Verizon App Challenge

What is the challenge?

The app challenge, part of Verizon Innovative Learning, is a nationwide contest in which middle and high school students are challenged to develop concepts for mobile apps that solve a problem in their community. It's a unique, hands-on activity that teaches collaboration, critical thinking, problem solving, and entrepreneurship, as well as STEM (science, technology, engineering, and math) skills and coding. It builds on students' excitement about technology and aims to equip them with skills they need to succeed in the jobs of the future.

How does the app challenge build skills for jobs of the future?

There is broad consensus that for students to succeed in the jobs of tomorrow, they will need skills such as collaboration, critical thinking, creative problem solving, and more. The app challenge is a hands-on project that:

- Builds teamwork: Teams of five to seven students work together to identify a problem, assign roles and responsibilities, and create an innovative solution. Team members hold each other accountable for their responsibilities. Students present their solution as a team.
- Teaches critical thinking: Students use research and analysis skills, as well as STEM knowledge, in identifying problems and devising their solutions.
- Builds character: By searching for problems that need solutions, students practice empathy.

Standards

Science	Math	Engineering
SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. **SCSh3.** Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry	**MGSE7.SP.8b** Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event. **MGSE7.SP.8c** Explain ways to set up a simulation and use the simulation to generate frequencies for compound events.	**ENGR-FET5 – Students will describe the essential systems and processes involved with invention, innovation, and entrepreneurship.** a. Explain the problem solving processes used by engineers, designers, and other technologists. b. Demonstrate creative approaches to problem solving. c. Create a solution to a given problem. d. Test and evaluate a problem solution. e. Implement a problem solution. f. Develop marketing materials associated with a problem solution.

Future Cities Competition

What is the challenge?

Future City starts with a question—how can we make the world a better place? To answer it, 6th, 7th, and 8th grade students imagine, research, design, and build cities of the future that showcase their solution to a citywide sustainability issue. Past topics include storm water management, urban agriculture, and green energy. The 2016-2017 topic is the Power of Public Space. Students present their solutions via a virtual city design (using SimCity); a 1,500-word city essay; a scale model; a project plan, and a presentation to judges at Regional Competitions in January. Regional winners represent their region at the National Finals in Washington, DC in February. After the competition is over, student participants are not only prepared to be citizens of today's complex and technical world, they are poised to become the drivers of tomorrow.

How does the app challenge build skills for jobs of the future?

This flexible, cross-curricular educational program gives students an opportunity to do the things that engineers do—identify problems; brainstorm ideas; design solutions; test, retest and build; and share their results. This process is called the engineering design process. With this at its center, Future City is an engaging way to build students' 21st century skills. Students participating in Future City:

- Apply math and science concepts to real-world issues
- Develop writing, public speaking, problem solving, and time management skills
- Research and propose solutions to engineering challenges
- Discover different types of engineering and explore careers options
- Learn how their communities work and become better citizens
- Develop strong time management and project management skills

Science	Math	Engineering
SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. **SCSh3.** Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry	**MGSE7.G.1** Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. **Reason quantitatively and use units to solve problems.** of measure (linear, area, capacity, rates, and time) as a way to understand problems: a. Identify, use, and record appropriate units of measure within context, within data displays, and on graphs; b. Convert units and rates using dimensional analysis (English-to-English and Metric-to-Metric without conversion factor provided and between English and Metric with conversion factor); c. Use units within multi-step problems and formulas; interpret units of input and resulting units of output.	**ENGR-FET5 – Students will describe the essential systems and processes involved with invention, innovation, and entrepreneurship.** a. Explain the problem solving processes used by engineers, designers, and other technologists. b. Demonstrate creative approaches to problem solving. c. Create a solution to a given problem. d. Test and evaluate a problem solution. e. Implement a problem solution. f. Develop marketing materials associated with a problem solution. **ENGR-FET6 – Students will use visual and verbal communication to express basic design elements.** a. Demonstrate fundamentals of technical sketching. b. Present a technical design using computer generated visuals.

Fly High Rocket

What is the challenge?

Students will use the Engineering Design Process to design, test, and improve stomp rockets while exploring Newton's Laws of Motion and Universal Gravitation through projectile motion. Students will test and improve distance and accuracy of each prototype. The end result is to accurately high the targets at 5, 10 and 15 meters.

How does the project build skills for jobs of the future?

This project will build students understanding and ability to use the Engineering Design Process. They will improve critical math and science skills while learning to work collaboratively as a team. These skills will be essential to being successful in various 21st century career. For example, accurate prediction of the movement of an object is fundamental to many engineering products. In addition, the intenerate cycle of building, testing, and redesigning is crucial to most innovations and to the success of many industries.

Science	Math	Engineering
SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. SCSh3. Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. SCSh8. Students will understand important features of the process of scientific inquiry **SPS7.** Students will relate transformations and flow of energy within a system. **SPS8.** Students will determine relationships among force, mass, and motion.	Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. **Reason quantitatively and use units to solve problems.** its of measure (linear, area, capacity, rates, and time) as a way to understand problems: a. Identify, use, and record appropriate units of measure within context, within data displays, and on graphs; b. Convert units and rates using dimensional analysis (English-to-English and Metric-to-Metric without conversion factor provided and between English and Metric with conversion factor); c. Use units within multi-step problems and formulas; interpret units of input and resulting units of output.	**ENGR-FET4 – Students will apply mathematics and science to the solution of a technological problem.** a. Construct a mathematical model for a known technological system. c. Explain the scientific principles behind a basic machine. **ENGR-FET5 – Students will describe the essential systems and processes involved with invention, innovation, and entrepreneurship.** a. Explain the problem solving processes used by engineers, designers, and other technologists. b. Demonstrate creative approaches to problem solving. c. Create a solution to a given problem. d. Test and evaluate a problem solution. e. Implement a problem solution. f. Develop marketing materials associated with a problem solution. **ENGR-FET6 – Students will use visual and verbal communication to express basic design elements.** a. Demonstrate fundamentals of technical sketching. b. Present a technical design using computer generated visuals.

FLL Robotics Competition

What is the challenge?

Tomorrow's innovators practice imaginative thinking and teamwork. Guided by two or more adult Coaches, *FIRST* LEGO League* teams (up to 10 members, grades 4-8**) research a real-world problem such as food safety, recycling, energy, etc., and are challenged to develop a solution. They also must design, build, program a robot using LEGO MINDSTORMS®, then compete on a table-top playing field.

For ANIMAL ALLIES, think of people and animals as allies in the quest to make life better for everyone. Sometimes people help animals and sometimes animals help people. Your Project mission this season is to make our interactions with animals better – hopefully better for all of us.

How does the project build skills for jobs of the future?

Participants in the First LEGO competition allows to students to:

- Research challenges facing today's scientists
- Design, build, test and program robots using LEGO® MINDSTORMS® technology
- Apply real-world math and science concepts
- Learn critical thinking, team-building, and presentation skills
- Participate in tournaments and celebrations
- Understand and practice Gracious Professionalism®

Science	Math	Engineering
SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science. **SCSh3**. Students will identify and investigate problems scientifically. SCSh6. Students will communicate scientific investigations and information clearly. **SCSh7**. Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry **SPS7.** Students will relate transformations and flow of energy within a system (through investigation of robotic sensors work). **SPS8.** Students will determine relationships among force, mass, and motion (robot's movement and use of simple machines)	**MGSE9-12.F.IF.4** Using tables, graphs, and verbal descriptions, interpret the key characteristics of a function which models the relationship between two quantities. Sketch a graph showing key features including: intercepts; interval where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; Reason quantitatively and use units to solve problems. **MGSE9-12.N.Q.1** Use units of measure (linear, area, capacity, rates, and time) as a way to understand problems: a. Identify, use, and record appropriate units of measure within context, within data displays, and on graphs; b. Convert units and rates using dimensional analysis (English-to-English and Metric-to-Metric without conversion factor provided and between English and Metric with conversion factor); c. Use units within multi-step problems and formulas; interpret units of input and resulting units of output.	**ENGR-STEM1** – Students will recognize the systems, components, and processes of a technological system. a. Describe the core concepts of technology. b. Identify the relationships among technologies along with connections to contemporary issues. c. Apply lifelong learning strategies necessary to understand the characteristics and scope of technology. **ENGR-STEM4** – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems. a. Work cooperatively in multi-disciplinary teams. b. Apply knowledge of mathematics, science, and engineering design. c. Demonstrate strategies for identifying, formulating, and solving technological problems. d. Demonstrate techniques, skills, and knowledge necessary to use and maintain technological products and systems.

NFPA Fluid Power Challenge

What is the challenge?

The Fluid Power Challenge is a series of math and science competitions designed to connect today's students to tomorrow's fluid power careers. The competition challenges middle school students to solve an engineering problem using fluid power. Students work in teams to design and build a fluid power machine, and then compete with other teams in a timed competition! The Challenge gives kids experience in hands-on learning, teamwork, problem-solving and perseverance. The Challenge is designed to encourage students to consider engineering as a career field. A scaled drawing of the prototype design and presentation of prototype is also required.

How does the project build skills for jobs of the future?

The Fluid Power Challenge fosters the development of the following 21st century skills:

- Apply real-world math and science concepts to a fluid power machine
- Learn critical thinking, team-building, and presentation skills
- Utilize the Engineering Design Process to design, create, and test a fluid-powered machine capable to moving object from one designated area to another designated area.

Science	Math	Engineering
SCSh3. Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry **SPS7.** Students will relate transformations and flow of energy within a system. **SPS8.** Students will determine relationships among force, mass, and motion.	**Reason quantitatively and use units to solve problems.** its of measure (linear, area, capacity, rates, and time) as a way to understand problems: a. Identify, use, and record appropriate units of measure within context, within data displays, and on graphs; b. Convert units and rates using dimensional analysis (English-to-English and Metric-to-Metric without conversion factor provided and between English and Metric with conversion factor); c. Use units within multi-step problems and formulas; interpret units of input and resulting units of output.	**ENGR-FET4 – Students will apply mathematics and science to the solution of a technological problem.** c. Explain the scientific principles behind a basic machine. **ENGR-STEM4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.** a. Work cooperatively in multi-disciplinary teams. b. Apply knowledge of mathematics, science, and engineering design. c. Demonstrate strategies for identifying, formulating, and solving technological problems. d. Demonstrate techniques, skills, and knowledge necessary to use and maintain technological products and systems.

Roller Coaster Design and Build

What is the challenge?

Students will utilize understanding of Newtonian physics principles to create a model of a gravity-powered roller coaster capable of allowing a marble "cart" to successfully complete a run with the following design element requirements: a strong framework, track must be at least two meters in length, footprint of no more than 18" x 28", height of no more than one meter above the design board, begins with a hill, a 360^0 loop, a place where the marble rolls up and over a hill, three changes of direction (i.e. curves), a funnel, a structure to catch the marble at the end, and overall theme with color added to structure Physics considerations (energy transformations, speed, and acceleration) and cost efficiency (via budget constraints) are linked to the design challenge. A scaled drawing of the prototype design and presentation including video of a successful run of prototype is also required.

How does the project build skills for jobs of the future?

The Roller Coaster Challenge fosters the development of the following 21st century skills:

- Apply real-world math and science concepts to the development of a roller coaster
- Learn critical thinking, team-building, multimedia, and presentation skills
- Utilize the Engineering Design Process to design, create, and test the roller coaster design
- Learn to work within a budget design constraint
- Create a scaled drawing of a project

Science	Math	Engineering
SCSh3. Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry **SPS7.** Students will relate transformations and flow of energy within a system. **SPS8.** Students will determine relationships among force, mass, and motion.	**MGSE9-12.A.CED.1** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear, quadratic, simple rational, and exponential functions (integer inputs only). **MGSE9-12.A.CED.2** Create linear, quadratic, and exponential equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (The phrase "in two or more variables" refers to formulas like the compound interest formula, in which $A = P(1 + r/n)^{nt}$ has multiple variables.) **MGSE9-12.A.CED.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret data points as possible (i.e. a solution) or not possible (i.e. a non-solution) under the established constraints.	**ENGR-FET4 – Students will apply mathematics and science to the solution of a technological problem.** c. Explain the scientific principles behind a basic machine. **ENGR-FET6 – Students will use visual and verbal communication to express basic design elements.** a. Demonstrate fundamentals of technical sketching. b. Present a technical design using computer generated visuals. **ENGR-STEM3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.** a. Demonstrate fundamental principles of design. b. Design and conduct experiments along with analysis and interpretation of data. c. Identify and consider realistic constraints relevant to the design of a system, component, or process.

Solar Oven Design Challenge

What is the challenge?

Students will design, create, and test a solar oven with the following criteria: the interior temperature of the oven must increase 20^0 C within ten minutes of being placed in the sun, the interior must have two distinct level of cooking, the sides, top, and bottom cannot be used for cooking, and the oven must be made from recycled materials. The thermal dynamic concepts must be used to explain how the oven works. The prototype must be capable of roasting marshmallows which, in turn, will be used to make s'mores. Students will consider manufacturing costs, will determine practical uses for the oven, and will design an advertising campaign to sell the solar ovens.

How does the project build skills for jobs of the future?

The Solar Oven Challenge fosters the development of the following 21st century skills:

- Apply real-world math and science concepts to create a solar oven prototype
- Learn critical thinking, team-building, and presentation skills
- Utilize the Engineering Design Process to design, create, and test the solar oven design
- Develop commercial aspects of the solar oven including manufacturing costs and advertising possibilities.

Science	Math	Engineering
SCSh3. Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry **SPS7.** Students will relate transformations and flow of energy within a system.	**MGSE9-12.A.CED.1** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear, quadratic, simple rational, and exponential functions (integer inputs only). **MGSE9-12.A.CED.2** Create linear, quadratic, and exponential equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (The phrase "in two or more variables" refers to formulas like the compound interest formula, in which $A = P(1 + r/n)^{nt}$ has multiple variables.) **MGSE9-12.A.CED.3** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret data points as possible (i.e. a solution) or not possible (i.e. a non-solution) under the established constraints.	**ENGR-FET4 – Students will apply mathematics and science to the solution of a technological problem.** c. Explain the scientific principles behind a basic machine. **ENGR-FET6 – Students will use visual and verbal communication to express basic design elements.** c. Demonstrate fundamentals of technical sketching. d. Present a technical design using computer generated visuals. **ENGR-STEM3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.** a. Demonstrate fundamental principles of design. b. Design and conduct experiments along with analysis and interpretation of data. c. Identify and consider realistic constraints relevant to the design of a system, component, or process.

Business Circuit Project

What is the challenge?

Students investigate their "dream" career including training or educational background required to launch a successful career. Next students consider the type of building environment they will need to conduct their business. Students design the building, focusing on the electrical outlay needed to run the various pieces of equipment that will be required during the day-to-day operations of their business. Lastly students will create a working prototype model and electrical diagram schematics for their businesses

How does the project build skills for jobs of the future?

The Business Circuit Challenge fosters the development of the following 21st century skills:

- Apply real-world math and science concepts to a whole house electrical circuit
- Learn critical thinking, team-building, and presentation skills
- Utilize the Engineering Design Process to design, create, and test the electric layout design for dream career
- Create an electric schematic drawing.

Science	Math	Engineering
SCSh3. Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry **SPS10**. Students will investigate the properties of electricity and magnetism.	**MGSE7.G.1** Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	**ENGR-FET1 – Students will describe the career pathways that are encompassed by Georgia Engineering and Technology Education.** a. Identify potential career opportunities related to engineering and technology. b. Explain the educational requirements and professional expectations associated with a chosen technological career path. **ENGR-STEM3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.** a. Demonstrate fundamental principles of design. b. Design and conduct experiments along with analysis and interpretation of data. **ENGR-FET4 – Students will apply mathematics and science to the solution of a technological problem.** c. Explain the scientific principles behind a basic machine. **ENGR-STEM4 – Students will apply principles of science, technology, engineering, mathematics, interpersonal communication, and teamwork to the solution of technological problems.** a. Work cooperatively in multi-disciplinary teams. b. Apply knowledge of mathematics, science, and engineering design.

Cooper Hydroponics Garden

What is the challenge?

Working in assigned teams, design and make an inexpensive, compact, portable, working hydroponic gardening system that can be conveniently used on your window sill or countertop to grow mesclun (lettuce), radishes, basil, or another quick growing, edible plants. Make your system aesthetically appealing since it will be highly visible for a long period of time. The produce from the garden will be donated to the local food bank.

How does the project build skills for jobs of the future?

The Cooper Hydroponics Garden fosters the development of the following 21st century skills:

- Apply real-world math and science concepts to the development of a hydroponics garden
- Learn critical thinking, team-building, and presentation skills
- Utilize the Engineering Design Process to design, create, and test the hydroponics garden
- Create an electric schematic drawing.

Science	Math	Engineering
SCSh3. Students will identify and investigate problems scientifically. **SCSh6.** Students will communicate scientific investigations and information clearly. **SCSh7.** Students will analyze how scientific knowledge is developed. **SCSh8**. Students will understand important features of the process of scientific inquiry **SPS8**. Students will determine relationships among force, mass, and motion.	**MGSE9-12.S.ID.6c** Using given or collected bivariate data, fit a linear function for a scatter plot that suggests a linear association. **MGSE9-12.S.ID.1** Represent data with plots on the real number line (dot plots, histograms, and box plots). **MGSE9-12.S.ID.2** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, mean absolute deviation, standard deviation) of two or more different data sets.	**ENGR-STEM3 – Students will design technological problem solutions using scientific investigation, analysis and interpretation of data, innovation, invention, and fabrication while considering economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability constraints.** a. Demonstrate fundamental principles of design. b. Design and conduct experiments along with analysis and interpretation of data. c. Identify and consider realistic constraints relevant to the design of a system, component, or process. **ENGR-FET6 – Students will use visual and verbal communication to express basic design elements.** a. Demonstrate fundamentals of technical sketching. (a) Present a technical design using computer generated visuals.