Lesson Plan	Ages	Learning Objectives	Hands-on Activity	Description
3D Printing by Hand	8-14	- 3D printers - additive manufacturing - how 3D printing works - CAD and STL files used in 3D printing	Create a 3D model of an object by hand.	In this lesson, students will explore how 3D printers work.Then, working in pairs, they will use the same methods used by 3D printers to create a 3D model of an object.
A Century of Plastics	8-18	- how plastics have been engineered	Redesign a product to use 50% less plastic components than in current designs.	This lesson explores how the development of plastics — and the engineering of plastic components into everyday products — has impacted the world. Students learn about the history of plastics, what plastics engineers do, and how many products have been enhanced through the addition of plastic components. Students work in teams to identify products without plastic, and products they think could not exist in a pre-plastic world. They work as teams of “engineers” to see if they can redesign a product to use 50% less plastic components than in current designs.
A Question of Balance	11-18	- manufacturing engineering - manufacturing systems - weight packaging and consistency	Develop a system to fill jars with a specific weight or count of products such as marbles or paperclips.	This lesson focuses on the use of weight scales and measurement by manufacturing engineers. Teams of students are posed with the challenge of developing a system to fill jars with a specific weight or count of products such as marbles or paperclips.
AC Motors	12-18	- basic alternating currant motors - engineering history	Assemble and analyze a simple AC motor	The lesson begins by outlining the work of some of the early experimenters and the sequence which eventually led to the realization of the tremendous advantages of an alternating current system, particularly for large scale and long distance applications. A necessary preliminary to this lesson is the lesson entitled “Basic Direct Current Generators and Motors” to be found elsewhere in this series. Toward the end of this lesson there is a very simple hands-on demonstration of the working principle of an AC motor, which can be assembled in the classroom. The lesson ends with a section in which the students are invited to discuss with the teacher, various ways in which they think the demonstration could be improved.
Adaptive Device Design	8-18	- adaptive devices - impact of adaptive devices on everyday life	Solve a specific problem by designing a new adaptive device or improving upon an existing one	This lesson focuses on the engineering of adaptive or assistive devices, such as prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, braces, etc. Students work in teams to design either an improvement to an existing adaptive device or a new device that solves a specific problem.
An Eye on Optics	10-14	- light - lenses	Design and analyze a system of lenses to	The goal of this lesson is to provide students with an open-ended opportunity to explore and work with materials, make

		- assistive vision technologies	improve the sight of a patient	and share observations, and build a foundational understanding of the relationship between gelatin shapes and light.
Arduino Blink Challenge	14-18	- circuits, computers, and software coding	Setup and program an Arduino board to "blink"	This lesson explores how computer and software engineers work to solve the challenges of a society, such as providing systems for turning lights on and off automatically. Students work in teams to set up and program an Arduino board to “blink” (i.e. turn a light on and off at a 5 second on and 2 second off interval).
Assembly Line	8-18	- assemble a project by hand - quality control - design an assembly line process - test and redesign assembly line process - compare individual product assembly vs assembly line	Design an assembly line to manufacture bricks as quickly and efficiently as possible	This lesson demonstrates the power of mass production. Students work in teams to design, construct, test, and redesign an assembly line to manufacture a product as quickly and efficiently as possible to meet the quality control criteria.
Basic Electricity & Magnetism	8-18	- electricity and magnetism - engineering history - cmmon elements of electricity - electrical equipment - how magnets are made - what magnets do - circuits, switches, conductors, resistors and batteries - what capacitators are made of and what they do - insulation and why it's necessary - basic safety precautions	Students assist the teacher in obtaining simple materials-mostly short lengths of soft iron or steel bar	This lesson focuses on the basics of electricity and magnetism. It begins by outlining the work of some of the early experimenters and the sequence which eventually led to the realization of how a changeable electromagnetic field could be harnessed to other purposes. From there the lesson goes on to demonstrate how electric currents, magnetic fields and electrostatic fields are so closely related. A series of simple hands-on activities are provided at the end of the lesson. The lesson ends with a section in which the students are invited to discuss with the teacher, various ways in which they think these demonstrations could be improved.
Be a Scanning Probe Microscrope	8-12	- nanotechnology - scanning probe microscopes	Use a pencil to visually feel the shape of objects that cannot be seen and mimic the function of a scanning probe microscope	This lesson explores how these microscopes gauge the surface of materials at the nano level. Students work in teams to learn about Scanning Probe Microscopes (SPMs), and then use a pencil to visually feel the shape of objects they cannot see. Based on the sense of touch through the pencil, students mimic the function of the SPM. They draw what their mind “saw.”
Binary Basics	9-12	- basics of binary numbers - how computers work	Analyze a series of questions and problems that provide a basic understanding of how the system of binary numbers works	This lesson is intended to provide very young students with a basic understanding of how the system of binary numbers works.
Biomimicry in Engineering	8-18	- biomimicry - engineering design	Develop a structure or system based on an example in nature that	This lesson focuses on the concept of biomimicry and students learn how engineers have incorporated structures

		and redesign - patents	would help people living on the moon	and methods from the living world in products and solutions for all industries. Students work in teams to develop a structure or system based on an example in nature that would help people living on the moon.
Blast Off!	14-18	- aerospace engineering - engineering design and redesign - space flight	Build and launch a model rocket	This lesson focuses on aerospace engineering and how space flight has been achieved from an engineering vantage point. Students build and launch a model rocket and consider the forces on a rocket, Newton's Laws, and other principles and challenges of actual space vehicle launch.
Build a Big Wheel	8-18	- engineering design - motion, load, and construction	Design and build a Ferris Wheel	This lesson focuses on the engineering behind big wheels (sometimes called Ferris wheels). Teams of students explore the engineering behind the "London Eye," explore the history of big wheels and construct a working wheel model.
Build Your Own Robot Arm	8-18	- design concepts	Design and build their own robot arm out of everyday items.	This lesson explores the design of a robot arm. Students design and build a working robotic arm from a set of everyday items with a goal of having the arm be able to pick up a cup. Students work in teams of "engineers" to design and build their own robot arm out of everyday items.
Can You Canoe	8-18	- materials engineering - engineering design - planning and construction	Design and build a canoe	This lesson explores how engineering has impacted the manufacturing of canoes over time, including the development of new, durable, and lighter materials. Students work in teams to design and build their own canoe.
Can You Copperplate?	12-18	- engineering design and redesign - chemical engineering	Copperplate a range of items using everyday materials	This lesson explores chemical engineering and how the processes of chemical plating and electroplating have impacted many industries. Students work in teams to copper plate a range of items using everyday materials.
Cast your Vote	8-12	- voting process and tools	Designing a reliable voting machine for your classroom.	This lesson focuses on how technology and engineering can impact society, and how poll-taking has been influenced by engineering over time. Students design and build a voting or polling machine out of everyday items, then test and evaluate the effectiveness of the design.
Chair Lift Challenge	8-18	- transportation engineering	Design a chairlift out of everyday items	This lesson focuses on unique challenges in transportation engineering, such as devising a method for skiers or hikers to get to the top of a mountain. Students work in teams to design a "chair lift" out of everyday items that can transport a ping pong ball in a chair of their own design from the bottom of a "valley" to the top of a "mountain" along a clothes line or wire without the ball falling out.
Classroom Paper Recycling	8-18	- recycled paper manufacturing - re-engineering	Students recycle and manufacture their own recycled paper	This lesson focuses on how engineers and others have developed and improved the manufacturing of recycled paper.

				Students work in teams to recycle and manufacture their own recycled paper while learning how recycled paper is manufactured on a larger scale in paper facilities. Student teams evaluate current processes for creating paper and develop improvements to the procedure.
Clipper Creations	8-18	- basic principals of engineering design - build a model of a simple machine - how a simple machine such as a nail clipper works	Design and build a working model of a nail clipper	In this lesson students learn about simple machines. Students design and build a working model of a nail clipper.
Complexity-It's Simple	14-18	- growth of sequences - difference between complexity and runtime - fundamental algorithms in computer science - how algorithm design affects performance	Analyze, develop, and execute algorithms using games	This lesson allows students to learn about complexity through illustrative games, teamwork activities and design tasks. Students will gain an intuitive understanding of different growth rates and how they determine the performance of algorithms such as sorting. Advanced students can also develop skills in analyzing the complexity of algorithms.
Conveyor Engineering	8-18	- engineering design and redesign - manufacturing processes and conveyor systems	Devise a conveyor system using everyday materials that can move pieces of candy	This lesson explores how engineers work to solve the challenges of a society, such as moving goods and people. Students work in teams to devise a conveyor system using everyday materials that can move pieces of candy.
Cracking the Code	8-18	- encoding systems and decoding technology - how barcodes interface with computer systems - how barcodes have improved distribution efficiency & pricing accuracy - how barcodes have impacted everyday life	Identify problems from barcodes on everyday items and propose a new system or product to improve the current barcode system	Lesson focuses on how computerized barcodes have improved efficiency in product distribution; explores the barcoding process and engineering design. Student teams work to identify problems associated with the current barcode system and propose a new system or product to improve the current system.
Critical Load	8-14	- civil engineering and the testing of building structure - efficiency ratings and critical load	Design and build a structure designed to hold increasingly greater weight	This lesson explores the concepts of structural engineering and how to measure the critical load or the maximum weight a structure can bear. Students design and build a structure designed to hold increasingly greater weight, while determining the structure's critical load.
DC Motor	8-18	- basic direct current generators and motors - engineering history	Assemble an electric motor with simple materials	The lesson begins by outlining the work of some of the early experimenters and the sequence which eventually led to the realization of how a changeable electromagnetic field could be harnessed to other purposes. From there the lesson goes on to demonstrate how electric currents, magnetic fields and electromagnetic fields are so closely related. A simple hands-on activity is provided at the end of the lesson where students assemble an electric motor with

				simple materials. The lesson ends with a section in which the students are invited to discuss with the teacher, various ways in which they think these demonstrations could be improved.
Desert Island Survival	5-7	- design a prototype - plan and sketch a design	Build a hut that will withstand a wind storm	Students will hear a story of Sir Charlie who is trying to survive living on a deserted island. His biggest challenge has been the wind at night. Students will follow the criteria and constraints to build a hut that will withstand a wind storm.
Design a Dome	8-18	- construction techniques	Build a small dome frame out of everyday items that can hold a weight on top	This lesson focuses on the engineering behind building framing for structures, and explores examples of geodesic domes and other buildings. Students work in teams to design and build a small dome frame out of everyday items that can hold a weight on top without collapsing.
Design and Build a Better Candy Bag	8-18	- how design impacts product performance - design and build a better candy bag - use science, math, and engineering design concepts - collect and analyze data to solve a problem	Design and build a better candy bag	This lesson demonstrates how product design differences can affect the success of a final product — in this case a bag for holding candy. Students work in pairs to design and build a better candy bag.
Designing Drones	8-12	- forces that impact flight	Design, build, and fly a simple rotor	This lesson explores how helicopter flight is possible and how drones (or quadcopters) have impacted our world. Students explore the forces that make helicopter flight possible, and learn about how material choice and shape can also have an impact on flight. Students work in teams to design, build and fly a simple rotor using basic materials that drops the slowest from a height of ten feet.
Dispenser Designs	11-18	- process of product re-engineering - patents and ethical issues - how user needs, materials, costs, and manufacturing processes impact the design of everyday items	Design a handheld tape dispenser	This lesson explores how engineers work in a team to solve problems. Students work in teams to develop a new design for a handheld tape dispenser that can be easily operated by a person who has limited strength and only has the use of one hand.
Downhill Skier	5-8	- friction - engineer design process	Design a skier that can race to the bottom of a ski ramp	In this lesson plan, students will learn about friction and force. Students will work in teams to design a skier out of everyday items that can race to the bottom of a classroom ski ramp the fastest.
Electric Dough	8-14	- basic concepts of electricity and electrical circuits - concepts of electrical insulation and conduction - how to build circuits	Design and build electricity conducting creations out of dough	In this lesson, students will learn about electricity and circuits by using conductive and insulating dough to build creative electric creations. This activity is based on the work of Dr. AnnMarie Thomas and her team at the University of St. Thomas.

		and how short circuits occur		
Electric Messages	8-14	- electrical based communications - Morse Code system - wiring, switches, and simple circuits - history of communication and its impact on world events	Construct a simple telegraph using a battery, wires, switch, and bulb	This lesson focuses on exploring electric message systems, from light signals using International Morse Code to text messaging. Students construct a simple telegraph using a battery, wires, a switch, and bulb, and explore the impact of communications on society.
Electric Switches	8-11	- how switches control the flow of electricity - how to draw basic wiring diagrams - how to predict outcomes and draw conclusions	Build a working circuit with a battery and bulb	This lesson demonstrates how electric circuits can be controlled with a simple switch. Students work in teams to build a working circuit with a battery and a bulb. Then, add a switch that turns the bulb on and off.
Engineer a Cane	8-18	- assistive devices and technology	Design and reengineer an existing assistive device (cane) to meet the needs of a client	This lesson explores customization of assistive devices. Students work in teams to reengineer an existing assistive device integrating technology to meet the needs of a “client.”
Engineering a Dam	8-18	- dams	Develop a system of damming water in a trough	This lesson focuses on the different uses of dams and how they are engineered. Students work in teams to develop a system of damming water in a trough. The system must completely hold back the water and also have a way of executing a controlled release.
Engineered Music	8-18	- planning and construction	Design a musical instrument using everyday materials	This lesson focuses on the engineering behind the design of musical instruments. Students explore how mass manufacturing impacted the recorder, and then work in teams to design their own musical instrument using easy to find materials.
Engineered Sports	11-18	- design of sports equipment - aerodynamics, drag, and air friction - physics of bounce	Apply the principles of bounce and aerospace to an aircraft design	This lesson explores the concept of how aerospace engineering has impacted sports, specifically exploring the design of golf balls. Students work in teams to explore the physics of bounce, determine the application of aerospace principles to aircraft design and present their plans to the class.
Engineering Air Traffic	11-18	- radar - air traffice control technology - systems engineering	Devise a plan to bring three planes safely through a set airspace	This lesson focuses on the engineering behind air traffic control systems. Students work in teams to evaluate data generated for a virtual air traffic system, and determine a plan to bring three planes safely through a set airspace.
Engineering Ups and Downs	11-18	- elevator operation	Construct a working elevator to service a toy car garage	This lesson focuses on the engineering behind elevators. Teams of students explore principles and requirements of vertical travel, then design and construct a working elevator to service a toy car garage.
Exploring at the Nanoscale	8-14	- nanotechnology - scale - surface area	Prepare a proposal to a potential funding	This lesson explores how nanotechnology has impacted the world, and how engineers have to consider the

			organization to request research funding	ramifications of working at a very small scale. Students work in teams and explore the increased surface area exposed as items are made smaller and smaller.
Filtration Investigation	8-18	- planning and construction	Design and build a filtration system to remove dirt from water	This lesson focuses on how filtration systems solve many problems throughout the world such as improving drinking water. Through this lesson, students work in teams to design and build a filtration system to remove dirt from water.
Find it With GPS	8-18	- global positioning systems	Apply GPS technology to meet the needs of a global society	This lesson explores the technology that makes GPS possible and takes a look at global variations. Students work in teams to brainstorm recommendations for applying GPS technology to meet the needs of a global society.
Fizzy Nano Challenge	8-14	- nanotechnology - surface area	Test how whole and crushed antacid tablets behave in water	This lesson focuses on how materials behave differently as their surface area increases. Students work in teams to develop hypotheses and then test how whole and crushed antacid tablets behave in water
Flashlights and Batteries	8-11	- how switches control the flow of electricity - how to draw basic electric schematic diagrams - how the electric circuit and battery within a flashlight operates	Disassemble a flashlight and draw a schematic of a flashlight's circuit design	This lesson explores how a flashlight works, showing the electric circuit and switch functions of this everyday household item. Students learn how batteries work, how they provide power to the simple circuit within a simple flashlight, and how the switch controls the flow of electrons. Students work in teams to disassemble a flashlight, and draw a schematic of a flashlight’s circuit design.
Fun With Sorting	10-16	- observe how there can be multiple ways of sorting numbers - how some ways of sorting are more efficient than others - observe how an algorithm is a “procedure” - why an algorithm must be very explicit in its instructions	Discover algorithms and come up with ways to sort numbers	This lesson introduces students to sorting, one of the most basic and fundamental problems in Computer Science. Students work in teams to discover algorithms and come up with ways to sort numbers.
Fun with Speedboats	11-18	- engineering design - ship design and engineering - world records	Develop a boat out of everyday materials to cover a distance of 5ft along a water trough	This lesson focuses on how engineers and ship designers have developed boats with a goal of breaking a water speed record. Students work in teams to develop a boat out of everyday materials that will prove to be the fastest in the classroom covering a distance of 5 ft or 150 cm along a water trough.
Get Connected with Ohm's Law	10-18	- Ohm's law - be able to use a digital multimeter to collect data - explore the concepts of voltage and current	Use a digital multimeter to collect data, plot points on a graph, and draw a best fit curve	This lesson plan demonstrates Ohm’s Law (E = I x R). Students use digital multimeters to collect data that are plotted to show that voltage and current are related by linear functions for ordinary resistors and by power functions for light bulbs.

Get it Write	8-18	- mechanical engineering	Develop a working pen out of everyday materials	This lesson explores how pens have been engineered and re-engineered over time. Students work in teams to develop a working pen out of everyday materials.
Getting Your Bearings	8-18	- friction - ball bearings - how engineers improved ball bearings - the development of roller bearings - how roller/ball bearings are used in machines - how roller/ball bearings impact everyday life	Design a system using roller bearings to move a classroom desk or a table 10 feet	This lesson explores the concept of friction and shows how ball bearings reduce friction. Students learn about different uses for ball bearings, how the design has changed over time to incorporate roller bearings, test friction using marbles, and identify the use of ball bearings in everyday items
Give Binary a Try	8-18	- binary code and its applications in computing - downloading, running, and managing software applications - wiring and manufacturing of a simple electronic device	Download and install binary clock software and read an online binary clock	This lesson focuses on how binary codes function and binary applications for computer engineers. Students complete an activity to learn how to download and install binary clock software and read an online binary clock.
Give Me a Brake	8-11	- braking systems - force and friction - interaction between different materials	Devise a simple braking system using low cost materials	This lesson explores the concept of how brakes can stop or slow mechanical motion. Students examine the operation of a bicycle brake and use low cost materials to devise a simple braking system, then work as a team to suggest improvements to current bicycle brake designs.
Graphics: Calculating Color	11-13	- how color is created on video screens using additive color - how color is created in printers using subtractive color - the difference between additive and subtractive color - how and why additive color is represented as a single number	Add and subtract colors of paint to match the color of an object	In a digital world we take color for granted. Through off-computer activities, students learn the difference between additive and subtractive color, and how images are generated on screen and transferred to physical print.
Hand Biometrics Technology	8-18	- biometrics technology - meeting the needs of society	Design a high-tech security system for a museum	This lesson not only explores how engineers incorporate biometrics technologies into products, but also explores the challenges of engineers who must weigh privacy, security and other issues when designing a system. Students explore different biometrics techniques, find their own hand geometry biometrics, then work in teams to design a high-tech security system for a museum.

Heart of the Matter	8-18	- valves - engineering design changes to mechanical heart valves - human/machine interface to meet human needs	Examine and operate both a ball valve and a gate valve; sketch enhancements to a mechanical heart valve	This lesson explores the concept of valve operation and how engineering adapted valves for use in mechanical heart valve design. Students examine and operate both a ball valve and a gate valve, then they work as a team to develop and sketch enhancements to the mechanical heart valve.
Here Comes the Sun	8-18	- solar power and solar panel design and operation - how calculators work - how calculators are comprised of many different parts	Disassemble a solar powered calculator and suggestions design enhancements	This lesson explores the concept of how solar energy is gathered by solar panels and adapted to provide power to a variety of machines, from calculators to spacecraft. Students disassemble a solar powered calculator and explore the component parts. Students work in teams to suggest design enhancements to the calculator to improve performance.
History of Computing - EEEEK - A Mouse!	8-18	- computer/human interface and mouse engineering - ongoing changes to mouse design	Disassemble a mouse and explore the movement on the X/Y axis that determines the mouse positioning	The History of Computing – EEEEK a Mouse! activity explores the concept of how engineering solved the problem of human/computer interface. Students disassemble a mouse and explore the movement on the X/Y axis that determines mouse positioning.
How the Rubber Meets the Road	8-18	- planning and construction	Design a new tire treat that will be safe in rainy conditions	This lesson focuses on how engineers design tire treads to increase safety and reliability. Students are presented with the challenge of designing a new tire tread that will be safe when driving in rainy conditions.
Hull Engineering	11-18	- ship design and engineering	Design and test a new boat hull design	This lesson focuses on how the shape of ship's hull can impact its speed and stability potential in water. Teams of students design their own ship's hull on paper, and build it using everyday materials. Teams review all hull designs, predict which will go farthest, and then test their design on water using a pull meter or rubber band for propulsion.
Infrared Investigations	8-18	- infrared technologies - how engineers incorporate different technologies in designs	Devise a plan to operate a television from an infrared remote control that is around a corner or into another room	This lesson focuses on how infrared technology is used by engineers creating equipment and systems for a variety of industries. Teams of students explore the application of infrared in remote controls, test materials that encourage or prevent infrared transmission, and develop systems that allow transmission of infrared in restricted environments.
Insulators and Conductors	8-11	- electrical properties of different materials - conductors and insulators react to electric current - solve simple algebraic manipulations - squares and square roots - make predictions and draw conclusions	Test various classroom materials to determine which are conductors and which are insulators	This lesson encourages students to test different classroom materials to determine if they are conductors or insulators of electricity. Students work in teams testing their predictions about each material, then groups compare results and discuss findings.

Interactive Gumball Machine	10-18	- explore potential and kinetic energy - design and build an interactive gumball machine - engineering design process	Build a gumball slide and an interactive gumball machine	This lesson focuses on the history of gumball machines and potential and kinetic energy. Students work in teams to first build a gumball slide and then an interactive gumball machine.
Irrigation Ideas	8-18	- civil engineering - engineering design - planning and construction	Design and build an irrigation system out of everyday items	This lesson explores how civil engineering has solved the challenge of moving water using irrigation. Students work in teams to design and build their own “irrigation system” out of everyday items.
Keep It Cool	8-18	- insulation, heat transfer, and vacuums - engineering design and redesign - engineering can help solve society’s challenges	Develop a device to keep water chilled	This lesson explores how engineers have met the challenge of keeping foods, liquids, and other items cool. Students learn about heat transfer, vacuums, and insulation and design a system to keep a cup of chilled water as cool as possible for one hour.
Laser Creations: Designing and Producing a Custom ID Tag	9-14	- how CO2 laser cutters/engravers work - recognizing laser compatible materials - basic graphic design concepts - laser engraving and cutting	Design a custome backpack/luggage tag	Using vector-based graphic design software and an Epilog Laser cutter/engraver, students will learn to design and produce their very own custom backpack/luggage tag.
LEDs and Resistors	8-12	- LED's-application and history - resistors and their function in electrical circuitry - currant flow - operational differences between series and parallel circuits - predict outcomes and draw conclusions	Design and build a simple breadboard circuit that will power an LED	This lesson explores LEDs and resistors and reviews the differences between parallel and series circuit design and functions.
Life Vest Challenge	8-14	- personal flotation devices (PFDs) - how engineering can help solve society’s challenges	Design and build a flotation device out of everyday materials	This lesson explores the engineering behind life vests or personal flotation devices and the challenges met by these devices. Students work in teams to design and build a flotation device out of everyday materials that can keep an unopened can of soup or vegetables afloat in a bucket of water or sink for a minute.
Light Sculpture	11-18	- Arudino and breadboarding basics - simulate with Tinkercad Electronics - design a light sculpture with creative light pattern and display	Design, program and present a light show with basic circuitry, breadboarding and microcontrollers using Tinkercad	This challenge encourages students to engage their creative side to design a light sculpture that expresses the personality of the team. They will design, program and present a light show with basic circuitry, breadboarding and microcontrollers using Tinkercad. They also design a creative display for their light design using everyday items and presents to the group.

Make a Light Bulb with Batteries	11-18	- electrical engineering - how to make a lightbulb - history of lightbulb and its inventor	Construct a makeshift lightbulb	When was the last time you lived without electric lights? Maybe a thunderstorm, hurricane, or blizzard caused a power outage in your neighborhood. Many of us feel so uncomfortable without electricity that we keep gasoline-powered generators on hand to minimize the effects of such an unexpected loss of power. Nevertheless, just 150 years ago, most of the world lived their normal lives without electricity and the dependable light that it supplies. One hundred years before that, and “normal” life was almost what it had been for perhaps 5000 years – only fire (torch, candle, etc.) to light the night. Now we have electric lighting almost everywhere we go, and with this activity you will be able to create your own.
Making a Motor Shield	12-18	- using a motor shield to control motor speed and direction - using online software library to install code - testing types of various motors	Add a motor shield to an Arduino board, testing its ability to control various motors that can be used in robotics and mechatronics projects.	This lesson, sponsored by Digi-Key Electronics, explores the power of a microcontroller by having students add a motor shield to an Arduino board and test its ability to control various motors that can be used in robotics and mechatronics projects.
Making Sense of Senors	8-18	-engineering design -instrumentation -teamwork and working in groups	Design and build a hygrometer out of everyday materials	This lesson focuses on the hygrometer, a sensor used to measure humidity. Students work in teams to design and build a hygrometer out of everyday items to measure humidity levels.
Me and My Shadow	5-7	- make observations - determine the effect of sunlight on the Earth’s surface - use tools and materials - build a structure that will block the light from the sun - develop a simple sketch - describe the activity and the effects of the sun on the Earth's surface	Design and build a structure to hide a groundhog's shadow	This lesson develops principles of the effect of sunlight on the Earth’s surface. Students will explore the effects of the location of the sun on shadow formation, and design and build a structure to hide a groundhog’s shadow.
Measuring the Wind	8-18	- anemometers - how engineering can help solve society’s challenges	Design and build a working anemometer out of everyday materials	This lesson focuses on how anemometers are engineered to measure the speed of wind, and how designs have changed over time. Student teams design and build a working anemometer out of everyday materials.
Move That Lighthouse	8-18	- environmental impacts civil engineering - how structures can be moved	Build a 2 foot tall lighthouse and then moving the lighthouse 10 feet without it falling	This lesson plan explores how engineers work in a team to solve problems. Students learn how structural, economic, and environmental factors must be evaluated when planning to move a lighthouse or other building.

Nano Waterproofing	8-18	- nanotechnology - hydrophobic effect - surface area	Develop and test a waterproofing technique for cotton fabric	This lesson explores how materials can be modified at the nano scale to provide features such as waterproofing and stain resistance. Student teams develop their own waterproofing technique for a cotton fabric and test their design against a fabric that has been altered through nanotechnology applications.
Oil Spill Solutions	8-18	- environmental engineering - chemistry and chemical engineering	Design and build an oil containment and clean-up system	This lesson focuses on how engineers use various techniques to provide speedy solutions to oil spills or other threats to natural water resources. Through this lesson, students work in teams to design and build an oil containment and clean-up system.
Pendulum Time	8-18	- timing and engineering - how engineering can help solve society's challenges	Build a working clock using a pendulum	This lesson explores how the pendulum has been a reliable way to keep time for centuries. Students work in teams to build their own working clock using a pendulum. They will need to be able to speed up and slow down the motion of the pendulum clock.
Pipeline Challenge	8-18	- how civil engineers approach large scale problem solving	Develop a pipeline system to transport both a golf ball and a ping pong ball	This lesson focuses on how engineers develop pipeline systems to transport oil, water, gas, and other materials over very long distances. Students work in teams to develop a pipeline system to transport both a golf ball and ping pong ball across the classroom terrain.
Planting with Precision	8-18	- machinery and systems for planting crops - how engineering can help solve society's challenges	Devise a system that can drop a seed every 15cm over a 60 cm space	This lesson explores how engineers work to solve the challenges of a society, such as efficient planting and harvesting. Students work in teams to devise a system that can drop a sunflower or pumpkin seed every 15cm over a 60cm space.
Playing with Parachutes	8-18	-design and construct a parachute -test and refine their designs -communicate design process and results	Design, construct, and test a parachute made from everyday materials	This lesson focuses on parachute design. Teams of students construct parachutes from everyday materials. They then test their parachutes to determine whether they can transport a metal washer to a target on the ground with the slowest possible rate of descent.
Polution Patrol	8-18	- design and build an outdoor air pollution detector - test and redefine designs - communicate design process and results	Construct and test outdoor air pollution detectors made from everyday materials	This lesson focuses on devices that are used to detect air pollution. Teams of students construct outdoor air pollution detectors from everyday materials. They then test their devices to see how much particulate pollutants they can capture.
Popsicle Bridge	8-18	- civil engineering - bridges	Design, build, and test a bridge made out of popsicle sticks and glue	This lesson focuses on how bridges are engineered to withstand weight, while being durable, and in some cases aesthetically pleasing. Students work in teams to design and build their own bridge out of up to 200 popsicle sticks and glue.

Pulleys and Forces	8-11	- learn about pulleys and pulley systems - reducing required force with multiple pulleys - pulley systems in everyday life	Test the ability to move weights using one, two, and four pulleys in a series	This lesson focuses on the concept of force and the use of pulleys to reduce required force. Students learn about different uses for pulleys, the impact of multiple pulleys, and identify pulley use in school and their community. Students test the ability to move weights using one, two, and four pulleys in a series.
Radio Reception and Transmission	8-18	- circuits and computers - radio receivers and transmitters	Build and test a radio receiver using a snap or soldering kit	This lesson explores the electronics behind radio, and its impact on society. Students work in teams to build and test a radio receiver and optional transmitter from either a snap or soldering kit (depending on level and age).
Recycling Sorter	8-14	- single stream recycling - materials recovery facilities (MRFs) - effective recycling in communities - creative technology for trash pick-up, litter, and pollution	Design a system to sort a mixed-up recycling bin	Students will learn about the challenges waste management centers face and different methods they use to sort recycling. In small teams, students will brainstorm and design a system to sort a mixed-up recycling bin.
Rescue Rover	8-18	- design and build a rescue device - test and refine designs - communicate design process and results	Construct a device out of everyday materials to rescue a puppy from a well	This lesson focuses on the tools and equipment used during technical rescue operations.Teams of students construct a device out of everyday materials to rescue a puppy from a well.
Robot Basketball	10-18	- explore precision and accuracy - design & build a free-throw shot device accurately - engineering design process	Design a device that can shoot a basketball free-throw shot accurately everytime	This lesson demonstrates the difference between precision and accuracy. Students design a device that can shoot a basketball free-throw shot accurately every time.
Rotation Equillibrium	14-18	- rotational equilibrium - basic algebraic equations - graphing - making and testing predictions	Build and test a mobile to explore the principles of rotational equilibrium	Demonstrate the concept of rotational equilibrium.
Rubber Band Racers	8-18	- design and construct a rubber band car - measure distance - calculate velocity - test and refine designs	Design and build a rubber band car out of everyday items	This lesson explores the design of rubber band powered cars. Students work in teams of “engineers” to design and build their own rubber band cars out of everyday items. They test their rubber band cars, evaluate their results, and present to the class.
Sail Away	8-18	- marine engineering and sailing principles - marine engineering and sailing principles - meeting the needs of society	Design a sailboat that can carry a set load across water for 1 meter	This lesson focuses on watercraft engineering and sailing. Students work in teams to design a sailboat that can carry a set load across water for 1 meter.
Salamander Crossing	8-14	- patterns of animal movement - disruption of animal lives from human	Construct a model of a salamander migration area	In this lesson, students will learn about different kinds of animal crossings engineered to help protect wildlife and the ways civil engineers take wildlife migration

		impact - challenges in civil engineering - improving road safety for animals		into account when developing engineering designs. Students will construct a model of a salamander migration area with a road passing through it and design a crossing to get the salamanders safely to their breeding grounds.
Search Engines	8-18	- basics of a search engine - query of search engines - finding relevant material using search engines	Build search queries and report relevancy of the search results	This lesson focuses on exploring how the development of search engines has revolutionized the Internet. Students work in teams to understand the technology behind search engines and explore how they can retrieve useful information using search engines.
Series and Parallel Circuits	8-14	- circuit designs resulting in different electrical behaviors - current flow - operational differences between series and parallel circuits - predicting outcomes and drawing conclusions	Design a system where one switch can turn on multiple lights	This lesson demonstrates simple circuits and the differences between parallel and serialcircuit design and functions. Students work in teams to predict the difference between the two circuit designs and then build examples of the two different circuits using wires, bulbs, and batteries.
Shake it Up with Seismographs	8-18	- seismograph technology - engineering design	Design a seismograph out of everyday materials	This lesson focuses on exploring how the development of seismographs has helped save lives around the world. Students work in teams to design their own seismograph out of everyday materials and test its ability to record a simulated classroom earthquake.
Ship the Chip	8-18	- engineering product planning and design - meeting the needs of society	Design the smallest, lightest package possible using everyday materials	In this lesson, students learn how engineers develop packaging design requirements, and work in a team to evaluate the external stresses that engineers must consider when developing a package or product design. Students develop a plan, select materials, manufacture their package, test it, and evaluate their results.
Shipping for Survival	8-18	- package engineering - engineering design and redesign - how engineering can help solve society's challenges	Design a shipping container and system to safely and effectively ship a flower in water	This lesson packaging engineering and how many products, from eggs to organs intended for transplant require special packaging to assure they arrive at their destination in perfect condition. Students work in teams to design a shipping container and system to safely ship a flower in water so that the flower is still fresh upon delivery.
Simple Machines	8-11	- different types of simple machines - engineering design - simple machines as part of daily life	Examine and analyze various can opener designs	This lesson focuses on simple machines and how they can be found in many everyday items. Students explore the different types of simple machines, how they work, and how they are integrated into many items. Students explore common kitchen machines and identify how many simple machine types are incorporated into each item.

Sketching Circuits	8-12	- alternatives to wiring in electrical circuitry - electrical properties of different materials - how conductors and insulators react to electric current - predicting outcomes and drawing conclusions	Design and build a simple circuit using drawn connectors	This lesson explores conductivity and introduces students to the new technique of drawing electrical pathways for circuitry with pens. Students will design, and build a simple circuit using drawn connectors and construct a device for testing materials for conductivity.
Smooth Operator	8-18	- design and build surgical instrument - test and refine designs - communicate design process and results	Design and build a surgical instrument out of everyday materials	This lesson explores how surgical instruments are designed to assist medical professionals in conducting surgical procedures. Students work in teams to design and build their own surgical instrument out of everyday materials.
Solar Power	8-14	- new energy technology	Measure the voltage and interna resistance of three connected solar cells	The lesson begins by making the point that while Wind Turbines often have dead spells when there is no wind blowing, they can often produce energy no matter whether it is day or night. On the other hand, so long as it is daylight, solar panels can produce power regardless of whether the wind is blowing or not. Furthermore, if a solar array is of the more elaborate type, which includes a battery and a DC/AC inverter, it can produce energy in the dark. Such installations are of course, more expensive. Students complete hands-on challenges with mini solar cells.
Solar Structures	8-18	- design and build a solar house - test and refine designs - communicate design process and results	Construct a passive solar house from everyday materials	This lesson focuses on how the sun's energy can be used to heat and cool buildings. Teams of students construct passive solar houses from everyday materials. The houses will be tested for how well they keep warm or cool depending on the time of year.
Solving a Simple Maze	14-18	- systematic problem analysis - algorithms - robotics algorithms and artificial intelligence	Design a simple 4x4 maze	This lesson focuses on algorithmic thinking and programming. Students design a simple 4×4 maze.
Sort It Out	8-18	- engineering system - coin manufacturing process	Design and build a system to sort different sized coins for packaging	This lesson focuses on the engineering behind industrial sorting processes. Students work in teams to design and build a system to sort different sized coins for packaging.
SparkPunk Hook Up	8-18	- understand a simple synthesizer - various electronic components and their functions - assembly (soldering) and testing of electronic components	Assemble, test, and modify a simple synthesizer	In this lesson students explore how a simple synthesizer (electronic machine that produces sound) works by assembling, testing and modify the SparkPunk (a simple synthesizer by Sparkfun). Students will explore various electronic components (integrated circuits, potentiometers, switches, diodes, resistors and capacitors) and their function within this application.

Spring Scale Engineering	8-18	- scales and measuring devices - engineering design and redesign - construction techniques	Design, build, and test a spring scale	This lesson focuses on the engineering behind building a spring scale and its use as a measuring device. Students work in teams to design, build, and test their own spring scale that can measure the weight of an apple using everyday items.
Statue Display Tower	10-18	- design a display tower - build, test, and redesign a prototype - disassembly and reassembly - calculating design cost	Design a low cost display tower that is easily disassembled and reassembled	In this lesson, students apply the engineering design process to solve the Golden Book design challenge to make a low cost display tower that can hold a statue and can be taken apart and reassembled easily for transporting from one library to another.
Sticky Engineering	8-18	- impact of component selection on engineering results - development of adhesives	Design a structure held together with glue that withstands the weight of a can of soup or soda	This lesson focuses on how engineers work to solve problems and impact daily life through new and improved products. Students work in teams to design a structure, held together with glue, which must withstand the weight of a can of soup or soda.
Stop and Go	8-18	- traffic engineering - engineering design and redesign - how engineering can help solve society's challenges	Design a new traffic light system	This lesson focuses on how engineers have developed and improved traffic management over time. Students work in teams to design a new traffic light system.
Sugar Crystal Challenge	8-14	- nanostructures - surface area	Explore different forms of sugar at different levels of coarseness	Lesson focuses on surface area and how the shape of sugar crystals may differ as they are grown from sugars of different grades of coarseness. Students explore surface area, nanostructures, and work in teams and participate in hands-on activities.
Take Flight	8-12	- impact of forces on flight - engineering design, testing, and troubleshooting - how engineering can help solve society's challenges	Design, build and test a glider made from simple materials	This lesson explores how flight is possible and how engineers have improved glider designs and materials to improve flight accuracy and distance. Students build and test their own gliders out of simple materials.
Tall Tower Challenge	8-18	- structural engineering - engineering design and redesign - how engineering can help solve society's challenges	Develop a tall tower that can support the weight of a golf ball	This lesson focuses on the growth of tall buildings and their structures. Students work in teams to develop the tallest tower they can build with limited materials that can support the weight of a golf ball for two minutes.
Telescoping Periscope	8-18	- engineering design and redesign - periscopes and optical devices - how engineering can help solve society's challenges	Design and build a periscope from limited materials	This lesson explores how a periscope works and is used. Students work in teams to devise their own periscope.
Temperature Tactics	8-14	- sensors that measure temperature - engineering design	Design and build a temperature gauge out of everyday products	Lesson focuses on how thermometers have been impacted by engineering over time, and also how materials engineering has developed temperature sensitive

		- properties of materials		materials. Student teams design and build a temperature gauge out of everyday products and test a variety of materials for thermal properties
Tennis Anyone?	8-18	- materials engineering - how engineering can help solve society's challenges	Design a racquet that can consistently hit a ball to a target	This lesson explores how engineers who work in the sports industry apply the latest materials, manufacturing techniques, and shapes to enhance sporting — while maintaining the rules of a sport. Students work in teams to design a racquet that can consistently hit a ball to a target.
The Boat and the Beetle	4-7	- making and improving model boats - testing and improving boat design	Design and build a boat out of modeling clay	This lesson further develops principles of floating and sinking to young learners. It allows children to explore how boats and ships use the principle of displacement and buoyancy to stay afloat. The activities allow children to experiment with different shapes and designs of a boat 'hull' to see which floats best.
The Power of Graphene	8-18	- nanotechnology - graphene - circuits, insulators, and conductors - how engineering can help solve society's challenges	Build and test a simple circuit using everyday materials	This lesson focuses on graphene and its electrical properties and applications. Students work in teams to hypothesize and then test whether graphene is an electrical conductor or insulator. They build a simple circuit using everyday items, and create a graphene sample using soft pencils on paper.
Tinkering with Tops	8-18	- design and build a spinning top - test and refine their designs - communicate design process and design	Design a spinning top that can spin for at least 10 seconds within a circle 30 cm in diameter	This lesson explores the history, design and motion of spinning tops. Student teams build spinning tops out of everyday materials. Their challenge is to design a spinning top that can spin for at least 10 seconds within a circle 30 cm in diameter.
Toxic Popcorn Design Challenge	8-18	- engineering design process - build, test, and redesign a prototype - teamwork and communication	Design a product and process to safely remove "toxic" popcorn and save the city	This lesson introduces students to the engineering design process (EDP)—the process engineers use to solve design challenges. Students work in teams to solve the challenge by designing both a product and process to safely remove "toxic" popcorn and save the city.
Transformers	12-18	- understand what transformers are and how they are made	Build and test a simple transformer using inexpensive materials	This lesson focuses on transformers as one of the most important components in any electrical system. Students engage in a hands-on activity where they build and test a simple but working transformer, using inexpensive materials.
Trebuchet Toss	12-18	- design and built a trebuchet - test and refine design - communicate design process	Design, construct, and test trebuchets made from everyday materials	This lesson focuses on trebuchet design. Teams of students construct trebuchets from everyday materials. They then test their trebuchets to determine the farthest distance they can hit a target with a marshmallow projectile.
Try Your Hand at Nano	8-11	- nanotechnology - liquid crystals - how engineering can help solve society's challenges	Investigate how the temperature of a student's hand or other items impact a liqiud crystal sheet	This lesson focuses on two simple activities younger students can do to gain an appreciation of nanotechnology. First, students measure their hands in nanometers. Second, students learn about liquid crystals, their applications and nanotechnology connections and test how

				the heat of their hands changes the color of the crystals.
Two Button Buzzer Circuit	8-14	- switches - flow of electricity - operation of electric circuits	Construct a two button buzzer model out of wires, a battery, buttons (switches), and a buzzer	This lesson plan explores an everyday situation, where either two or more buttons can ring a buzzer. Students learn how this type of circuit is structured by constructing a two button buzzer model out of wires, a battery, buttons (switches), and a buzzer.
Using Ohm's Law to Build a Voltage Divider	8-18	- Ohm's Law as a tool for engineering design - using a digital multimeter - electrical requirements of light emitting diodes (LED's	Use a breadboard to build a voltage divider circuit that can illuminate and LED bulb	This lesson focuses on the voltage divider, a basic circuit of electrical engineering. Using breadboards, student teams apply Ohm's Law to construct voltage divider circuits. Students learn how to read resistor codes and calculate resistor values.
Virtual Reality and Anaglyph Stereoscopic Technology	11-14	- VR technologies - use of stereo images to provide the illusion of 3D depth - scientific method to compare anaglyph technologies	Complete an activity using 3D glasses and 3D images	This lesson focuses on virtual reality technologies. These display technologies are based around artificial stereo images, and provide a view with illusions of 3D depth in virtual environments. Students complete an activity using 3D glasses and 3D images.
Water Fountain	10-18	- hydraulic pumps - design and build a water fountain - engineering design process	Design and build a unique water foundtain that employes a hydraulic pump	This lesson demonstrates how a hydraulic pump works. Students work in teams to design and build a unique water fountain that employs a hydraulic pump.
Water Rocket Launch	8-18	- aerospace engineering - space flight - how engineering can help solve society's challenges	Build and launch a rocket made out of a soda bottle and powered with an air pump	This lesson focuses on aerospace engineering and how space flight has been achieved from an engineering vantage point. Student teams build and launch a rocket made out of a soda bottle, powered with an air pump, and consider the forces on a rocket, Newton's Laws, and other principles and challenges of actual space vehicle launch.
Water Tower Challenge	8-18	- Water delivery systems - engineering design and redesign - how engineering can help solve society's challenges	Develop a water tower out of everyday materials that can supply and shut off water as needed	This lesson focuses on water storage and how engineering helps communities preserve and supply water to populations. Students work in teams to design and build a water tower out of everyday materials that can "supply" and "shut off" water as needed.
Waterproof That Roof!	8-18	- structural engineering - materials engineering - how engineering can help solve society's challenges	Design a roof that will keep the contents of plastic house dry during a water test	Lesson focuses on how structural engineers have improved the designs of building — specifically roofing — over the years to improve the quality of homes and life. Teams of students work together using simple materials to design a roof that will keep the contents of a plastic house dry during a water test.
What is a Nanometer	8-12	- nanotechnology - scale	Measure ten objects in the classroom at the nano scale	Lesson focuses on how to measure at the nano scale and provides students with an understanding of how small a nanometer really is. Students work in teams and measure a range of everyday classroom items, first using metric rulers and then convert the results to the nano scale.

Wind Tunnel Testing	11-18	-wind tunnels and engineering testing	Build a model car from everyday materials and test in a wind tunnel	This lesson focuses on wind tunnel tests that engineers use to develop products such as airplanes, cars, and even buildings. Teams of students build their own model car out of everyday materials and test their design in a wind tunnel made of a fan blowing through a long cardboard box.
Working With Watermills	8-18	- how watermills generate power	Design and build a working watermill out of everday materials	This lesson focuses on how watermills generate power. Student teams design and build a working watermill out of everyday materials and test their design in a basin. Student watermills must be able to sustain three minutes of rotation.
Working With Wind Energy	8-18	- wind energy and wind turbines - engineering design - how engineering can help solve society's challenges	Design and build a working wind turbine out of everyday materials	This lesson focuses on how wind energy can be generated on both a large and small scale. Student teams design and build a working wind turbine out of everyday materials that can lift a teabag in one minute or less.
Writing in HTML	8-14	- HTML code - computer language - coding a basic website	Create a web page and translate it into HTML	Students will learn basic HTML and explore how code can translate into a final visual design, such as a web page. They will create a web page design, translate it into HTML, and then use the computer language to communicate their design to a partner. Their partner will then act as a web browser, converting the code into the original web page design.

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