

Summer Workshops STEM EDUCATION // PK-12

Attention K-12 Educators! The Center is excited to be offering the following professional development opportunities to teachers this July and August at The College of New Jersey. If you joined us last summer, we have many new experiences for you to sign up for this year. If you are new, please look closely through all titles and descriptions, and reach out if you have any questions. Workshops in high demand may be duplicated and added as additional sessions. More complete information about each workshop, and registration guidelines can be found by clicking on the links after each description.

<http://centerforstem.pages.tcnj.edu/summer-pd-workshops/>

Session Titles Listing (Mixed K-12)

Intro to Elementary Engineering for NGSS, PK-5

iSTEM for NGSS, Grades PK-2

iSTEM for NGSS, Grades 3-5

Next Steps for NGSS, PreK-5

Genius Hour for Elementary (Grades K-5)

How to Start a STEM Class/Makerspace for Middle/High School

EbD Grade K: A Home for All Seasons

EbD Grade 1: Agriculture Around Us

EbD Grade 2: Our Environment, Our Health

EbD Grade 3: Every Drop Matters

EbD Grade 4: The Power of Solar

EbD Grade 5: Community Connections

Intro to 3D Printers, Laser Cutters and CAD Applications, Grades K-12

Mousetrap Cars & Rat-trap Boat Design Challenges, Grades 5-12

Robotic Arm Control System Design Challenge, Grades 6-12

Mag-Lev Egg Crashing CO2 Powered Vehicles, Grades 6-12

Intro to ARDUINO: Programmable Control Systems, Grades 4-12

Hydroponic & Aquaponic Farming Systems, Grades PK-12

Intro to Electricity, Circuits and Alternative Energy, Grades K-12

Intro to Elementary Engineering for NGSS, PK-5

Session A - July 8 // Session B - July 22

In this introductory workshop, teachers from PK-5 will be introduced to the concepts and skills associated with the addition of “Engineering & Technology” core disciplinary ideas in Science on the Next Generation Science Standards (NGSS). Educators will engage with model lessons, scientific language, and instructional materials that they can turnkey in their classrooms to address NGSS, and the daily connections with The Arts, Social Studies, Math and Language Arts Literacy. Every teacher will receive a free copy of the read aloud – *The Most Magnificent Thing* – a fun way to introduce the elementary students to the *engineering habits of mind*.

Session A

<http://events.constantcontact.com/register/event?llr=hfitem6fab&oeidk=a07ech3pfk5d482ebcb>

Session B

<http://events.constantcontact.com/register/event?llr=hfitem6fab&oeidk=a07ech3rnsp71438c92>

iSTEM for NGSS, Grades PK-2

July 11-13 :

Are you implementing the NGSS (Next Generation Science Standards) in your Grades PK- 2 classroom? Are you Starting an Elementary STEM class or makerspace? Do you want to brush up on basic science principles? In this 3-Day experience, participants will explore engineering design challenges for Earth & Space, Life, and Physical Science, dealing with primary level concepts relevant to younger learners, blending the practices of science and engineering based on NGSS. The Focus of these days will be on Grades PK-2 best practices for design-based pedagogy, instructional and assessment materials linking Social Studies, Math and Language Arts Literacy to the NGSS. Activities will include the integration of literature and real-world connections for instruction, creating a classroom “Maker” environment, tips for unit/lesson planning, and hands on experiences with practical programs and tools for developing meaningful iSTEM experiences for students in the fall and throughout next year!

Prerequisite: (Any one of the following)

- “Intro to Elementary Engineering & NGSS Grades PK-5” (held this summer);
- any of the EbD TEEMS Trainings;
- an equivalent TCNJ/ iSTEM PD experience (check with the Center for permissions)

<http://events.constantcontact.com/register/event?llr=hfitem6fab&oeidk=a07ecjdnpsb4933bf3e>

iSTEM for NGSS, Grades 3-5

July 25-27

Are you implementing the NGSS (Next Generation Science Standards) in your Grades 3-5 classroom? Are you Starting an Elementary STEM class or makerspace? Do you want to brush up on basic science principles? In this 3-Day experience, participants will explore engineering design challenges for Earth & Space, Life, and Physical Science, dealing with primary level concepts relevant to younger learners, blending the practices of science and engineering based on NGSS. The Focus of these days will be on Grades 3-5 best practices for design-based pedagogy, instructional and assessment materials linking Social Studies, Math and Language Arts Literacy to the NGSS. Activities will include the integration of literature and real-world connections for instruction, creating a classroom “Maker” environment, tips for unit/lesson planning, and hands on experiences with practical programs for developing meaningful iSTEM experiences.

Prerequisite: Any one of the following:

- “Intro to Elementary Engineering & NGSS Grades PK-5” (held this summer);
- any of the EbD TEEMS Trainings;
- an equivalent TCNJ/ iSTEM PD experience (check with the Center for permission)

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ecgn1fn2b3fdab00>

Next Steps for NGSS, PreK-5

July 7

In this 1-Day experience, participants will be introduced to new resources (updated from last summer’s PD sessions) and best practices for implementing the NGSS in PK-5 classrooms and *makerspace* environments such as the multimedia center. Participants are encouraged to bring along any curriculum and/or instructional materials they are piloting or developing - including a favorite content theme, piece of literature or picture book - in order to further refine those units and materials with grade level peers under the guidance of the instructor. Hands on experiences will include a refresher on the three dimensions of NGSS, as well as new programs and tools to broaden classroom applications. Collaborate with like minded educators and instructors that having been working with pilot teachers out in the field to gain a greater command of NGSS and strengthen your curriculum!

Prerequisite (any of the following)

- *Any of the EbD TEEMS K-5 Unit trainings held at TCNJ or on site at your school over the last few years*
- *Intro to PK-5 Elementary Engineering for NGSS (held Summer 2015)*
- *An equivalent experience in PD to one of the above; or, check with the Center for permission on an individual basis.*

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ecgmz5l012d36aee>

Genius Hour for Elementary (Grades K-5)

July 29

Are you ready to create a geniuses in your classroom? How about getting Started with Genius Hour? Genius hour is a student driven, research based time that allows students to explore their own passions and encourages creativity while promoting the NGSS Engineering Performance Expectations in your classroom. Genius Hour can be used with students of all grade levels and abilities, and can be used to lay the foundation for a new science fair, an *Invention Convention*, or *Passion Project!* It is also an excellent way to incorporate 3-D learning as students explore their passions. Classrooms can use the traditional method of using interactive engineering notebooks, as well as digital use of GAFE. Real K-5 teachers who have been implementing Genius Hour with their students will share their experiences from the field, as well as practical tips to help you get started. By attending this workshop you will be able to:

- Understand the Genius Hour concept
- Implement GH in the classroom this fall
- Have a digital bank of NGSS aligned resources
- Create classroom expectations
- Turnkey Lesson Plans w/ Standards
- Integrate Google Classroom with GH
- Set Up Student Blogs

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ecjdiueg3b99bf7d>

How to Start a STEM Class/Makerspace for Middle/High School

July 11-15

Do you have the task of starting a STEM class (e.g., full-half year course, elective, or club) or *Makerspace* at the middle or high school level? Are you Science teacher looking to integrate Engineering practices and Core Disciplinary Ideas from NGSS into your classroom? Teachers from various content areas (including media specialists) will receive an introduction to design-based pedagogy and necessary skills for facilitating a safe and effective project based, 21st Century Learning Environment aligned to Next Generation Science Standards. Participants leave with sample curriculum outlines and strategies for adaptation within their own school(s); as well as sample instructional, curricular and assessment materials. An integrative STEM course, club and/or elective is an excellent way to acquaint all students to the engineering practices and other conceptual shifts that they will begin to encounter in science, as well as other content areas Grades 6-12. If you are running a makerspace, you'll certainly need to introduce students to a sequence of activities before they can use the space autonomously! Each participant will be issued a certificate for 30 hours of PD. Major topics addressed through hands-on, constructivist experience and group reflections:

| <u>Major Topics & Lessons</u> | <u>Design Challenges/Activities Covered</u> |
|---|---|
| <ul style="list-style-type: none"> • Engineering Design Process • Facilities/Safety • 2D/3D Sketching and Drawing • Tools/Machines/Processes • 3D Modeling • Color Theory • Creativity, Invention and Innovation • Alignment to NGSS and Common Core • Engineering Core Disciplinary Ideas • Formative Assessments, Portfolios and Engineering Notebooks • Co-curriculars Events and Competitions, TSA Club, Robotics Clubs • Budgeting, Vendors, Donations, Grants • Nature of Technology, Human Impacts, Systems, Product Life Cycle • Areas of Designed World: Construction, Manufacturing, Transportation, Communication/Information, Biotechnology, Power & Energy | <ul style="list-style-type: none"> • Engineering/Process Drawings • Morphologic Charts/Brainstorming • Innovative Device Stand/ Shark Tank • Marble Maze Challenge / Paper Engineering • Foam Sculpture/Form vs. Function • Rube Goldberg/Simple Machines • Earth-Friendly Greeting Cards/Structures and Mechanisms • Socially Responsible Device/Fun Theory/Nudging • Recycled LED Light Source/Electricity & Circuits • Mousetrap Car • Magnetic Levitation Breaking & Control Systems |

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ecjdkc1kfb4457aa>

EbD Grade K: A Home for All Seasons

July 14-15

Engages young learners in hands-on inquiry and design as they explore animal homes. Scientific inquiry and technological design are purposefully used as learning approaches in order to develop students' STEM literacy and higher level thinking skills. Literacy strategies are integrated throughout lessons to support the development of reading, writing, and speaking skills. Core math concepts and skills of numbers and quantities, measurement, and shapes are reinforced through opportunities for application within meaningful STEM contexts.

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ech2obxna80a16b9>

EbD Grade 1: Agriculture Around Us

July 18-19

Develops students' understanding of green technologies, matter, earth materials, and the importance of managing the Earth's land. Scientific inquiry and technological design are purposefully used as learning approaches in order to develop students' STEM literacy and higher level thinking skills. Literacy strategies are integrated throughout lessons to support the development of reading, writing, and speaking skills. Core first grade math concepts and skills of fractions, measuring volume, recording data, and graphing data are reinforced through opportunities for application within meaningful STEM contexts.

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ech3fsj4d39083a6>

EbD Grade 2: Our Environment, Our Health

July 20-21

Utilizes a collaborative approach to explore our dependence on fossil fuels as a global issue, and to recognize that stewardship and innovation can make a difference in solving the world's problems. Scientific inquiry and technological design are purposefully used as learning approaches in order to develop students' STEM literacy and higher level thinking skills. Literacy strategies are integrated throughout lessons to support the development of reading, writing, and speaking skills. Core second grade science and mathematics concepts include pollution, matter, fossil fuels, natural resources, place value, length, recording data, and graphing data are reinforced through opportunities for application within meaningful STEM contexts.

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ech3ft4vb020f781>

EbD Grade 3: Every Drop Matters

August 1-2

Develops students' understanding of green technologies, matter, earth materials, and the importance of water conservation. Scientific inquiry and technological design are purposefully used as learning approaches in order to develop students' STEM literacy and higher level thinking skills. Literacy strategies are integrated throughout lessons to support the development of reading, writing, and speaking skills. Core third grade math concepts and skills of fractions, measuring volume, recording data, and graphing data are reinforced through opportunities for application within meaningful STEM contexts.

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ech3gobk6a4466f6>

EbD Grade 4: The Power of Solar

August 3-4

Develops students' understanding of energy systems and related technologies, temperature, electricity, and sustainable sources of energy. Scientific inquiry and technological design are purposefully used as learning approaches in order to develop students' STEM literacy and higher level thinking skills. Literacy strategies are integrated throughout lessons to support the development of reading, writing, and speaking skills. Core fourth grade math concepts and skills of decimals, perimeter, area, angles, points, lines, rays, and symmetry are reinforced through opportunities for application within meaningful STEM contexts.

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ech3hkjg30499ea1>

EbD Grade 5: Community Connections

August 8-9

Develops students' understanding of transportation and communication technologies, basic principles of motion, human impact on the natural world, and sustainable use of land. Scientific inquiry and technological design are purposefully used as learning approaches in order to develop students' STEM literacy and higher level thinking skills. Literacy strategies are integrated throughout lessons to support the development of reading, writing, and speaking skills. Core fifth grade math concepts and skills of converting of units in the metric system, plotting coordinates, and measures of center within statistics are reinforced through opportunities for application within meaningful STEM contexts.

<http://events.constantcontact.com/register/event?llr=hfem6fab&oeidk=a07ech3k7zw254e9afd>

Additional Sessions for STEM / NGSS / Makerspace:

*The following workshops have been designed to support a wide range of teachers and educators seeking an immersive, hands-on experience in a specific area of Science & Engineering, including multiple lessons and activities (design challenges) that can be integrated into Science classrooms, STEM courses and/or Makerspace environments. Sessions vary in length, and may be grade-level specific, though all will address specific performance expectations, core disciplinary ideas and S/E practices from the Next Generation Science Standards. *Also perfect for anyone who completed the 5-Day “How to Start a STEM Course” workshop in a previous year!*

Intro to 3D Printers, Laser Cutters and CAD Applications, Grades K-12

July 25-27

In this session, participants will learn to develop 2D and 3D models using CAD (computer aided design) applications - such as Sketchup, TinkerCAD, and ProEngineer - and CAM (computer aided manufacturing) equipment with rapid prototyping applications, including 3D plastic printers and laser cutters/engravers. This session will be held in the School of Engineering’s 3D studios, where participants will learn how to use the software and equipment from the ground up, starting with introductory lessons on the computers and various pieces of equipment, before working in teams on real-world design challenges to create, prototype, test and redesign their 3D solutions.

<http://events.constantcontact.com/register/event?llr=hftem6fab&oeidk=a07ecjdp4d9c956dd84>

Intro to ARDUINO: Programmable Control Systems, Grades 4-12

July 28

ARDUINO is a popular programmable control module with infinite applications for makerspace projects, coding and computer science units, and electronics or robotics activities. In this session, participants will receive their own ARDUINO unit and engage in foundational lessons related to programmable control systems that can be turn-keyed back at their schools. Experiments with various input sensors, programmable code, and output mechanisms will culminate in an Engineering design challenge at the end of the session, requiring participants to solve a problem through the automation of a simple process communicating information with LED light signals.

<http://events.constantcontact.com/register/event?llr=hftem6fab&oeidk=a07ecjdp4f9aafdea65>

Mousetrap Cars & Rat-trap Boat Design Challenges, Grades 5-12

August 1

Mousetrap car kits have been around for a long time, but constructing one of these kits requires little design and engineering skill, unless presented within the context of a real-world challenge. The premise becomes a lot more fun once students are required to innovate those kits by designing a custom vehicle with the goal of producing the greatest speed or torque, allowing teachers to use this activity as a way to engage students in the practices of science and engineering within Engineering and Physical Science Core

Disciplinary Ideas from Next Generation Science Standards, especially in middle and high school, where the activity is also being used in co-curricular clubs and team-based activities. In this session, participants will gain the first-hand experiences and resources they need to successfully orchestrate this PBL with students, even when the stakes are raised, and the challenge moves from land to water, as they design and test mousetrap boats - or the larger rattrap boat, through an iterative process that students will never forget!

<http://events.constantcontact.com/register/event?llr=hfitem6fab&oeidk=a07ecjdp4h5d3051cab>

Robotic Arm Control System Design Challenge, Grades 6-12

August 2

In this session, participants will learn about levers and linkages, structures and mechanisms, hydraulic and pneumatic control systems, before synthesizing their knowledge and skills to create an articulating robotic arm as part of an engineering design challenge fusing core disciplinary ideas from Earth & Space science, Physical science and Engineering. Learn how to upgrade this project-based learning activity to a problem-based iSTEM unit, as well as variations of the challenge that can be used to address different content areas and grade levels. Whether you are constrained by a shoestring budget and restricted to cardboard donations, or you are seeking to integrate this challenge with your 3D printer and classroom laser cutter, this session will give you the first-hand experience you need to successfully facilitate the design challenge back in your own classroom, taking students through the practices of science and engineering, while providing an opportunity to assess bundles of performance expectations from NGSS.

<http://events.constantcontact.com/register/event?llr=hfitem6fab&oeidk=a07ecjdp4mga207fd6f>

Mag-Lev Egg Crashing CO2 Powered Vehicles, Grades 6-12

August 3

Looking for a massively engaging, affordable design challenge for teaching motion, energy and matter? Are you a science teacher that must address the Engineering and Physical Science performance expectations for grades 6-8, or 9-12? Participants in this workshop will start the session with an introduction to the Co2 Powered, Magnetic Levitation Egg Crashing Vehicle design challenge, requiring them to engage in the practices of science and engineering to develop transportation safety systems on a vehicle which will be shot into a brick wall in a high speed collision! Participants will experience model lessons on forces, Newton's laws, and various types of safety system and packaging designs before being thrust into the process of creating and optimizing their vehicles using evidence-based calculations.

<http://events.constantcontact.com/register/event?llr=hfitem6fab&oeidk=a07ecjdp4sg93929b82>

Hydroponic & Aquaponic Farming Systems, Grades PK-12

August 8-9

In this workshop, global environmental issues associated with factory farming will serve as a launching point for investigations into the structure and function of plants and aquamarine life on both the micro and macroscopic levels, raising simple and complex questions about the movement of matter and energy within ecosystems, as well as the human impacts of the technologies used to control and optimize the lifecycle of various plants and fish found in fresh, as well as processed foods. By the end of day one, participants will begin an engineering design challenge to create a self-contained hydroponic system for growing specific plants under unique conditions in a range of environments, each with their own set of problems. The hydroponic systems will be explored as a way to introduce engineering notebooks that can be used to carry out long-term investigations, and an iterative, evidence based approach to designing and modeling of solutions. By the end of day two, participants will be designing, constructing and troubleshooting their own personal aquaponics system, which can be taken back to their classrooms and scaled up or down - even on a shoestring budget - fostering iSTEM experiences linking bundles of PEs from across all four core disciplines in NGSS.

<http://events.constantcontact.com/register/event?llr=hftem6fab&oeidk=a07ecjdp4u69e27d1d6>

Intro to Electricity, Circuits and Alternative Energy, Grades K-12

August 10-11

In this 2-day experience, participants will begin by learning about the fundamentals of electricity, simple circuit design, and various technologies represented in the fields of traditional and alternative power and energy technologies. Next they will work through a series of simple demonstration lessons and inexpensive experiments related to electricity, leading up to various PBLs utilizing commercially available kits within the practices of science and engineering from NGSS. By the second day, educators will work in teams to explain phenomena and develop solutions to real-world engineering problems related to green and sustainable energy.

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| <p><u>Major Topics & Lessons</u></p> <ul style="list-style-type: none">• Intro to Electricity• Magnetic Forces• Simple Circuits and Components• Series and Parallel Circuits• Schematic Diagrams• Power & Energy Equations• Power & Energy Technologies• Human Impacts• Carbon-based, Alternative Energy• Energy Efficiency• Benefits, Tradeoffs and Human Impacts of Coal, Solar, Wind, etc.• LED lights vs. Incandescent Bulbs | <p><u>Commercial Kits</u></p> <ul style="list-style-type: none">• Squishy Circuits• Makey Makey Circuits <p><u>Experiments and Engineering Challenges</u></p> <ul style="list-style-type: none">• Static Electricity• Table-top Electric Motors/Generators <p><u>Design Challenges</u></p> <ul style="list-style-type: none">• Wind-Powered Turbine• Reverse Engineering & Repurposing Solar Walkway Lights• LED Light-Up Prototypes and Signaling Devices• Lunch-Box Alarm System |
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<http://events.constantcontact.com/register/event?llr=hftem6fab&oeidk=a07ecjdp4y64d7851ff>