TO: Paul Hambleton, Chief Academic Officer, Maine Department of Education  
FROM: Thomas E. Keller, Ed.D.  
DATE: 27 February 2018 (revised 4 pm 2/27/18)  
RE: State science standards review

My name is Tom Keller and I have been a science educator for over 30 years. In that time, I have been a science teacher, a state science supervisor, a school curriculum administrator, a senior program officer at the National Academy of Sciences, and a senior research scientist. This is my personal statement, based upon those 30+ years of experience, and do not represent the views of any organization with which I am or was associated.

There are four major issues with the current Maine Learning Results (MLRs) in Science and Technology.

1. Separation of content and process – the current MLRs are in two different chapters of the law. This has had the unfortunate consequence of splitting science into content (in one chapter on federal accountability standards) and process (in a different chapter on essential parameters for instruction). This policy requires the exact opposite of where research says we should be, that science need to engage in the practices of science to help them understand how scientific knowledge develops.

2. Testing focus on content – with the content pieces of the science MLRs in the chapter on federal accountability, our Maine Educational Assessment focuses instruction on the teaching of content. The analogy that content is a pile of bricks that need to be skillfully crafted into a structure to be useful is a good one. Content, especially in the 21st century, is not sufficient preparation for a time when critical thinking and innovative and use that pile of bricks to build a skyscraper or a Mars launch facility.

3. Not informed by current research – significant research on learning has been undertaken in the past few years and is not reflected in the current MLRs. For example, in many of the preK-2 standards, there are either no performance indicators or very low level ones using verbs like identify or observe. Current research shows that kindergarteners have sophisticated ways of thinking. Work of the National Academy of Sciences, the premier, non-governmental science institution in the country has released several key research reports since 2007.

4. Exclusive of engineering – the current MLRs mention engineers once and engineering once. This vital career path is virtually ignored, and Maine students are given no introduction to engineering, yet Maine is begging for more engineers. Maine ranks 49th in national production of engineers with a BS degree. This is an opportunity to show the common lineage of science and engineering in practices, core ideas and crosscutting concepts.

As a senior program officer at the National Academy of Sciences, I co-directed development of the Framework for K-12 Science Education. This Framework detailed the scientific and engineering practices, disciplinary core ideas and crosscutting concepts that students need to know and be able to do to prepare them for the 21st century. So said a committee of 18, comprised of 9 members of the National Academy of Sciences or National Academy of
Engineering including a Nobel Laureate in chemistry and one in physics, and 9 members who are leaders in their fields of cognition, learning sciences, education policy, education research and educational practitioners. The veracity of such an esteemed group is beyond reproach.

The Framework is based on educational research conducted within the past twenty years. Central to this body of research is the agreement that memorizing content is an insufficient background for either career or further study. For true learning to occur, students must engage in science and engineering through practices as do scientists and engineers as they consider core ideas and crosscutting concepts. In today’s age of the freely available data through ‘Siri’ or ‘Alexa’, facts or content alone are easily located but it is what students do with their facts, how they learn to think critically with them that is important. It is more about figuring out than learning about.

Ask any employer about what they want in new employees – what they will say is that they want employees who are critical thinkers, ones who can integrate across boundaries, and ones who can communicate effectively and from evidence. Basic knowledge is important, but it may be more important that students know what to do with this knowledge.

That is what a 21st century set of science learning standards will do for Maine students.

Maine teachers helped create such a set of standards 3 years ago, and most Maine districts have already adopted them and spent hundreds of thousands of dollars implementing them. The Framework was the foundation of the Next Generation Science Standards which Maine should review and adopt.

Maine teachers can take these standards and create units and lessons by using their creativity. It is time to let Maine students obtain a science education worthy of this century.

Thank you.