IEEE PRE-UNIVERSITY EDUCATION LESSON PLANS

http://tryengineering.org/lesson-plans

TryEngineering offers a variety of lesson plans that align with education standards to allow teachers and students to apply engineering principles in the classroom. The matrix below will allow you to select a lesson that will be age and content appropriate for your classroom.

Lesson Title	Lesson Focus	Age
A Century of Plastics	Lesson focuses on how plastics of all sorts have been engineered in to everyday products over the past century, with emphasis on materials selection and engineering.	8-18
A Question of Balance	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.	11-18
Adaptive Device Design	Lesson focuses on the engineering of adaptive or assistive devices, such as prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, or braces.	8-18
AI Search: Lions and Gazelles	This is an introduction to Artificial Intelligence (AI) 'state-space search.' Students will write and perform a skit that solves the problem using pre-made paper props, as they explore the concept of state representation.	8-13
Animation with Object Efficiency	This lesson shows how an object made of connected parts can be animated by displaying it as a series of graphic images.	11-13
Arduino Blink Challenge	Lesson explores computer programming and the impact of computers on society. Students build and test a program to turn a light on and off using an Arduino board. They connect the hardware, program the code, test their system, adapt it for variations in blinking times, evaluate their results, and share observations with their class.	14-18
Assembly Line	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.	8-18
Be A Scanning Probe Microscope	Lesson focuses on how engineers have developed and use special tools that can observe the landscape of materials when they are working at the nano scale. Students learn about Scanning Probe Microscopes (SPM) and then work in teams using a pencil to explore and identify the shape of objects they cannot see, just as the SPM does at the nano level. They draw what their mind "sees" on paper, compare their results with other student teams, and share observations with their class.	8-14
Binary Basics	This lesson is intended to provide very young students with a basic understanding of how the system of binary numbers works.	9-12

Biomimicry in Engineering	Lesson focuses on the concept of Biomimicry and students learn how engineers have incorporated structures and methods from the living world in products and solutions for all industries. Students then work in teams to develop a structure or system based on an example in nature that would help people living on the moon. They design their structure on paper, learn about patents, and share their designs with the class.	8-18
Blast Off!	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. They design their structure on paper, learn about aerospace engineering, launch their rocket, and share observations with their class.	14-18
Boolean Algebra is Elementary	Sherlock Holmes delighted in saying 'It's elementary, my dear Watson'. This lesson provides a brief overview of how Boolean algebra provides the basis for artificial intelligence reasoning.	13-18
Build a Big Wheel	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 using pasta, glue, and teabags.	8-18
Build Your Own Robot Arm	Develop a robot arm using common materials. Students will explore design, construction, teamwork, and materials selection and use.	8-18
Can You Canoe?	Lesson focuses on how canoes, which have been hand built for centuries, have been impacted by engineered materials and manufacturing processes over the years. Student teams design and build a model canoe frame and then cover their frame with everyday materials and test their design in a basin. Student model canoes must be able to float, travel a distance of 4 feet, and support a load. Students then evaluate the effectiveness of their canoes and those of other teams, and present their findings to the class.	8-12
Can You Copperplate?	Lesson explores chemical engineering and explores 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. They develop a hypothesis about which materials and surface preparations will result in the best copper plate, present their plans to the class, test their process, evaluate their results and those of classmates, and share observations with their class.	12-18
Cast Your Vote	Lesson focuses on how technology and engineering impact society, and how poll-taking has been influenced by engineering over time. Students design and construct a voting or polling machine out of everyday items, then evaluate the effectiveness of the design.	8-12

Chair Lift Challenge	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 an open front cup from the bottom of a "valley" to the top of a "mountain" along a clothes line or wire without the ball falling out. Students design their chairlift on paper, execute their design, test it, reflect on the challenge, and share their experiences with the class.	8-18
Choose Your Best Way	Lesson focuses on how mathematic models help to solve real problems and are realized in computers. Students work in teams to build a graph model of their city map while learning how mathematic models work. Student should be encouraged to use this model to solve real problems.	12-18
Circuits and Boolean Expressions	Boolean logic is essential to understanding computer architecture. It is also useful in program construction and Artificial Intelligence.	8-13
Classroom Paper Recycling	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 improvement to the procedure.	8-18
Clipper Creations	Develop a working model of a nail clipper.	8-18
Coloring Discrete Structures	This lesson introduces students to areas of mathematics that computer scientists use to do computational problems.	11-13
Complexity – It's Simple	This lesson allows students to playfully understand algorithms and complexity.	14-18
Concurrency Means Cooperation	This lesson provides a number of kinesthetic exercises that illustrate how teamwork can contribute to efficient problem solutions.	8-10
Conveyor Engineering	Lesson explores the engineering behind the conveyor belt and considers the impact this invention has had on transportation and the coordinated shipping and delivery of goods. Students work in teams to design and build a conveyor system out of everyday materials that can transport pieces of candy 4 feet (120cm). The conveyor must make a 90 degree turn as it moves along. Student teams design their system, build and test it, evaluate their designs and those of classmates, and share observations with their class.	8-18
Cracking the Code	Lesson focuses on how computerized barcodes have improved efficiency in product distribution; explores the barcoding process and engineering design.	8-18
Critical Load	Lesson focuses on issues civil engineers face, including critical load and how to reinforce the design of a structure to hold more weight.	8-14
Data Representation: Millions of Colors	By first creating, and then playing a card game, students learn how additive color is represented as binary and hexadecimal numbers.	14-17

Design a Dome	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.	8-18
Design and Build a Better Candy Bag	Demonstrate 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 evaluate, design, and build a better candy bag.	8-18
Dispenser Designs	Lesson focuses on how engineers have to design objects to meet the needs of users, while considering the limitations of materials, and the implications of cost.	11-18
Electric Messages: Then and Now	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.	8-14
Electric Switches	Demonstrate how electric circuits can be controlled with a simple switch. Note: This lesson plan is designed for classroom use only, with supervision by a teacher familiar with electrical and electronic concepts.	8-11
Encryption – All About Code	Students learn how alphanumeric symbols can be encoded for a multitude of fun purposes. In the first of two sessions (each 2 hours long) they learn about codes, and are asked to make their own with a limited number of symbols. In the second session they are asked to break each other's codes and discover the relationship among encryption, decryption, and shared keys.	8-10
Engineer a Cane	Lesson focuses on how engineers improve assistive devices such as a cane to meet the needs of the elderly. Students work in teams to re-engineer a cane for a "client." They are assigned a client profile, develop a design to suit the needs of the user, and those in older grades build a working prototype of their design.	8-18
Engineer a Dam	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.	8-18
Engineered Music	Lesson focuses on the engineering behind the design of musical instruments. Teams of students explore the engineering behind recorder manufacturing, and then design, construct, test, and evaluate a working musical instrument using easily found materials.	8-18
Engineered Sports	Lesson focuses on how the principles of aerospace engineering have impacted golf ball design, along with equipment used in other sports. Students analyze the use of dimples on golf balls, and work as a team of engineers to determine whether adding dimples to airplanes would increase fuel efficiency for the airline industry. They also explore the physics of bounce as it relates to several sports balls.	11-18

Engineering Air Traffic	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. They then recommend engineering enhancement to the current system.	11-18
Engineering Ups and Downs	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 using wheels, pulleys, string, cardboard and other materials.	11-18
Exploring at the Nanoscale	Lesson focuses on how nanotechnology has impacted our society and how engineers have learned to explore the world at the nanoscale. Students participate in hands-on activities to understand exactly how small the nanoscale is, explore how surface area changes at the nano scale, and work in teams to develop futuristic applications of nanotechnology.	8-14
Failure: Seeds of Innovation	Lesson focuses on how failure is part of the engineering process. Students work in teams and learn about many inventions and advances in engineering were brought about after a mistake or failure. Students research an example of such an innovation and develop a presentation related to how the tenacity of the engineer allowed him or her to move past a failure and into the realm of innovation. Students reflect on the value of moving on after a failure or setback, present the results of their research to the class, and provide examples of how the innovation they researched has impacted society -- only because the engineer didn't give up.	8-18
Fibonacci via Recursion and Iteration	Lesson Focus:This lesson introduces how to calculate an arithmetic series, specifically Fibonacci. In the first of two hour-long sessions, using a spreadsheet (e.g. Microsoft Excel or Google Drive Sheets), students are shown how to calculate a series based on two prior values (the iterative solution), and by using a user-defined function (the recursive solution). With a large enough domain, most computers will exhibit real delays in calculating the recursion for values greater than 30. In the second session, they will explore why the iterative solution is faster, and why the recursive solution significantly slows down for large values. This lesson assumes that the teacher is well versed in using spreadsheets, including copy-down formulas.	14-18
Filtration Investigation	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. Students select from everyday items to build their filter, test the resulting system evaluate the effectiveness of their filters and those of other teams, and present their findings to the class.	8-18

Find it with GPS!	Lesson focuses on exploring how the development of global positioning systems has revolutionized both defense and consumer product engineering. Students work in teams to understand the technology behind GPS, explore current applications, and brainstorm new applications for global use of GPS. They use both a simple GPS handheld device and online resources to understand the functioning and potential of this engineering technology.	8-18
Fizzy Nano Challenge	Lesson focuses on how materials behave differently as their surface area increases.Students work in teams to explore examples of how surface area impacts functionality. They hypothesize how surface area will impact the performance of antacid tablets, conduct an experiment using whole and crushed tablets to see how they behave when introduced to water, observe what they see, extrapolate to other examples, compare their hypotheses and the results with those of other student teams, reflect on the experience, and share observations with the class.	8-14
Flashlights and Batteries	Lesson focuses on the concept of electron flow through the demonstration of electrical circuits in a flashlight, and how batteries operate.	8-11
Folding Matters	Lesson focuses on how the process of folding has impacts on engineering and is evident in nature. Students consider many applications of folding such as parachutes, wings in a cocoon, heart stents, and solar panels in space. They work in teams to create a model out of everyday items of a solar panel that can be folded (for transport) and expanded (in space). Students design their solar panel on paper, build it for transport, and open or test it. All teams evaluate their results, reflect on their design, and present to the class.	8-18
Fun with Sorting	The lesson focuses on introducing the fundamental problem of “sorting an array” to pre-university students.	10-16
Fun with Speedboats	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 classroom trough. Students design, build, and test their speedboats; evaluate their designs and those of classmates; and share observations with their class.	11-18
Get Connected With Ohm’s Law	Demonstrate Ohm’s Law using digital multi-meters. Fun hands-on activities are presented that demonstrate Ohm’s Law. Teachers use digital multi-meters 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.	10-18

Get It Write	Lesson focuses on how writing instruments have been engineered over time. Students work in teams to design and build a functional "pen" out of everyday materials that can deliver washable liquid watercolor (ink) to a sheet of paper in a controlled manner. They design their pen, build and test their design, evaluate their results, and share observations with the class.	8-18
Getting Your Bearings	Lesson focuses on the concept of friction and the use of ball bearings to reduce friction.	8-18
Give Binary a Try!	Lesson focuses on how binary codes function and binary applications for computer engineers. The lesson offers students an activity to learn to download software and read online binary clock, and advanced students an opportunity to build one from a kit.	8-18
Give Me a Brake	Lesson focuses on brakes, force, and friction, using bicycle rim brakes to demonstrate basic braking mechanisms to stop, slow, or prevent motion.	8-18
Graphics: Bits and Points	Computer graphics dominates young people's lives. Their worldview is heavily influenced by pixels.	8-11
Graphics: Calculating Color	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.	11-13
Hand Biometrics Technology	Students learn how biometrics technologies have been used worldwide to address security and identification systems.	8-18
Heart of the Matter	Lesson focuses on the engineering and operation of artificial heart valves, and the interface between man and machine.	8-18
Here Comes the Sun	Lesson focuses on solar panel design, and its application in the standard calculator. It explores how both solar panels and calculators operate and explores simple circuits using solar power.	8-18
History of Computing - EEEEK- A Mouse!	Lesson focuses on computer and mechanical engineering and explores how computer mice operate and how engineering provided an interface between man and machine.	8-18
History of Computing - Engineered Memory	Lesson focuses on the engineering behind storage devices, and engineering improvements over time. Though exploring the operation of the "floppy" disk, students explore the mechanics underlying operation, and then test the disk under a variety of conditions.	8-18
How the Rubber Meets the Road	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. Student teams will design and construct a sample tread out of clay, then test and evaluate the effectiveness of the design, evaluate their results, and present their findings to the class.	8-18

Hull Engineering	Lesson focuses on how the shape of ship's hull can impact its speed and stability potential in water. Teams of students design and test their own ship's hull on paper, and build it using foam and other everyday materials.	11-18
Infrared Investigations	Lesson focuses on how infrared technology is used by engineers creating equipment and system 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.	8-18
Insulators and Conductors	Demonstrating the concept of conducting or insulating electricity. Note: This lesson plan is designed for classroom use only, with supervision by a teacher familiar with electrical and electronic concepts.	8-11
Interactive Gumball Machine	Students explore potential and kinetic energy while working in teams to design and build an interactive gumball machine.	10-18
Irrigation Ideas	Lesson focuses on how through the centuries man has had the need to move water from one place to another. Engineered irrigation has proved critical throughout the world. Through this lesson, students work in teams to design and build a system to move water from one source to two different delivery areas. The challenge is to move two cups of water for at least three feet and distribute it evenly in two separate containers. They work with everyday items, develop a plan, build their "irrigation" system, and test their system. Students then evaluate the effectiveness of their own irrigation systems and those of other teams, and present their findings to the class.	8-18
Keep it Cool	Lesson focuses on the engineering behind keeping food and other items cool. Students work in teams to develop a system to make an insulated liquid container that will keep chilled water as cool as possible for an hour using everyday items. Students will need to devise a way to have a thermometer rest in the water and be able to read the temperature throughout the hour. They plan their design, execute and test their system and share their experiences with the class.	8-18
Life Vest Challenge	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. They design their life vest, build and test it, evaluate their designs and those of classmates, and share observations with their class.	8-14

Making Sense of Sensors	Lesson focuses on how sensors are used in many applications to gather information about our environment. This lesson focuses on the hygrometer, a sensor used to measure humidity. Through this lesson, students work in teams to design and build a hygrometer out of everyday items to measure humidity levels. The student hygrometers are not meant to be exact, but are expected to indicate a change. Students select from everyday items to build their hygrometer, test their machine using a spray bottle to increase humidity, evaluate the effectiveness of their system and those of other teams, and present their findings to the class.	8-18
Measuring the Wind	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 products and learn about how anemometers are used for feasibility tests on locations considering alternative energy from wind turbines. Student anemometers must be able to sustain the wind generated by a fan or hairdryer at varying speed and students must develop a way to measure and chart rotations at different wind speeds. Students evaluate the effectiveness of their anemometer and those of other teams, and present their findings to the class.	8-18
Move That Lighthouse!	Lesson focuses on how engineers have to evaluate multiple structural, economic, and environmental factors when moving a building.	8-18
Nano Waterproofing	Lesson focuses on how nanotechnology has impacted the design and engineering of many everyday items, from paint to fabrics. Students learn about the hydrophobic effect and how similar properties can be introduced by reengineering products at the nano level. Students work in teams to develop a waterproof material and compare their results with nano waterproof materials developed recently by engineers and scientists.	8-18
Networks	Young people take the Internet for granted. Through a serious of web-based explorations and kinesthetic exercises students explore the basic principles of graph theory and how it applies not only to their social connections but to how information is passed around.	11-13
Oil Spill Solutions	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 analyze an "oil spill" in the classroom, then design, build, and test a system to first contain, and then remove the oil from the water. Students select from everyday items to build their oil containment and clean-up systems, evaluate the effectiveness of their solution and those of other teams, and present their findings to the class.	8-18

Pendulum Time	Lesson focuses on how pendulums have been used to measure time and how mechanical mechanism pendulum clocks operate. Students work in teams to develop a pendulum out of everyday objects that can reliably measure time and operate at two different speeds. They will determine the materials, the optimal length of swing or size of weight to adjust speed, and then develop their designs on paper. Next, they will build and test their mechanism, compare their results with other student teams, and share observations with their class.	8-18
Pipeline Challenge	Lesson focuses on how engineers develop pipeline systems to transport oil, water, gas, and other materials over very long distances. Students work in teams of "engineers" to develop a pipeline system to transport both a golf ball and ping pong ball across the classroom terrain.	8-18
Planting with Precision	Lesson explores agricultural and engineering and challenges students to engineer a system out of everyday materials that can drop a seed every 15 cm over a 60 cm distance. Students learn about seed drills and planters and consider the impact these inventions have had on farming and agriculture over the years. Students build and test their planters, evaluate their designs and those of classmates, and share observations with their class.	8-18
Playing with Parachutes	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.	8-18
Pollution Patrol	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.	8-18
Popsicle Bridge	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. Bridges must have a span of at least 14 inches and be able to hold a five pound weight (younger students) or a twenty pound weight (older students). Students are encouraged to be frugal, and use the fewest number of popsicle sticks while still achieving their goals. Students then evaluate the effectiveness of their own bridge designs and those of other teams, and present their findings to the class.	8-18
Program Your Own Game	Lesson focuses on how software engineers design computer games and other software. Student teams work together to develop a simple computer program using free software that is available in multiple languages.	11-18
Public Keys, One Way Functions and Hard Problems	This lesson introduces two important concepts: public key encryption and one-way functions.	11-14

Pulleys and Force	Lesson focuses on the concept of force and the use of pulleys to reduce required force.	8-11
Radio Reception and Transmission	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). They review challenges encountered in the building and testing process, evaluate their results, and share observations with their class.	8-18
Recursion: Smaller Sibling Pyramids	Recursion, Iteration (Looping), and Concurrency. In the first of two sessions (at most an hour each), students are asked to calculate a simple summation by themselves, based on a procedure they are given. Then, through a guided role-playing procedure, students are asked to do the same problem by pushing a sub-problem off onto a 'little sibling'. In the second session, they use a divide-and-conquer approach to understand a simple formula for summation. During this session they also talk about the big ideas behind these three problem solving methods.	8-13
Rescue Rover	This lesson focuses on the tools and equipment used during technical rescue operations. Teams of students construct rescue devices from everyday materials. They then test their devices to determine whether they can rescue a puppy from a sewer.	8-11
Robot Basketball	This lesson demonstrates the difference between precision and accuracy. Students design a device that can shoot a basketball free-throw shot accurately every time.	10-18
Rotational Equilibrium	Demonstrate the concept of rotational equilibrium.	14-18
Rubber Band Racers	The focus of this lesson is on rubber band powered car design. Teams of students construct rubber band powered cars from everyday materials. Students must design their cars to travel in a straight line for a distance of at least 3 meters within a 1 meter wide track.	8-18
Sail Away	Lesson focuses on watercraft engineering and sailing. Students work in teams to design a sailboat out of everyday objects that can catch a breeze from a fan, stay afloat with a set load, and sail four feet.	8-18
Search Engines	Lesson focuses on exploring how the development of search engines has revolutionized Internet. Students work in teams to understand the technology behind search engines and explore how they can retrieve useful information using search engines.	8-18
Series and Parallel Circuits	Demonstrate and discuss simple circuits and the differences between parallel and serial circuit design and functions. Note: This lesson plan is designed for classroom use only, with supervision by a teacher familiar with electrical and electronic concepts.	8-14

Shake it Up with Seismographs!	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 items, and test its ability to record a simulated classroom earthquake. Students evaluate their own seismographs, those of classmate teams, and present findings to the class.	8-18
Ship the Chip	Lesson focuses on engineering package designs that meet the needs of safely shipping a product. Students work in teams of "engineers" to design a package using standard materials that will safely ship a single chip through the mail to the school address.	8-18
Shipping for Survival	Lesson focuses on how packaging engineers develop customized shipping and packaging containers to meet the needs of many different industries. Students learn about different packages that have been engineered to transport hearts for surgery, blood for analysis, and foods to retain freshness. Students then work in teams to build a container that will allow a flower to be shipped without damage and with water using everyday items. Flowers must remain fresh and not wilted for 24 hours after being sealed in the box.	8-18
Simple Kitchen Machines	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.	8-11
Simple Machines	Simple machines: their principles and uses.	8-11
Smart Buildings and the Internet of Things	This lesson explores the practical, scientific, ethical, and environmental issues that emerge in building 'smart buildings' that rely on 'the internet of things'.	11-17
Smooth Operator	This lesson focuses on surgical instrument design. Teams of students construct surgical instruments from everyday materials. They then test their surgical instruments to determine how well they can perform a simulated "surgical procedure".	8-18
Solar Structures	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. They then test their solar houses to determine how well they regulate temperature.	8-18
Solving a Simple Maze	Lesson focuses on algorithmic thinking and programming. Make the students aware of the beauty of simple algorithms and their implementation in real fun games.	14-18
Solving Problems with Decision Trees	This lesson focuses on how computing decision trees are used to specify and solve problems.	14-18
Sort it Out!	Lesson focuses on the engineering behind industrial sorting processes. Working as an engineering group, students then work in teams to design and build a system to sort different sized coins for packaging.	8-18
Sorting Socks is Algorithm Complexity	This lesson introduces some simple ideas about algorithms and their complexity through a series of exercises involving a collection of socks.	11-13

Spring Scale Engineering	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. They compare their designs with those of other student teams and reflect on the experience.	8-18
Statue Display Tower	Students design, build, test and redesign a display tower that will meet a specific set of criteria and constraints.	10-18
Sticky Engineering Challenge	Lesson focuses on how engineers work to solve problems and impact daily life through new and improved products. As engineers do, teams of students select adhesive options to help them meet a construction goal.	8-18
Stop And Go	Lesson focuses on how engineers have developed and improved traffic management over time by engineering and re-engineering the traffic light. Students work in teams to design a new traffic light system to meet the needs of a potential client. They must devise a system or technical enhancement to accommodate a busy bicycle lane and roadway that intersects a hospital emergency room entrance. As a team they devise their planned improvements, draw a design of the improved traffic signal, develop a written and verbal presentation to the client, present their designs to the class, provide feedback on other team's designs, and share observations about re-engineering.	8-18
Sugar Crystal Challenge	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.	8-14
Tall Tower Challenge	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. They develop a design on paper, build their tower, present and test their tower to the class, evaluate their results and those of their teammates, and complete reflection sheets.	8-18
Telescoping Periscope	Lesson focuses on the many uses of periscopes and how this simple device was designed and is used in many applications. Students work in teams to design and build their own working periscope out of everyday materials. They design their periscope, build and test it, evaluate their designs and those of classmates, and share observations with their class.	8-18
Temperature Tactics	Lesson focuses on how thermometers have been impacted by engineering over time, and also how materials engineering has developed temperature sensitive materials. Student teams design and build a temperature gauge out of everyday products and test a variety of materials for thermal properties. Students evaluate the effectiveness of their temperature gauge and those of other teams, and present their findings to the class.	8-14

Tennis Anyone?	Lesson focuses on sports engineering and advanced materials development. Students work in a team to devise a racquet out of everyday materials that could be used to volley a ping pong ball across a table against an opponent's racquet. Students design their racquet on paper, build the racquet, and test it against those made by other student teams. All teams evaluate their results, reflect on their design, and present to the class.	8-18
The Boat and the Beetle	This lesson further develops principles of floating and sinking to young learners.	4-7
The Phone Charger Conundrum	Student teams learn how engineers work together to develop products that are compatible with other products.	12-18
The Power of Graphene	Lesson focuses on graphene and its electrical properties and applications. Students learn about nanotechnology and how engineers can harness the differences in how materials behave when small to address challenges in many industries. 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. They observe what they see, extrapolate to broader applications, present their ideas to the class, and reflect on the experience.	8-18
Tinkering with Tops	In this lesson, students 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.	8-18
Toxic Popcorn Design Challenge	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.	8-18
Trebuchet Toss	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.	12-18
Try Your Hand at Nano	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. They observe what they see, present their findings to the class, and reflect on the experience.	8-11
Two Button Buzzer Circuit	Demonstrate how two switches interact in an electrical circuit such as that used to sound a buzzer. Note: This lesson plan is designed for classroom use only, with supervision by a teacher familiar with electrical and electronic concepts.	8-14

Using Ohm's Law to Build a Voltage Divider	Students will design, build, and characterize one of the basic circuits of electrical engineering, the voltage divider. These circuits produce a wide range of output voltages and are building blocks for more complex circuits. Circuit design will emphasize the concepts of Ohm's Law and students will explore mathematical relationships of parallel and series resistors. Students will demonstrate their design efforts by building prototype circuits and using test measurement tools to confirm their predictions.	14-18
Vector Graphics Use Functions	This lesson introduces vector graphics and functions through a collaborative design activity.	11-14
Virtual Reality and Anaglyph Stereoscopic Technology	Students will use the scientific method to study 'anaglyph' (movie 3D) technologies to model computer science design and learn how stereo images create the illusion of 3D.	11-14
Water Fountain	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.	10-18
Water Rocket Launch	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 and 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. Teams design their structure on paper, learn about aerospace engineering, launch their rocket, and share observations with their class.	8-18
Water Tower Challenge	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. The system will need to deliver water in a controlled manner to a paper cup that is about 36 inches or 90 cm away in a controlled manner. They design their tower, build and test their system, evaluate their results, and share observations with their class.	8-18
Waterproof That Roof!	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 box dry during a water test. Students determine both the shape of the roof and materials used for construction, test their designs, and present their findings to the class.	8-18
What is a Nanometer?	Lesson focuses on how to measure at the nano scale and provides students with an understanding of how small a nanometer really is."Students learn about electron microscopes, participate in hands-on activities to measure common classroom objects in the metric scale, and then convert the result to nanometers.	8-12

Wind Tunnel Testing	Lesson focuses on how watermills generate power. Student teams design and build a working watermill out of everyday products and test their design in a basin. Student watermills must be able to sustain three minutes of rotation. As an extension activity, older students may design a gear system that is powered by the watermill. Students then evaluate the effectiveness of their watermill and those of other teams, and present their findings to the class.	11-18
Working with Watermills	Lesson focuses on how wind energy can be generated on both a large and small scale. Student teams design and build a working windmill out of everyday products and learn about anemometer and site testing. Student windmills must be able to sustain the wind generated by a fan or hairdryer at medium speed at 2 feet and rotate, lifting a small object upward. Students evaluate the effectiveness of their windmill and those of other teams, and present their findings to the class.	8-18
Working with Wind Energy	Lesson focuses on wind tunnel tests that engineers in many industries use to when developing products such as airplanes, cars, and even buildings. Teams of students build their own model car out of everyday products and test their design in a wind tunnel made of a fan blowing through a long cardboard box.	8-18

IEEE PRE-UNIVERSITY EDUCATION FOUNDATIONAL LESSON PLANS

http://tryengineering.org/lesson-plans/foundations

Additionally, TryEngineering also offers a variety of lesson plans explore foundational concepts in electrical and mechanical engineering.		
Basic Alternating Current Motors	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. 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.	12-17
Basic Direct Current Generators and Motors	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 electro-magnetic field could be harnessed to other purposes. From there the lesson goes on to demonstrate how electric currents, magnetic fields and electro-magnetic fields are so closely related. A simple hands-on activity is 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.	10-14
Basic Electricity and Magnetism	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 electro-magnetic field could be harnessed to other purposes. From there the lesson goes on to demonstrate how electric currents, magnetic fields and electro-static 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.	8-18
Basic Electric Transformers	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.	14-18