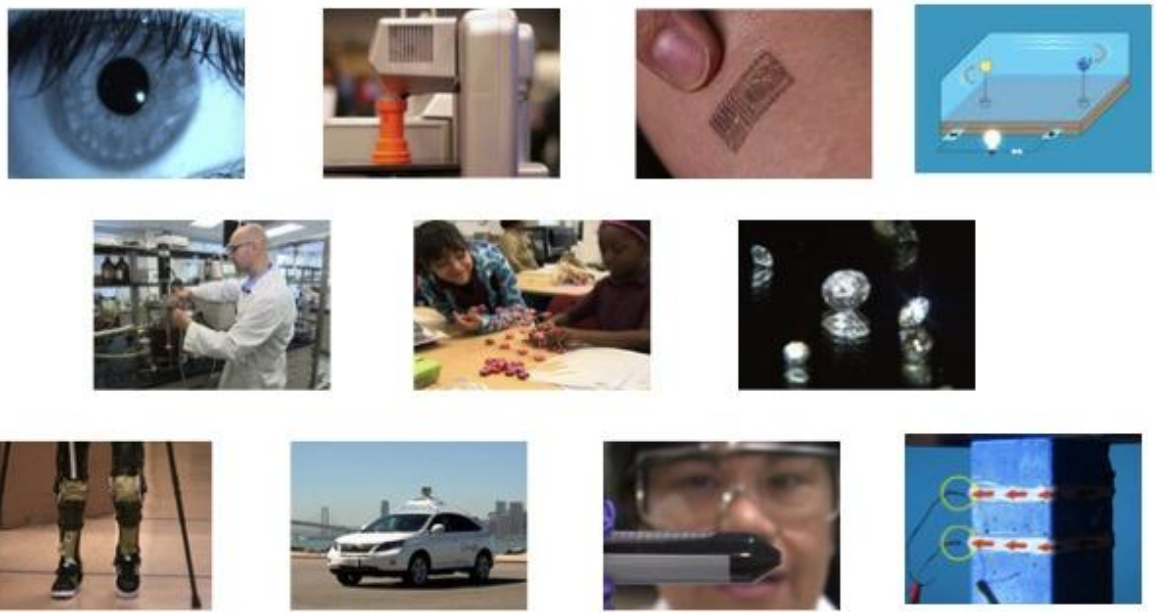
Science of Innovation Stories

Energy, Health Care, Advanced Manufacturing, Transportation, Agriculture



The Science of Innovation curricula affords the application of STEM education to intellectual property and innovation through a rich assortment of learning models that spans a variety of topic areas, including, advanced manufacturing and 3D printing through healthcare, the environment, security, and transportation solutions of the future. Students are engaged in deep learning about STEM and are encouraged through the innovation process to link the components of STEM together in order to realize innovation. The curricula involves project-based learning and the application of the science writing heuristic methods that fully engages student learning through probative questions, reflection and peer-to-peer collaboration and team-based solutions.

Science of Innovation

Overview

Science of Innovation was developed to provide the broadest application to STEM curricula. Most lessons and topics in the series can be easily integrated into current school curriculum. Lesson plans meets national K-12 standards in science and engineering education. Pick a topic of your choice below and get your students innovating with STEM today!

Connecting IP to STEM

Video	Biology	Chemistry	Physical Science	Physics	Math	Engineering Technology	IP
Innovation Overview	✓	✓	✓	✓	✓	✓	✓
Smart Concrete		✓	✓	✓	✓	✓	✓
Electronic Tattoo	✓	✓	✓	✓	✓	✓	✓
3D Printing	✓	✓	✓	✓	✓	✓	✓
Bionic Limbs	✓	✓	✓	✓	✓	✓	✓
Biometrics	✓		✓	✓	✓	✓	✓
Biofuels	✓	✓	✓			✓	✓
Synthetic Diamonds		✓	✓	✓		✓	✓
Self-Driving Cars			✓	✓	✓	✓	✓
Nano Fuel Cells	✓	✓	✓	✓	✓	✓	✓
Counterfeiting	✓	✓	✓	✓		✓	✓

3D Printing: Unlike traditional manufacturing techniques that fabricate objects by removing material from a larger block (subtractive processing), additive fabrication consists of building objects up in thin layers—one layer at a time. Students can quickly produce their own three-dimensional objects using computer software and ink-jet technology equipment—to enable the manufacture of objects that are difficult to produce with current techniques. In this activity, students investigate how to find the topography of a region of their choice, and then reconstruct it as a model of the Earth's surface.

For more details about this activity please see lesson plan links on video page

Biofuels: While sources of biofuel currently exist, such as ethanol made from corn, a new approach to producing biofuels from cellulosic biomass, using a bacterium discovered in the Chesapeake Bay, is presented in this lesson plan. Students design an experiment for use in determining the type of growing conditions for yeast that would yield the greatest amount of the by-product—carbon dioxide b using a balloon to capture the gas produced. Student results may include plans, controls, and actual data collected.

For more details about this activity please see lesson plan links on video page

Biometrics: Biometric identification, in which people can be identified by personal physical traits—such as the patterns of blood vessels in the eye's sclera, in addition to the more commonly used iris. This lesson plan discusses how computers can analyze the patterns in the eye and digitize them into a binary code, which can then be tested for a match to enable identification of individuals. Students use their hands in a simple yet fun way to develop a secret identity code, which in turn is used to find a "secret spy" agent in the classroom.

For more details about this activity please see lesson plan links on video page

Bionic Limbs: Electrically powered "exoskeletons," which attach to the body (e.g., the legs) thus allowing people who are paralyzed to "walk" again. Bionic devices and systems replicate the functions of joints and muscles, and work with the human central nervous system to help make walking possible again. Student use a mechanical dog assembly to simulate the movement and actions required to walk the dog. Some students might wish to extend their investigation by playing with the online game "QWOP". This rather challenging game uses the keyboard letters Q, W, O, and P to control the motions of a character's right and left thighs and calves, to try to run a 100-meter sprint. Students may engage in friendly competition to see who can run the farthest playing QWOP.

For more details about this activity please see lesson plan links on video page

Driverless Cars: The Google self-driving car is a type of "smart" car that uses data gathered from multiple on-board devices and the science of artificial intelligence to navigate through long stretches of open highway, curvy mountainous roads, and bustling intercity traffic. Students investigate a question about how to model the way a laser range finder or radar device works. This device is key to the collection of data for analyses that permits the car to navigate without human intervention. The activity requires students to use determine a mystery object in a box by using a series of probe measurements and then mapping the results on a 3D surface map.

For more details about this activity please see lesson plan links on video page

Electronic Tattoos: Ultra-thin, flexible, elastic membranes capable of detecting and recording electrical signals from the heart, brain, and various other muscles and organs work by simply adhering to a person's skin. These nano-membranes, which have been dubbed electronic tattoos because of their similarities to temporary tattoos, are much, much thinner than a single strand of human hair; yet include silicon-based circuitry that can be used to monitor functions inside the body. In this activity students investigate how temperature affects the flow of electricity in a simple silicon diode comprised of the same semiconductor material used to build the electronic tattoo prototype.

For more details about this activity please see lesson plan links on video page

Micro Fuel Cells: Cellular-level probes and biofuel cells are used in this invention to produce a fuel cell that is 100 times more efficient than existing fuel cells. By placing carbon nanotubes on a cell surface using an electric field technique known as electrophoresis, scientists can now monitor electrical functions at the cellular level. When combined with enzymes to drive the flow of glucose, a very efficient biofuel cell is produced. In this activity, students explore how the amount of chemical energy in food dictates the amount of work that can be done. Students compare the conversion of the chemical energy to thermal energy by burning foods and measuring the rise in temperature of water in the can.

For more details about this activity please see lesson plan links on video page

Smart Concrete: A new type of concrete, dubbed smart concrete, which is composed not only of the basic ingredients of any concrete—water, a cement binder, and gravel—but also carbon fibers. These fibers easily conduct electricity and can be used to measure conductivity across a block of the smart concrete. Changes in its resistivity might indicate the presence of minute cracks or other types of deformation in concrete structures long before they are visible to the naked eye. In this activity students create cylinders from different batches of plaster of Paris that use the same amount of powder but different volumes of water or other materials such as fine sand, gravel, wood chips or shredded paper. Students use a vise or car jack to exert force on their blocks to detect the forces leading to cracks.

For more details about this activity please see lesson plan links on video page

Synthetic Diamonds: Diamonds, both natural and synthetic, have valuable science and engineering applications that result from their hardness, durability, chemical inertness, and ability to withstand change when exposed to very high temperatures and pressures. A new method is invented that produces larger synthetic diamonds than those that have been produced using other methods of fabrication. In this activity, students investigate the multitude of applications that nano-diamond materials have ranging from medical applications to their use as a cosmetic additive.

For more details about this activity please see lesson plan links on video page