The Engineering byDesign™ Program is built on the belief that the ingenuity of children is untapped, unrealized potential that, when properly motivated, will lead to the next generation of technologists, innovators, designers, and engineers.

The International Technology and Engineering Educators Association's STEM±Center for Teaching and Learning™ has developed the only standards-based national model for Grades K-12 that delivers technological literacy in a STEM context.

The model, Engineering byDesign™ is built on the Common Core State Standards (High School / Middle School), Next Generation Science Standards (K-12), Standards for Technological Literacy (ITEEA); Principles and Standards for School Mathematics (NCTM); and Project 2061, Benchmarks for Science Literacy (AAAS). Additionally, the Program K-12 has been mapped to the National Academy of Engineering's Grand Challenges for Engineering.

Using constructivist models, students participating in the program learn concepts and principles in an authentic, problem/project-based environment. Through an integrative STEM environment, EbD™ uses all four content areas as well as English-Language Arts to help students understand the complexities of tomorrow.

EbD TEEMS NxtGen
Computing byDesign - PreK to 5
At-A-Glance

Intended Audience: PreK-5th Grade   Course Length: 2 Days

Computing byDesign course is designed to introduce students to technology and engineering at early levels to develop early understanding with hands on learning, problem solving skills, methodologies, and design challenges. All lessons tie into the TEEMS NxtGen curriculum and is meant to accentuate the lessons with new ideas and perspectives.

Objectives

- Introduce students to computing and robotics
- Develop a plan to complete a task
- Collaborate effectively as a member of a team
- Apply concepts and skills from technology activities that reinforce concepts and skills across multiple subjects and content areas.
- Illustrate helpful and harnful effects of technology
- Investigate the use of technology in the home and community
- Apply design concepts, principles ad processes through play and exploration
- Analyze how things work
- Explain how various relationships can exist between technology and other content areas
- Judge technologies to determine the best one to use to complete a given task or meet a need.
- Follow directions to complete a technological task

For More Information

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EbD TEEMS NxtGen – PreK
At-A-Glance

Intended Audience: PreK (ages 3-4)　　　　　**Course Length: 6-8 weeks**

In **Our Living World**, preschool students will be introduced to the life cycles of plants, butterflies, and frogs. They will use a multisensory approach as they plant and observe seed growth, experience hands-on lessons, enjoy literature, and share with teachers and students the circle of life.

Objectives

- Students will be able to identify a seed as the origin of a plant and demonstrate the sequence of events in the life cycle of a plant.
- Recognize similarities between characters/situations in a narrative and their own life experiences.
- Identify the similarities/differences between a plant's life cycle parts and a human's life cycle.
- Students will use new vocabulary words to describe the life cycle of a plant.
- Identify a terrarium and its purpose and list key differences between natural and human-made objects.
- Observe, describe, compare, and categorize human-made objects found discarded outdoors.
- Students will be better able to illustrate their understanding of the different parts of a plant and how a plant grows from a seed.
- Students will investigate seeds and make predictions about plant growth.
- Plant and water seeds and observe their sprouts and roots as they grow.
- Continue to develop an understanding of how a plant grows from a seed.
- Demonstrate or explain the life cycle of a butterfly.
- Recognize similarities between characters/situations in a narrative and their own experiences.
- Create their own "caterpillars" that will, over the next few days, transform into cocoons, and then into butterflies.
- Demonstrate a basic understanding of the metamorphosis process and describe what happened to the caterpillars and the cocoons, demonstrating a basic understanding of the metamorphosis process.
- Students will measure, observe, and record growing seeds/plants and transplant them to a new home.
- Recall events in the order in which they occurred in the text and illustrate the life cycle of a frog.
- Compare the life cycle of a plant with a frog's life cycle.
- Students will discuss and plan a terrarium design project.
- Students will plan and create a collaborative terrarium project that demonstrates what they have learned about the life cycles of living organisms.
- Communicate to classmates and teachers about the habitat that they have created.

For More Information

Contact Us At

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EbD TEEMS NxtGen – Kindergarten At-A-Glance

Intended Audience: Kindergarten   **Course Length: 6-8 weeks**

A Home for All Seasons engages young learners in hands-on inquiry and design as they explore animal homes. The Kindergarten Building Block integrates concepts of science, technology, engineering, and mathematics as students create various animal homes. Science and mathematics concepts that are reinforced include the basic needs of organisms, the environment in which organisms live, numbers and quantities, measurement, and shapes. Following guided inquiry activities, a design challenge provides an opportunity for students to apply knowledge and skills in a meaningful way as they design and build a birdhouse.

Objectives
- Distinguish between the natural world and the human-made world.
- Categorize objects as either natural or designed by humans.
- Ask questions and make predictions.
- Identify the main topic and retell details of text with prompting.
- Ask and answer questions about details in a text with prompting.
- Ask and answer questions about unknown words with prompting.
- Sort words into categories to gain a sense of the concepts represented by the categories.
- Communicate ideas and solutions through discussion, writing, drawing, and presentation.
- Determine the meaning and use of domain-specific words.
- Know that humans use tools and devices to help them do a variety of things.
- Understand how things are made and how they work.
- List different types of structures and their purposes (animal homes).
- Describe how the use of tools and machines can be helpful or harmful.
- Describe basic needs of plants and animals (e.g., air, water, nutrients, shelter, and light).
- Identify physical characteristics of the environment necessary for animal survival in different environments (e.g., wetland, tundra, desert, forest, ocean).
- Generate questions about objects, organisms, or events that can be answered through scientific investigations.
- Identify and describe objects using names of geometric shapes.
- Draw and build shapes to model geometric shapes in the world.
- Describe how the type of structure determines how the parts are put together (homes of different animals).
- Identify physical characteristics of the environment necessary for animal survival in different environments (e.g., wetland, tundra, desert, forest, ocean).
- Collaboratively write informative text based on a specific topic.
- Describe measurable attributes of objects such as length or weight.
- Identify numbers used to represent quantities.
- Describe measurable attributes of objects such as length or weight.
- Name tools and describe their use.
- Identify appropriate tools or instruments for specific tasks and describe the information they can provide (e.g., Measuring: length – ruler, volume – beaker, temperature – thermometer).
- Recognize that everyone can design solutions to problems.
- Apply a design process that includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others to solve a technological problem.
- Write and draw ideas and solutions during the design process.
- Construct an object using the design process.

EbD TEEMS NxtGen – Grade 1
At-A-Glance

Intended Audience: 1st Grade   **Course Length: 6-8 weeks**

Can You Hear Me? engages young learners in hands-on inquiry and design as they explore one of the greatest challenges of the 21st century: how we are able to hear and process sounds. This Building Block integrates concepts of science, technology, engineering, and mathematics through the environmental context of noise pollution. Science and mathematics concepts that are reinforced include the history of the telephone, echolocation, vibrations, and counting beats of a rhythm. By utilizing an experiential approach, students collaboratively investigate the issue of noise pollution, which is probably something they do not realize is a form of pollution. Following guided inquiry activities, a design challenge provides an opportunity for students to apply knowledge and skills in a meaningful way as they design and create something that makes a sound and also helps them detect sounds. A *Grand Challenge for Engineering* identified by the National Academy of Engineering as "Reverse-Engineer the Brain" serves as a real-world inspiration for students to connect their learning with the present and the future.

Objectives

- Identify tools and techniques that people use to help them complete tasks.
- Name materials used to make things.
- Distinguish between the natural world and the human-made world.
- Identify science as a way of answering questions and explaining the natural world.
- Identify technology as a way of inventing tools and techniques to solve human problems.
- Categorize objects as either natural or designed by humans.
- Describe a product that has been made to meet a specific human need or want.
- Provide an example of how the way people live and work has changed throughout history because of technology.
- Recognize that everyone can design solutions to problems.
- Describe design as a creative process.
- Apply a design process that includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others to solve a technological problem.
- Write and draw ideas and solutions during the design process.
- Construct an object using the design process.
- Identify agricultural technologies that make it possible for food to be available year round and to conserve resources.
- Generate questions about objects, organisms, or events that can be answered through scientific investigations.
- Design, conduct, and/or describe the steps of an investigation to test one variable.
- State a conclusion consistent with information, observations, or data.
- Identify contributions that humans have made throughout the history of science and technology.
- Ask and answer questions about details in a text with prompting.
- Identify the main topic and retell key details of a text.
- Ask and answer questions to determine unknown words.
- Write informative text that includes the topic name, some facts supplied about the topic, and a closure.
- Answer questions on a provided topic following shared research.
- Describe familiar people, places, things, and events with relevant details and express ideas clearly.
- Accurately count beats using a variety of rhythms.

For More Information

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EbD TEEMS NxtGen – Grade 2
At-A-Glance

Intended Audience: 2nd Grade   **Course Length: 6-8 weeks**

From Nature to Me engages young learners in hands-on inquiry and design as they explore biomimicry (one of the most important challenges of the 21st century) and learn how we can obtain from nature the tools necessary for scientific discovery. This Building Block integrates concepts of science, technology, engineering, and mathematics through the environmental context of learning about bees and researching why they seem to be disappearing. By utilizing an experiential approach, students collaboratively begin to explore how animals spread seeds and how their environment is then suitable for habitation. Following guided inquiry activities, a design challenge allows students to create a device that will travel on land or air to disperse seeds. Thus, they will be engineering the tools of scientific discovery. This experience serves as a real-world inspiration for students to connect their learning with both the present and the future.

Objectives
- Distinguish between the natural world and the human-made world.
- Identify tools and techniques that people use to help them complete tasks.
- Describe how the use of tools and machines can be helpful or harmful particularly to the environment.
- Describe a product that has been made to meet a specific human need or want.
- Recognize that everyone can design solutions to problems.
- Describe design as a creative process.
- Apply a design process that includes identifying a problem, looking for ideas, developing solutions, and sharing solutions with others to solve a technological problem.
- Construct an object using the design process.
- Describe a manufacturing process or system used to produce a specific product in quantity.
- Generate questions about objects, organisms, or events that can be answered through scientific investigations.
- Design, conduct, and/or describe the steps of an investigation to test one variable.
- Identify appropriate tools or instruments for specific tasks and describe information they can provide (e.g., measuring: length – ruler, volume – beaker, temperature – thermometer).
- Categorize or sort objects using physical characteristics of the materials from which they are made.
- Identify earth resources and materials that come from the environment to meet the needs and wants of humans.
- Use physical properties (e.g., shape, size, color, texture, temperature, volume) to describe matter.
- Identify science as a way of answering questions and explaining the natural world.
- Identify technology as a way of inventing tools and techniques to solve human problems.
- Identify resources that come from basic materials (e.g., air, water, soil) and their uses.
- Describe how the effects of new ideas, new ways of doing things, and inventions can be good or bad.
- Identify contributions that humans have made throughout the history of science and technology.
- Create bar graphs to show specific amounts.
- Ask and answer who, what, where, when, and how questions about key details in a text.
- Identify the main topic and the focus of specific paragraphs in a text.
- Write informative text in which a topic is introduced, some facts supplied to develop points, and a conclusion is provided.
- Report on a topic with appropriate facts and relevant, descriptive details while speaking clearly at an understandable pace.
- Recognize that manufactured products are designed.

For More Information

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EbD TEEMS NxtGen – Grade 3
At-A-Glance

Intended Audience: 3rd Grade   **Course Length: 6-8 weeks**

Natural Hazards engages young learners in hands-on inquiry and design as they explore natural hazards that occur on the Earth. This Third Grade Building Block in the EbD-TEEMS Integrative-STEM Curricula for PreK-6 integrates concepts of science, technology, engineering, and mathematics through the environmental context of natural hazards. Science and mathematics concepts that are reinforced include multiple hands-on, inquiry-based activities such as creating designs, exploring regions of the Earth, and analyzing weather data as students learn about weather and climate, and the natural hazards that occur around the world. The final design challenge provides an opportunity for students to apply knowledge and skills in a meaningful way as they develop a design for a snow shoe to help people travel during a blizzard. A Grand Challenge for Engineering, identified by the National Academy of Engineering —Engineer the Tools of Scientific Discovery— serves as a real-world inspiration for students to connect their learning about Natural Hazards and design solutions that reduce the impacts of these hazards.

Objectives

- Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
- Compare and contrast the most important points and key details presented in two texts on the same topic.
- Interpret data and graphs in order to describe typical weather conditions expected during particular seasons.
- Reason abstractly and quantitatively about weather and climate and use mathematical models.
- Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories.
- Create a design solution to reduce the impacts of a weather-related hazard by engineering a blizzard shoe design.
- Develop an understanding of the attributes of design and engineering design.
- Read *Wild Weather* by Melvin Berger in order to learn about the different types of weather hazards that happen on the Earth.
- Research a specific natural hazard and create a poster to display information about the hazard as well as possible impact solutions.
- Experiment with different materials to come up with the best combination that will keep a container warm while it is submerged in ice.
- Develop the abilities to apply the design process using appropriate tools strategically.
- Design a structure that will survive the shake table.
- Read about ancient rituals intended to produce rain and create a rain stick as a way to reduce the impact of having a drought by making it rain.
- Investigate using different materials to see how they perform against each other for waterproofing.
- Learn how to set up and use a STEM notebook in order to maximize knowledge of concepts and skills throughout this building block.
- Design a plan for a solution to help reduce the impact of a natural hazard that happens at home.
- Read the story about the life of Sir Francis Beaufort and review the Beaufort Wind Scale and read the Beaufort Wind Scale by answering questions.
- Build a house that will survive the wind of a fan and follow specific criteria for success and constraints on materials.
- Apply learning throughout this Building Block and design a shoe that will reduce the impact of the weather-related hazard while following the design process and meeting the criteria and constraints of the challenge.

For More Information

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EbD TEEMS NxtGen – Grade 4
At-A-Glance

Intended Audience: 4th Grade   **Course Length: 6-8 weeks**

The Power of Solar develops students' understanding of energy systems and related technologies, temperature, electricity, and sustainable sources of energy. In this Building Block, scientific inquiry and technological design are purposefully used as learning approaches to develop students' STEM literacy and higher-level thinking skills. Science and mathematics concepts that are reinforced include the solar system, energy transfer, temperature, electricity, decimals, perimeter, area, angles, points, lines, rays, and symmetry. By utilizing an experiential approach, students collaboratively investigate solar energy as a global issue and learn that stewardship and innovation can make a difference in solving the world's problems.

Objectives

- Describe how tools are used to design, make, use, or assess technology.
- Identify science as a way of answering questions and explaining the natural world.
- Identify technology as a way of inventing tools and techniques to solve human problems.
- Identify earth resources and materials that come from the environment to meet the needs and wants of humans.
- Describe an example of common technological change in a community (e.g., transportation, communication) that has had either a positive or negative impact on society or the environment.
- Describe how the results of the use of technology can be good or bad.
- Draw inferences from a text, referring to details and examples in the text as evidence.
- Describe how tools, machines, products, and systems use energy.
- Distinguish between a scientific fact and an opinion, providing clear explanations that connect claims and evidence.
- Use evidence to construct an explanation relating the speed of an object to the energy of that object.
- Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.
- Design, conduct, and/or describe the steps of an investigation to test one variable.
- Identify appropriate tools or instruments for specific tasks and describe information students can provide (Example: measuring = length - ruler, volume - beaker, temperature - thermometer).
- State a conclusion consistent with information, observations, or data.
- Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
- Illustrate a complete direct current series circuit composed of a power source (battery or solar cell), wire, and bulb (LED or incandescent).
- Identify parts of a system and explain how the system may not work as planned if a part is missing.
- Write clear and coherent informative text in which the development and organization are appropriate to task, purpose, and audience.
- Identify technology as a way of inventing tools and techniques to solve human problems.
- Describe how tools and machines extend human capabilities in science and technology.
- Apply a design process that includes defining a problem, generating ideas, selecting a solution, making an item, evaluating it, and presenting results to solve a technological problem.
- Identify that requirements are the criteria or limits that must be met when designing or making a product.
- Identify specific resources (e.g., tools, materials, information, people, time) necessary to complete specified tasks.
- Apply a design process that includes defining a problem, generating ideas, selecting a solution, making an item, evaluating it, and presenting results to solve a technological problem.

For More Information

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EbD TEEMS NxtGen – Grade 5
At-A-Glance

Intended Audience: 5th Grade   **Course Length: 6-8 weeks**

Our Water, Our World engages learners in hands-on inquiry and design as they explore one of the greatest challenges of the 21st century: universal access to clean water. This Building Block integrates concepts of science, technology, engineering, and mathematics through the environmental context of water resource management and conservation. By utilizing an experiential approach, students collaboratively investigate global water issues and learn that stewardship and innovation can make a difference in solving the world's problems.

Objectives

- Identify Earth resources and materials that come from the environment to meet the needs and wants of humans.
- Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.
- Identify science as a way of answering questions and explaining the natural world.
- Identify technology as a way of inventing tools and techniques to solve human problems.
- Describe an example of a common technological change in a community (transportation, communication) that has had either a positive or negative impact on society or the environment.
- Distinguish changes in the environment as natural or human-made.
- Compare changes in the environment that are good or bad.
- Describe how the results of the use of technology can be good or bad.
- Identify contributions that humans have made throughout the history of science and technology.
- Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- Distinguish the difference between the different spheres and how they interact with each other.
- Distinguish between a scientific fact and an opinion, providing clear explanations that connect claims and evidence.
- Describe the movement of water on Earth as it circulates through the phases of the water cycle.
- Generate questions about objects, organisms, or events that can be answered through scientific investigations.
- State a conclusion consistent with information, observations, and data.
- Use physical properties (shape, size, color, texture, temperature, volume) to describe matter.
- Provide an example of the effect that human waste has had on the environment (water).
- Determine the main idea of a text and support it with key details.
- Apply knowledge about a topic gained through research to the completion of a specified project.
- Design, conduct, and/or describe the steps of an investigation to test one variable.
- Identify tools, materials, and techniques used to make things or complete tasks.
- Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of a problem.
- Describe the design process as a method of developing solutions to problems.
- Apply a design process that includes defining a problem, generating ideas, selecting a solution, making an item, evaluating it, and presenting results to solve a technological problem.
- Describe how the effects of new ideas, new ways of doing things, and inventions can be good or bad.

For More Information

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EbD TEEMS NxtGen – Grade 6
At-A-Glance

Intended Audience: 6th Grade   **Course Length: 6-8 weeks**

Our World and Me serves as a capstone experience for sixth-grade learners using hands-on inquiry and design as they explore robotics through the engineering field of mechatronics. Mechatronics is an interdisciplinary engineering field that focuses on the integration of mechanical, electrical, and software systems. This curriculum extends ITEEA's **EbD-TEEMS Integrative-STEM Curricula for K-6** as the students create an interactive automaton that (1) educates others about environmental impacts caused by humans/technology, OR (2) presents a new idea on how to reduce human/technological impacts on the environment. Following guided inquiry activities, a design challenge provides an opportunity for students to apply knowledge and skills in a meaningful way as their automaton moves from a mere mechanical device to a robot. In this course, students learn about robotics, coding, computational thinking and programming fundamentals.

Objectives

- Students will use the brainstorming guidelines to generate ideas.
- Students collaborate as a team to select and share ideas regarding a selected topic. Students will view multiple videos (and other multimedia sources as appropriate) to gather information on the historical and cultural origins of automata and mechanical toys and record their observations in their engineering design notebooks.
- Students will use the practice of reverse-engineering to examine how an object/device works and record their observations in their engineering design notebooks.
- Students will use construction methods such as folding, cutting, gluing, and/or taping to construct a crank mechanism.
- Using the storyboard technique, students will observe how their crank mechanism works and create a five-panel storyboard and demonstration for class members who constructed a different crank mechanism.
- Students will identify and describe the types of motion found in their crank mechanism by using the terms oscillation, rotary, reciprocating, irregular, linear, and intermittent.
- Students will learn how three-dimensional figures are represented using nets made up of rectangles and apply these techniques in the context of solving real-world and mathematical problems.
- Students will use the skill of prototyping to construct a new display stand by either scaling up or scaling down from the original design.
- Students will practice using the Engineering Design Process to understand the Mini-Challenge Design Brief: Electrify!
- Students will read, interpret, and use electronic schematic symbols found in Technical Data Sheets, Standard Operating Procedure documents, and schematic diagrams; as well as schematic symbols used on electrical components (e.g., battery, battery holder) and instruments (e.g., digital multimeter).
- Students will use the digital multimeter (DMM) to perform electrical measurements including battery voltage checks and continuity checks of a designed circuit.
- Students will use Technical Data Sheets (TDS) to gain an understanding of various electrical components and will add information to the TDS based on their use of the components.
- Students will use Standard Operating Procedure documents (SOP) in the use of electrical components, tools, or processes.
- Students will construct schematic diagrams demonstrating the relative speed and the direction of the motor.
- Students will use a multimeter to determine the potentiometer's maximum resistance, left-center range, and right-center range.
- Students will use tools to connect devices to a controller. Students will create expressions and sequences using programming software.
- Students learn coding, computational thinking and programming fundamentals.

For More Information

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Exploring Technology
At-A-Glance

Intended Audience: 6th Grade   **Course Length: 18 weeks**

Meeting Engineering and Technology: Engineering and technology impact every individual and society as a whole.

- Introduction to Technology: Technology addresses our current wants and needs. Through innovation, humans have changed natural resources into products.

- Areas of Technology: Technology is a broad name for many fields of study.

- System Design: Technology is most useful when each facet of its creative design is carefully considered, such as its inputs, process, output, and feedback.

- Transforming Resources into Technology: The process of selecting necessary resources should be based upon the desired result of the technology being designed.

Design and Engineering: Technology exists to solve problems through the use of creative solutions that work best by demonstrating careful selection of resources to generate the best outcomes. Use of resources are a result of detailed and accurate plans based on ideas evolved through utilization of the Engineering Design Process in an Engineering Design Journal to ensure production of the technology designed solution is developed to achieve desired results.

- Documenting Ideas: Writing and sketching are important communication and documentation skills. An Engineering Design Journal (EDJ) is used to document class activities using narratives and sketches.

For More Information

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Invention and Innovation
At-A-Glance

Intended Audience: Grade 7   **Course Length: 18 weeks**

Students learn all about invention and innovation. They study the history of inventions and innovations, including their impacts on society. They learn about the core concepts of technology and about the various approaches to solving problems, including engineering design and experimentation. Students 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.

Invention, Innovation, and the Design Process: Invention and Innovation are created using the Engineering Design Process.

- Inventing 101: Introduce students to the history of invention and innovation. Students will gain a basic vocabulary to use through the curriculum and a basic understanding of invention and innovation.
- Engineering Design Process: Learn that using the Engineering Design Process as a systematic problem-solving strategy results in the best possible solution to a technological problem.
- Innovation in Action: Combine the knowledge gained in Lessons One and Two to innovate a board game to make it both educational and entertaining.

Core Concepts: Invention and innovation are driven by human needs and wants and are influenced by the core concepts of technology: systems, resources, requirements, optimization, trade-offs, processes, and controls

- Systems: Introduce students to the core concepts of technology and how they are used to invent, innovate, or evaluate technology products or systems.
- Reverse Engineering: Give students an in-depth look at how a product works while looking for ways to innovate and improve the product.
- Mechanisms: Reinforce the use of mechanisms in everyday objects. Introduction to mechanical subsystems and types of motion. Students will take their knowledge of mechanical subsystems to innovate a greeting card.

Technological Impacts: Create awareness and understanding that while technology has allowed humans to prosper, negative impacts have also resulted.

- Reducing, Reusing, and Recycling: Introduce students to the concept of technological impacts.
- Cleaning Up the Mess: Learn that decisions about the use of technology can put environmental, economic, political, and societal concerns in conflict with each other
- Creating Alternative Solutions: Familiarize students with the importance of tracking technological impacts on the environment.

Getting Creative: Engage students in the engineering design process while teaching them to sketch, draw, and design.

- Drawing and Designing: introduce students to the different types of drawing. Sketching is a major component to the Engineering Design Process and students should understand how to choose and use appropriate drawing types.
- Creating a Scale: Teach students how to create accurate scale drawings. Students will reflect on their drawings from the preliminary challenge and recreate the drawing using an appropriate scale.
- Digital Drawing: Introduce students to Computer-Aided Drafting (CAD) also known as digital drawing. In Lessons One and Two, students focused on learning technical drafting skills. In this lesson, students will use the knowledge previously acquired to make CAD drawings of a previous created piece.

For More Information

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Technological Systems
At-A-Glance

Intended Audience: Grade 8   **Course Length: 18 weeks**

Technological Systems is intended to teach students how systems work together to solve problems and capture opportunities. A system can be as small as two components working together (technical system/device level) or can contain millions of interacting devices (user system/network level). We often break down the Macro systems into less complicated Microsystems in order to better understand the entire system. However, technology is becoming more integrated and systems are becoming more dependent upon each other than ever before. Electronic systems are interacting with natural (e.g., bio) systems as humans use more and more monitoring devices for medical reasons. Electrical systems are interacting with mechanical and fluid power systems as manufacturing establishments become increasingly automated. This course gives students a general background on the different types of systems with a concentration on the connections between these systems.

Technological Systems, How They Work: Investigate technological systems through their function, design, development, interaction, and maintenance. Systems included in this exploration include communications, construction, manufacturing, bio-medical, and power energy.
- Development of Technological Systems: Technological Systems are developed to meet specific criteria and must be able to function to complete the systems loop.
- Design of Technological Systems: Technological systems are designed to meet a specific need while addressing design constraints.

Technological Systems, Issues and Impacts: Technological systems can impact the world in a variety of ways and can be both positive and negative.
- Social and Cultural Impacts: Human needs and interests in technological devices reflect social and cultural priorities.
- Environments and Economics: Technology can have both positive and negative impacts on the environment and the economy.

Technological System Interaction: Technological Systems are designed to meet a specific need and can address this need through a variety of functions, processes, and interactions with other systems.
- System Functions and Processes: Processes within systems serve different functions and can cause problems with the performance of the system if there is a malfunction.
- System Design and Development: Knowledge from a variety of fields is used in the development of products and systems and the completed system can be used in multiple applications.

Maintaining Technological Systems: Technical information comes in many forms, and is used to test, evaluate, and problem-solve within systems.
- Understanding Technical Information
- Problem Solving with Systems: At times, systems will need to be adjusted or repaired and tools and equipment must be used safely to maintain these systems.
- System Testing and Evaluation: Systems are designed with a specific purpose and controls are placed within systems to address their performance.

Technological Systems in the Designed World: A variety of different technological tools, processes, and materials can be integrated to form systems.
- Power and Energy Systems: Energy is needed to do work of any kind, by human, machine, system, or other means.
- Communication Systems: The process of communication can take place between humans, machines, and humans and machines.
- Constructing Specialized Manufacturing Environments: Production and manufacturing environments for biological and medical equipment and materials must align to standards that ensure the quality of the material produced.

The Refocus of NASA: Space transportation systems, although highly sophisticated and technologically advanced, employ the basic subsystems found in conventional transportation systems.
- Celebrating the Space Shuttle: The analysis of current technologies is essential to future technological change and innovation.
- The Future of the Space Program: Transportation systems are made up of subsystems that work together to function as a whole.

For More Information

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Intended Audience: Grades 6-8   **Course Length: 12 weeks**

The Engineering for All (EfA) project has been funded by the National Science Foundation (Grant # DRL 1316601) to create, test, and revise two six-week modules for middle school technology education classes on the important social contexts of food and water. The units are built on four "drivers" that underpin the Engineering for All approach. These include:

- Promoting the potential of engineering as a social good.
- Revisiting unifying engineering and technology themes (i.e., design, modeling, systems, resources, and human values) in authentic social contexts.
- Using design-based engineering activities as authentic contexts for teaching and learning Science, Technology, Engineering and Mathematics (STEM) ideas and practices
- Using *informed design* as the core pedagogical methodology.

Vertical Farms: Fresh Food for Cities

In order to address the Grand Challenge of producing food for a growing world population, students become "experts" in designing and constructing hydroponic systems. Once their hydroponic systems are up and running and plants are growing, the students receive a message that their firm has been asked to design a hydroponic system for the wall of an existing apartment building.

Small teams compete to design the best possible system. Their work culminates in design drawing and a presentation to their classmates, who will consider each design on its merits, and then work together to plan the best possible design for their client. The overarching goal of this unit is for students to develop engineering design and systems analysis skills while coming to understand that engineering has great potential to be a social good by solving such critical problems as providing food and water for people around the world.

Water: The World in Crisis

To address the grand challenge of improving water availability and safety, students will explore issues of water scarcity, including the effects of unsafe water, water contaminants, and water filtration methods. The unit begins as students are told they have been accepted to be part of a team of engineering students working with the local chapter of Engineers across Borders. Students learn about the world water crisis and water scarcity and become "experts" in "traditional" design and construction of water filtration systems

For More Information

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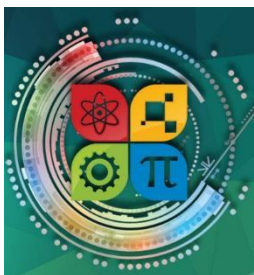
Foundations of Technology and Engineering At-A-Glance

Intended Audience: Grades 9-10   **Course Length: 36 weeks**

Foundations of Technology and Engineering prepares students to understand and apply technological concepts and processes that are the cornerstone for the high school technology and engineering program. Group and individual activities engage students in creating ideas, developing innovations, and engineering practical solutions. Technology and Engineering content, resources, and laboratory/classroom activities apply student applications of science, mathematics, and other school subjects in authentic situations. The educator is offered the choice to use Onshape, or CAD for Unit 5/5a when teaching the courseware.

- **Computer Science Principles byDesign**: develop technological skills in solving problems, documenting the engineering design process, and computer coding.
  - o Block Coding Principles
  - o Variables and Functions
  - o Computer Programming Logic
  - o Sensors and Mathematics
  - o 3D Modeling with Onshape

- **The Engineering Design Process**: a systematic iterative problem solving method that produces solutions to meet human wants and desires.
  - o Engineering Design Process
  - o Criteria and Constraints
  - o Design Principles
  - o Prototypes and Modeling
  - o Collecting and Processing
  - o Applying the Design

- **The Designed World**: A byproduct of the engineering design process, which transforms resources (tools/machines, people, information, energy, capital, and time) into usable products and services.
  - o Energy and Power
  - o Manufacturing
  - o Construction
  - o Information and Communication
  - o Agriculture and Transportation
  - o Telemedicine

- **Systems:** The building blocks of technology and users must properly maintain, troubleshoot, and analyze systems to ensure safe and proper function.
  - o Core Technologies: Every system and product is made up of one or more of the nine core technologies: bio-, electrical, electronic, fluid, material, mechanical, optical, structural, and thermal technology.
  - o Systems Model: The Universal Systems Model
  - o Reverse Engineering
  - o Troubleshooting

- **Design with CAD Systems**: CAD systems (Unit 5) allow for engineers, technicians, and designers to communicate ideas effectively and efficiently while transcending barriers of location, time, and language.
  - o AutoCAD command introduction and skill development, Community Design Project, Global Design Project, and Industry Certification Preparation
- **Onshape Certification by Design:** Sketching and Features (Unit 5a) enables students to complete modeling, assembling, and engineering drawing challenges while designing parts/assemblies.
  - o Industry Certification Preparation, Sketching, Extrusions, Constraining, Variables, and Measurements.

For More Information

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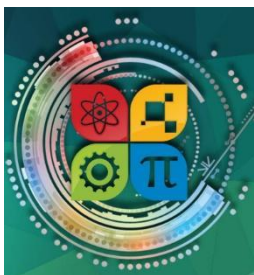
Foundations of Technology and Engineering- ONLINE At-A-Glance

Intended Audience: Grades 9-10   **Course Length: 36 weeks**

Foundations of Technology and Engineering Online prepares students to understand and apply technological concepts and processes that are the cornerstone for the high school technology program. Group and individual activities engage students in creating ideas, developing innovations, and engineering practical solutions. Technology content, resources, and laboratory/classroom activities apply student applications of science, mathematics, and other school subjects in authentic situations. Each unit is listed below along with the Learning Cycles for the unit. This course is student facing. Students may complete with minimal instructor input. The educator is offered the choice to use Onshape, or CAD for Unit 5/5a when teaching the courseware.

- **Technological Inventions and Innovations**: A result of evolutionary technological development and systematic research and development.
    - o   The History of Technology
    - o   Inventions and Innovations: An Evolutionary Process
    - o   The Role of Research and Development: A Problem-Solving Approach
    - o   Advertising and Marketing Effects on Technology

- **The Engineering Design Process**: A systematic iterative problem-solving method that produces solutions to meet human wants and desires.
    - o   Engineering Design Process
    - o   Criteria and Constraints
    - o   Design Principles
    - o   Prototypes and Modeling
    - o   Collecting and Processing
    - o   Applying the Design

- **The Designed World**: A byproduct of the engineering design process, which transforms resources (tools/machines, people, information, energy, capital, and time) into usable products and services.
    - o   Energy and Power
    - o   Manufacturing
    - o   Construction
    - o   Information and Communication
    - o   Agriculture and Transportation
    - o   Telemedicine

- **Systems Engineering and Technology:** The building blocks of technology and users must understand, properly maintain, troubleshoot, and analyze systems to ensure their safe and proper function.
    - o   Systems Model: The Universal Systems Model
    - o   Core Technologies
    - o   Simple Machines
    - o   Electrical Fundamentals
    - o   Reverse Engineering
    - o   Engineering Systems

- **Design with CAD Systems**: CAD systems (Unit 5) allow for engineers, technicians, and designers to communicate ideas effectively and efficiently while transcending barriers of location, time, and language.
    - o   AutoCAD command introduction and skill development, Community Design Project, Global Design Project, and Industry Certification Preparation
- **Onshape Certification by Design:** Sketching and Features (Unit 5a) enables students to complete modeling, assembling, and engineering drawing challenges while designing parts/assemblies.
    - o   Industry Certification Preparation, Sketching, Extrusions, Constraining, Variables, and Measurements.

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The Engineering byDesign™ Industry Certification Pathway

Introduction

To encourage more students to work toward a selected industry credential while in high school, the Engineering byDesign™ Industry Certification Pathway was developed by ITEEA's STEM Center for Teaching and Learning. By following the suggested pathway delineated in this document, educators can prepare students for a successful attempt at an industry certification through Onshape for the Associates Certification Exam. The Engineering byDesign™ Industry Certification Pathway includes the following courses: *Foundations of Technology, Technological Design,* and *Engineering Design*. Also, a stand-alone Onshape Associate Certificaton Course will be offered. This course can be utilized in any classroom to strengthen Onshape currently being taught in classes or serve as a course to be taught in its entirety as a standard Computer Aided Design course.

Included in this document are infographics that provide visual representations of the Engineering byDesign™ (EbD) three-year course sequences (p. 2).

Infographics

Each individual EbD™ course is delivered in 36 weeks. Educators should follow the curriculum with specific attention to the software *focus* assigned for each course. The stand-alone course is 18 weeks.

Three-Year Course Sequence

In Year One (blue callout in Figure 1 on the right side), students take *Foundations of Technology*, followed by Technological Design in Year Two (blue callout in Figure 1 on the right side), and Engineering Design in Year Three (blue callout in Figure 1 on the right side). All courses have a *focus* on Onshape. Toward the end of the *Engineering Design* course, students take the certification exam for Onshape (red callout in Figure 1 at the bottom).

One-Year Course Sequence

Throughout the course of the year, the *Onshape Associates Certification Course* can be used as a course taught throughout the course of 18 weeks or as a supplemental resource for instruction taught directly for Onshape. At the end of the course, students take the certification exam for Onshape (red callout in Figure 1 at the bottom).

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Onshape Certified Associate Exam
Pathways and Outline

Figure 1:
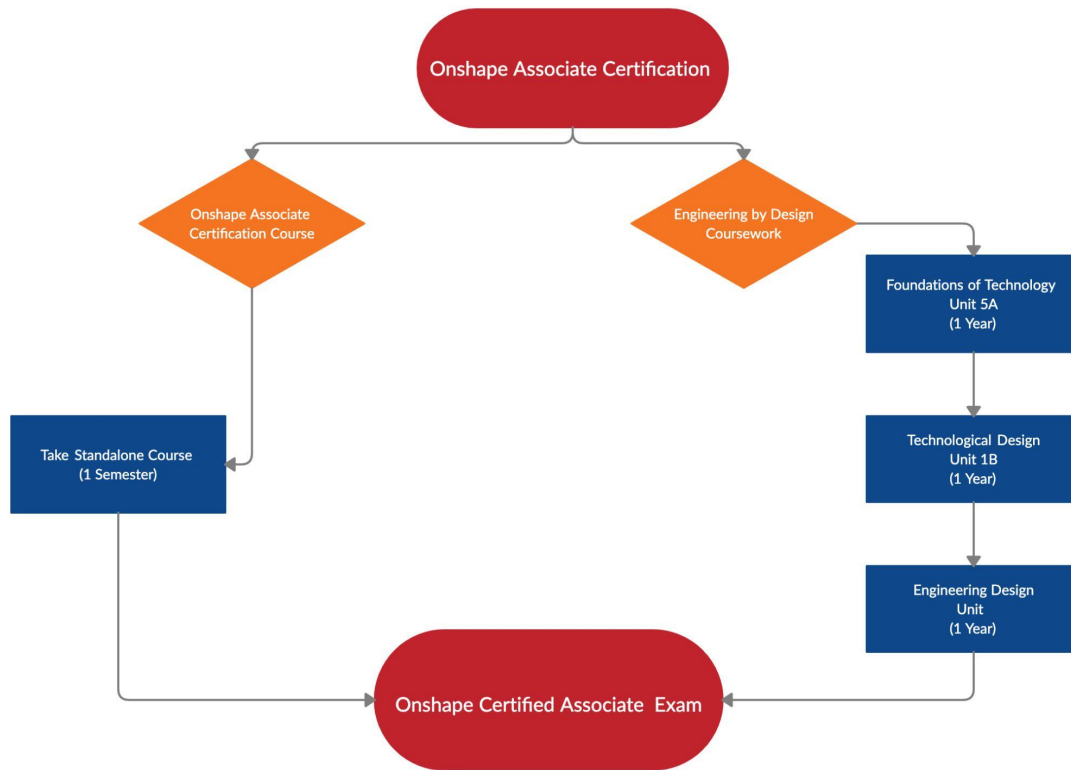
Sketching
- Planes
- Line
- Circle
- *Arc*
- Fillets
- *Point*
- Use
- Trim/Extend
- Offset
- *Mirror*
- *Pattern*
- Dimensions
- Constraints
    - https://www.onshape.com/en/resource-center/tech-tips/tech-tip-constraining-your-sketch

Features
- Extrude
    - Add
    - New
    - Remove
- Revolve
- Fillet
- Chamfer

Assembly
- Mates
    - Cylindrical
    - Planar
    - Parallel
    - Tangent
- Inserting Content
- Standard Content
    - Standards (ANSI, ISO)

Onshape Knowledge
- Materials
- Standard Content
- Renaming
- Part Studio/Assembly/Engineering Drawings
- Measure
- Mass Properties
- Keyboard shortcuts
    - https://cad.onshape.com/help/Content/shortcut_keys.htm

Modeling/Assembly Objects
- Bench Grinder
    - Engineering Drawings
        - Section View
    - Change sizes from one assignment to another
- Can Crusher
    - From 2D Engineering Drawings
    - Center of Mass

* Italicized items are not needed but can aid in efficiency for exam

Computer Science Principles byDesign
At-A-Glance

Intended Audience: Grades 9-10   **Course Length: 36 weeks**

The **Computer Science Principles byDesign™** course was developed to introduce students to fundamental computer science principles as well as prepare students to take the AP CSP Exam. The course is organized using the College Board AP Computer Science Big Ideas and Computational Thinking Practices. In this course, students program using the Snap programming language, learn some of the most powerful ideas of computer science, demonstrate creativity, and discuss the social implications of computing, thinking deeply about how they can be personally active in promoting and reducing the possible harms.

- **Introduction to Programming**: an introduction to foundational concepts of programming.
    - Click Alonzo Game
    - Gossip and Greet
    - Modern Art with Polygons
    - Protecting Your Privacy
    - Follow the Leader
- **Abstraction**: an investigation into data structures and program control structures.
    - Improving Games by Using Variables
    - Making Art by Using Data Structures
    - Making Decisions by Using Predicates
    - Dealing with Complexity
    - Copyrights
- **Data Processing and Lists**: a focus on lists, abstraction, and higher order functions.
    - Contact Lists
    - Tic-Tac-Toe
    - Robots and Artificial Intelligence
    - Building Data Visualization Tools
    - Big Data
    - Optional Projects
- **How the Internet Works**: addresses network protocols and cybersecurity
    - Reliable Communication
    - Communication Protocols
    - Cybersecurity
    - Community and Online Interactions
    - AP CSP Explore Task
- **Algorithms and Simulations**: use several types of analysis to solve problems.
    - Search Algorithms
    - Models and Simulations
    - Timing Experiments
    - Unsolvable and Undecidable Problems
    - Computing in War
    - AP CSP Create Task
- **How Computers Work**: an overview of the history of computers, software, hardware, number bases, and binary data.
    - Computer Abstraction Hierarchy
    - Data Representation and Compression
    - A Brief History and Impact of Computers

For More Information

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Advanced Design Applications
At-A-Glance

Intended Audience: Grades 11-12   **Course Length: 36 weeks**

Advanced Design Applications focuses on the three dimensions of technological literacy "knowledge, ways of thinking and acting, and capabilities" with the goal of students developing the characteristics of technologically literate citizens. It employs teaching/learning strategies that enable students to explore and deepen their understanding of "big ideas" regarding technology and makes use of a variety of assessment instruments to reveal the extent of understanding.

Objectives

- **Construction**: Construction technology involves the design of structures to meet various requirements.
  - The Incredible Shrinking Design: Various techniques and tools are used in technical drawing and modeling, including scales, measurement, and conversion.
  - Seeing Green: Construction technology involves the design of structures to meet various requirements and the development of plans for how those buildings can fit into the surrounding community environment.
- **Energy and Power:** The law of conservation of energy, when applied to renewable energies, involves trade-offs among competing constraints and requirements, including engineering, economic, political, social, and environmental considerations.
  - Measurement and Introduction to Energy: The law of conservation of energy, when applied to renewable energies, involves trade-offs among competing constraints and requirements, including engineering, economic, political, social, and environmental considerations.
  - Energy Transfer: Energy and Power are technologies that are necessary to use in the designed world. Reviewing simple machines and learning how they can be used to manipulate mechanical advantage will allow users to take advantage of energy and power that is generated.
- **Manufacturing**: Modern manufacturing technologies and processes can produce quality products that are essential for economic health and also enhance the quality of life for many people, while having a minimal negative impact on environment.
  - Under Pressure: The design and manufacture of products is affected by customer, societal, economic, political, and environmental concerns.
  - In Control: Computer controlled manufacturing has enabled engineers and designers to reduce costs in almost every aspect of production, from producing designs to packaging and shipping, in a safe, economical, and timely manner, as well as reduce the time and effort required by dozens of human workers.
- **Transportation**: Transportation varies culturally, but plays a vital role in each society and includes many subsystems to deliver products and services.
  - Safety First: Evaluating the benefits, limitations, and risks associated with existing and proposed technologies is essential to the engineering process and the success of the design solution.
  - Out of Control: Utilization of a variety of simple and complex technologies is essential to understanding methods of controlling new technologies.
- **SeaPerch:** Students learn about robotics, engineering, science, technology, and mathematics (STEM) while building and operating an underwater ROV as part of the *Advanced Design Applications* course.
  - From Submarines to ROVs: Conduct research on real-world uses of remotely operated vehicles.

For More Information

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Advanced Technological Applications
At-A-Glance

Intended Audience: Grades 10-12   **Course Length: 36 weeks**

In the *Advanced Technological Applications* course, students study five components of the Designed World.

- **Engineering Design Graphics and Spatial Skills:** The purpose of this unit is to assist students in understanding the concepts and principles underlying orthographic projections; how to create 2D drawings and 3D solid models using CAD software and apply these techniques to solve real-world problems.
    - Primary Challenge: Designing for Assisted Living. Students create an accurate description of a moderately complex design and will modify an existing design using an *ADA* design brief.

- **Cybersecurity:** Today, there are approximately 3.2 billion internet users worldwide. With that many users, connecting to the internet leaves computers and users vulnerable. This unit is intended to help students become well informed about protecting their personal information online and maintaining a safe internet presence.
    - Primary Challenge: Public Service Announcement. Students will create a Public Service Announcement campaign to target specific age groups with age-appropriate cybersecurity tips. They will design and create computer-generated posters to distribute to three targeted groups: elementary ages, middle school ages, and high school ages through age 70.

- **Biotechnology:** Students will learn about current technological systems that employ organisms as tools as well as develop their own ideas as to how technological systems can be further improved with creativity.
    - Primary Challenge: Johanna's Market Stand. Students will solve a real-world problem for the end user, Johanna. The end user is interested in increasing her profits at her local farmer's market stand. The solution must incorporate the use of animals, plants, or microorganisms (or parts of these organisms) as tools.

- **Information Technology:** This unit is intended to help students gather, select, evaluate, and utilize diverse data to communicate the model to help make decisions about their design or solution and communicate their analysis and solution to diverse audiences. Students will learn to use Excel™ as a data analysis tool and Alice™ as a visualization/3D modeling tool for communication purposes.
    - Primary Challenge: Unjamming Traffic: Visualize to Communicate. Students (teams) will be responsible for designing and implement their traffic "un"-jamming model from the preliminary challenge through an animation in Alice.

- **Robotics:** The purpose of this unit is to expose students to principles of automation and enable them to understand automated technologies around them so they can make educated decisions about them and so they can create new ones. This unit culminates the *Advanced Technological Application* course by synthesizing concepts students learned through the course and providing students an opportunity to demonstrate their learning through hands-on and minds-on learning experiences.
    - Primary Challenge: Electromechanical Robotics. Students will be able to design a self-driving car program to navigate a course with obstacles.

For More Information

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Technological Design
At-A-Glance

Intended Audience: Grades 10-12   **Course Length: 36 weeks**

In *Technological Design*, engineering scope, content, and professional practices are presented through practical applications. Students in engineering teams apply STEM concepts and skills to solve engineering design problems and innovate designs. Students research, develop, test, and analyze engineering designs using criteria such as design effectiveness, public safety, human factors, and ethics. The educator is offered the choice to use Onshape, or CAD for Unit 1/1a when teaching the courseware.

Unit 1: Engineering Graphics: Enhanceing students' understanding of engineering graphics and modeling towards certification.

- Learning Cycles Cover History of Computer- Aided Design and Drafting System - CADD Milestone Research (1), Orthographic Sketching and Drawing - Mobile Phone Drawings (2), Isometric Drawing - Mobile Phone Isometric (3), Drawing to Scale - Classroom Drawing (4), Classroom Design - Classroom Design (preliminary Challenge), and Product Design Drawings - Mobile Phone Case Design (Primary Challenge)

Unit 1a: Onshape Certification byDesign: Assemblies and Engineering Drawings (Unit 1a) creates assemblies of 3-dimensional models for design problems leading towards certification. Students may be readily prepared to take the Industry exam proceeding this unit.

- Learning Cycles cover Inserting and Standard Content (1), Mates (2), Reading Engineering Drawings (3), Engineering Drawing Basics (4), Advanced Engineering Drawings (5), Mounting Block and Cap (Preliminary Challege), and Double V Belt Pulley (primary Challenge)

Unit 2: Design Fundamentals-Construction: Students use researching skills to investigate concepts of construction and material properties, and experiment with materials to understand their strengths and weaknesses to allow them to select appropriate materials for future products.

- Learning Cycle 1: Structure Design - Paper Tower Challenge
- Learning Cycle 2: Structure Design - Bridge Construction
- Learning Cycle 3: Material Properties - Material Properties Research
- Learning Cycle 4: Material Properties - Material Properties Testing
- Preliminary Challenge: Material Properties and Design - Safety Barrier Design
- Primary Challenge: Material Properties and Design - Concrete Beam

Unit 3: Technological Skills - Electronics / Robotics: Students will design, build, and code robotic solutions for real-world problems. This unit can be taught using hands-on robotics kits, online simulation, or any combination of these education modes.

- Learning Cycle 1: Electronics Fundamentals - Basic Circuit Introduction
- Learning Cycle 2: Microcontroller Fundamentals - Arduino Introduction
- Learning Cycle 3: Automation Fundamentals - Automation with Arduino
- Learning Cycle 4: Autonomy - Autonomous Robots
- Preliminary Challenge: Ultrasonic Tape Measure
- Primary Challenge: Coin Sorting Machine

Unit 4: Technology and Society: Students will assess the effects that technology has on people, society, and the environment. Students will research issues affecting their community and the world to develop technological solutions to these issues.

- Learning Cycle 1: Ecological Problem - Ecological Problem Poster Design
- Learning Cycle 2: Technological Advancement - Technological Advancement Presentation
- Learning Cycle 3: Ocean Pollution - Analyze the Effects of Ocean Pollution
- Learning Cycle 4: Ocean Pollution - Public Service Announcement
- Preliminary Challenge: Ocean Trash Removal
- Primary Challenge: Sustainable Furniture

Emerging Technologies: Students will analyze, explore, and experiment with emerging technologies. Students will investigate the impacts of virtual/augmented reality and wearable technologies. Students will also create their own wearable technology using the skills they learned in Unit 3 and create virtual and augmented reality experiences.

- Learning Cycle 1: VR Technology - Analyze Virtual Reality Technology
- Learning Cycle 2: 360° Photography
- Learning Cycle 3: Augmented Reality
- Learning Cycle 4: Wearable Technology - Analyze the Impacts of a Wearable Technology
- Preliminary Challenge: Wearable Technology - Develop a Wearable Technology
- Primary Challenge: Virtual Reality - Create a Virtual Reality Experience

For More Information

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Engineering Design
At-A-Glance

Intended Audience: Grades 11-12　　　　　　**Course Length: 36 weeks**

This course focuses on how engineers apply their creativity, resourcefulness, mathematical, scientific, and technical knowledge and skills in the creation or refinement of technological products/systems. A key approach will be the employment of a sophisticated, sequential, and iterative design and development process to solve authentic engineering tasks/problems.

Fundamentals of Design Engineering: There are fundamental principles that impact human thinking and actions when engaged in the process of designing technological products. A combination of personal qualities such as creativity and resourcefulness and design constraints imposed by numerous factors are employed in a formal process to create new or refined technologies.

- Human Factors Affecting Design and Environmental Factors Affecting Design
- Industrial Factors Affecting Design
- Design through Research
- Market and Profit Influence
- Design – A Formal Process
- Analyzing and Interpreting Data – Prioritizing Design Constraints

Elements of Design: There are core technologies involving systems within a range of sophistication that are critical to all technological innovations, including mechanical, structural, fluid, optical, electrical, electronic, thermal, bio-technical, and material. Mathematical and scientific calculations and concepts are documented and used by engineers and designers for specific applications in all engineering fields. These documents are valuable reference materials used to ensure high quality designs.

- Design Requirements: Product design always includes requirements (criteria, constraints and efficiency) that require "trade-offs."
- Technology Systems – Using Models Requirements: There are nine "Core Technologies" that are fundamental to all technology systems that must be recognized and understood.

Structural Design: Modeling, Prototyping, and Protecting Ideas: A combination of personal abilities such as creativity, resourcefulness, and abstract thinking applied to a formal engineering design process, supported by full testing with documentation, can result in dynamic and dramatic technological invention or innovation.

- Patent Process: Technological innovation can lead to unintended, yet very useful, applications in other industries resulting in a "technological transfer."

- Mathematical and Computational Resources: Engineers use numerous and diverse resources to ensure accurate and appropriate calculations in all design work.

- Materials Science: Materials (natural, synthetic, or blended) provide many options for final product designs across all industries.

- Creativity in Design: Creativity varies in individuals, but can be enhanced and refined in all people.

Product and Systems Engineering and Analysis Management: Project management involves research-based techniques and strategies designed to control major business functions and ensure efficiency in the design and quality of a final product. A primary goal of any engineering enterprise is to identify problems to solve, predict overall value and success of the project, and then manage that project in the most cost-effective way.

- Managing Engineering Design, Quality Assurance, Evaluating, and Communicating Information.

For More Information

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