National Center for
Technological Literacy®
Museum of Science, Boston

Science Park
Boston, MA 02114-1099
www.nctl.org

Response to the
House Education and Labor Committee
draft of
No Child Left Behind Reauthorization
from the
National Center for Technological Literacy ©
Museum of Science, Boston

Dr. Ioannis Miaoulis, NCTL© Director and President of the Museum of Science
Ms. Patti Curtis, Managing Director, Washington Office of the NCTL©

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We appreciate the opportunity to provide the House Education and Labor Committee suggestions and recommendations regarding the reauthorization of the Elementary and Secondary Education Act and the No Child Left Behind Act.

The National Center for Technological Literacy® (NCTL®) at the Museum of Science, Boston aims to enhance teacher and student knowledge of technology and engineering and to inspire the next generation of engineers, inventors, and innovators. Unique in recognizing that a 21st-century curriculum must include today's human-made world, the goal of the NCTL is to introduce engineering as early as elementary school and continue it through high school. The National Center for Technological Literacy works nationwide with leaders in education, government, and industry to integrate engineering as a new discipline.

Our focus is on Technology and Engineering in STEM (science, technology, engineering and mathematics) education and in advancing Technological Literacy. To that end, we provide the following:

Technological Literacy Suggestions for NCLB

(Italic items can and should be done in the near term)

DEFINITIONS

We recommend that technology and engineering education be understood and defined to mean a curriculum and instruction that:

a.) develops an understanding of the many fields of technology and related careers through design skills and the use of materials, tools, processes, and resources;
b.) teaches innovation and the engineering design process using a variety of technologies; and,
c.) enhances proficiency in abstract ideas and in problem solving techniques, through the application of engineering design principles and concepts.

In both the National Science Education Standards (NRC, 1996) and the Benchmarks for Scientific Literacy (AAAS, 1993), the term "technological design" refers to the process that underlies the development of all technologies, from paperclips to space stations. As pointed out in the *National Standards,* this meaning "is not to be confused with 'instructional technology,' which provides students and teachers with exciting tools—such as computers—to conduct inquiry and to understand science." The National Standards defines technology and its relationship to science as follows:

> "As used in the Standards, the central distinguishing characteristic between science and technology is a difference in goal: The goal of science is to understand the natural world, and the goal of technology is to make modifications in the world to meet human needs. Technology as design is included in the Standards as parallel to science as inquiry." (NAEP Science 2009 Framework, p. 24)

We recommend, to avoid confusion and to accurately reflect what is expected, that the NCLB/Enhancing Education Through Technology (EETT) requirement that students be "technology literate" by 8th grade should be revised to read "information and communication technology literacy." The context of that program (educational technologies, i.e. computers, internet, smartboards, calculator, and software use) is far narrower than the definition of Technological Literacy defined by the National Research Council, the National Academy of Engineering, the International Technology Education Association, and the National Center for Technological Literacy.

<u>STANDARDS</u>

We recommend that national grade level standards or expectations be developed for Technology and Engineering as well as in Science and Mathematics. The Standards for Technological Literacy by the ITEA (2000), developed in collaboration with the NAE, should be considered as a base. (National Science Board Draft STEM Action Plan, National Governors Association STEM Agenda, February 2007)

<u>ASSESSMENTS</u>

We support accountability and the inclusion of Science in Adequate Yearly Progress (AYP) requirements or other student achievement growth measures.

We recommend the inclusion of technology and engineering in alternate assessment models or indicators, in addition to science, history, government & writing. (Ed & Labor Draft bill, pg. 67)

We recommend that science assessments in No Child Left Behind should mirror the newly adopted NAEP Science 2009 Framework which includes "Technological Design" as a required skill set. (NAEP)

We recommend that National Assessment Governing Board (NAGB) should study and develop age-appropriate assessments for technological literacy as defined by the National Research Council.

These should initially be integrated into existing NAEP assessments, particularly in science, math and history, and eventually developed into a separate assessment and administered at least once in elementary, middle and high school. NAGB plans to conduct a feasibility study for a technological literacy in 2012. (NAGB)

We suggest that efforts should be taken to recommend that the TIMSS and PISA assessments include technological literacy items. (Tech Tally, NAE & NRC, p.180)

STUDENTS/COURSEWORK

We recommend the inclusion of Engineering AP (development underway) along with other AP, IB, and other advanced and rigorous core postsecondary preparatory courses.

We recommend that the Core Curriculum Development program (Title I, Part I and the Expanded Learning Time Demonstration Program) include technology and engineering instruction.

We recommend that after-school activities be structured to expand student interest in Science, Technology, Engineering, and Mathematics careers, such as exposure to building materials, computer art or design software, design challenges, and other technologies. After-school programs for older students should be used to develop career interests and skills through authentic experiences, such as apprenticeships.

We recommend that the definition of "rigorous curricula," should require that each student take at least one technology/engineering course for graduation. A rigorous technology/engineering course would include the integration of mathematics, science and technology in a project or problem-based engineering context, which results in improved student critical thinking, problem-solving and group collaboration skills. This benefits all students, even if they do not pursue a technical career.

TEACHERS

We recommend that technology and engineering teachers be included alongside math and science teachers in any and all incentive programs enacted to recruit, train, mentor, retain and further educate teachers in order to bring their skills up to 21st century expectations, including the teaching of the engineering and innovation process.

We recommend that the Math & Science Partnerships at both the NSF and the US Department of Education be renamed and retooled to include professional development for technology and engineering teachers. Currently, the law allows for math and science teachers to learn how to use educational technologies. We recommend technology and engineering teachers be eligible participants and the content include the broad array of technologies and the engineering design process.

We recommend when states determine whether teachers are "highly qualified," they should include items that measure technological literacy in their assessments to the extent possible, particularly science, math, technology & engineering teachers. The US Department of Education

should review and reward state plans that move in this direction. (Tech Tally, NAE & NRC, pg. 183)

We recommend that teacher preparation and certification programs include Colleges of Technology and Colleges of Engineering, particularly in preparing technology and engineering teachers, in addition to the Colleges of Education and Arts & Sciences. Engineering is separate from Arts & Sciences and should to be included.

RATIONALE

1. Innovation needs to be taught. To quote the National Science Board (NSB) Action Plan, "American ingenuity, built on a foundation of science and engineering, has led our country to the forefront of innovation and discovery in the 19th and 20th centuries and has changed the basis of our country." While we agree that science and mathematics are important bodies of knowledge and skills, they do not in themselves guarantee that our students will be able to define and solve problems, and make technological breakthroughs. Along with science and mathematics, Pre-K–16 students need to engage in the type of innovative thinking that technology and engineering education provides and that we will ask of them when they leave school and enter the global workplace.

2. Engineering know-how is paramount. There is great confusion among the populace, and even among many educators that "technology" means the ability to use computers, and other modern electronics, so that "technologically literate" has come to mean finding information on the Internet, using spreadsheets, and so on. In fact, the term "technology" refers to all of the ways that people modify the natural world to meet human needs and desires; while "engineering" is the process of improving current technologies and creating new ones. According to the U.S. Bureau of Labor Statistics, our country employs four engineers for every scientist, and NASA employs ten engineers for every scientist. Yet, few students even learn what engineers do unless they happen to have an engineer in the family. Engineering—and technology in the broadest sense of the word—should be included and integrated along with science and mathematics in the grade level expectations for all students.

3. The need for 21st century skills is urgent. Our generation has not even begun to solve such problems as global warming, widespread famine, invasive species, depletion of clean water resources, atmospheric pollution, and countless other problems. It is therefore important that our Pre-K-16 school systems ensure that our students will develop such engineering skills as the ability to define problems in terms of criteria and constraints, to generate and test solutions, to consider trade-offs, to conduct life-cycle analyses, and to reengineer entire systems. These skills are every bit as urgent as the scientific ability to inquire about the natural world, and the mathematical ability to manipulate numbers with insight and skill.

4. Diversity requires new approaches. In order to increase the number of women and people of color who enter STEM fields, it will be necessary to consider new educational ideas and new role models to attract today's youth. Fields such as biomedical, environmental, and agricultural engineering—professions that apply technical knowledge to the improvement of living conditions and quality of life—can have great appeal to many of today's youth, while helping them build the

knowledge and skills that they will need to tackle the most pressing problems of our time. Introducing these concepts and opportunities at school at an early age is our best chance of success.

If you have any questions or need additional resources or support, please contact Patti Curtis at 571.237.6367 or curtisp@mos.org.

RESOURCES

ITEA, Standards for Technological Literacy, 2000, www.iteaconnect.org/TAA/PDFs/xstnd.pdf
National Assessment Governing Board, www.nagb.org
Approved Schedule www.nagb.org/naep/NAEP_schedule_approved_03_07.doc
NAEP Science Frameworks 2009,
http://nagb.org/frameworks/naep_science_framework_2009_re.doc
National Governors Association, STEM Agenda, February 2007,
www.nga.org/Files/pdf/0702INNOVATIONSTEM.PDF
National Science Board, STEM Action Plan Draft www.nsf.gov/nsb/edu_com/report.pdf
Tech Tally, National Academy of Engineering and National Research Council, 2006
www.nap.edu/catalog.php?record_id=11691#toc
Tech Tally Podcast http://media.nap.edu/podcasts/nax9techtallyx.mp3
Technically Speaking, National Academy of Engineering and National Research Council, 2002,
http://books.nap.edu/catalog.php?record_id=10250