

H-F-M BOCES Two-Year High School Technology Program

The Business and Education Alliance has identified two barriers to preparing entry-level technicians:

- Residents of the area are generally unaware of the growth in diversity of industry sectors.
- Students who graduate from the area's high schools have not necessarily obtained the skills needed to work in a high-tech industry or to become enrolled in college high-tech programs.

To address the barriers identified by the Alliance, FMCC, in partnership with the H-F-M BOCES, plans to develop and implement a new 11th and 12th grade H-F-M BOCES High School Technology program. The curricular units to be developed will contribute to a better prepared workforce by providing students:

- opportunities to explore current and emerging fields of engineering technology and careers.
- new educational pathways and academic preparation for those interested in pursuing technician and engineering training and education either at FMCC, or at other two- or four-year colleges.
- unique motivational opportunities to earn 15 semester hours of college credits during 11th and 12th grades to be applicable to STEM programs at FMCC or elsewhere.

In addition to H-F-M BOCES STEM curricular units providing students from component high schools opportunities to earn college credit during 11th and 12th grades, these students could participate in FMCC's Early Admission program (see Appendix Item 4: FMCC Early Admission Program) should they wish to complete additional technology and engineering program requirements at FMCC. Also, students in the program will have access to college facilities and resources such as the FMCC library and academic support services.

As a pre-grant activity, a curriculum development committee consisting of an industry representative and faculty from FMCC, H-F-M BOCES, and a component high school met and composed program outcomes and the following student learning outcomes to guide curriculum development and project assessment. Here is a sample: (Also see Appendix Item 5: A Sample of Measurable Program Outcomes)

H-F-M BOCES Two-Year High School Technology Program Student Learning Outcomes

(What the students should know and be able to do)

1. Apply informed engineering design iteratively to complete a project. (Possible steps: Define the problem, clarify specifications/constraints, conduct research, generate alternative design solutions, select optimal solution, develop prototype, test/evaluate, refine, and communicate process/results.)
2. Use computer-aided engineering design to address challenges.
3. Describe the fabrication process involved in producing integrated circuits, semiconductor devices and fiber optic components.
4. Work in small groups to accomplish goals, while interacting effectively with others.
5. Solve engineering technology problems, applying relevant principles of mechanics; heat/thermodynamics; structure of matter; electricity/magnetism; and sound/electromagnetic waves.

6. Apply algebra and trigonometry to solve problems in physics and engineering technology.
7. Relate engineering/technological fields to their impact on individuals, society, and the environment.
8. Cite and describe career pathways in STEM fields.

The curriculum development committee also created a two-year framework that will serve as a foundation for developing curricular units addressing mathematics, science and technology (MST) content from the New York State and ITEA Standards. The framework lists year one and year two curricular unit topics (a curricular unit is treated in one to three weeks, including lab and design challenge time) and a timeline that shows sequence of presentations. (See Appendix Item 6: Proposed H-F-M BOCES Two-Year High School Technology Program Under TEPP - Year 1 and Year 2 Samples)

Design projects that require team work will be an integral part of the two-year high school program. Since adequate preparation in problem solving skills is of great benefit to those pursuing success in post-secondary technician education, the STEM Vertical Alignment model will place major emphasis on how to develop basic problem solving skills (see Insert 1: A Skill Set From the 21st Century Skills Project⁷, for a sample of relevant general skills.)

Insert 1: A Skill Set from the 21st Century Skills Project

Schools must align classroom environments with real world environments to help students face the rigors of coursework, career challenges, and a globally competitive workforce. Students must be able to:

- apply information and communication skills,
- think critically and systematically while problem solving,
- practice productive interpersonal and self-direction skills,
- behave in ways that show global awareness, and
- demonstrate literacy concerning financial, economic, and entrepreneurial issues.

that students visit sites in the area to become exposed to industrial processes through observation and from presentations by practicing technicians and engineers.

The H-F-M BOCES STEM curricular units for 11th and 12 grades will highlight technician and engineering career pathways, and foster collegial relationships among high school and community college faculty members through assessment and joint curriculum and program development activities. The curriculum development committee has determined that the three textbooks that are described next will be integral parts of the curricular units.

Coursework in each of the two years of the H-F-M BOCES High School Technology program will feature materials developed through NSF ATE funding (CCfT, DUE 0603403) and published by Delmar Cengage Learning (© 2010, ISBN-13: 978-1-4180-7389-3). The *Engineering and Technology* instructional program includes a core textbook, student activity guide, and instructor guide that engage high school technology learners through challenges and experiences having to do with several broad contexts: physical technology, information technology, and technology in the living world. (See Appendix Item 7: *Engineering and Technology* Chapter Outline)

The CCfT activities apply “informed design” pedagogy that were developed and validated during several large-scale NSF-funded ATE projects managed by co-authors David Burghardt, Michael Hacker, and Richard Prestopnik (PI for TEPP). Informed design has students enhance their own related knowledge and skill base before attempting to develop design solutions. Research, inquiry, and analysis foster discourse and cultivate language proficiency. To provide the foundation for informed design, the student activities engage groups of learners in a progression of knowledge and skill builders (KSBs) – short, focused activities designed to teach salient

concepts and skills. KSBs prepare students to approach design challenges from a knowledge base and to consistently provide evidence for their ideas.

The CC/T curricular materials were developed by a team of content specialists and educators who have directed Centers in Information Technology and Biotechnology, such as the Hofstra University Center for Technological Literacy, and the FMCC NASA Center for Spatial Information Technology. The curricular materials are driven by the ITEA Standards and include:

- readings, student “informed design” inquiries, assessment items, further investigations, and a set of design features that present chapter ideas within an engineering context.
- “Technology and People” that introduces the readers to women and men who have made meaningful and interesting technological contributions.
- “Technology in the Real World” that includes articles that showcase interesting innovations and trends, extreme engineering, and socio-technological impacts.
- “Careers in Technology,” that encourages students to pursue promising careers as technicians.

The two-year H-F-M BOCES high school program will also make use of the textbook *Conceptual Physics* by Paul Hewitt, 10th edition, 2009, published by Pearson Addison-Wesley. The book introduces physics concepts in the context of relevant everyday situations. Chapters include projects that students carry out at home or in the lab using readily available materials. The students will use the FMCC’s physics lab regularly for lab work. The lab is equipped with computers, and many of the investigations use software, computer interface and a variety of sensors from Vernier Software and Technology for collecting data and for graphing.

The mathematics textbook to be used is *Algebra 2: Learning in Context*, 2008, published by CORD Communications. Mathematics concepts are introduced and applied in the context of the workplace. Each chapter has math labs where small student groups collect data, calculate, and discuss results. The lab activities emphasize hands on learning, and graphing calculators are used throughout the book. The algebra and the trigonometry that the students apply from this book will be seamlessly integrated with coursework in physics and the various technologies.

The TEPP management team visualizes development of the H-F-M BOCES Two-Year High School Technology program progressing in this way:

Year one (2010-2011) - The curriculum development committee will refine the project timeline and schedule the project meetings. They then will develop 30 curricular units for the first year, following the framework developed for that purpose, and begin development of the 30 curricular units for the second year of the program. A detailed instructional plan will be followed to ensure that each unit addresses the ITEA Standards, and the New York State MST Standards that drive New York evaluation measures, as well as FMCC’s student learning outcomes for five courses. This will allow students completing the two-year program to earn 15 semester hours of college credits and up to seven high school STEM credits from their respective high schools.

Starting in fall 2010, recruitment of the first cohort of up to 24 11th grade students will begin and will intensify during the late winter and spring of 2011. H-F-M BOCES staff will select the participants from a pool of 10th grade students nominated by their teachers and high school guidance counselors. Selection criteria will include such factors as grade point average and successful completion of high school algebra.

The following steps will be taken by H-F-M BOCES to promote this new program:

- Criteria developed for selection of students for new program.
- Program presentation to the component schools’ superintendents at a monthly Leadership Team meeting (October, 2010). Share same information with H-F-M Business and Education Alliance.

- Presentation to the component schools' high school principals during a monthly Secondary Principal's meeting (October or November, 2010).
- Presentation to the component schools' guidance counselors during an annual Counselor's meeting (October 2010).
- Curriculum information and program description shared among the mathematics/science department chairpersons in the component school districts.
- Guidance counselors from component high schools and/or science/mathematics teachers identify students interested in this emerging technological opportunity.
- H-F-M BOCES Career and Technical representatives along with FMCC personnel meet with students who have been identified as having an interest in the program (Spring 2011).
- Open house held for parents and students interested in the program; information and tours of H-F-M BOCES and FMCC will be a part of the session.

Year two (2011-2012) - The H-F-M BOCES High School Technology program will provide instruction for the first cohort of 11th grade students in the new STEM units of the exploratory technology program. This half-day (400 hours) component will run for the full H-F-M BOCES academic year (September-June). Recruitment and selection of the second cohort of 24 11th grade students will take place; the curriculum development committee will complete work on the 30 units for the second year of the program; the students, curriculum development committee, advisory council, and the external evaluator will evaluate the first year of the program and the results will be used to improve the curricular materials and their delivery for the following year.

Year three (2012-2013) - The second cohort of 11th grade students will enter the first year of the H-F-M BOCES high school technology program and experience the 30 revised curricular units of the exploratory technology program. The first cohort of 11th grade students will advance to the 12th grade (the second year of the High School Technology program). This half-day (400 hour) component of the program also will run for the full academic year and will feature 12th grade technician education. Students will have a capstone experience in the form of a two-week internship at a business or industry associated with their coursework. The internship is required of second-year students enrolled in Career and Technical Education programs at H-F-M BOCES. Year-long evaluation data for the second-year program gathered through students, curriculum development committee, advisory council, and the external project evaluator will be used to improve the curricular materials and their delivery for the following year. Recruitment and selection of the third cohort of 11th grade students also will take place during the third year of the project.

Program description from the HFM BOCES website:

http://www.hfmboces.org/HFMStudentServices/Career_and_Tech/Engineeringtech.htm

Video that describes the program:

<http://hfm.welearntube.org/?q=node/15>

