# Science, Technology, Engineering, and Mathematics: Engineering and Technology

## Career Pathway Plan of Study for Learners, Parents, Counselors, Teachers/Faculty

This Career Pathway Plan of Study (based on the Engineering and Technology Pathway of the Science, Technology, Engineering, and Mathematics Career Cluster) can serve as a guide, along with other career planning materials, as learners continue on a career path. Courses listed within this plan are only recommended coursework and should be individualized to meet each learner’s educational and career goals.

*This Plan of Study, used for learners at an educational institution, should be customized with course titles and appropriate high school graduation requirements as well as college entrance requirements.*

<table>
<thead>
<tr>
<th>EDUCATION LEVELS</th>
<th>GRADE</th>
<th>English/Language Arts</th>
<th>Math</th>
<th>Science</th>
<th>Social Studies/Sciences</th>
<th>Other Required Courses and/or Degree Major Courses for Engineering and Technology Pathway</th>
<th>SAMPLE Occupations Relating to This Pathway</th>
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<tbody>
<tr>
<td>SECONDARY</td>
<td>9</td>
<td>English/Language Arts I</td>
<td>Algebra I or Geometry</td>
<td>Biology</td>
<td>State History Civics</td>
<td>• Introduction to Engineering Design</td>
<td>• Aeronautical Engineer</td>
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<td>10 English/Language Arts II</td>
<td>Geometry or Algebra II</td>
<td>Chemistry</td>
<td>U.S. History</td>
<td>• Principles of Engineering</td>
<td>• Aerospace Engineer</td>
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<td>11 English/Language Arts III</td>
<td>Algebra II or Trigonometry Pre-Calculus or Statistics</td>
<td>Physics</td>
<td>World History World Geography</td>
<td>• Information Technology Applications</td>
<td>• Agricultural Engineer</td>
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<td>12</td>
<td>English/Language Arts IV</td>
<td>Trigonometry or Pre-Calculus/Calculus or AP Calculus or Math Analysis</td>
<td>AP Science or Structured Computer Program Language</td>
<td>Economics Entrepreneurship</td>
<td>• Product Engineering and Development</td>
<td>• Architectural Engineer</td>
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<td></td>
<td>• Digital Electronics</td>
<td>• Automotive Engineer</td>
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<td>POSTSECONDARY</td>
<td>13</td>
<td>English Composition English Literature</td>
<td>Algebra or Trigonometry Calculus I Calculus II</td>
<td>Chemistry Physics I</td>
<td>Psychology Global Issues</td>
<td>• Civil Engineering and Architecture</td>
<td>• Biomedical Engineer</td>
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<td>• Engineering Innovation</td>
<td>• Biotechnology Engineer</td>
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<td>14</td>
<td>Speech/Oral Communication Professional and Technical Writing</td>
<td>Introduction to Differential Equations Calculus III Statistics</td>
<td>Physics II Biology</td>
<td>American History Sociology Ethics and Legal Issues</td>
<td>• Engineering Processes</td>
<td>• CAD Technician</td>
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<td>• Chemical Engineer</td>
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<td>15</td>
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<td>• Continue Courses in the Area of Specialization</td>
<td>• Civil Engineer</td>
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<td>16</td>
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<td></td>
<td>• Complete Engineering and Technology Major (4-Year Degree Program)</td>
<td>• Communications Engineer</td>
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<td>Continue courses in the area of specialization.</td>
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<td>• Computer Engineer</td>
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</tbody>
</table>

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*College Placement Assessments-Academic/Career Advisement Provided

*Articulation/Dual Credit Transcribed-Postsecondary courses may be taken/moved to the secondary level for articulation/dual credit purposes.

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Creating Your Institution’s Own Instructional Plan of Study

With a team of partners (secondary/postsecondary teachers and faculty, counselors, business/industry representatives, instructional leaders, and administrators), use the following steps to develop your own scope and sequence of career and technical courses as well as degree major courses for your institution’s plan of study.

1. Crosswalk the Cluster Foundation Knowledge and Skills (available at http://www.careerclusters.org/goto.cfm?id=96) to the content of your existing secondary and postsecondary programs/courses.

2. Crosswalk the Pathway Knowledge and Skills (available at http://www.careerclusters.org/goto.cfm?id=73) to the content of your existing secondary/postsecondary programs and courses.

3. Based on the crosswalks in steps 1 and 2, determine which existing programs/courses would adequately align to (cover) the knowledge and skills. These programs/courses would be revised to tighten up any alignment weaknesses and would become a part of a sequence of courses to address this pathway.

4. Based on the crosswalks in steps 1 and 2, determine what new courses need to be added to address any alignment weaknesses.

5. Sequence the content and learner outcomes of the existing programs/courses identified in step 3 and new courses identified in step 4 into a course sequence leading to preparation for all occupations within this pathway. (See list of occupations on page 1 of this document.)

6. The goal of this process would be a series of courses and their descriptions. The names of these courses would be inserted into the Career and Technical Courses column on the Plan of Study on page 1 of this document.

7. Below is a sample result of steps 1-6, and these course titles are inserted into the Plan of Study on page 1 of this document.

8. Crosswalk your state academic standards and applicable national standards (e.g., for mathematics, science, history, language arts, etc.) to the sequence of courses formulated in step 6.
SAMPLE

Below are suggested courses that could result from steps 1-6 above. However, as an educational institution, course titles, descriptions and the sequence will be your own. This is a good model of courses for you to use as an example and to help you jump-start your process. Course content may be taught as concepts within other courses, or as modules or units of instruction.

The following course is based on the Cluster Foundation Knowledge and Skills found at http://www.careerclusters.org/goto.cfm?id=96. These skills are reinforced through participation in student organization activities.

#1
Introduction to Engineering Design: This course helps students understand the field of engineering/engineering technology. Students are encouraged to use a problem-solving model to improve existing products and invent new ones. They learn how to apply this model to solve any problems, even outside of the classroom. Students use sophisticated three-dimension modeling software to communicate the details of these products. Emphasis is placed on analyzing potential solutions and communicating ideas to others. This may be taught as a career exploration course in conjunction with other foundation Career Cluster courses.

The following courses are based on the Cluster Foundation Knowledge and Skills as well as the Pathway Knowledge and Skills found at http://www.careerclusters.org/goto.cfm?id=73. These skills are reinforced through participation in student organization activities.

#2
Principles of Engineering: This course helps students explore various technology and manufacturing processes and systems to learn how engineers and technicians use mathematics, science and technology in an engineering problem-solving process to benefit people. This course also includes concerns about social and political consequences of technological change.

#3
Information Technology Applications: Students will use technology tools to manage personal schedules and contact information, create memos and notes, prepare simple reports and other business communications, manage computer operations and file storage, and use electronic mail, Internet applications and GIS to communicate, search for and access information. Students will develop skills related to word processing, database management and spreadsheet applications.

The following courses expose students to Pathway Knowledge and Skills found at http://www.careerclusters.org/goto.cfm?id=73 and should include appropriate student activities.

#4
Product Engineering and Development: Students will learn concepts of product engineering and development using robotics and automated manufacturing techniques and process systems. Concepts of three-dimensional designs and the use of modeling software integrate with lean and agile applications. The focus is on teams who work together as concurrent development organizations where life cycle of the product is analyzed and all concepts of the product are applied.

#5
Digital Electronics: This course teaches students the application of electronic circuits and devices. Students will use their knowledge of both computer simulation and breadboards to design, build and test their own circuits. Students become skilled at using a mathematical logic approach to simplify complex circuits.

#6
Civil Engineering and Architecture: Students will learn about various aspects of civil engineering and architecture through a long-term project that involves the development of a local property site modeling the real-world experiences of practicing civil engineers and architects. The course of study includes the roles of civil engineers and architects, project and site planning, building design, and project documentation and presentation.

#7
Engineering Innovation: Students will utilize ethical and professional practices to work in teams to apply a research and problem-solving model to solve problems of their own choosing. Students will apply engineering principles and be guided by a community mentor. Students will brainstorm possibilities, research current patents and regulations, construct a working model, test the model, document their designs, and present and defend the design to a panel of experts.

#8
Engineering Analysis: Students will study the integrated development of linear algebra and statistics emphasizing engineering applications and incorporating computer exercises involving matrix techniques and calculations using available software packages. Students will choose or create models and other appropriate statistical methods to analyze data and help make decisions.

#9
Engineering Design: This course provides an introduction to the techniques for creating solid models of engineering designs. Topics include three-dimensional modeling of parts and assemblies, visualization, orthographic and isometric free-hand sketching, and computer-generated design documentation. Students will examine elements of the design process including the history of innovation and invention and application concepts of design. Students will demonstrate and apply the design process by designing and/or altering a system, product or service.

#10
Engineering Processes: Students will use mathematics, science and technology concepts and processes to solve problems in engineering projects. Students will apply technological concepts and principles, model technical competence in project and system management, and safely use a variety of tools, machines, equipment, materials and various measuring methods and instruments.