Course: Science and Technology
PEIMS Code: 1120039 *Abbreviation:* SCITECH
Number of credits that may be earned: 1/2-1

Brief description of the course (150 words or less):

Science and Technology (SciTech) is a high-level, hands-on science and engineering course. Through self and peer evaluation, SciTech requires students to interact verbally, in writing, and through improving the performance of devices. After a short direct teaching section covering physics and basic drawing skills, an original mechanical engineering challenge is introduced to the students. Solving the challenge requires using a "four step" design process: conceptualization, design, layout/construction, and evaluation. The students develop individual conceptual plans (ICP), are placed in groups of three where they share their ICP's, develop a group conceptual plan, and write a design report. The students present the content of their reports to engineers. Students then modify their design and proceed to build a prototype of their solution. The prototype is tested and modified until it works. Once the prototype works, three final devices are built. Each final device is course tested for consistency of function.

Working on one problem for sixteen weeks without one standard solution (not every group is successful) creates a unique learning environment in SciTech. SciTech has developed a system where students experience the joy of true authorship of ideas that only comes from making one's own ideas work in the real world, following them from conception to completion. The course imparts a useful set of content and process skills preparing students for applications in physics, engineering, communication, teaming, hands-on fabrication, and design. SciTech teaches each group what they need to make their device successful. Learning is student-driven, establishing that evaluation of an individual's learning achievement is based on what they can produce with the new ideas, not on the amount of information they can store through memorizing. SciTech prepares students to perform in industry and university work environments with industry level evaluation by professional engineers.

Essential Knowledge and Skills of the course:

(a) General requirements. This course is recommended for students in Grade 9. There is no prerequisite for this course.

(b) Introduction. In SciTech students develop into complex, collaborative thinkers who research, explore and implement mechanical engineering solutions to local and community challenges, and effectively apply telecommunications in this process using proper laboratory and woodshop safety procedures and directed and reviewed by the teacher throughout the course.

(c) Knowledge and Skills.

(1) The student becomes a collaborative worker. The student is expected to:

(A) Use and amplify individual strengths to contribute to the efforts of the design team.

(B) Present an individual design to the group, including a function description, design sketch, and a pros/cons self-analysis.

(C) Define group structure, including group roles, division of labor and group evaluation.

(D) Actively participate in class-wide discussions and hold regular group meetings, the sharing of class and workshop resources, and peer teaching at computer and shop tool skills development.

(E) Contribute to the group conceptualization of the design, including evolving individual ideas into group ideas and building group a consensus, developing a sketch of the design, producing a design function description, producing a friction analysis, and labeling device parts.

(F) Use layout skills to produce layout sketches for the construction phase of the course and a division and sequencing of labor including the procurement of building materials not provided by SciTech.

(2) The student becomes an effective communicator. The student is expected to:

(A) Design, communicate, and justify ideas to be researched throughout the design and production process.

(B) Use computer networking skills to utilize individual accounts and shared student drives; to manage personal files/directories, and research materials and costs on the Internet.

(C) Utilize electronic submission procedures including the use of shared drives, flash drives, and www.turnitin.com.

(D) Use professional written communication to produce a complete resume, a final design report, and a final report reflecting their functioning device.

(E) Use professional visual communication (Solidworks) to produce a complete set of orthographic drawings for the full device assembly and individual parts, and a storyboard for their device function. Use of other visual presentation materials including but not limited to: brochures, Power Point presentations, and posters.

(F) Use professional oral communication to present their design solution to a panel of professional engineers from the local community.

(G) Use various communication techniques to keep a positive group dynamic, including evaluation rubrics, meetings, and group log entries.

(3) The student becomes a quality producer and performer. The student will be able to:

(A) Ensure that their product meets every project specification.

(B) Ensure that all work produced by the individual and group is of world-class quality.

(C) Produce work that demonstrates honesty and integrity.

(D) Follow all science laboratory and CTE safety guidelines.

(4) The student will become a local and global community contributor. The student will be able to:

(A) Reflect on how their problem solving skills enable them to make meaningful contribution to others.

(B) Utilize problem-solving skills to make meaningful contributions to their group and the class as a whole.

(C) Interact, communicate, and collaborate with authentic mechanical engineers from the local community to solve design problems.

(D) Present the products of their work to significant visitors such as school district, university, and community representatives as well as at various school and community showcases and functions such as the Science Academy Symposium and the National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology *(*NCSSSMST) Professional conference.

(5) The student will become a complex and critical thinker. The student will be able to:

(A) Recognize how the interrelationships between their design's individual components affect the refinement of the design idea.

(B) Use orthographic drawing skills to transfer their three-dimensional concepts to the two-dimensional environment of Solidworks.

(C) Establish three-dimensional part relationships thorough Solidworks and drafting skills

(D) Document and analyze energy sources, friction points, energy flowcharts, and design limitations.

(E) Implement experimental design and execution to collect data for various energy sources such as mousetraps, rubber bands, gravitational potential energy, and to analyze each source's working efficiency.

(F) Implement math model design and execution for various function spreadsheets such as wheel and axle, torque, and two-dimensional projectile motion analysis.

(6) The student will become a self-directed learner. The student will be able to:

(A) Reflect upon and recognize how they can most effectively use their time, motivation, and skills to design and implement their solution to the design problem.
(B) Develop skills to search and explore cyberspace responsibly.

(C) Self-assess through logbook entries with an emphasis on goals, time spent on activities, and time management.

(D) Self-reflect through resume development on personal characteristics, history, and strengths/weaknesses

(E) Self-assess problem-solving skills such as but not limited to: computer skills, critical thinking, and teaming skills.

(F) Self-monitor for safe work environment and practices in the work shop.

Description of the specific student needs this course is designed to meet:

The student will design, build, operate, and evaluate a device that meets the requirements and constraints of the class challenge using the Engineering Design Algorithm. The student will apply real world problem solving and critical thinking skills at every step of the design process and in team/class interactions. The student will learn to: collaborate with peers to collectively solve the design challenge; communicate effectively in both written project design reports and oral presentations to professional engineers; develop a strong sense of personal responsibility, self motivation, ethics, and an aptitude for following directions; recognize and evaluate quality in both individual and group performance; master basic usage of a variety of hand and power tools, as well as the engineering design software Solidworks.

Major resources and materials to be used in the course:

SciTech requires teachers to have an understanding of the AAAS (American Association for the Advancement of Science) Project 2061 report, physics, basic draftsmanship, and wood working skills. The teacher needs to have access to basic physics lab supplies, mechanical engineering teaching aides, and safety videos.

Resources required per student include one computer with MS Office, Solidworks, and Internet access. In addition, students need access to a fully outfitted woodshop with safety equipment, electric hand tools, hand tools, and machinery including band saws, drill presses, and rod shearers.

Required activities and sample optional activities to be used:

Skills development in physics, technology, problem solving and teaming (3 weeks)

- One day mini design projects
- Drafting and physics instruction
- Various Solidworks, Word, and Excel activities geared to teaching the programs
- Woodshop Safety instruction

Group Design Process

- Brainstorm individual solutions
- Work in groups of 2 to 3 students to create a final design report including design specifications, a bill of materials, energy and mass analyses, orthographic drawings of all parts of their device using Solidworks, Excel, and Word.
- Panel review of design concepts by professional engineers from the community
- Build, test, and analyze design to create a functioning device

Methods for evaluating student outcomes:

SciTech uses several methods of evaluating student outcomes. These include, but are not limited to:

- Student log entries, which include daily entry of the students class notes, student observations of the progress and performance of the development of their prototype, a daily listing of four benchmarks of their progress—First, What did I do learn today in SciTech, and why? Second, What must I prepare or procure to make tomorrow more productive? Third, What percentage of my goals is complete? and Fourth, What factors or people contributed to my success in SciTech today either positively or negatively?
- Safety testing, both written and practical. Oral quizzing about all aspects of the course and a comprehensive end of semester examination.
- Peer and self evaluation at several key junctures in the course allowing the students to evaluate both their own and their team members contributions and performance.
- Direct interpersonal teacher/student interviews on several occasions to evaluate understanding of materials to date a preparedness to move forward.
- Teacher supervision provides opportunities to maintain safe working conditions and an informal observation. Formal observations are made at key junctures (such at the demonstration of the working prototype) and are required for movement to the next step of the project.
- Major student reports evaluate both the ability of the students to work with a group and the groups' performance as a whole.
- Course evaluation meeting where all students are given a chance to evaluate SciTech and offer suggestions for improvement.

Teacher Qualifications:

The teachers for this course must be certified in the area of Physical Science or Composite Science. There must be at least one Career and Technology Education (CTE) teacher on the SciTech teaching team.

Additional information (optional):

Austin ISD