**Summary of the Higher Education Faculty Reviewers Meeting for the**

***Revised Science and Technology/Engineering Standards***

**December 7, 2015,** 11:30a.m.-2:00p.m.

University of Massachusetts Collaborative Services Facility, Shrewsbury, MA

The Department of Higher Education (DHE) and the Department of Elementary and Secondary Education (ESE) convened higher education faculty representing science and engineering disciplines to review draft revised Science and Technology/Engineering (STE) standards to evaluate how well the standards prepare students for success in introductory college courses.

**Key Points**

* Participants agreed that students taking a high school course in a particular subject prepares the students to be successful in a corresponding introductory college course.
* Participants agreed[[1]](#footnote-1) that students taking three high school science or engineering courses in subjects other than the faculty’s own prepares students to be successful in an introductory college course in the faculty’s own subject provided the science and engineering practices (critical/analytical thinking) are well developed.
* Participants valued the integration of disciplinary core ideas with science and engineering practices. As one faculty member noted:

*It’s really easy to make science complex. It’s really hard to simplify it.*

* Participants emphasized the need to attend to relevance and application of content to real-world needs and problems to encourage student interest and motivation.
* Participants emphasized the need for students to have a strong mathematics preparation.

**Faculty Recruitment**

Sue Lane from the DHE coordinated the outreach to state colleges and universities. She contacted leadership of the various state institutions with a request for leaders to identify or nominate faculty in different subject areas. After names were submitted, Sue coordinated a meeting date and invited all identified faculty to participate, with a preference for in-person participation, if possible. All faculty were asked to review the draft revised STE standards and invited to provide written comments, particularly if they were not able to attend the in-person meeting. Not all nominated and invited faculty participated or submitted comments.

**Faculty Participation**

*Present for in-person discussion (underlines indicate faculty submitted written comments as well):* Kristin Chon (Framingham State University), Alex Fowler (UMass Dartmouth), Allen Gontz (UMass Boston), Liz Gordon (Fitchburg State University), Patrick Gordon (Cape Cod Community College), Lisa Grimm (Fitchburg State University), Chris Himes (MCLA), David Keil (Framingham State University), Kate LePore (Cape Cod Community College), Mark Reinhold (Northern Essex Community College), Nick Stroud (MCLA), Jay Wang (UMass Dartmouth), Stephen Witzig (UMass Dartmouth), Jiang Yu (Fitchburg State University), Reema Zeineldin (Mount Ida College)

*Summited written comments only***:** Paul Chanley (Northern Essex Community College), Sumudu Lewis (UMass Lowell), Alexia Pollack (UMass Boston)

**Summary Notes**

Jake Foster from ESE presented an overview of the revised STE standards, including the vision of the standards and what the intended changes include at a broad scale, the science and engineering practices ([http://www.doe.mass.edu/stem/resources/SciEngPractices-Matrix.pdf),](http://www.doe.mass.edu/stem/ste/) and the draft definition of College Career Readiness for STE (see below). Participants reviewed the context and purpose of the meeting, specifically to discuss whether the STE standards prepare students for entering introductory college science courses (for general education students, not STEM majors). Faculty then worked in small content groups (Physical Science, Life Science, Earth and Space Science, and Engineering) to respond to three questions, summarized below:

1. **If a student enters your introductory college science course having taken the corresponding high school course, would they likely be successful in your course?**

* **Are there any concepts you would not consider “critical” for an entering student?**
* **Are there any critical concepts missing?**
* **Assume students would be proficient with and able to do the high school standards in that course.**

**Physical Science** (includes Chemistry and Physics)

The group agreed that the concepts in the high school standards provide a strong foundation for introductory college courses and that no significant concepts were missing. They noted many of the high school topics are the same as what they teach in college, but at a bit more of a foundational level. One chemistry faculty member noted the high school chemistry standards are more than a general education student would need. They did like the addition of waves and fields to the revised standards. They would like to see an emphasis on mathematics including, graphing and mathematical representations (i.e., pictorial, graphical, and mathematical). The group expressed concern about how mathematics is taught in high school and what the high school mathematics expectations are.

**Earth and Space Science**

The group agreed that the concepts provide a solid foundation for earth and space science at the college level. Possible additions could include spatial analysis, the concept of deep time, and paleo-climate.

**Life Science**

The group emphasized the importance of focusing on the major concepts without being bogged down in the details and agreed that the high school standards do a good job at this. They suggested discussing conservation of matter and energy at earlier grades (grade 5 or 6) and that microorganisms are missing from the standards and could be used as examples for decomposition. The group, including a professor of Biology, who had also been a high school biology teacher, expressed that there may be too many standards for high school biology. They described that introductory college biology courses address very similar material as high school honors biology courses.

**Engineering**

The two engineering faculty were split on opinions for the high school technology/engineering standards; one participated in person and other submitted comments (see attached) so there was no opportunity to achieve consensus. The professor at the meeting highlighted the importance of having technology/engineering standards with the science standards, using science concepts to apply to engineering, and that the standards are highly motivational to engage and interest students to go into the engineering field. He noted that the technology/engineering standards could include more worldwide problems to enhance relevance and application across contexts. He also expressed concern that elementary and middle school teachers likely do not have enough background knowledge to teach the content and that students need better mathematics preparation before taking an engineering course. The engineering faculty member who submitted comments stated that the high school course sets up students for success in an introductory college course.

1. **If a student enters your introductory college science course NOT having taken a high school course in your subject, but having taken three different high school courses, would they likely be successful in your course?**

* **What concepts and/or practices from the other courses would you consider “most critical” for an entering student?**
* **May want to look at middle school for your content area.**
* **Assume students would be proficient with and able to do the high school standards in those three courses.**
* **Assume all the high school courses include the practices (those are consistent across the courses).**

**Physical Science**

The group agreed, provided that the students were able to critically think, because they would use the science and engineering practices to learn new science content. The group emphasized the need for a strong mathematics foundation for physics and chemistry and would like to see students not just analyzing data but also criticizing data.

**Earth and Space Science**

Earth Science is taught less in high school than the other subjects so it is very common for students to not have had a high school earth science course before taking, and succeeding, in an ESS college course. If the students took life and physical science it increases their understanding of earth and space science. They noted that the revised STE standards even at a middle school level are better than the current MA standards.

**Life Science**

The group agreed that students would be successful if the other high school courses focused on the integration of science practices and critical thinking. The professor’s current assumption is that students have not had any of the life science material before they come into their college class. Again, the topics taught in college introductory biology are very similar to the high school standards so it is possible to succeed without having taken a high school biology class.

**Technology/Engineering**

The engineering faculty member argued that students need to take introductory physics before taking engineering courses and also stressed the importance of the science and engineering practices. He did not believe that students would succeed in an introductory engineering course without having taken a prior quantitative science or engineering course (preferably physics). (Note: the written submission from the second engineering professor did not directly address this question).

1. **Do the STE standards prepare students for entering introductory college science courses for STEM majors?**

Participants argued that the question actually didn’t make sense; that it is not a matter of one particular high school course that would be the deciding factor in preparing a student for a STEM major. Pathways to a STEM major can be varied and whether a student is prepared for a STEM major requires looking at the full set of courses a student has taken. Participants felt the better question to ask was “Do the STE standards *excite* students to consider a STEM major?”

Most faculty contributed comments and input during the in-person meeting; five submitted written comments.

**Draft Definition of College and Career Readiness for STE**

The input of this panel reinforces key elements of the draft definition of college and career readiness for science and technology/engineering:

Essential Competencies: Learning

Students who are college and career ready in Science and Technology/Engineering will demonstrate the academic knowledge, skills, and practices necessary to enter into and succeed in entry-level, credit-bearing science, engineering or technical courses; certificate or workplace training programs requiring an equivalent level of science; or a comparable entry-level science or technical course at the institution. College and career ready students in Science and Technology/Engineering will be academically prepared to:

* Analyze scientific phenomena and solve technical problems in real-world contexts using relevant science and engineering practices and disciplinary core ideas.
* Use appropriate scientific and technical reasoning to support, critique, and communicate scientific and technical claims and decisions.
* Appropriately apply relevant mathematics in scientific and technical contexts.

This definition was developed in 2013 as part of the STE standards revision process in which a number of regional sessions involving K-12, higher education, and business representatives were held in partnership with the DHE. This paragraph is intended to be inserted into the state’s definition of College and Career Readiness to complement the paragraphs already there on mathematics and English language arts.

1. With the exception of one Engineering faculty member. [↑](#footnote-ref-1)