A.M. Presenter Abstracts + Poster Sessions

Parallel Session A - Tech 222	
Time	**8:30 - 8:50**
Presenter	**Danielle Bugge** *West Windsor-Plainsboro HS* danielle.bugge@rutgers.edu
Topic of Talk	*Using Lab Reports to Help High School Students Develop Assumption-Associated Scientific Abilities*

Science practices are an integral part of learning science. This talk describes how high school physics students, initially unfamiliar with an inquiry-based environment, engaged in ISLE labs that focus on the development of student scientific abilities. Based on previous investigations, we know that factors such as time, ability type, student group dynamics, and instructor experience influence student development of scientific abilities. This talk will focus on student development of assumption-associated abilities during the six months they studied mechanics. Using their written laboratory reports, we found that repeated exposure helped students gain competence identifying and evaluating assumptions. We also continue to investigate differences in individual and group reports and students' self-assessments and reflections of their progress in the development of these scientific abilities.

Time	**8:55 - 9:15**
Presenter	**Jennifer Broekman** *Emerson HS* jbroekman@emersonschools.org **Patricia L. White** *Manchester HS* pwhite@mtschools.org
Topic of Talk	*Computational Modeling in Physics First using Bootstrap's Pyret Language*

Physics students have a hard time distinguishing between velocity, acceleration, and what multiple forces do to an object's motion. This curriculum is designed for the physics first 9th grade class room but can be used with any 1st time physics class in middle or high school. We will present a sequence of hands-on activities designed to help students visualize physics. These activities will be reinforced through computational simulation using the Pyret language. The computational simulations will strengthen mathematical concepts of functions and logic. Pyret is a web-based programming language that does not need to be loaded on computers.
(Bringing a laptop/chromebook is highly recommended.)

Time	**9:20 - 9:40**
Presenter	**Mark Greenman** *Boston University* greenman@bu.edu
Topic of Talk	*Project Accelerate: Closing the Access Gap to Physical Science for Underserved Populations*

Boston University is in the 2nd year of implementing a 3-year NSF DRK12 award bringing AP Physics to underserved populations who do not have access to AP Physics. Boston University, through Project Accelerate, is partnering with 20 high schools in three states bringing a College Board approved Advanced Placement® Physics 1 course to schools not offering this opportunity to students. Project Accelerate students (1) perform as well as peer groups in traditional AP Physics classrooms on the College Board AP Physics 1 exam, and (2) were more inclined to engage in additional Science, Technology, Engineering and Mathematics (STEM) programs than they were prior to participating in Project Accelerate.

Project Accelerate combines the supportive infrastructures from the students' traditional school, a highly interactive private edX online course and small group laboratory experiences. Project Accelerate offers a replicable solution to a significant problem of too few underserved high school students having access to high quality physics education, resulting in these students being ill prepared to enter STEM careers and STEM programs in college. The online instructional tool provides a full AP Physics 1 curriculum with 28 graded homework assignments, 25 graded virtual explorations, 24 graded quizzes, 8 AP style tests and a suite of downloadable hands-on explorations with downloadable data files.

Time	**9:45 - 10:05**
Presenter	**Michael McConnell** *Cinnaminson HS* mcconnellm@cinnaminson.com
Topic of Talk	*Expanding Spreadsheet Modeling Capability with Numerical Methods in High School Science and Math Using The Spreadsheet Lab Manual Pedagogy*

Spreadsheet software is widely used, versatile and can replicate calculations in mass with simple commands. This makes it the ideal platform for teaching students to analyze data and build models. Compared to hand held calculators, a spreadsheet increases a student's computational rate by several orders of magnitude. This makes learning in STEM more efficient and more interactive while students gain proficiency and skills they will need in higher education and many future careers. Spreadsheets have standardized layout, cell referencing and formula writing conventions, and virtually every function shares the same language across multiple brands. Spreadsheets are fundamental to data analysis, skills are in demand and provide a foundation for literacy with more complex software such as databases. This presentation will discuss opportunities for expanding spreadsheet modeling applications within the Physics curriculum. The goal is to help students learning science experience the value added that spreadsheet modeling offers, just as spreadsheets have already benefited business and industry.

Models that simulate realistic behavior analytically (such as motion with drag force, continually changing temperatures, populations) are typically complex, using mathematics such as calculus or differential equations. The spreadsheet, however can use replicated linear calculations to solve the same problem. This opens up the modeling capability of the realm of calculus and differential equations for high school students using exclusively algebraic equations. This can be accomplished by having students follow precisely guided procedures to program and then study a spreadsheet model starting from a blank spreadsheet. Modeling techniques include numerical methods such areas of trapezoids, Euler's Method, slope of lines, difference equations, applied incrementally over large numbers of cells (102-104). Using the computational power of the spreadsheet along with these and other modeling techniques enhances the study of Physics in many areas of the curriculum. Three areas in particular that will be presented are quantitative spreadsheet models of (1 and 2 dimensional) freefall motion with drag force, dynamic heat transfer using Newton's Law of Cooling, and electrostatics (single and multidimensional) charge distributions. There are many other applications, but the Next Generation Science Standards (NGSS), has clearly endorsed the development and study of models. Modeling science with spreadsheets delivers the capability of the modern computer to students to investigate limitless quantitative applications. The spreadsheet is here to stay and is availability, simplicity and calculating power mean it represents the best opportunity for expanding computer science and programming in high school and college Physics.

Parallel Session B - Tech 220	
Time	**8:30 - 8:50**
Presenter	**Thomas Gordon** *NJIT* thomasg@njit.edu
Topic of Talk	*Maintenance of Standards and a Five-fold reduction of failure in Physics 1*

We have addressed both standards and the failure rate in a 15-section physics course that is required for most students at NJIT. This course is the first one that entering students take, and prior to our project 50% of the students failed and 10% got A grades. Over 5 years, we tried a variety of changes, designed to keep the % of A grades constant while reducing the failure rate. We have succeeded in both keeping high standards and reducing failure. This talk will analyze the methods we used, including encouraging a philosophy of helping rather than weeding out students. We also used an ETS method of exam construction, variants of active learning, less pure lecturing, increased tutoring, and increased advising. We also see problems with these efforts in the future.

Time	**8:55 - 9:15**
Presenter	**Chaz Ruggieri** *Rutgers University* chazr@physics.rutgers.edu
Topic of Talk	*Assessable Learning Objectives that Facilitate Developing Physics Habits of Mind: A Case-Study of an ISLE-based E&M Lab Course*

Rutgers University has completed its second year of a transformation of the E&M and Modern Physics portions of its introductory calculus-based physics sequence – involving ~800 students per semester – from a traditional structure to one that includes Investigative Science Learning Environment (ISLE)-based labs. The lab, which had previously been a separate course, is now central to the course structure, and this happened from a bottom up change strategy. Over 10 faculty and staff members worked together on the transformation. In this talk we discuss the process of developing learning objectives, from which emerged a shared recognition of the central role that ISLE laboratory experiences play in meeting the learning objectives the faculty articulated as being important. We outline the steps we undertook transforming the labs, share student learning data, lessons learned, and future plans. We will discuss the essential features of transformation progress at Rutgers (1) administrative support and PER champion(s), (2) close collaboration of instructors and curriculum designers, (3) weekly professional development, and (4) a flexible grading system which encourages students to revise and resubmit work based on instructor feedback.

Time	9:20 - 9:40
Presenter	**Ashuwin Vaidya** *Montclair State University* vaidyaa@mail.montclair.edu
Topic of Talk	*Experiments in Project Based Learning in Classical Mechanics*

This talk will present experiments with problem based learning(PBL) in a first major course in Classical Mechanics. The PBL model was implemented via the final project of the course at Montclair State University where students worked on final projects which required them to build art inspired artefacts. In some years, students in the class worked in groups to build a human powered generator while in other years, students worked to recreate a smaller version of a 'Strandbeest', a kinetic sculpture designed originally by the Dutch artist, Theo Janssen, which harnessed wind energy to move. These projects were designed in an open ended manner so students were completely in charge with the instructor serving as a mere guide and facilitator. This talk will include a discussion of the projects, relationship between PBL and creative thinking in the physics classroom, the response of the students to such an instructional model and future work in this direction.

Time	9:45 - 10:05
Presenter	**Tyler Reese** *Manhattan College* treese01@manhattan.edu
Topic of Talk	*Higgs Physics at the LHC*

The Standard Model of Particle Physics is a comprehensive yet still incomplete model of three out of the four fundamental forces. It is built on local gauge symmetries corresponding to the fields of the Strong, Electromagnetic, and Weak forces. Save for a few precision measurements, the detection of the Higgs Boson by the ATLAS and CMS experiments at CERN [1,2] completed the search for Standard Model physics. New physics, as in heavier particles, requires collisions at energies much higher than the capabilities of the LHC. Until a new larger collider is built, evidence of new particles can only by utilizing Effective Field Theories. An example of the application of EFT's is the search for CP Violation in processes with Higgs bosons. The detection of CP Violation would not only indicate that heavier particles, namely a CP-Odd Higgs, do in fact lie higher up the energy scale but also could point to an explanation for the matter/antimatter asymmetry in the universe. The Higgs Basis EFT [3] is a good choice for modeling studies such as this because it includes CP-Violating terms parameterized in a convenient way. Monte Carlo simulations done using the Higgs Basis will be used to interpret detector results. Preliminary work for this research has been done validating the Higgs Basis generator, Hto4l and Madgraph5.

Poster Session	
Presenter	**Robert Nitzky** nitzkyr4@students.rowan.edu
Topic of Poster	*Electromagnetic-Induced Hypothermia in Wires*

Hyperthermia, or the heating of tissue, can be used as a type of cancer therapy. This increased temperature can be attained using a variety of methods, including laser ablation, microwave exposure, and direct contact. One non-invasive way to generate hyperthermia is to induce a heating response in metallic particles upon exposure to an oscillating magnetic field. This effect can be applied to nanoparticles that are targeted to seek out different tumor biomarkers; the heat generated by the nanoparticles is translated to the tumor, which retains the heat due to its poor vasculature. When used in conjunction with traditional chemical or radiation therapies, hyperthermia can improve patient outcomes in cases of resistant cancer.

While targeted nanoparticles are a promising direction for hyperthermic therapy, there are many obstacles to overcome regarding delivery of the particles (hence, the heat) to the tumor location. One potential way to bridge this gap is through the insertion of small metallic wire segments directly into the tumor volume. This method is inspired by brachytherapy, where small radioactive 'seeds' are directly implanted into a tumor to produce continuous low-dose radiation therapy inside of the tumor. In our case, the metallic wire segments (or seeds) would be implanted into a tumor and exposed to the alternating magnetic field to produce a heating effect due to induction (where eddy currents moving through the conductor create joule heating). This type of therapy may be potentially attractive for recurring hyperthermia sessions, where the seeds are implanted once and then therapy can be performed on multiple occurrences over a given time period.

Our initial studies regarding this project aim to characterize metallic wire segments for their hyperthemic response during exposure to oscillating magnetic fields. Preliminary studies concentrate on Fe-, CuNi-, and CuMnNi-wires submerged in a phosphate-buffered saline solution; the type of wire, gauge, length, and mass of the wires were varied across experiments. Hyperthermia was induced using an alternating magnetic field across a range of magnetic field strengths and oscillation frequencies. Throughout this process, temperature changes of the sample were recorded to analyze the thermal response as a function of time for each of the varying parameters. As expected, the heating effect increased linearly with wire mass, and the elemental composition of the wire also affected the ability to generate heat. Somewhat surprisingly, an optimal wire length of 5 mm was found to generate the greatest heating effect; this parameter is the focus of ongoing studies. Future stages of this project will examine implantable hyperthermia seeds in vivo, with the use of various orthotopic cancer mice. Additional types of implantable material, ranging from gold microwire to carbon fiber, will also be explored.

Additional improvements to the hyperthermia experiment (for both macroscopic wires and nano-scale particles) include the construction of a modular and adjustable sample holder, as well as design of a new high frequency coil. The new sample holder was constructed from off-the-shelf high temperature plastic and allows a variety of sample geometries to be tested at different coil heights. Plans are underway for creation of a next generation 3-D printed sample holder. Furthermore, the current hyperthermia device is a commercially available unit that operates at ten distinct frequencies (100 kHz - 1 MHz). As some materials respond to even higher frequency field oscillations, a new coil setup is currently under design and construction (in-lab) that will allow hyperthermia at even higher (up to 27 MHz) frequencies; this will broaden the array of biocompatible materials that can be applied for hyperthermia.

Presenter	**Hsuan-Lillian Labowsky** *Ridgewood HS* hlabowsky@ridgewood.k12.nj.us
Topic of Poster	*Using an iPhone Accelerometer App, students evaluate the impact force of various sports helmets*

Using an iPhone Accelerometer App, students evaluate the impact force of various sports helmets. The "impact force" is created by dropping a helmet from a fixed height onto the floor. As opposed to standard helmet testing that measures external force, the iPhone is fastened inside the helmet to simulate the effect on the brain. The app records the acceleration components as a function of time. The data is transferred to and graphed in an Excel spreadsheet. Graphs show the "free fall" and the "impact" regions, although an app with a data collection rate greater than the available 30Hz is desirable. After testing an unmodified helmet, the students then add foam and/or crumple zones in attempts to improve cushioning. Students exercise the scientific method in data collection/interpretation and draw meaningful conclusions. The experiment is particularly timely/meaningful in light of the concern over sports-related concussions.

Presenter	**Rich Terwilliger** babyblueazurite@aol.com
Topic of Poster	*Terwilliger's Physics, a collection of over six-hundred Microsoft Word, Excel and PowerPoint documents that have been classroom tested and revised*

This presentation is a brief introduction to Terwilliger's Physics, a collection of over six-hundred Microsoft Word, Excel and PowerPoint documents that have been classroom tested and revised many times according to student suggestions. Terwilliger's Physics allows you to flip your classes and spend precious time developing more demonstrations, labs, and classroom activities. Why spend hours developing worksheets and class lesson plans or searching the web for mediocre material when you can have it all with just a couple clicks of the mouse?

Presenter	**Bart Horn, Peter Gilmartin** *Manhattan College* bhorn01@manhattan.edu
Topic of Poster	*Observable relics of the simple harmonic universe*

The current explosion of precision data for early universe cosmology is creating opportunities for cutting-edge student research, using and modifying existing software packages such as CLASS and MontePython in order to simulate the growth of primordial structure, and to compare predictions against publicly available data. We analyze possible observational signatures corresponding to the "simple harmonic universe", which consists of spherical spatial curvature, negative vacuum energy, and one or more exotic matter sources, which then quantum tunnels and/or evolves into our present observer patch.

Presenter	**Tyler Reese** *Manhattan College* treese01@manhattan.edu
Topic of Talk	*Higgs Physics at the LHC*

The Standard Model of Particle Physics is a comprehensive yet still incomplete model of three out of the four fundamental forces. It is built on local gauge symmetries corresponding to the fields of the Strong, Electromagnetic, and Weak forces. Save for a few precision measurements, the detection of the Higgs Boson by the ATLAS and CMS experiments at CERN [1,2] completed the search for Standard Model physics. New physics, as in heavier particles, requires collisions at energies much higher than the capabilities of the LHC. Until a new larger collider is built, evidence of new particles can only by utilizing Effective Field Theories. An example of the application of EFT's is the search for CP Violation in processes with Higgs bosons. The detection of CP Violation would not only indicate that heavier particles, namely a CP-Odd Higgs, do in fact lie higher up the energy scale but also could point to an explanation for the matter/antimatter asymmetry in the universe. The Higgs Basis EFT [3] is a good choice for modeling studies such as this because it includes CP-Violating terms parameterized in a convenient way. Monte Carlo simulations done using the Higgs Basis will be used to interpret detector results. Preliminary work for this research has been done validating the Higgs Basis generator, Hto4l and Madgraph5.