can help better serve specific types of users of that product.
- Virtual reality is an innovation in the video and computer gaming industry.
- Lack of cash sustainability is the number one reason companies go out of business.
- Production of a product should happen just in time to sell to the public so that inventory can quickly turn over.
- As a business owner you must first offset your expenses with revenue in order to balance assets and liabilities, and second learn to time your spending so you do not run out of cash.
- Coding is a relatively inexpensive way to earn money.
- Collegiate Inventors are shaping the world through their ideas.
- The biomedical industry is a platform for invention to enhance and save lives.
- Design thinking is a discipline that uses a designer's methods to match people's needs with what is technologically possible and what has market value.
- Design thinking techniques, such as exercising empathy, is critical and valuable to the design process.
- A capitalization plan helps a company determine how much money, or capital it will need at a given time. If the company does not raise enough capital, it could go out of business because there will not be enough cash to operate.
- A venture capitalist gives investment money to start-up companies or small businesses, anticipating the long-term growth potential of the start-up or small business.
- An angel investor is usually a family member or friend who gives money to a company, entrepreneur, or inventor to help further their business endeavors.
- Banks can be a source of cash for start-up businesses, but the loans often require collaterals, which is a risk since they must be paid back.

- Constructive criticism is a useful tool that provides feedback, which can strengthen an idea or product.
- When a business “goes public”, they allow the public to buy stock in the business, which brings in cash, but sacrifices some control.
- Code is a computer programming language that is often used in computer science that consists of a system of words, letters, figures, numbers, or symbols arranged in a pattern that creates a distinct reaction.
- Code is a creative tool that inspires critical thinking and enables people to communicate ideas in new and innovative ways.
- Code can be used to interface digital devices so that they can communicate with each other.
- A catapult is a machine used to launch an object a great distance without explosives.
- Iteration can maximize your company’s assets.
- Hybrid animals are the offspring of two animals of different breeds, varieties, species, sub-species or genera.
- Hybrid animals are typically a result of one of the following reasons: purposeful breeding in zoo habitats, naturally occurring in the wild, purposeful breeding to produce exotic pets, scientific research and efforts to preserve some genetics of an animal on the brink of extinction.
- A trait is a distinct, observable characteristic of an organism that may be inherited, environmentally determined or somewhere in between. A feature is a prominent part or characteristic.
- An integrated circuit, also known as a microchip, is an essential piece of almost all electronic systems created today.
- Many toys are built with similar mechanical parts. Understanding how those gears, circuit boards, and motors work allows inventors to apply them in all new ways.
- Flight is created when wings redirect flowing air downward, which then helps to lift the object up. The air needs to be pushed downward with enough force to generate force in the opposite direction that can lift the object.
- Exit strategy is the method that a business owner or investor intends to get out of an investment. It can be thought of as “cashing out.”
- A successful exit strategy requires planning.
- Exit strategies include some of the following: selling a portion of the company in the public markets, another company purchases the company (called an acquisition), or having the next generation of managers purchase the company.
- Having a vision of your future can help you keep focused on your goals.

## OBJECTIVES

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- Discover an area of the ocean known as the Twilight Zone and the elusive Greenland shark.
- Design cost-effective underwater research vehicles to explore the Twilight Zone.
- Hear about the newest aquarium exhibit and the challenges of the aquarium they are being recruited to help.
- Design an innovative flashlight that will give them certain privileges and powers during the aquarium’s nighttime events, including behind the scenes tours.
- Give the flashlight a name and a slogan that they will trademark, and decide what will be special about its look to apply for a design patent, as well as what will be special about its functionality, in order to apply for a utility patent.
- Discuss inventions that have helped save lives.
- Discover elastic properties can be found in living human tissue.
- Consider how elastic materials are incorporated into many inventions because of their ability to return to their original shape when stretched and deformed.
- Design and build a prototype after being challenged to step into the shoes of a person who cares for babies.
- Analyze problems with the design of current safety cones in order to design a solution.
- Create a mascot and catchy slogan to showcase their companies’ unique product.
- Apply various advertising techniques to attract customers.
- Identify signs of disease and illness in animals.
- Explore veterinary science and the role of invention when caring for mammals.

- Design prototypes of inventions that will aid veterinarians.
- Design a rapid prototype of a hovering game or piece of equipment.
- Hear about business concepts such as manufacturing, licensing, and outsourcing.
- Determine their ideal production model for their new hovering prototype.
- Discover how crop rotation creates a sustainable agricultural ecosystem.
- Solve a fun crop rotation puzzle to earn energy points.
- Barter energy points for materials to build shelters.
- Hear about National Inventors Hall of Fame Inductee Alfred Nobel and his impact on the construction world.
- Discover the science behind demolition, weight, and loads.
- Build structures designed for a specific target audience and with requested materials.
- Calculate the Cost of Goods Sold for their building, including assembly, freight, and unit costs.
- Explore strange scientific principles through unique materials.
- Start a business and determine how to be profitable.
- Design unique branding and logos.
- Pitch their ideas to a potential franchisee.
- Explore a few of the National Inventors Hall of Fame Inductees, the scientific superheroes of our time.
- Find inspiration from the National Inventors Hall of Fame Inductees and make prototypes to solve problems.
- Utilize mirrors and a laser light to locate a new planet.
- Race rovers to target locations in order to collect data on their new planet.
- Terraform a planet, inventing and building structures and devices to make it habitable.
- Brainstorm futuristic inventions.
- Build a patentable time machine prototype.
- Explore patents, trademarks, and copyrights.
- Examine suspect profiles and consider the background information to form an impression.
- Collect, analyze, and classify fingerprints by performing a fingerprint analysis technique.
- Perform the laboratory separation technique to examine the similarities and differences in the ink patterns of two different black pens.
- Modify a pen to help Crime Scene Investigators and Forensic Scientists to help them in job duties.
- Discover business principles associated with cash flow, inventory turnover, and timing.
- Design and build a prototype and model of a virtual reality game.
- Hear from 2015 Collegiate Inventors Competition Graduate Silver Prize Winner Stafford Sheehan, inventor of Corrosion-Resistant Molecular Coatings about computer programming.
- Hear insights from a Collegiate Inventors Competition Winner and then use these insights as inspiration for their invention process.
- Employ design thinking to create biomedical devices that address medical, health, and wellness challenges.
- Discover how National Inventors Hall of Fame Inductee Al Langer applied constructive criticism from a peer to figure out what aspects of his invention (the implantable cardiac defibrillator) needed to be troubleshooted and improved upon.
- Hear about a start-up business' options of how to acquire cash to get off the ground, and the pros and cons of each.
- Decide on a capitalization plan for their start-up business and discover the outcome.
- Design and build a prototype of a wearable or personalizable medical device for a start-up medical technology business.
- Constructively criticize another's prototype and use received criticism to strengthen their own prototype.
- Examine a "magic" trick that involves the Binary Number System.
- Code and decode messages using the Binary Number System to communicate with fellow Innovators.
- Design and build a prototype of a device that can interface with a smartphone.
- Explore catapults and trajectory.

- Explore business principals that allow companies to gain success as they iterate products.
- Create animal hybrids with specific traits and features.
- Build their own flying electronic bird.
- Rapid design mock companies, choose their Exit Strategies, and receive the fate of their choices.
- After exiting, they take the time to envision their future goals and aspirations, as they create high-tech Dream Boxes.

## COMMON CORE STATE STANDARDS FOR MATHEMATICS CONTENT ALIGNED TO INVENTION PROJECT III(TM) / 6-8

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### RATIOS AND PROPORTIONAL RELATIONSHIPS

- Understand ratio concepts and use ratio reasoning to solve problems.
  - 6.RP.3 Use ratio and rate reasoning to solve real-world and mathematical problems.
    - a. Make tables of equivalent ratios relating quantities with whole number measurements, find missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios.
    - b. Solve unit rate problems including those involving unit pricing and constant speed.
    - c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.
- Analyze proportional relationships and use them to solve real-world and mathematical problems.
  - 7.RP.2 Recognize and represent proportional relationships by equations. For example, if total cost  $t$  is proportional to the number  $n$  of items purchased at a constant price  $p$ , the relationship between the total cost and the number of items can be expressed as  $t = pn$

### THE NUMBER SYSTEM

- Compute fluently with multi-digit numbers and find common factors and multiples.
  - 6.NS.2 Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation.
- Apply and extend previous understanding of numbers to the system of rational numbers.
  - 6.NS.7 Understand ordering and absolute value of rational numbers.
    - b. Write, interpret, and explain statements of order for rational numbers in real-world contexts.
    - c. Understand the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation.
- Apply and extend previous understanding of operations with fractions to add, subtract, multiply, and divide rational numbers.
  - 7.NS.1 Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram.
    - d. apply properties of operations as strategies to add and subtract rational numbers.
  - 7.NS.2 Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
    - c. Apply properties of operations as strategies to multiply and divide rational numbers.
    - d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0's or eventually repeats.
- Know that there are numbers that are not rational, and approximate them by rational numbers.

8.NS.1 Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion, which repeats eventually into a rational number.

## GEOMETRY

- Solve real-world and mathematical problems involving area, surface area, and volume.

6.G.4 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in context of solving real-world and mathematical problems.

- Draw, construct, and describe geometrical figures and describe the relationships between them.

7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

## STATISTICS AND PROBABILITY

- Summarize and describe distributions.

6.SP.5 Summarize numerical data sets in relation to their context, such as by:

- a. Reporting the number of observations.
- b. Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
- c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.

# COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS CONTENT ALIGNED TO INVENTION PROJECT III(TM) / 6-8

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## SPEAKING AND LISTENING

- Comprehension and Collaboration

6.SL.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 6 topics, texts, and issues, building on other's ideas and expressing their own clearly.

- a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
- b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.
- c. Pose and respond to specific questions with elaborations and detail by making comments that contribute to the topic, text, or issue under discussion.

7.SL.1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.

- a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
- b. Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.
- c. Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussions back on topic as needed.
- d. Acknowledge new information expressed by others and, when warranted, modify their own views.

8.SL1 Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacherled)d with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.



- a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
- b. Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.
- c. Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
- d. Acknowledge new information expressed by others, and when warranted, qualify or justify their own views in light of the evidence presented.

- **Presentation of Knowledge and Ideas**

6.SL.2 Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

6.SL.3 Include multimedia components (e.g., graphics images, music, sound) and visual displays in presentations to clarify information.

7.SL.2 Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

7.SL.3 Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

8.SL.2 Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

8.SL.3 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

## **STANDARDS FOR LITERACY IN SCIENCE AND TECHNICAL SUBJECTS**

- **Key ideas and Details**

6-8.RST.3 Follow precisely a multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks.

## **NEXT GENERATION SCIENCE STANDARDS ALIGNED TO INVENTION PROJECT III(TM) 6-8**

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### **MIDDLE SCHOOL PHYSICAL SCIENCES**

- **MS-PS1 Matter and Its Interactions**

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

- **MS.PS2 Motion and Stability: Forces and Interactions**

MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

- MS.PS3 Energy

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

- MS.PS4 Waves and their Applications in Technologies for Information Transfer

MS-PS4-2. Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

MS-PS4-3. Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.

## MIDDLE SCHOOL LIFE SCIENCE

- MS.LS1 From Molecules to Organisms: Structures and Processes

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS-LS1-6. Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.

- MS.LS2.2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

- MS.LS3 Heredity: Inheritance and Variation of Traits

MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

MS-LS3-2. Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

## MIDDLE SCHOOL EARTH AND SPACE SCIENCES

- MS.ESS1.Earth's Place in the Universe



MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.

- MS.ESS2 Earth's Systems

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

MS-ESS2-5. Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions.

MS-ESS2-6. Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates.

- MS.ESS3.Earth and Human Activity

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ESS3-4. Construct an argument supported by evidence for how increases in human population and per-capita consumption

of natural resources impact Earth's systems.

## MIDDLE SCHOOL ENGINEERING DESIGN

- MS.ETS1 Engineering Design

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.