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Massachusetts Technology Literacy Standards and Expectations

April 2008

This document was prepared by the
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Dear Colleagues,

I am pleased to present the *Massachusetts Technology Literacy Standards.* This document updates and defines what K–12 students should know and be able to do in order to use technology for learning. The Board of Elementary and Secondary Education voted to approve these standards on April 29, 2008.

I want to thank the Massachusetts Technology Leadership Council (MTLC) for convening a group of educators and business leaders to help the Department review and update our 2001 technology standards and expectations. I also want to thank the many educators across the state who provided their expertise and guidance.

In this revised document we have
- grouped specific technology skills under four grade spans;
- focused on 21st century skills; and
- devoted more attention to digital citizenship, ethics, society, and safety.

The goal of this document is to help students develop technology literacy skills to learn the content of the curriculum, as well as to be able to succeed and thrive in their adult lives. These skills will help them function effectively in a world where new technologies continue to emerge and information grows ever more abundant.

The teaching and learning of these skills should be integrated into the general curriculum, not taught in isolation. As students develop technology skills, they should apply these skills in their classroom, school, and life so that they will understand why these skills are important. An essential benefit of integrating the appropriate use of technology into the curriculum is that it can enhance the learning of the content without overburdening an already full curriculum.

We will continue our work with schools and districts to prepare students for the world of work, higher education, and lifelong learning using multiple technology tools. Thank you for your ongoing support and for your commitment to achieving the goals of education reform.

Sincerely,

Jeffrey Nellhaus
Acting Commissioner of Education

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Massachusetts Technology Literacy Standards

Introduction

In announcing our participation in the Partnership for 21st Century Skills, a national network of states, Governor Deval Patrick said, "Throughout its history, the Commonwealth has been a leader in education. But our world is changing and so we, too, must change in order to ensure our place at the top for the next generation. The vision our administration has laid out will guarantee that Massachusetts students graduate with the tools to allow them to compete not just on the national stage, but with their peers across the globe."[1]

The Partnership for 21st Century Skills states in its *Policymakers' Guide*, "To thrive in the world today, students need higher-end skills, such as the ability to communicate effectively beyond their peer groups, analyze complex information from multiple sources, write or present well-reasoned arguments about nuanced issues and develop solutions to interdisciplinary problems that have no one right answer. In this light, technology is a powerful springboard to higher-level learning."[2]

This publication is designed to help today's students take advantage of the power of technology. It provides a set of guidelines for schools, describing what students should know and be able to do in order to use technology effectively for learning. These guidelines represent realistic, attainable activities that link to the content standards of the *Massachusetts Curriculum Frameworks*.

The Massachusetts Technology Literacy Standards incorporate the Information and Communication Technology (ICT) Literacy skills developed by the Partnership for 21st Century Skills; the National Educational Technology Standards for Students (NETS•S) developed by the International Society for Technology in Education (ISTE); as well as ISTE's 2007 draft NETS Refresh.[3] The Massachusetts Technology Literacy Standards fall into three broad categories:

Standard 1. Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.

This standard includes:
- proficiency in basic productivity tools such as word processing, spreadsheet, database, electronic research, e-mail, and applications for presentations and graphics;
- conceptual understandings of the nature and operation of technology systems; and
- learning and adapting to new and emerging technology tools.

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[1] The announcement is available online at
http://www.21stcenturyskills.org/index.php?option=com_content&task=view&id=328&Itemid=64
[2] *The Road to 21stCentury Learning: A Policymaker's Guide to 21stCentury Skills* (2003) is available online at
http://www.21stcenturyskills.org/images/stories/otherdocs/p21up_Policy_Paper.pdf
[3] See Appendix C and Appendix D.

Standard 2. Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.

This standard
- relates to social, ethical, and human issues. It promotes positive attitudes toward the uses of technology, as well as responsible use of information. This standard also includes recognition of technology's impact on civic participation, the democratic process, and the environment;
- aims to ensure that students understand general rules for safe Internet practices, including how to protect their personal information on the Internet;
- is to help students develop an awareness of the personal image that they convey through the information they post on the Internet;
- aims to ensure that students understand federal and state laws regarding computer crimes; and
- supports students in exhibiting leadership for digital citizenship.

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

This standard:
- focuses on applying a wide range of technology tools to student learning and everyday life;
- aims to ensure that students will be able to use technology to process and analyze information;
- is to help students develop skills for effective technology-based communication;
- includes the use of technology to explore and create new ideas, identify trends, and forecast possibilities; and
- aims to provide students with an awareness of how technology is used in the real world.

Overview of Grade Spans

Although technology opens up exciting avenues for learning, computers should complement, rather than replace successful methods that teachers use to help students develop basic skills and understanding. The Massachusetts Department of Elementary and Secondary Education encourages the use of a wide range of tools, both traditional and technological, to help students gain those understandings. For example, although students may become fluent in keyboarding on a computer, they need to continue developing legible handwriting. By the same token, even though students might become highly skilled in electronic research, they should know how to find a book in the library. Throughout their school years, students will grow to regard technology as one of the many tools they can use to help them solve problems and improve their productivity and their capacity to learn as they move through life.

In this publication, specific technology skills are listed for each grade span. Although these proficiency expectations are recommended by the Department, local school districts make their own decisions about their students' technology proficiency. Local decisions should be based on the accessibility and availability of technology, as well as the developmental readiness of a district's students.

Based on the developmental readiness of the students, this document groups the technology skills in four grade spans:
- Grades K–2
- Grades 3–5
- Grades 6–8
- Grades 9–12

Skills/Knowledge Acquisition

Students can acquire the skills/knowledge enumerated in this document in a variety of ways:
- everyday classroom activities (gaining technology skills while learning the content of the curriculum – see page 18 to page 22)
- specific course work (e.g., taking a Web design course)
- independent study (e.g., supporting a specific project)
- an after-school activity (e.g., publishing a school newsletter)
- peer tutoring (e.g., a high school student coaching a middle school student)
- work at home (Although concerns regarding access to technology by less affluent families are well founded, Department surveys indicate a much higher presence of computers in the homes of low income and limited English proficient families than many educators presume; such surveys at the classroom and school level can be instructive.)

The teaching of technology literacy skills should not be separate from the curriculum. Integrating the appropriate use of technology into the curriculum should enhance the learning of the content. The example on page 23 is a good demonstration of how a school district provides students the technology skills they need, not as a discrete subject, but as "flowing through the curriculum."

In this document, we focus on educational/instructional technology rather than on computer science or engineering standards.

Massachusetts Technology Literacy Standards
Grades K through 2 – Technology Exploratory Skills and Expectations

In the early grades, technology should not replace the manipulatives, pencil-and-paper, and other manual methods through which children acquire basic skills. The *Mathematics Curriculum Framework*, for example, stresses the importance of understanding basic arithmetic operations in elementary school. Given this context, the technology literacy standards for the earliest grade span allow the teacher flexibility in deciding when students are ready to use technology. For this reason, the competencies listed for K–2 are described as exploratory concepts and skills. These are skills that will be introduced and, in some cases, developed in elementary grades and mastered in middle and high school.

Standard 1. Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.

Exploratory Skills and Expectations

Basic Operations

K-2: 1.1   Demonstrate beginning steps in using available hardware and applications (e.g., turn on a computer, launch a program, use a pointing device such as a mouse).

K-2: 1.2   Explain that icons (e.g., recycle bin/trash, folder) are symbols used to signify a command, file, or application.

K-2: 1.3   Identify, locate, and use letters, numbers, and special keys (e.g., space bar, Shift, Delete) on the keyboard.

K-2: 1.4   Recognize the functions of basic file menu commands (e.g., New, Open, Close, Save, Print).

Word Processing and Desktop Publishing

K-2: 1.5   Use a word processing application to write, edit, print, and save simple assignments.

K-2: 1.6   Insert and size a graphic in a word processing document.

Database and Spreadsheet (Tables/Charts and Graphs)

K-2: 1.7   Explain that computers can store and organize information so that it can be searched.

K-2: 1.8   Use a simple computer graphing application to display data.

Internet and Multimedia

K-2: 1.9   Explain that the Internet links computers around the world, allowing people to access information and communicate.

K-2: 1.10   Demonstrate the ability to use tools in painting and/or drawing programs.

Standard 2. Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.

Exploratory Skills and Expectations

<u>Ethics</u>

K-2: 2.1   Follow classroom rules for the responsible use of computers, peripheral devices, and resources.

K-2: 2.2   Explain the importance of giving credit to media creators when using their work in student projects.

<u>Classroom/Society</u>

K-2: 2.3   Explain why there are rules for using technology at home and at school.

K-2: 2.4   Identify the purpose of a media message (to inform, persuade, or entertain).

K-2: 2.5   Describe how people use many types of technologies in their daily lives.

<u>Health and Safety</u>

K-2: 2.6   Follow the school rules for safe and ethical Internet use. (Use of Internet in this grade span is determined by district policy.)

K-2: 2.7   Demonstrate knowledge of ergonomics and electrical safety when using computers.

K-2: 2.8   Explain that a password helps protect the privacy of information.

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

Exploratory Skills and Expectations

<u>Research (Gathering and Using Information)</u>

K-2: 3.1   Use various age-appropriate technologies to locate, collect, and organize information.

K-2: 3.2   Review teacher-selected Internet resources and explain why each resource is or is not useful.

<u>Problem Solving</u>

K-2: 3.3   Use age-appropriate technologies (e.g., a simple graphing application) to gather and analyze data.

<u>Communication & Collaboration</u>

K-2: 3.4   Use a variety of age-appropriate technologies (e.g., drawing program, presentation software) to communicate and exchange ideas.

Massachusetts Technology Literacy Standards

Grades 3 through 5 – Technology Standards and Expectations

By the end of fifth grade, all students should have the opportunity to become familiar with the tools they will be expected to use with proficiency. Through this exposure, they will have gained a positive view of technology as a tool for learning. For example, electronic sources such as multimedia encyclopedias and teacher-previewed Web sites can be used to gather information for a report. Additionally, there are many developmentally appropriate applications for children: interactive books, graphic organizers, and writing assistants, as well as mathematical and scientific tools. Such tools can enhance learning for all children, including those with disabilities; for example, multimedia reading software reinforces literacy skills by providing visual and auditory feedback to early readers. These tools can be integrated appropriately in an effective lesson plan.

Standard 1. Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.

Basic Operations

G3-5: 1.1   Demonstrate basic steps in using available hardware and applications (e.g., log into a computer, connect/disconnect peripherals, upload files from peripherals).

G3-5: 1.2   Select a printer, use print preview, and print a document with the appropriate page setup and orientation.

G3-5: 1.3   Use various operating system features (e.g., open more than one application/program, work with menus, use the taskbar/dock).

G3-5: 1.4   Demonstrate intermediate[4] keyboarding skills and proper[5] keyboarding techniques.

Word Processing/Desktop Publishing

G3-5: 1.5   Use menu/tool bar functions in a word processing program (i.e., font size/style, line spacing, margins) to format, edit, and print a document.

G3-5: 1.6   Copy and paste text and images within a document, as well as from one document to another.

G3-5: 1.7   Proofread and edit writing using appropriate resources (e.g., dictionary, spell-checker, grammar resources).

Database

G3-5: 1.8   Define the term "database" and provide examples from everyday life (e.g., library catalogues, school records, telephone directories).

G3-5: 1.9   Define terms related to databases, such as "record," "field," and "search."

G3-5: 1.10 Do simple searches of existing databases (e.g., online library catalog, electronic encyclopedia).

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[4] By the end of eighth grade, students should have keyboarding skills between 25-30 wpm with fewer than 5 errors. In this grade span, districts determine the intermediate level so that students will reach this standard by the end of eighth grade.
[5] It is a district's decision to determine whether touch-typing skills are needed. However, students should know the proper ergonomics when using the keyboard.

Spreadsheet

G3-5: 1.11 Demonstrate an understanding of the spreadsheet as a tool to record, organize, and graph information.

G3-5: 1.12 Identify and explain terms and concepts related to spreadsheets (i.e., cell, column, row, values, labels, chart, graph).

G3-5: 1.13 Enter/edit data in spreadsheets and perform calculations using simple formulas (+, -, *, /), observing the changes that occur.

Internet, Networking, and Online Communication

G3-5: 1.14 Explain and use age-appropriate online tools and resources (e.g., tutorial, assessment, Web browser).

G3-5: 1.15 Save, retrieve, and delete electronic files on a hard drive or school network.

G3-5: 1.16 Explain terms related to the use of networks (e.g., username, password, network, file server).

G3-5: 1.17 Identify and use terms related to the Internet (e.g., Web browser, URL, keyword, World Wide Web, search engine, links).

G3-5: 1.18 Use age-appropriate Internet-based search engines to locate and extract information, selecting appropriate key words.

Multimedia and Presentation Tools

G3-5: 1.19 Create, edit, and format text on a slide.

G3-5: 1.20 Create a series of slides and organize them to present research or convey an idea.

G3-5: 1.21 Copy and paste or import graphics; change their size and position on a slide.

G3-5: 1.22 Use painting and drawing applications to create and edit work.

Standard 2. Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.

Ethics

G3-5: 2.1 Explain and demonstrate compliance with school rules (Acceptable Use Policy) regarding responsible use of computers and networks.

G3-5: 2.2 Explain responsible uses of technology and digital information; describe possible consequences of inappropriate use.

G3-5: 2.3 Explain Fair Use Guidelines for the use of copyrighted materials (e.g., text, images, music, video) in student projects.

Society

G3-5: 2.4 Identify ways in which technology is used in the workplace and in society.

G3-5: 2.5 Work collaboratively online with other students under teacher supervision.

G3-5: 2.6 Analyze media messages and determine if their purpose is to inform, persuade, or entertain.

G3-5: 2.7 Explain that some Web sites and search engines may include sponsored commercial links.

G3-5: 2.8 Explain how hardware and applications can enable people with disabilities to learn.

<u>*Health and Safety*</u>

G3-5: 2.9 Recognize and describe the potential risks and dangers associated with various forms of online communications.

G3-5: 2.10 Identify and explain the strategies used for the safe and efficient use of computers (e.g., passwords, virus protection software, spam filters, popup blockers).

G3-5: 2.11 Demonstrate safe e-mail practices, recognition of the potentially public exposure of e-mail and appropriate e-mail etiquette (if the district allows student e-mail use).

G3-5: 2.12 Identify cyber bullying and describe strategies to deal with such a situation.

G3-5: 2.13 Recognize and demonstrate ergonomically sound and safe use of equipment.

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

<u>*Research*</u>

G3-5: 3.1 Locate, download, and organize content from digital media collections for specific purposes, citing sources.

G3-5: 3.2 Perform basic searches on databases (e.g., library card catalogue, encyclopedia) to locate information, using two or more key words and techniques to refine and limit such searches.

G3-5: 3.3 Evaluate Internet resources in terms of their usefulness for research.

G3-5: 3.4 Use content-specific technology tools (e.g., environmental probes, sensors, measuring devices, simulations) to gather and analyze data.

G3-5: 3.5 Use online tools (e.g., e-mail, online discussion forums, blogs, and wikis) to gather and share information collaboratively with other students, if the district allows it.

<u>*Problem Solving*</u>

G3-5: 3.6 With teacher direction, use appropriate technology tools (e.g., graphic organizer) to define problems and propose hypotheses.

G3-5: 3.7 Use spreadsheets and other applications to make predictions, solve problems, and draw conclusions.

<u>*Communication*</u>

G3-5: 3.8 Create projects that use text and various forms of graphics, audio, and video (with proper citations) to communicate ideas.

G3-5: 3.9 Use teacher-developed guidelines to evaluate multimedia presentations for organization, content, design, presentation, and appropriate use of citations.

G3-5: 3.10 Communicate with other students and other classes using appropriate technology, including e-mail if the district allows it.

Massachusetts Technology Literacy Standards

Grades 6 through 8 – Technology Standards and Expectations

By the completion of eighth grade, students should demonstrate competencies in using tools such as word processing, database, spreadsheet, Web browser, presentation, and graphics applications. Students should be familiar enough with the purpose and function of these technologies to enable them to select the appropriate tool for a task. Students should be able to identify various components of a computer system and be able to explain basic concepts of networking. Students should practice good file management skills and operate peripheral equipment independently.

Students should understand the legal, ethical, and safety issues concerning the use of e-mail, the Internet, and other online tools. Students should understand how to protect their personal identification and information on the Internet and be knowledgeable about general rules for safe Internet practices. In addition, students should develop an awareness of how they present themselves on the Internet.

By the end of eighth grade, students should have had ample opportunity to become fluent in the use of technology tools for research, problem solving, and communication across all curriculum areas. They should know how to communicate their learning with peers and other audiences through multimedia presentations, desktop-published reports, and other electronic media. They should have learned effective strategies for locating and validating information on the Internet. Moreover, students should understand why it is important to use multiple Web sites for their research, rather than relying on a single site for information.

In summary, when students enter the ninth grade, they should be able to use technology to learn and enhance their understanding of academic subjects and the world around them. Technology should be incorporated into their everyday learning activities, both inside and outside the classroom.

Standard 1. Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.

Basic Operations

G6-8: 1:1   Use features of a computer operating system (e.g., determine available space on local storage devices and remote storage resources, access the size and format of files, identify the version of an application).

G6-8: 1.2   Identify successful troubleshooting strategies for minor hardware and software issues/problems (e.g., "frozen screen").

G6-8: 1.3   Independently operate peripheral equipment (e.g., scanner, digital camera, camcorder), if available.

G6-8: 1.4   Identify and use a variety of storage media (e.g., CDs, DVDs, flash drives, school servers, and online storage spaces), and provide a rationale for using a certain medium for a specific purpose.

G6-8: 1.5   Demonstrate keyboarding skills between 25-30 wpm with fewer than 5 errors. (For students with disabilities, demonstrate alternate input techniques as appropriate.)

Word Processing/Desktop Publishing

G6-8: 1.6   Demonstrate use of intermediate features in word processing applications (e.g., tabs, indents, headers and footers, end notes, bullet and numbering, tables).

G6-8: 1.7   Create, save, open, and import a word processing document in different file formats (e.g., RTF, HTML).

Database

G6-8: 1.8   Describe the structure and function of a database, using related terms appropriately.

G6-8: 1.9   Create a simple database, defining field formats and adding new records.

G6-8: 1.10 Perform simple operations in a database (i.e., browse, sort, filter, search on selected criteria, delete data, enter data).

G6-8: 1.11 Plan and develop database reports to organize and display information.

Spreadsheet

G6-8: 1.12 Describe the use of spreadsheets to calculate, graph, organize, and present data in a variety of real-world settings.

G6-8: 1.13 Create an original spreadsheet, using formulas.

G6-8: 1.14 Use various number formats (e.g., scientific notation, percentages, exponents) as appropriate.

G6-8: 1.15 Produce simple charts and graphs from a spreadsheet.

G6-8: 1.16 Distinguish among different types of charts and graphs, and choose the most appropriate type to represent given data.

G6-8: 1.17 Apply advanced formatting features to customize tables, charts, and graphs.

Internet, Networking, and Online Communication

G6-8: 1.18 Use Web browsing to access information (e.g., enter a URL, access links, create bookmarks/favorites, print Web pages).

G6-8: 1.19 Identify probable types and locations of Web sites by examining their domain names, and explain that misleading domain names are sometimes created in order to deceive people (e.g., .edu, .com, .org, .gov, .au).

G6-8: 1.20 Explain and correctly use terms related to networks (e.g., LANs, WANs, servers, and routers) and Internet connectivity (e.g., DSL, T1, T3).

G6-8: 1.21 Explain and correctly use terms related to online learning (e.g., IP address, post, thread, Intranet, discussion forum, drop box, account, password).

G6-8: 1.22 Explain that some Web sites require the use of plug-ins and specific browser versions to access content.

G6-8: 1.23 Use e-mail functions and features (e.g., replying, forwarding, attachments, subject lines, signature, and address book.) The use of e-mail is at the school district's discretion and may be a class-wide activity if students do not have individual accounts.

Multimedia

G6-8: 1.24 Create a multimedia presentation using various media as appropriate (e.g., audio, video, animations, etc.).

G6-8: 1.25 Use a variety of technology tools (e.g., dictionary, thesaurus, grammar-checker, calculator) to maximize the accuracy of work.

Standard 2. Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.

Ethics

G6-8: 2.1   Explain ethical issues related to privacy, plagiarism, spam, viruses, hacking, and file sharing.

G6-8: 2.2   Explain how copyright law protects the ownership of intellectual property, and explain possible consequences of violating the law.

G6-8: 2.3   Explain fair use guidelines for using copyrighted materials (e.g., images, music, video, text) in school projects.

G6-8: 2.4   Describe appropriate and responsible use of communication tools (e.g., chats, instant messaging, blogs, and wikis).

Society

G6-8: 2.5   Identify and discuss the technology proficiencies needed in the workplace, as well as ways to prepare to meet these demands.

G6-8: 2.6   Identify and describe the effect technological changes have had on society.

G6-8: 2.7   Explain how technology can support communication and collaboration, personal and professional productivity, and lifelong learning.

G6-8: 2.8   Analyze and explain how media and technology can be used to distort, exaggerate, and misrepresent information.

G6-8: 2.9   Give examples of hardware and applications that enable people with disabilities to use technology.

Health and Safety

G6-8: 2.10 Explain the potential risks associated with the use of networked digital information (e.g., Internet, mobile phones, wireless, LANs).

G6-8: 2.11 Provide examples of safe and unsafe practices for sharing personal information via e-mail and the Internet.

G6-8: 2.12 Explain why computers, networks, and information need to be protected from viruses, intrusion, and vandalism.

G6-8: 2.13 Explain terms associated with the safe, effective, and efficient use of telecommunications/Internet (e.g., password, firewalls, spam, security, Acceptable Use Policy).

G6-8: 2.14 Describe how cyber bullying can be blocked.

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

Research

G6-8: 3.1   Explain and demonstrate effective searching and browsing strategies when working on projects.

G6-8: 3.2   Collect, organize, and analyze digital information from a variety of sources, with attribution.

G6-8: 3.3   Use a variety of computing devices (e.g., probeware, handheld computers, digital cameras, scanners) to collect, analyze, and present information for curriculum assignments.

Problem Solving

G6-8: 3.4   Independently use appropriate technology tools (e.g., graphic organizer) to define problems and propose hypotheses.

G6-8: 3.5   Use and modify databases and spreadsheets to analyze data and propose solutions.

G6-8: 3.6   Develop and use guidelines to evaluate the content, organization, design, use of citations, and presentation of technologically enhanced projects.

Communication

G6-8: 3.7   Plan, design, and develop a multimedia product to present research findings and creative ideas effectively, citing sources.

G6-8: 3.8   Identify differences between various media and explain issues associated with repurposing information from one medium to another (e.g., from print to the Web).

G6-8: 3.9   Use a variety of telecommunication tools (e.g., e-mail, discussion groups, Web pages, blogs, Web conferences) to collaborate and communicate with peers, experts, and other audiences (at district's discretion).

Massachusetts Technology Literacy Standards

Grades 9 through 12 – Technology Standards and Expectations

Throughout high school, as students take courses to prepare themselves for college and the world of work, they should acquire increasingly sophisticated technology skills. Depending on the pathways and courses they choose to take, high school students will become more adept with certain technology tools than others. Moreover, as the curriculum demands more complicated learning tasks, students will discover advanced capabilities in tools such as database and spreadsheet applications.

Starting in high school, students are selecting specific courses to prepare themselves for college and/or entry into the world of work. To accommodate the needs of high school students and teachers better, this publication lists technology skills for all the high school years together, rather than listing the skills by individual grade levels. Teachers should integrate the appropriate technology skills into their courses to help their students learn those subject areas and/or prepare for those careers.

During high school, students should have the opportunity to use more specialized technology tools that enhance their learning. These might include simulation software, geographic information systems, computer-aided design software, or any of a wide variety of content-specific tools. In addition, students should have the opportunity to learn how to write code in a commonly used programming language.

By the completion of high school, students should have developed an appreciation for the capabilities and capacities of technology, as well as an understanding of how these tools can be used for lifelong learning. In addition, students should be knowledgeable about the role technology plays in various fields of work, enabling them to better plan for their careers in the 21st century.

Standard 1. Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.

Basic Operations

G9-12: 1.1 Identify the platform, version, properties, function, and interoperability of computing devices including a wide range of devices that compute and/or manage digital media.

G9-12: 1.2 Use online help and other support to learn about features of hardware and software, as well as to assess and resolve problems.

G9-12: 1.3 Install and uninstall software; compress and expand files (if the district allows it).

G9-12: 1.4 Explain effective backup and recovery strategies.

G9-12: 1.5 Explain criteria for evaluating hardware and software appropriate for a given task (e.g., features, versions, capacity).

G9-12: 1.6 Demonstrate keyboarding techniques,[6] including the use of keyboard shortcuts, to complete assignments efficiently and accurately. (For students with disabilities, demonstrate alternate input techniques as appropriate.)

G9-12: 1.7 Identify and assess the capabilities and limitations of emerging technologies.

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[6] By the end of eighth grade, students should have keyboarding skills between 25-30 wpm with fewer than 5 errors.

Word Processing/Desktop Publishing

G9-12: 1.8   Apply advanced formatting and page layout features when appropriate (e.g., columns, templates, and styles) to improve the appearance of documents and materials.

G9-12: 1.9   Use editing features appropriately (e.g., track changes, insert comments).

G9-12: 1.10 Identify the use of word processing and desktop publishing skills in various careers.

Database

G9-12: 1.11 Explain the importance of designing the structure of a database to meet its intended goals.

G9-12: 1.12 Duplicate the structure of a database without data.

G9-12: 1.13 Save database files in various formats.

G9-12: 1.14 Manipulate non-alphanumeric digital data (e.g., geospatial data from MassGIS[7], images, audio) within a database.

G9-12: 1.15 Define the term "metadata," and explain how metadata describes the structure and workings of an organization's use of information.

G9-12: 1.16 Use database features to create mailing labels, form letters, and perform mail merges.

G9-12: 1.17 Identify the use of database skills in various careers.

Spreadsheet

G9-12: 1.18 Define and use functions of a spreadsheet application (e.g., sort, filter, find).

G9-12: 1.19 Enter formulas and functions; use the auto-fill feature in a spreadsheet application.

G9-12: 1.20 Explain and use advanced formatting features of a spreadsheet application (e.g., reposition columns and rows, add and name worksheets).

G9-12: 1.21 Differentiate between formulas with absolute and relative cell references.

 G9-12: 1.22 Use multiple sheets within a workbook, and create links among worksheets to solve problems.

G9-12: 1.23 Import and export data between spreadsheets and other applications.

G9-12: 1.24 Create and use pivot tables.

G9-12: 1.25 Explain how various formatting options are used to convey information in charts or graphs.

G9-12: 1.26 Identify the use of spreadsheet skills in various careers.

Internet, Networking, and Online Communication

G9-12: 1.27 Use search engines and online directories. Explain the differences among various search engines and how they rank results.

G9-12: 1.28 Explain and demonstrate effective search strategies for locating and retrieving electronic information (e.g., using syntax and Boolean logic operators).

G9-12: 1.29 Describe good practices for password protection and authentication.

G9-12: 1.30 Demonstrate a basic understanding of addressing schemes (e.g., IP addresses, DHCP, DNS).

G9-12: 1.31 Identify career options in network technologies.

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[7] For more information, see MassGIS's Web page, GIS in Education, at http://www.mass.gov/mgis/gisedu.htm.

<u>Multimedia</u>

G9-12: 1.32 Identify technology tools (e.g., authoring tools) that can be used to create a multimedia product.

G9-12: 1.33 Use a variety of applications to plan, create, and edit multimedia products (e.g., slide presentations, videos, animations, simulations, podcasts).

G9-12: 1.34 Link information residing in different applications (e.g., linking a chart in a word-processing document to the spreadsheet where it was created).

G9-12: 1.35 Identify career options in multimedia and software development.

<u>Web Authoring</u>

G9-12: 1.36 Distinguish between effective and ineffective Web site designs; explain the reasons.

G9-12: 1.37 Explain terminology related to Web page authoring (e.g., HTML, URL, links, browsers, plug-ins, Web servers).

G9-12: 1.38 Use HTML or Web-authoring tools to create, edit, and publish well organized Web sites with effective navigation.

G9-12: 1.39 Explain basic practices that contribute to a Web site's accessibility to people with disabilities (e.g., using alternative text, captioning, consistent structure).

G9-12: 1.40 Explain how to test and debug Web files for quality assurance.

G9-12: 1.41 Identify career options in Web design, development, and management.

Standard 2. Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.

<u>Ethics</u>

G9-12: 2.1 Demonstrate compliance with the school's Acceptable Use Policy.

G9-12: 2.2 Explain issues related to the responsible use of technology (e.g., privacy, security).

G9-12: 2.3 Explain laws restricting the use of copyrighted materials.

G9-12: 2.4 Identify examples of plagiarism, and discuss the possible consequences of plagiarizing the work of others.

G9-12: 2.5 Write correct in-text citations and reference lists for text and images gathered from electronic sources.

G9-12: 2.6 Give examples of the appropriate and responsible use of communication tools (e.g., chats, instant messaging, blogs, wikis).

G9-12: 2.7 Discuss misuse of technology for personal and commercial reasons (e.g., software piracy, unauthorized file sharing/downloading, virus spreading, and hacking); explain possible consequences.

Society

G9-12: 2.8　Design and implement a personal learning plan that includes the use of technology to support lifelong learning goals.

G9-12: 2.9　Evaluate the authenticity, accuracy, appropriateness, and bias of electronic resources, including Web sites.

G9-12: 2.10　Analyze the values and points of view that are presented in media messages.

G9-12: 2.11　Describe devices, applications, and operating system features that offer accessibility for people with disabilities.

Health and Safety

G9-12: 2.12　Evaluate school and work environments in terms of ergonomic practices.

G9-12: 2.13　Describe and use safe and appropriate practices when participating in online communities (e.g., discussion groups, blogs, social networking sites).

G9-12: 2.14　Explain and use practices to protect one's personal safety online (e.g., not sharing personal information with strangers, being alert for online predators, reporting suspicious activities).

G9-12: 2.15　Explain ways individuals can protect their technology systems and information from unethical users.

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

Research

G9-12: 3.1　Devise and demonstrate strategies for efficiently collecting and organizing information from electronic sources.

G9-12: 3.2　Compare, evaluate, and select appropriate electronic resources to locate specific information.

G9-12: 3.3　Select the most appropriate search engines and directories for specific research tasks.

G9-12: 3.4　Search for information within an electronic source (e.g., using the find command).

Problem Solving

G9-12: 3.5　Explain and demonstrate how specialized technology tools can be used for problem solving, decision making, and creativity in all subject areas (e.g., simulation software, environmental probes, computer-aided design, geographic information systems, dynamic geometric software, graphing calculators, art and music composition software).

Communication

G9-12: 3.6 Use a variety of media to present information for specific purposes (e.g., reports, research papers, presentations, newsletters, Web sites, podcasts, blogs), citing sources.

G9-12: 3.7 Demonstrate how the use of various techniques and effects (e.g., editing, music, color, rhetorical devices) can be used to convey meaning in media.

G9-12: 3.8 Use online communication tools to collaborate with peers, community members, and field experts as appropriate (e.g., bulletin boards, discussion forums, listservs, Web conferencing).

G9-12: 3.9 Plan and implement a collaborative project with students in other classrooms and schools using telecommunications tools (e.g., e-mail, discussion forums, groupware, interactive Web sites, videoconferencing).

G9-12: 3.10 Complete at least one online credit or non-credit course or tutorial; discuss the benefits and disadvantages of this method of learning.

Gaining Technology Skills
While Learning the Content of the Curriculum

Anyone who has taken a training course in the use of a spreadsheet, for example, knows how quickly we forget the skills unless we can apply them in our work on a regular basis. Whether technology instruction takes place in the classroom or in the computer lab, it is important that students be able to apply their newly acquired skills to subject matter learning. For example, a student who has gathered data for a science project and needs to organize the data in a database will see a reason for learning about the features and function of a database. This is context-sensitive learning in which technology skills instruction is centered on the curriculum.

Initial technology skills instruction needs to be provided by someone who is proficient in the use of that technology tool. Although some teachers are skilled enough with technology to teach their students to use the tools within the context of the curriculum content, other teachers may not be prepared to do this. A possible solution is for a staff person with technology expertise (such as an instructional technology specialist, library teacher, or another classroom teacher acting as a mentor) to provide mentoring or to co-teach alongside the teacher.

As technology tools become an integral part of the learning environment, and as students gain the knowledge and skills to use them appropriately, new opportunities for learning open up. Dynamic geometric applets, for example, can help students visualize and understand complex mathematics concepts. Simulation software enables students to investigate models of real-world problems such as climate change and population growth. Basic tools such as spreadsheet and database applications can be applied across the curriculum to analyze and solve problems. Even basic word processing software can encourage students to organize their thoughts and revise their work.

The following scenarios show how technology can be applied in the classroom so that students acquire these skills while addressing the standards of the curriculum frameworks. The scenarios, which were originally published by the Massachusetts Department of Elementary and Secondary Education in its technology toolkit, were drawn from school districts that participated in Project MEET, from districts that received instructional technology grants from the Department, and from award-winning teachers.

Each scenario features a lesson unit on a specific curriculum topic. Several criteria were used to select these lesson units. First, the lesson needed to have a clear curriculum focus that was aligned with the state's *Curriculum Frameworks*. Second, the lesson had to integrate learning technology skills with learning the curriculum content. Third, the lesson also had to address the fact that students have varying abilities, backgrounds, and interests. Finally, the lesson needed to have a way to evaluate how much students had learned.

All of these scenarios, plus more, are available on the Department's Web site (http://www.doe.mass.edu/edtech/practices/). The online version includes links to sample student work, classroom photographs, videos, multimedia presentations, and digital artwork.

Integrated Learning Scenario #1

Reciprocating Art[8]
Grades 1-4 Art

Instructional objective: The student will be able to use the principles and elements of design to create artwork collaboratively with students in another country.

Project description: In this art project the teacher worked with a school in Japan so that American and Japanese students could collaborate to create unique artwork. A translator helped the teacher use e-mail and language translation software to communicate with the Japanese principal and determine the exchange process. Thirty-nine Japanese students and thirty-nine American students each created a background for a painting. They then exchanged artwork through regular mail and finished each other's paintings. The American students used technology to communicate with the Japanese students, creating a video to send messages in English and Japanese. The teachers communicated through e-mail. The completed artwork was sent back to the original schools through regular mail.

Evaluation: To evaluate the students' work, the teacher used peer review, artwork critique, and evaluation of the finished products.

Evidence of effectiveness: The students were deeply involved in the process of critiquing, comparing, and contrasting the artwork. Their families also valued the students' participation in the project. Many American families framed their child's work from this art exchange project. In fact, some have framed the correspondence from this project as well as the artwork and have placed them next to each other. Of course, all of the vocabulary had to be translated. The Japanese writing next to the American writing is a piece of art onto itself. Many families thought so as well. The idea of accepting cultural differences and knowing that one culture is not better than the next but can be learned from is important for the students to understand. This was accomplished through discussion and student activities.

Technology standards addressed

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity and innovation.

K-2: 3.4 Use a variety of age-appropriate technologies (e.g., drawing program, presentation software, etc.) to communicate and exchange ideas.

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[8] Robert Wilson at the Floral Street School in Shrewsbury Public Schools developed Reciprocating Art.

Integrated Learning Scenario #2

Becoming Scientists[9]
Grade 4 Science and Technology/Engineering

Instructional objective: At the conclusion of this unit, students will be able to demonstrate their understanding of the properties of light and sound through classroom instruction and authentic data collection activities.

Project description: This project involved the development of two science units that address the curriculum standards for the study of light and sound. Each unit followed the same format, integrating the use of science probes with the teaching unit. To ensure that students were highly motivated to conduct the investigations, the students were given fictitious scenarios presenting problems that could only be solved after sound and light data had been collected and analyzed. The result of integrating technology in this way was that students became deeply engaged in this authentic learning experience.

Evaluation: Student learning of the science content standards was evaluated using classroom quizzes and rubric scoring of their works. The technology benchmarks were evaluated by observation of student use of Palm handhelds and sensor use, the accuracy and organization of graphed information, and the use of word processing tools.

Evidence of effectiveness: The integration of data collection into the study of physics brings authenticity to the learning experience. The teachers and students have expressed overwhelming enthusiasm for these learning activities. At the conclusion of both units it became clear to the teaching staff that when learning becomes authentic, deeper understanding of the content is achieved.

Technology standards addressed

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

G3-5: 3.4 Use content-specific technology tools (e.g., environmental probes, sensors, measuring devices, simulations) to gather and analyze data.

G3-5: 3.6 Use spreadsheets and other applications to make predictions, solve problems, and draw conclusions.

G3-5: 3.8 Create projects that use text and various forms of graphics, audio, and video (with proper citations) to communicate ideas.

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[9] Becoming Scientists was developed by a team of educators at the Bernardston Elementary School in the Pioneer Valley Regional School District: Mary Leyden, Marge Bruno, Chris Hershiser, and Wendy Abramson.

Integrated Learning Scenario #3

SELECT Math[10]
Grade 7 Mathematics

Instructional objective: Students will be able to identify and distinguish between part-to-part and part-to-whole ratios and recognize situations in which ratios are a useful form of comparison.

Project description: This investigation focused on the part-to-part and part-to-whole meaning of fractions. Students informally explored rates and ratios using proportional reasoning to determine how to combine orange juice concentrate and water to make enough orange juice for a given number of people. The students used virtual manipulatives, such as online fraction circles and visual models, to help them solve problems and check their solutions.

Evaluation: To evaluate students' progress in meeting the mathematics standards, the teacher assessed the students' ability to represent a ratio graphically and to write part-to-part and part-to-whole ratios from a graphical representation. To evaluate the students' progress in meeting the technology standards, the teacher checked whether the students were able to independently access the Web site, use the mouse, and enter the data. The teacher also evaluated how efficiently the students were able to use Microsoft Word's drawing tools to represent each given mixture.

Evidence of effectiveness: The students were excited about using the technology, and they were focused on how they could use the technology to evaluate the orange juice recipes. In their minds the technology was doing the work for them. The teacher made references throughout the year to the orange juice problems because the strategies students used truly stayed with them. Every student felt successful solving these problems when they used the technology.

Technology standards addressed

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

G6-8: 3.3 Use a variety of computing devices (e.g., probeware, handheld computers, digital cameras, scanners) to collect, analyze, and present information for curriculum assignments.

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[10] SELECT Math was developed by Susan Young and Jim Coffey of Boston Public Schools.

Integrated Learning Scenario #4

Africa[11]
Grade 6 Social Studies

Instructional objective: The students will be able to determine, through research and comparison, which African countries are developed and which are developing.

Project description: This Africa unit integrated research, technology, art, and music to reach its goals. After studying the continent of Africa, each student chose a country to study in depth. Students researched their countries and entered their data into a shared spreadsheet, which the class used to sort and rank the countries by various attributes. The students used what they learned to create PowerPoint projects, which were shared using SMARTBoard technology. During the time that students were researching Africa, the art and music teachers provided activities to help make students more aware of African customs. In art class, students discussed and constructed African masks, while in music class they explored African drumming.

Evaluation: The PowerPoint presentations and spreadsheets were graded first as rough copy outlines and later as finished products. The teacher informally assessed each student's ability to judge which stage of development a country was in and used data to argue the case for the country he or she studied. The teacher also evaluated each student's ability to collect data on a specific country, add the data to a spreadsheet, and sort the data across several fields.

Evidence of effectiveness: The use of technology for this unit allowed students to produce higher quality work in a shorter period of time. Having computers available at virtually any time allowed the students to work on their projects during periods of down time. The fact that the projects would be presented to the class motivated the students to do their most careful work. Some of the PowerPoint presentations were shared with parents as well. Having the ability to burn CDs and take digital pictures allowed teachers to share the students' works with their parents.

Technology standards addressed

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

G6-8: 3.2 Collect, organize, and analyze digital information from a variety of sources, citing sources.

G6-8: 3.5 Use and modify databases and spreadsheets to analyze data and propose solutions.

G6-8: 3.7 Plan, design, and develop a multimedia product to effectively present research findings and creative ideas, citing sources.

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[11] Africa was developed by a team of educators in the Manchester-Essex Regional School District: Paul B. Clark, Becky Baun, Anne Wood, and Kathleen Lorenzo.

Integrated Learning Scenario #5

The Greyhound® Bus Depot[12]
Grades 10-12 English Language Arts

Instructional objective: Students will use the Web to research the historical and cultural contexts for the literature they are studying and then write a travelogue or travel brochure presenting their findings.

Project description: In this online lesson, students were asked to take an imaginary bus trip to the time and place in which the story, poem, or play they were studying was written. When the students read a Kabuki play, for example, they ventured back to seventeenth-century Japan; when they read the stories of Isaac Bashevis Singer, they toured late nineteenth- and early twentieth-century Poland. Students were first asked to find as much information online as they could on their own; however, search sites were provided for students who were having trouble finding the information. Students were asked to look for historical events, cultural events, and movements, and to pay attention to the food and fashions of the time. The students were then asked to write a travelogue or travel brochure to present their findings and make a connection to the work of literature the class was reading. The unit also included a short lesson on assessing the validity of Web sites and online information.

Evidence of effectiveness: Students often commented that this assignment helped them understand the literature a bit more deeply and that it added to their appreciation of the text. In their written analysis of the literature, the teacher found references to details learned in this assignment and an appreciation for nuances in the text that required an understanding of the historical and cultural contexts.

Technology standards addressed

Standard 2. Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.

G9-12: 2.5 Write correct in-text citations and reference lists for text and images gathered from electronic sources.

G9-12: 2.9 Evaluate the authenticity, accuracy, appropriateness, and bias of electronic resources, including Web sites.

Standard 3. Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.

G9-12 3.1 Devise and demonstrate strategies for efficiently collecting and organizing information from electronic sources.

G9-12 3.3 Select the most appropriate search engines and directories for specific research tasks.

G9-12: 3.6 Use a variety of media to present information for specific purposes (e.g., reports, research papers, presentations, newsletters, Web sites, podcasts, blogs), citing sources.

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[12] The Greyhound Bus Depot was developed by J.W. Wilson of Wareham High School and Virtual High School.

District-Wide Implementation of the Standards

Teaching the Technology Standards[13]
Grades PreK-12

District Goals: Nauset does not view technology as a separate subject, but "flowing through the curriculum." The district's goal is to provide students the skills they need to be able to determine and use the appropriate technology for the task at hand, to be able to locate and evaluate information that targets the purpose of their task, and to be able to communicate effectively both the process and content of their research to a specific audience.

Standards Implementation and Assessment: Nauset teachers use a unit-design process called an "Effective Teaching Unit Design" to develop their curriculum units. The Instructional Technology Specialists (ITS) in the district select units that target the age-appropriate technology standards, develop project-based assessments, and plug them into the unit-design format. The classroom teacher then has access to a unit with the technology and information literacy standards already populated, the learning experiences outlined, resources identified, and both an exemplar and a rubric for assessment of the project-based assessment included. In this way, Nauset is moving towards its goal of having an appropriate technology component in each unit. Doing so helps ensure that students are attaining the technology and information literacy skills they need in the content areas.

Nauset is comprised of four elementary school districts and one grade 6-12 regional school district. Each elementary school has an ITS, who co-plans with the classroom teacher and co-delivers the technology-infused portion of the lesson. Students meet either once a week or once every two weeks formally with the two teachers. Also, there are open computer lab times in which classroom teachers can provide additional enhancements to the lesson. At the middle school, students in each grade receive technology instruction from the ITS for one full term each school year. At the high school, there are required courses in electronic research in the freshman year, a tech-investigation class during sophomore year, and a variety of other technology-specific courses, as well as the widespread use of technology to support the subject areas.

Grades K-8 ITS have traditionally reported student's mastery of the standards using a spreadsheet. In the 2007-2008 school year, because of the draft update of the Massachusetts technology standards, Nauset has implemented three student self-assessments. There will be more formal assessment of the technology skills for students in grades 5, 8, and 12 by the ITS.

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[13] This piece was written by Kathleen Schrock, Administrator for Technology in Nauset Public Schools.

Appendix A

Acknowledgments

This document was developed with the support of many experts.

Technology Standards Update Committee		
Name	**Title**	**Organization**
Deborah Boisvert	Director	BATEC, UMass Boston
Donna Boivin	CIO	Springfield Public Schools
Anita Greenwood	Director	School of Education, UMass Lowell
Susan Hargrave	Instructional Technology Specialist	Massachusetts Department of Elementary and Secondary Education
Heather Johnson	Vice President	Massachusetts Technology Leadership Council
Connie Louie	Instructional Technology Director	Massachusetts Department of Elementary and Secondary Education
Joyce L. Plotkin	President	Massachusetts Technology Leadership Council
G'Tanya Small	Technology Director	Boston Public Schools
Jim Stanton	Director	The Technology Initiative Metro South/West REB
Carol A. Vallone	Chairman	Massachusetts Technology Leadership Council, Education Foundation
Isa Zimmerman	Senior Fellow	STEM, Donahue Institutes, UMass President Office

The following organizations and educators provided input to this document:
- CAST, Inc.
- Educational Technology Advisory Council (ETAC)
- Educators from Massachusetts Public Schools who attended the roundtable meetings on January 16, 2007 at Blackstone Valley Regional Vocational High School
- Educators from Massachusetts Public Schools who attended the roundtable meeting on January 19, 2007 at the Meline Kasparian Professional Development Center, Springfield
- MassCUE, Inc. (Massachusetts Computer Using Educators)
- BATEC (Boston Area Advanced Technological Education Connections)
- Representatives from the Board of the Massachusetts Technology Leadership Council

Appendix B

Development of this Document

In October 2001, the Massachusetts Department of Education published the *Massachusetts Recommended PreK-12 Technology Literacy Standards* to define what Massachusetts K-12 students should know and be able to do in order to use technology for learning. Since then, continuing technological advances have led to new opportunities, new challenges, and new risks. As a result, the Department has updated the original document to include the knowledge and skills that students are likely to need now and in the future.

Another reason the Department has revised the document is that, under No Child Left Behind's Title IID, Enhancing Education Through Technology Program, every state is required to include the following performance measure in its data collection from local school districts:

> "The percentage of eighth-grade students that meet their state's technology literacy standards." (According to Sec. 2402 of NCLB)

Beginning in 2007, Massachusetts reported the number of students who have met the technology standards as part of the Annual Mandatory Collection of Elementary and Secondary Education Data for the Education Data Exchange Network (EDEN).

In May 2006, the Massachusetts Technology Leadership Council (MTLC) brought together a group[14] of educators from higher education, K-12 school districts, and educational organizations to help the Department review and update the original document.

The working group reviewed, compared, and evaluated a number of national, state, and local standards documents in order to ensure that the Massachusetts standards would be as comprehensive as possible. The group first looked at the 2001 Massachusetts standards, which were based on those published in 1998 by the National Educational Technology Standards (NETS) Project.[15] Next the group examined standards from other states. The group also studied the newly updated standards developed by the Boston and Springfield Public Schools. Because technology and media are closely intertwined, the group looked at recommendations from the Center for Media Literacy and the Massachusetts School Library Association. A draft of the revised *Massachusetts Technology Literacy Standards* was developed in September 2006.

In October 2006, the Department shared the draft of the updated standards with a small number of business representatives from the Massachusetts Technology Leadership Council. In addition, educators across the Commonwealth had an opportunity to review and comment on the draft at two roundtable discussion meetings in January of 2007. Educators also submitted additional comments and suggestions to the Department using electronic feedback forms and e-mail. The Massachusetts Department of Elementary and Secondary Education has incorporated these recommendations into this current version.

In January 2007, ISTE announced a draft of its updated NETS standards, called the "Refreshed ISTE NETS for Students,"[16] which describes "what students should know and be able to do to learn effectively and live productively in an increasingly digital world." The Department has incorporated the new NETS standards into the state standards.

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[14] See Appendix A for a list of the members of the working group and other contributors, e.g. CAST.
[15] NETS is an initiative of the International Society for Technology in Education (ISTE) and the U.S. Department of Education
[16] See Appendix C for the alignment of the *Massachusetts Technology Literacy Standards* with Refreshed ISTE NETS Draft.

Appendix C

Comparing the Updated K-12 State Standards to the Refreshed ISTE NETS•S

As a general frame of reference for developing these standards, we continue to use the *Technology Foundation Standards for Students*, developed by the National Educational Technology Standards (NETS) Project. In January 2007, ISTE announced a draft revision of the NETS. We have incorporated the "Refreshed ISTE NETS" into this document.

The goal of the NETS Project is to develop national standards for educational technology. The framework for the Refreshed ISTE NETS includes:

1. Creativity and Innovation
2. Communication and Collaboration
3. Research and Information Fluency
4. Critical Thinking, Problem Solving, and Decision Making
5. Digital Citizenship
6. Technology Operations

In 2001, the Massachusetts Department of Education collapsed the six NETS standards into three standards. In this document, the Department once again incorporated the new NETS•S standards into the three standards of the *Massachusetts Technology Literacy Standards and Expectations* as follows:

UPDATED MASSACHUSETTS TECHNOLOGY LITERACY STANDARDS	CORRESPONDING NETS FOUNDATION STANDARDS	CORRESPONDING REFRESHED ISTE NETS
Standard 1	**Standards 1 and 3**	**Standards 1, 2, 3, and 4**
Standard 2	**Standard 2**	**Standard 5**
Standard 3	**Standards 3, 4, 5, and 6**	**Standard 6**

Appendix D

21st Century Skills

In addition to the *National Educational Technology Standards (NETS)* and the models of other states, this updated version of the Massachusetts K-12 Technology Literacy Standards also incorporates the recommendations of the Partnership for 21st Century Skills.[17] The Partnership's *Framework for 21st Century Learning* includes six key elements:

1. Core subjects as identified by the No Child Left Behind Act of 2001.

2. 21st century content that includes global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; and health and wellness awareness.

3. Learning and thinking skills that include critical thinking and problem solving, communication skills, creativity and innovation skills, collaboration skills, contextual learning skills, and information and media literacy skills.

4. Information and communications technology (ICT) literacy, enabling students to learn, think critically, solve problems, use information, communicate, innovate, and collaborate.

5. Life skills that include leadership, ethics, accountability, personal productivity, personal responsibility, people skills, self-direction, and social responsibility.

6. 21st century assessments that measure the core subjects, 21st century content, learning and thinking skills, ICT literacy, and life skills. The use of modern technologies in assessment is recommended to "increase efficiency and timeliness."

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[17] The Partnership for 21stCentury Skills (http://www.21stcenturyskills.org/index.php) is a tax-exempt 501 (c) 3 organization that includes approximately 26 member organizations. The Partnership's original work was supported by a two-year grant from the U.S. Department of Education.