



# Neshaminy School District

## *Office of Curriculum, Instruction & Assessment*

### Science, Technology, Engineering and Mathematics (STEM) Report March 2015

Neshaminy School District is proud to provide science, technology, engineering and math (STEM) opportunities for our students at each grade level.

PA Definition of STEM: “STEM education is an intentional, integrative approach to teaching and learning in science, technology, engineering, and mathematics. Students become adept problem solvers, innovators, and inventors who are self-reliant by asking questions, investigating, making informed decisions about how they live their daily lives and engage in their vocations and communities.”

In addition, we believe that STEM is the . . .

1. Integration of science, technology, engineering and mathematics.
2. Teaching of concepts in activity-, project-, and problem-based learning experiences, rather than just talking about them.
3. Application of these principles in real world experiences rather than as abstract concepts.
4. Promotion of careers in which this integrated approach is the norm.
5. Need to develop strong “soft skills” along with the technical skills.

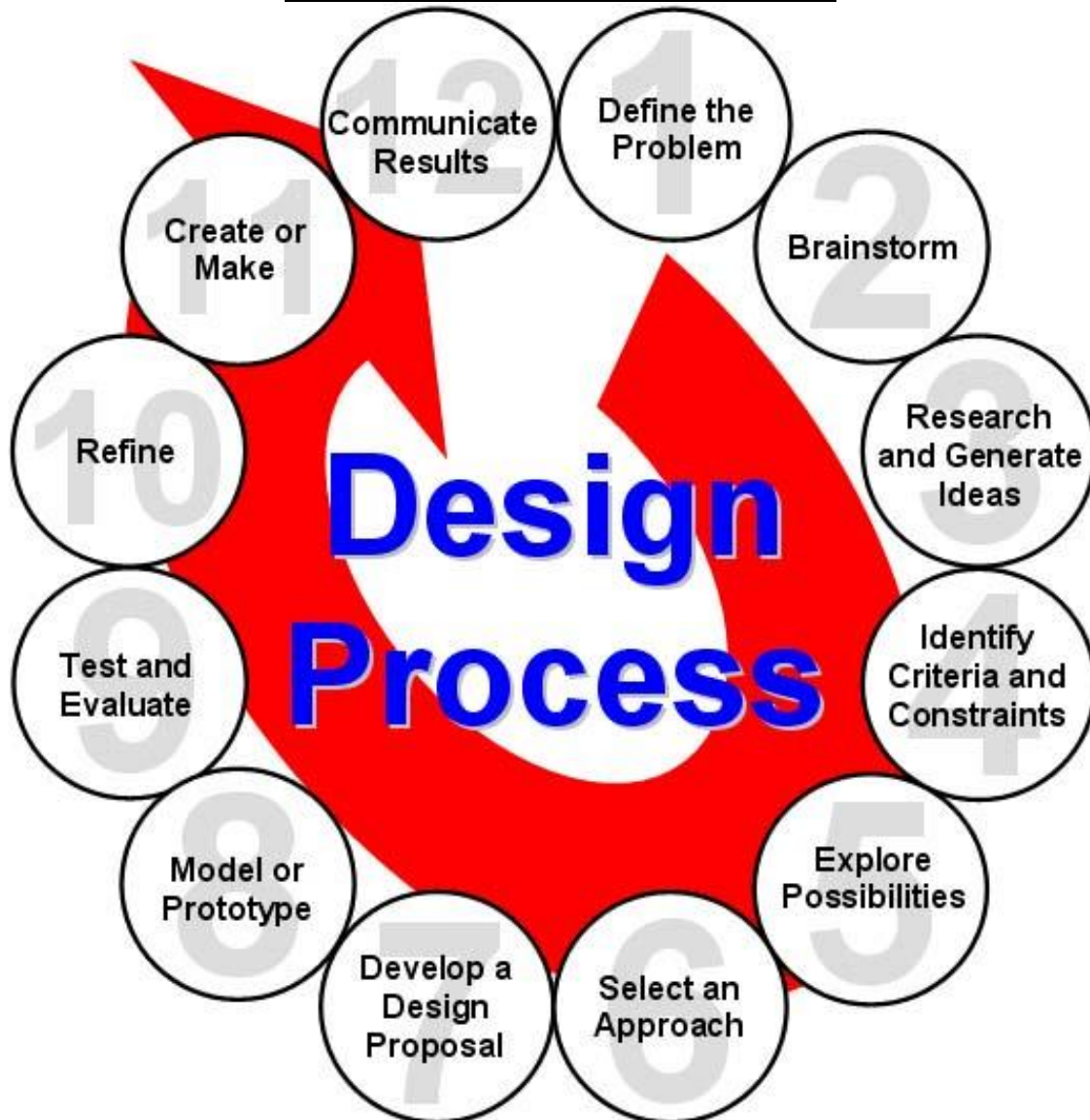
There also are engineering and design processes to keep in mind as we develop our STEM program as represented and explained with following graphics starting with the most advanced process. Project Lead the Way (PLTW) is our primary STEM-focused educational framework.

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# 1 Engineering Design Processes

## ITEEA Engineering Design Process



1. Define a Problem
  - a. Receive a problem to solve from the client.
  - b. Gather information.
  - c. Be inspired through media exposure of a current problem and take action.
2. Brainstorm
  - a. Present ideas in an open forum.
  - b. Generate and record ideas.
  - c. Keep the mind alert through rapidly paced sessions.
  - d. Develop preliminary ideas.
3. Research and Generate Ideas
  - a. Conduct interviews with those affected by the problem.

- b. Research solutions that may already exist; identify shortcomings and reasons why they aren't appropriate to a given situation.
  - c. Compile ideas and report findings to the team.
4. Identify Criteria and Specify Constraints
- a. Identify what the solution should do and the degree to which the solution will be pursued.
  - b. Identify constraints (i.e., budget and time are typical considerations).
  - c. Draft the Design Brief.
5. Explore Possibilities
- a. Consider further development of brainstorming ideas with constraints and tradeoffs.
  - b. Explore alternative ideas based on further knowledge and technologies.
6. Select an Approach
- a. Review brainstormed information and answer any lingering questions.
  - b. Narrow ideas down through a voting process, or by use of a decision matrix.
  - c. Decide on final idea, usually through group consensus.
7. Develop a Design Proposal
- a. Explore the idea in greater detail with annotated sketches.
  - b. Make critical decisions such as material types and manufacturing methods.
  - c. Generate through computer models detailed sketches to further refine the idea.
  - d. Produce working drawings so the idea can be built.
8. Make a Model or Prototype
- a. Make models to help communicate the idea, and study aspects such as shape, form, fit, or texture.
  - b. Construct a prototype from the working drawings, so the solution can be tested.
9. Test and Evaluate the Design Using Specifications
- a. Design experiments and test the prototype in controlled and working environments.
  - b. Gather performance data; analyze and check results against established criteria.
  - c. Conduct a formal critique to flesh out areas of concerns, identify shortcomings, and establish any need for redesign work.
10. Refine the Design
- a. Make design changes; modify or rebuild the prototype.
  - b. Make refinements until accuracy and repeatability of the prototype's performance results are consistent.
  - c. Update documentation to reflect changes.
  - d. Receive user's critique to provide outside perspective to help determine if established criteria have been met.
11. Create or Make Solution
- a. Determine custom/mass production.
  - b. Consider packaging.
12. Communicate Processes and Results
- a. Communicate the designer's final solution through media such as PowerPoint, poster session, technical report.
  - b. Market the Product.
  - c. Distribute.

This Cyclical STEM Design Process should guide our decisions about what is pure/true STEM and what is STEM-connected or STEM-like. As students are involved in more of the 12 steps described above, they, with the facilitation of their teachers, are moving closer to pure/true STEM activities and design focused projects and problem solving.

**NOTES:**

- The ITEEA (International Technology and Engineering Education Association) Design process is the most expanded process. Most other design/engineering processes combine or generalize steps and create truncated versions.
- PLTW does not prescribe one set design process; they recognize that multiple versions exist and that the iterative use of a chosen model is what makes the process successful.
- PLTW does prescribe the Introduction to Engineering Design (IED) design process; it is shown below in Image #1.
- The widely accepted and most used process in Neshaminy, and the surrounding area, is the Technological Design Loop (Image #2) as found in Hutchinson, J., & Karsnitz, J. (1994). *Design and problem solving in technology*. Albany, N.Y.: Delmar.
- Elementary level Engineering is Elementary (Image #3) and PLTW Launch (Image #4) use similar 5-step processes.

Image #1. IED Design Process

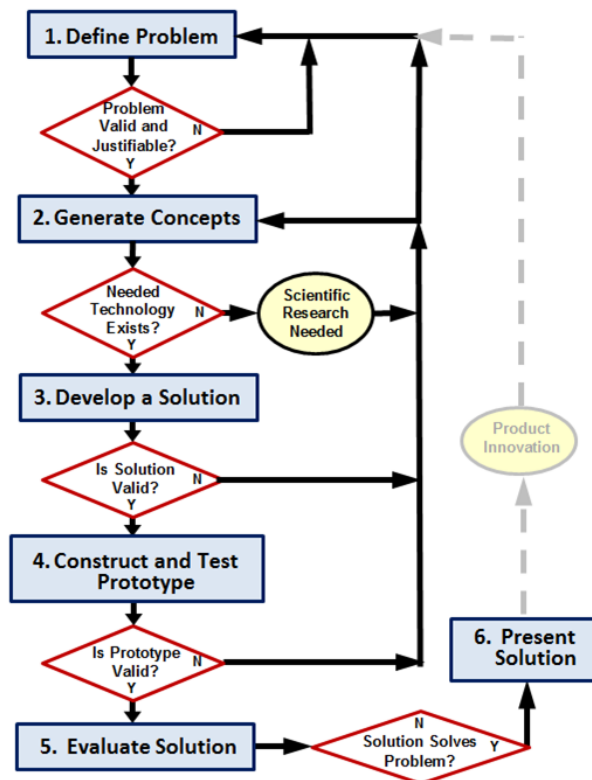


Image #2. Technological Design Loop

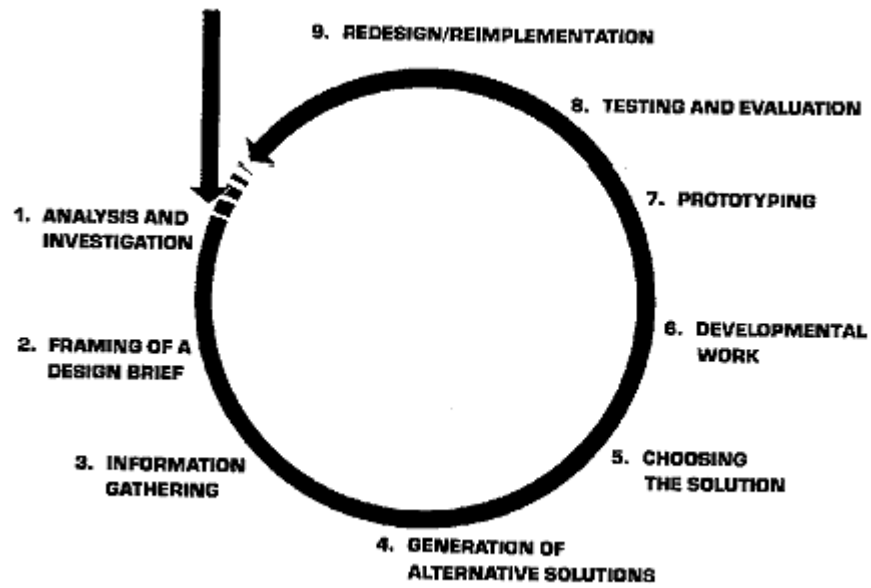


Image #3. Engineering is Elementary

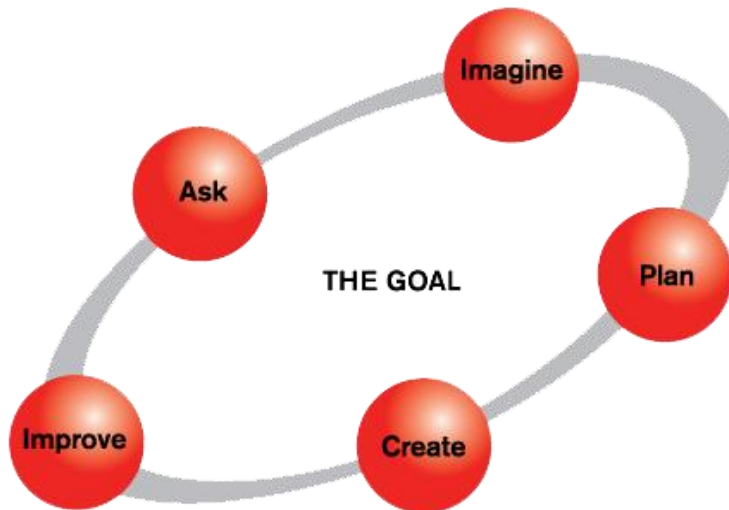
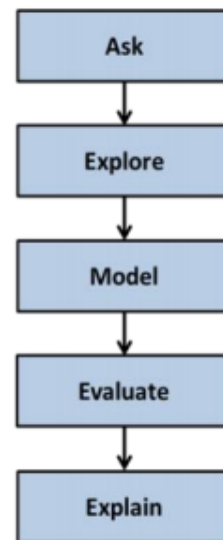


Image #4. PLTW Launch



Launch

## 2 Status Update: High School

At the high school level, the new **Advanced Placement Chemistry** course is going well this year with two sections of mostly juniors – Dana Puskas teaching. We anticipate having all these students take the AP Chemistry exam, and their participation/good scores will positively impact the SPP for the high school.

We have **three sections of AP Environmental Science** running this year—a significant increase from the past. So, more of these students will be taking the AP exam as well. Some continue to be involved with the annual Envirothon competition as well.

The **AP Environmental Science and AP Biology** courses are designed to promote a balance between developing solid content knowledge and applying that knowledge.

Some examples:

- A Spectrophotometer has been purchased for use in AP Chemistry labs and the other AP Science courses so that students will be able to conduct their own research on unknown substances to determine their composition;
- Environmental Sciences content integrates all of the sciences (physical, earth and life) to challenge students to critically explore issues in our local environment. Students collect data through field investigations and use technology tools, such as google docs to mathematically analyze and report their findings through writing and power point presentations. They also are using renewable energy models to investigate the most efficient sources of energy. The final post-exam project requires the students to design a project that their group found interesting during the course of the year, solicit funding to complete the project and report their efforts to their peers;
- AP Environmental Science courses use the vast resources of our 125 acre Idlewood Environmental Station to work in teams to investigate the core content required by the AP College Board. The Environmental education students have participated in and performed well in the Envirothon competition; and,
- AP Biology, guided by microbiologist, Dr. Nancy Oliveira, utilizes a state of the art Thermo cyler as part of their Genetics STEM Lab activities and Polymerase Chain Reaction (PCR).

In **AP Physics** classes students are regularly engaged in problem based learning as demonstrated through the construction and launching of a weather balloon. Additionally, two engineers are on staff to lead the engineering aspects of STEM activities

We will continue to better prepare students for the **Biology Keystone exam** through increased collaboration of the biology teachers in delivering the eligible content instruction as effectively as possible and providing students with CDT, Study Island and a strategically crafted mid-term assessment that highly reflects the Keystone questions and level of rigor.

Our students taking the **9th grade science program** will continue to have access to STEM professionals and cutting-edge research through the JASON Mission Center website. Students receive an integrated science experience with enough of a focus on biology to prepare them well for the **full year Keystone**

**course in 10th grade.** This website is inquiry-based (asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information) and contains online curriculum, digital labs(PHET online labs to reinforce concepts and allow students to work at their own pace to discover and grow in their content understanding) and games, teacher classroom management tools and online community features. Hands-on experimental investigations and applications of biology, earth science, chemistry and physics are also provided as an introduction to these content specific courses in subsequent years. Additionally, through live webcasts students are connected to inspirational STEM role models on an ongoing basis. Edmodo is the online tool used for delivering assignments as well as having students submit their work. Updates are posted on content covered and student and teacher connections as well as student to student connections are established and maintained. See <http://www.jason.org/> for examples.

In our second year for **Project Lead the Way (PLTW)**, students are taking courses in Introduction to Engineering Design (IED), Principles of Engineering (POE) and Digital Electronics (DE). **We will be offering two more PLTW courses in 2015-2016: Civil Engineering and Architecture (CEA) and Computer Science and Software Engineering (CSE).** The plan is to add the capstone course, Engineering Design and Development (EDD) beyond next year and have our PLTW program become fully accredited/recognized by PLTW.

In addition, all of the PLTW courses, along with the robotics class, will be offered at the honors level for students next year. We anticipate that this increase in the availability of honors level T&EE courses will attract an increased diversity of students to the program. Teachers are committed to providing instruction and assessments at an honors level as specified in the provided PLTW curriculum that they receive during their training classes. The appropriate teachers are scheduled to receive training classes for the CEA and CSE courses this summer. The faculty will market the remaining T&EE elective high school courses so that all levels of students will be interested in taking these classes, and their parents will be well-informed as well.

Below are brief descriptions of the T&EE courses.

- **PLTW: Introduction to Engineering Design (IED)** GRADE LEVEL: 9-12  
*Introduction to Engineering* is a hands-on course that develops student's problem solving and critical thinking skills through the design process. In this course, students will use 3D modeling software called AutoDesk Inventor, and will document their work to communicate solutions to peers and members of the professional community.
- **PLTW: Principles of Engineering (POE)** GRADE LEVEL: 10-12  
*Principles of Engineering* is a course that exposes students to major concepts they will encounter in postsecondary engineering courses of study. Students will employ scientific concepts in the solution of engineering design problems, as well as developing problem solving and critical thinking skills in terms of mechanisms, energy, statics, materials, and kinematics.
- **PLTW: Digital Electronics (DE)** GRADE LEVEL: 10-12  
*Digital Electronics (DE)* provides the foundation for all modern electronic devices such as cellphones, MP3 players, laptop computers, video-game systems, and HDTV. The major focus of the DE course is to expose students to electronics laws and concepts, design processes, and engineering standards. Students will gain experience with a variety of

hands-on activities including soldering, bread-boarding of circuits, and programming Arduino-based robots. Students will use industry-standard software to plan, simulate, test and troubleshoot various digital logic circuits.

- **PLTW: Civil Engineering and Architecture (CE)** GRADE LEVEL: 9-12  
*Civil Engineering and Architecture* is a hands-on course where the students will solve problems using real life scenarios that civil engineers and architects face daily. The students will use 3-D design software to solve problems in the areas of land surveying, water resources & management, environmental issues, soil testing, architectural building design, landscape design, model building and structural strength of materials.
- **PLTW: Computer Science and Software Engineering (CSE)** GRADE LEVEL: 10-12  
*Computer Science and Software Engineering* will develop computational thinking skills used to solve practical problems in the real world. Focus will be placed on object oriented programming environments, specifically the Python language. Additionally, students will code their own applications for use on provided Android tablets. Students will also create interactive web 2.0 software working with HTML5, CSS and JavaScript.
- **Robotics** GRADE LEVEL: 9-12  
*Robotics* has been designed for students who would like to explore the rapidly expanding technologies involved in building, programming, and controlling robots. Through the use of the LEGO MINDSTORMS<sup>®</sup> robotic kits, the students will build robots that use light, ultrasonic, sound, touch, and motion sensors to perform a variety of tasks. TETRIX<sup>®</sup>, an aluminum construction set, and RC controllers are introduced to the students to build stronger and more powerful robots. These robots require coding in the language RobotC. The course parallels Carnegie Mellon University's Robotics Academy.

Our **Mathematics** curriculum provides advanced placement opportunities for students. Math is at the core of many of the calculations as well as the analytical and problem solving nature of science, technology and engineering challenges and lab activities faced by our students.

- **Advanced Placement Statistics** course exposes students to four major statistical themes: Exploring Data, Sampling and Experimentation, Anticipating Patterns, and Statistical Inferencing. This accelerated statistics class prepares students for taking the recommended Advanced Placement Statistics Examination.
- **Advanced Placement Calculus** is an accelerated Calculus course and will cover all the topics included in an Advanced Placement program. It is recommended that students taking this course take the Advanced Placement Calculus AB Examination.
- **Advanced Placement Computer Math Java** is an advanced course in Java emphasizing programming methodology and functional abstraction, including the study of algorithms, data structures, and data manipulation with respect to the APCS Java subset. Topics of the AP Computer Science curriculum, Level A and AB will be examined. It is recommended that students taking this course take the **Advanced Placement** examination in **computer science** at the end of this course.

Our **Business Computers and Information Technology (BCIT)** curriculum is connected to STEM education as summarized below--current classroom teaching and plans for the 2015 – 2016 school year.



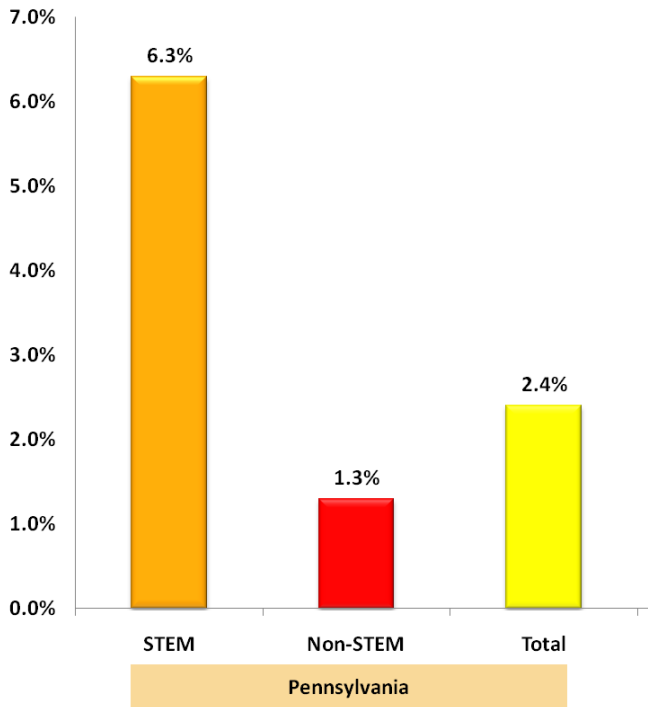
- **Information Technology 1** is a Microsoft Excel course where students learn to transfer and manipulate data into database, spreadsheet and chart format. Students apply Excel functions to interpret, filter and generate desired output. Students also learn how to produce reports that correctly show data supporting an intended message.
- **Information Technology 2** is an advanced Microsoft Excel course that builds expert skills. Advanced skills involving functions, formulas, validation, lookups, integration and multi-page projects are covered, as well as a unit in Microsoft Access. Students completing this course are expected to be prepared to take the Microsoft Certification Test in Excel and the department hopes to be a testing site for the 2015-2016 school year and beyond.
- **Microsoft Certification Prep** is a course that will be offered in September. Curriculum will support student preparation for Microsoft Certification testing in Word and PowerPoint. Microsoft Publisher and a unit in Dragon Naturally Speaking voice recognition software will also be taught. Skill development in Microsoft application software will include: formatting documents, integration of software applications, mail merge with databases, plus incorporating digital imaging, voice, sound and video. The department hopes to be a testing site for the 2015-2016 school year and beyond.
- **Business SIM and APP Programming** is a course that will be offered in September. It will replace the current Programming and Web Design course. Students will create APPs and practical business simulations, then market the APP/SIM through a custom designed website. Languages and software include: HTML, CSS, Adobe Dreamweaver, Flash, Photoshop, Gamemaker, Alice, Scratch and JavaScript. Opportunities will be available for students to submit projects to various computer science and business competitions (FBLA).
- **Social Networking for Careers** is a course that strengthens communication skills through computer networking. Students learn how to build personal profiles on seven social media platforms to positively influence career opportunities and engage prospective employers. Students also learn to navigate with MS Outlook to improve organizational skills. These computer networking skills can also be utilized in most marketing and public relations positions today.
- **Cyber Forensics and Digital Law** is a course that will be offered in September. It will focus on computer forensics as a way to build evidence in civil and criminal high tech cases. Students will access computer hardware and system software on “stand alone” computers to experience the effects of fraud. Students will learn how to protect digital content and become familiar with the cyber law applied to the use of computers, transactions conducted over the Internet, cellphones, and software or hardware storage devices.
- **Google Classroom** is being utilized as a classroom management tool in eight BCIT courses. Students access their Google Classroom to receive assignments, submit work, obtain files for lessons and collaborate with classmates. Students are also using Google applications for lessons and developing file management skills through Google Drive. The Cloud-based applications allow students to access their classroom anywhere, encouraging students to become active in online learning environments.

**Virtual Business Simulations from Knowledge Matters Inc.** are web based simulations mirroring “real world” business operations. Students manipulate software to reflect business decisions that hopefully

achieve benchmarks. Students interpret conditions, analyze options, compute needs, make decisions, manipulate software, evaluate effectiveness and initiate change in operations if needed. There are Virtual Business Simulations in five BCIT courses: **Entrepreneurship, Finance and Investment, Marketing for Fashion and Hospitality, Marketing for Sports and Entertainment, and Management for Sports and Entertainment.**

Discussion should continue about increasing the credit requirement for graduation; one of the credit requirements could be a STEM-designated course. Neshaminy High School does have a lower than average credit requirement in the region.

Figure 1. *Projected Growth in STEM and Non-STEM Occupations 2008 – 2018, PA Department of Labor & Industry*



With a greater percentage of occupations in Pennsylvania having a STEM focus (Fig. 1), we should be doing more to expose students to STEM fields of study. The ongoing addition of PLTW courses would serve this purpose well. Some of the current and more updated elective courses in BCIT (Macroeconomics and Microeconomics) and FCS (Textile Design, Engineering and Construction) could be considered STEM courses. Adding more semester-length math and science electives could support this requirement as well, e.g., a semester long course in bioengineering or biochemistry, an advanced programming course with applications in a variety of STEM fields, etc. PLTW has engineering and science based course options for these content areas. We do need to keep in mind the need to have enough students in these classes for them to run which will impact staffing and room utilization.

**Opportunities:**

The high school robotics team will continue to develop into 2015-16 as more students choose to take robotics classes and as the younger summer STEM academy students make their way to the high school. We will also continue to identify and participate in STEM contests and activities offered throughout the state to support more of these co- and extracurricular opportunities for students. Our nature/Envirothon, environmental action, science, MATHletes and Future Business Leaders of America clubs continue to be active.

**3 Status Update: Middle School**

The middle school level is in its **1st year for Project Lead the Way (PLTW)** with the addition of Design and Modeling (DM) units in 6th grade, the first course in the PLTW Gateway Program. The T&EE computers at the middle level are running the Inventor software needed for the Design and Modeling student activities.

We are planning a **STEM special course (36 days) for the incoming 5th grade students** who will be attending the middle school for the first time next year. T&EE department members are excited about the additional learning opportunities for students. There are numerous units of study and activities within their established T&EE curriculum and within the PLTW Gateway Program that can be added and/or integrated into the new 5th grade program and the existing 6th-8th grade program. Additional PLTW classes are possible as we move forward. There is more to be done to have the Design and Modeling units fully integrated into the middle level curriculum. Automation & Robotics is a good next choice at the MS after the Design and Modeling is better established T&EE teachers will meet after school and during future in-service days to plan for next year.

Through collaboration with the science department, the 5-8 middle school Technology and Engineering curriculum has been redesigned to support and address the PA Science and Technology Education standards that are assessed on the 8th grade science PSSA. As with prior iterations of the curriculum, the Engineering Design Process is the essential knowledge that runs through the whole curriculum and provides an opportunity to acquire Technological Literacy. The new 5-8 program will infuse content from the Project Lead the Way: Design and Modeling unit throughout all four years. Additionally, the courses will provide hands-on activities to apply identified areas of science content.

#### 5th Grade

- PLTW Introductory Units on STEM definitions and applications
- Engineering Design Process and application
- Engineering activity to reinforce simple machine content from science curriculum

#### 6th Grade

- PLTW Measuring, Sketching, Dimensioning Units
- Engineering Design Process and application
- Technology Education content on Construction and Manufacturing
- Engineering activity to reinforce forces and materials content from science curriculum

#### 7th Grade

- PLTW 3D modeling units using AutoDesk Inventor
- Engineering Design Process and application
- Technology Education content on Transportation
- Engineering activity to reinforce transfer of energy content from science curriculum

#### 8th Grade

- PLTW Advanced 3D modeling units using AutoDesk Inventor
- Engineering Design Process and application
- Technology Education content on Communication and Biotech
- Engineering activity to reinforce waves and information transfer content from science curriculum

For more information, see: <https://www.pltw.org/our-programs/gateway>

On the **middle school science** front, we reviewed the curriculum for science and technology and engineering education (T&EE) and compared what is being taught to the eligible content in the 8th grade science PSSA. It has become clear that a spiraled approach will be more effective than a grade level physical science, life science and earth science framework that has existed for many years. Our current stagnation on the eighth grade science PSSA scores is also prompting us to examine the science

sequence/integration and develop strategies to improve student performance and preparation for high school level courses.

During the summer of 2013, the middle school science leadership team was formed and conducted a crosswalk between the current Neshaminy Middle School science curriculum and the **Next Generation Science Standards (NGSS)**. The NGSS are K-12 science standards that are rich in content and practice and arranged in a coherent manner across grades and disciplines. Developed jointly by representatives of 26 lead states, experts in elementary, middle, and high school science, industry and workforce development experts, and experienced professionals in assessment, English language acquisition, and students with disabilities, these standards provide all students with an internationally benchmarked science education that is based on the *Framework for K-12 Science Education* developed by the National Research Council. This crosswalk document was then re-visited during December of 2013 and shared with all middle school science teachers. During the summer of 2014, the middle school teacher leadership team (Brian Suter, Connie Welke, Tom Brown and Tim Hunt) met for two consecutive days, and they learned a technique to design a scope and sequence using the NGSS. The leadership team completed a scope and sequence with big ideas, components and standards.

**The existing curriculum, where each grade focuses on a single subject area (earth, life, or physical science), will become integrated/spiraled one year at a time, beginning with the 2015-2016 school year.** Starting in the fall of 2015, the 6th grade students will have a course that incorporates life, physical and earth sciences with a high dose of the "nature of science" skills (science and engineering practices and crosscutting concepts). The same will take place more completely in 2016-2017 for 7th grade and in 2017-2018 for 8th grade. This approach will better prepare students for the 8th grade PSSA and more completely incorporate the NGSS and engineering practices. Our T&EE faculty will support this approach by including relevant eligible content in the 5th-8th grade T&EE curriculum. Health teachers can do the same with eligible content related to anatomy and physiology. We should keep the arts in mind for some of this integration as well to promote *STEAM* – science, technology, engineering, the arts, and mathematics.

With **middle school mathematics**, major efforts have taken place to embed PSSA eligible content into the less general math courses, such as pre-algebra, and all the algebra courses. This will help students to perform better on their PSSAs/Algebra Keystone and show growth. Math and science teachers are becoming more proficient in administering and analyzing the results of CDTs. We have purchased PSSA prep books for math and algebra and will do so for science as we move forward. Also, **this is our second year in having four sections of pre-algebra students in 6th grade.** By having our most advanced math students in pre-algebra in 6th grade, they will be able to take geometry in middle school and two years of calculus in high school with some taking an AP calculus exam both years. The integration of math with science is clearly evident, especially in physics and engineering courses.

Our BCIT curriculum at the middle school level (current classroom teaching and plans for the 2015 – 2016 school year) is STEM-like.

- **7th grade – Emerging Technologies and Skills** The course begins with identifying and explaining the district's Acceptable Use Policy and applying it to technology devices. Content promotes personal safety and protection from online and offline reputations, as well as the need to consider ethics and societal factors for decision making. Programming with Scratch begins. Students learn the details of design and execute scripting programs. They design with parallelism and sequencing concepts. Students practice encoding and decoding through the debugging process. Students also learn MS OneNote and utilize the

application for notetaking, questioning and decision-making. Students use MS OneNote to create a digital journal that assesses the influence technologies have on daily life.

- **8th grade – Business, Computer and Information Technology** The first semester of the course centers activity around a Pizza business operated by students. The following skills are developed through assignments relating back to the business. Students research and interpret data using technology, create an electronic portfolio in Google Docs, demonstrate use of presentation software, demonstrate MS Publisher layout and design skills, use Google Docs collaboration and file conversion skills. Google Spreadsheets are used for tracking and charting data, plus multimedia tools for advertising. The second semester is entirely focused on developing coding and programming skills for students. It takes students further into Scratch, will teach basic HTML coding and will connect students to programming with Alice. There are numerous computer science student learning outcomes expected from these programming units. Some of these skills include: practicing computational thinking strategies, filtering information, solving authentic problems, and innovating to reach higher depths of knowledge.
- **5th Grade – BCIT Curriculum** In September the BCIT Department presented a recommendation for curriculum. There were three components; a keyboarding unit, a software applications unit and a unit teaching the fundamentals of computer programming. Department faculty will plan the 5th grade 36 day curriculum rotation during workshops and in-service days.
- **All three middle schools are actively coordinating an after-school Computer Club.** Sandburg and Maple Point are in the early stages but plan to follow Poquessing’s success. The teachers have thoughts of a district competition among clubs and hope to share guest speakers with their webcams. Poquessing students have joined a 20-hour *Introduction to Computer Science* course through <http://code.org/>, using lessons as a 15 minute warm-up during meetings. There are guest speakers and student demonstrations with interesting hardware. Students have disassembled computers to identify parts and to see how they work. Students are now using those parts to make robots.

## 4 Status Update: Elementary School

At the elementary school level, we will review the sequence and timing of the FOSS kits in science and consider more upgrades to them in meeting the NGSS just as we are doing this year with the *Materials of the World* kit in kindergarten. FOSS representatives reported that their NGSS kits are only ready for 2nd & 3rd grades at this point, and they anticipate having other grades ready by 2016. It may be possible to incorporate an additional kit in K-2 to support overall nature of science development in this inquiry-based approach to teaching/learning. We will investigate other science kits. Carolina Biological has NGSS kits for kindergarten through 5th grade, developed by the Smithsonian--their Science and Technology for Children (STC) kits. <http://www.carolinacurriculum.com/STC/Elementary/index.asp>

Science Companion Prime is another hands-on learning program developed by the Chicago Science Group. <http://www.sciencecompanion.com/>

We will investigate ways to integrate more STEM at the elementary level as we move into next year. Engineering is Elementary (EiE) is one program to consider to support engineering literacy for children

along with the PLTW Launch elementary program. The Smithsonian's STC kits have engineering activities within their curriculum materials. These could possibly supplement our FOSS materials. However, working collaboratively with the elementary teachers to teach the existing science FOSS kit program well will benefit students in their integrated science/T&EE learning in grades 1-4 and preparation for the 4th grade science PSSA. **Our 4th grade students have demonstrated success on their science PSSA—91% proficient/advanced compared to the state average of 79%.**

The **Math in Focus** instruction will continue to move forward with teachers reviewing the options of chapter sequence that will be most effective in helping students to develop their math skills in a research supported manner while still learning as much of the eligible content as possible prior to their grade level PSSA. We had a math coach collaborate for a week recently and the same coach was here last August, and her suggestions will be reviewed and implemented as appropriate. **Teachers will be scheduled for more time to collaborate in their buildings and between buildings.** The use of Skype and/or another video communication tool can be used to help facilitate these video collaborations when common time together is limited. Most building librarians and technology support staff as well as tech advocates can provide support with this. Having the **Singapore Math approach in the 5th grade** will provide opportunities for 6th grade math teachers to be exposed to this approach so that they can respond more effectively to students using bar models and other newer problem solving approaches (after school workshops, peer-observations, in-service day collaboration). They can support these approaches and blend them with the more traditional abstract/algorithmic approaches.

## **5 Extracurricular STEM Programs**

The **Summer STEM Academy** has been successful and will take place for a fourth time this summer. The addition of a second level advanced week should be popular for students who already attended the basic robotics camp and the advanced camp. There is an interest in continuing to build upon student skills and interest levels as they become middle school aged and pursue the rigorous, honors level PLTW courses at the high school.

Consideration is being given to alternative summer STEM camp options as well--programs established by outside companies that specialize in summer STEM programs and provide training to teachers. "Camp Invention" is one to consider. <http://campinvention.org/2015-program/>

A concerted effort is made to engage girls in STEM career fields in which women are underrepresented. **Girls in grades 6-10 will participate in a #girlSTEM conference at the Bucks County Intermediate Unit (BCIU) in May 2015** as a way to inspire middle and high school girls to embrace careers in the STEM-related fields. The conference features interactive seminars with professional women, hands-on workshops and open forum discussions. **We plan to make this an annual event for Neshaminy girls and will have two buses go to the event this year with approximately 80 girls.**

### **Hour of Code, Computer Fair, FBLA, K'Nex competition and other clubs/activities**

Both the high school and middle school BCIT teachers participated in Hour of Code this year, reaching 1600 students. Students used tutorials to work with pre-coded blocks and created coding puzzles and games to learn language concepts. Students learned the basics of JavaScript programming, edited strings, included math operations, variables, functions and arrays to code. They demonstrated robotic devices, and designed a product using 3-D printing code. Students of the Poquessing Computer Club tutored fourth and fifth grade students from nearby Ferderbar Elementary in basic programming while also



helping them navigate through the code.org site. **The BCIU Computer Fair will be held March 20, 2015.** There are BCIT middle school students participating, and Karen Moraes is coordinating. A few students advanced to the state level last year. **The FBLA State Competition and Conference will be April 12 – 15th** where twenty students will be competing in business and technology events. Our academic enrichment (AE) students are also exposed to STEM/PLTW content. One participation example is the **K'nex STEM design challenge**—a STEM competition sponsored by the Bucks County Intermediate Unit. STEM debate topics have been added to the middle school AE curriculum. AE level participation prepares students for higher level, middle and high school contests and competitions by engaging students in more problem solving and critical thinking activities. Examples include, but are not limited to, STEM related co- and extracurricular activities, such as **Tower of Power competition, Science/Computer Fairs, Chess Club, Math Olympiad, BCIT club activities and the 24 Challenge Math competitions.** We have high school students competing in **MATHetes, Envirothon, FBLA and the regional Science Fair.** Enrichment opportunities in STEM and the Humanities can be incorporated into the WIN period at the middle school level.

## 6 A Way Forward

**Financial support** for various STEM curricular and co-curricular activities is available through the Ready-To-Learn grant. Such funding will be appreciated next year if it remains available. Uses of the money will be prioritized as done this year with a focus more toward the middle school content areas and ongoing support of the transition to 5-8 middle schools. Efforts will continue to be directed to secure various grants regionally and nationally with the National Science Foundation, Toshiba, and the Bemis Company as three to pursue initially.

ASSET STEM Education is a national STEM education improvement nonprofit organization. ASSET provides a variety of professional development and educational materials to educators that are inquiry based and aligned to national and state standards. This national group has a PA organization which supports many initiatives in STEM and has held several conferences. We are making a connection with this nonprofit.

<http://www.assetinc.org/our-philosophy/about-us.aspx>, <http://www.assetinc.org/contact.aspx>

### **STEM Advisory Council**

**To assist in implementation and monitoring of the STEM program, a STEM Advisory Council will be created to develop a plan for K-12 STEM education that is aligned to the district's strategic plan. The council will be comprised of one administrator from the high school, one administrator from the middle school level, one administrator from the elementary level, 2-3 STEM teachers (including AE) from each of the levels, a cabinet/board level representative, a STEM field community member, a parent, a high school student, and a middle school student.**

**Sharing and marketing of our overall STEM program can be supported through collaborative efforts with our community relations specialist, various individuals updating/maintaining STEM content area web pages on the district and building level websites, use of the districts Facebook page, Twitter, district newsletters, creation of informative and STEM highlight videos, local newspapers, etc.**

## 7 Spending Plan

Ready-To-Learn Grant for STEM Grades 4-12

### **\$75,000--Instruction (Items listed in order of priority)**

1. Major purchases of instructional materials to support the STEM special course at the 5th grade level along with any changes to the FOSS kits in grades 5/6 and the changes to the curriculum in 7th/8th. A more specific list of these instructional materials will be developed in collaboration with the teachers before the end of FY 2015. I anticipate these expenses will be close to \$50,000.
2. Instructional support of the summer STEM program--additional materials, robotics equipment, engineering equipment, etc. that can increase the rigor and interest level of the summer STEM students and also be available to the high school PLTW and T&EE classes as needed.
3. Additional supplies to support the 3D printing at the secondary level.
4. New/replacement microscopes to support the life science and biology programs.
5. Additional PLTW materials for the secondary level, particularly for the Design and Modeling Engineering course at the middle school level.
6. Microsoft Certification Practice Test 5-seat licenses and certification prep booklets for students in the BCIT program.
7. Upgraded physics equipment, especially what is needed to support computer assisted instruction and lab activities--sensory devices enabling observations to be sent to computer programs for use in data analysis, graphing, etc.
8. More/replacement lab equipment to adequately equip the high and middle school science lab stations; much of what currently exists is relatively old and outdated.

### **\$30,000 remaining--Professional Development (Items listed in order of priority)**

1. Lead science and 3 middle school science teachers to NSTA conference in Philadelphia--approximately \$7500.
2. Guest presenter(s)/coaches for middle school science teachers. One possibility from St. Joseph's University (Joseph Cifelli)--approximately \$5000.
3. PD for 5th grade science teachers as needed to implement the FOSS kits potentially in rooms without windows and/or running water—some may be new to science at this level and will need support in science instruction strategies—A FOSS kit trainer/coach—approximately \$5000.
4. Additional Singapore Math coaching and middle school math support as needed for grades 4/5--approximately \$5000. Davidson Group is providing workshops in August (Philadelphia): <http://teacherbilldavidson.com/workshops/> Staff Development for Educators is also available.
5. PD time for secondary science teachers to learn how to most effectively use our more sophisticated lab equipment (spectrophotometer, thermocycler for DNA analysis, data gathering probes (how to use probes to collect data during labs).
6. Jason Learning science program—additional PD to support current 9th grade program.



7. Summer PD for teachers--Possibly the National Aerospace Training and Research center in Southampton (NASTAR) with 10 different teacher workshops available.

**\$60,000 remaining--Supplies and Materials (Items listed in order of priority)**

**Various supplies, resources, staff compensations, transportation, etc. to support:**

1. The transition of 5th grade and the STEM special class at the middle school level.
2. The overall increased spiraling nature of the middle school science program—curriculum realignment.
3. The high school science club; Tower of Power at Sandburg.
4. K'Nex and computer fair competitions; robotics club/competitions; STEM girls trip to BCIU.
5. A new middle school STEM program/activity at Sandburg—Family Tools and Technology and any other new extra- and/or co-curricular STEM activities.
6. Science fairs at the elementary school level.
7. BCIT clubs at the middle school level.
8. The high school envirothon club/competition.
9. Any newly created or existing math clubs/competitions (would like to promote more of these).  
Examples: Math competition (Pi Day) at Holy Ghost Prep and 24 Challenge Competition at BCCC
10. AE supplies to support their activities/competitions mostly at the middle school level.
11. A water distillation apparatus for the high school; mostly for chemistry and environmental science lab activities.

We can also pursue financial and materials/resources donations from parent/community members and regional businesses.