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Massachusetts Recommended K-12 Instructional Technology Standards

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Massachusetts Recommended K-12 Instructional Technology Standards

Introduction

In October 2001, the Massachusetts Department of Education published the *Massachusetts Recommended PreK-12 Instructional Technology 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. In the 21st century, students must expand their knowledge and develop a myriad of new skills in order to take advantage of technology's increased power. Becoming proficient in technology will enable students to enhance their learning and prepare themselves for the increasingly competitive world beyond school. Most jobs today require some proficiency with technology; tomorrow's job will require even higher levels of proficiency. In addition, unless our students graduate from high school ready to use technology, our economy is likely to suffer in the face of global competition. In addition, learning to adopt new technologies provides students with an essential skill for lifelong learning. As a result, the Department has updated the original document to include the knowledge and skills that students are likely to need.

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 will report 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).

Development of This Document

In May of 2006, the Massachusetts Technology Leadership Council (MTLC) brought together a group¹ 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*². Next the group examined standards from other states and determined that those from North Carolina and Michigan provided some useful models for the Massachusetts standards. The group also studied the newly updated standards developed by the Boston and Springfield Public Schools. A draft of the revised Massachusetts K-12 Instructional Technology Standards was developed in September 2006.

In October of 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 email. The Massachusetts Department of Education has incorporated these recommendations into this current version.

¹ See Appendix A for a list of the members of the working group and other contributors, e.g. CAST.

² NETS is an initiative of the International Society for Technology in Education (ISTE) and the U.S. Department of Education

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In January 2007, ISTE announced a draft of its updated NETS standards, called the “Refreshed ISTE NETS for Students,”³ 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 our state standards.

Students’ technology skills will need to grow as a result of new developments in technology. The Massachusetts Department of Education will continue to invite teachers, administrators, other educators, and businesses people to assist in the continuing development and implementation of these Standards.

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 Instructional Technology Standards also incorporates the recommendations of the Partnership for 21st Century Skills.⁴ 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.”

Commissioner David Driscoll articulated the importance of helping students develop 21st century skills in his op-ed piece in Boston Globe article entitled “Tough choices in education.”⁵

“Times and expectations have changed. College used to be an option for young people, but in the 21st century choices are limited for those without a college degree. Manufacturing jobs are going overseas, salaries for blue-collar jobs are low, and most white-collar jobs today require at least an undergraduate -- if not graduate -- degree. This, coupled with the rise in global competition and the demand for new jobs in the science, technology, and engineering industries, creates an urgent need for all students to strive to reach their full academic potential in school . . .

³ See Appendix 2 for the alignment of the Massachusetts Revised K-12 Instructional Technology Standards with Refreshed ISTE NETS Draft.

⁴ The Partnership for 21st Century 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.

⁵ Boston Globe, February 28, 2007

http://www.boston.com/news/globe/editorial_opinion/oped/articles/2007/02/28/tough_choices_in_education/

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. . . . If we want to remain competitive, we need to work together to replace the old vision of public education with one that reflects the demands of the 21st century and is focused around higher expectations for all students, regardless of race, ethnicity, income level, or hometown.”

In this publication, 21st century skills are integrated in all the standards and grade levels.

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Standards Overview

This publication provides a set of guidelines for schools, describing what students should know and be able to do in order to use technology for learning in school and for lifelong learning. School districts can use these recommended standards to make sure that their students are comfortable and proficient with multiple technology tools.

As students learn these skills, they should apply them in their classroom and everyday life in order to understand why the skills are important. The teaching of these skills should be integrated into the general curriculum, as opposed to being taught as isolated skills. The example provided in the 2001 standards is still very pertinent:

“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 functions of a database.”⁶

These standards incorporate the ISTE NETS and the Partnership for 21st Century Skills into three broad standards:

Standard 1. Basic Operations, Concepts, and Productivity Tools

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.

Standard 2. Digital Citizenship, Ethics, Society, and Safety

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 designed to help students develop an awareness of the personal image that they convey through information they post on the Internet.
- Aims to ensure that students need to understand federal and state laws regarding computer crimes.
- Supports students in exhibiting leadership for digital citizenship.

Standard 3. Research and Information Fluency; Critical Thinking, Problem Solving & Decision Making; Communication and Collaboration; and Creativity and Innovation

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

⁶ Massachusetts Recommended PreK-12 Instructional Standards, October 2001, page 17.

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This standard focuses on applying a wide range of technology tools to student learning and everyday life.

Research and Information Fluency

When technology is used appropriately and proficiently it will:

- Help students understand how to “process” information; that is, engage in computational thinking.
- Allow students to manage huge amounts of data and to generate reports speedily.
- Enable students to become competent in using technology for project management, analysis and collaboration.
- Help students plan strategies to guide their inquiry.

Critical Thinking, Problem Solving and Decision Making

When technology is used appropriately and proficiently it will:

- Help students understand and think differently. (For example, technology allows people to quickly design, analyze, and alter three-dimensional objects with many variables. This enables a different kind of thinking--not sequential and linear as in the past.)
- Provide students with a way to select the “right” tool for the task.
- Allow students to identify and define authentic problems and ask significant questions for investigation.
- Help students explore alternative solutions.

Communication and Collaboration

When technology is used appropriately and proficiently it will:

- Help students develop appropriate skills for technology-based communication, including methods for engagement, feedback, and understanding while using email, videoconferencing, telephone, and so on.
- Help students interact, collaborate, and publish with peers.
- Allow students to engage with learners of other cultures.

Creativity and Innovation

When technology is used appropriately and proficiently it will:

- Help students create original works.
- Allow students to use models and simulations to explore and create new ideas, identify trends, and forecast possibilities.

Application of Technology

When technology is used appropriately and proficiently it will:

- Provide students with an understanding and appreciation of how technology is used in different careers.
- Give students a general awareness of technologies that are currently available, even if they are not used in their school or their home, such as handheld computers, global positioning devices, videoconferencing systems, etc.
- Position students to learn and use new technologies as they become available.

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Overview of Grade Levels and 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 understandings. The Massachusetts Department of 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 still need to continue developing legible handwriting. By the same token, even though students might become highly skilled in electronic research, they should still 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 that can be used to help them solve problems and improve their productivity and their capacity to learn as they move through life.

Grade Level Skills and Standards

In this publication, specific technology skills are listed for each grade level from kindergarten to eighth grade. The letters I, D, M, and E in the tables in the following pages indicate whether the specific skills and standards should be Introduced, Developed, Mastered, or Extended at a particular grade level. Although these proficiency levels are recommended by the Department of Education, local school districts can 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.

Starting in high school, students are selecting specific courses to prepare themselves for college and/or entry into the working world. To better accommodate the needs of high school students and teachers, this publication lists technology skills for all of 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.

Grade Span Levels

Based on the developmental readiness of the students, this document also groups the technology skills in grade span levels. Four grade span levels are identified:

- Grades K – 2
- Grades 3 – 5
- Grades 6 – 8
- Grades 9 – 12

Skills/knowledge Acquisition

The skills/knowledge enumerated in this document can be acquired by students in a variety of ways:

- Everyday classroom activities (gaining technology skills while learning the content of the curriculum – see page 26)
- 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)

In this document we focus on educational or instructional technology as opposed to computer science or engineering standards.

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Massachusetts Technology 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 arithmetical operations in elementary school. Given this context, the instructional technology 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.

1. Basic Operations and Productivity Tools	Grade		
	<i>I = Introduce</i> <i>D = Develop</i> <i>M = Master</i> <i>E = Extend</i>		
1.1 Basic Operations	K	1	2
K-2: 1.11 Demonstrate basic steps in using available hardware and applications (e.g., turn on a computer, launch a program, use a pointing device such as a mouse).	I	D	D
K-2: 1.12 Describe how people use many types of technologies in their daily lives (i.e. computers, cameras, audio/video players, cell phones, televisions, traffic lights, wrist watches, coffee makers, cash registers, etc.).	D	D	D
K-2: 1.13 Recognize and name major components of a computer and demonstrate an understanding of the basic functions (monitor, screen, keyboard, mouse).	D	D	D
K-2: 1.14 Explain that icons (e.g., recycle bin/trash, folder) are symbols on the computer used to signify a command, file or record (e.g., the picture of a disk may refer to saving a file).	I	D	D
K-2: 1.15 Describe the basic care of computer hardware and various media storage devices (e.g., keyboard, monitor, LCD, audio/video tapes, CDs or DVDs).	I	D	D
K-2: 1.16 Identify, locate, and use letters, numbers, and special keys (e.g., arrow keys, space bar, Shift, Enter/Return, Backspace, Delete), on the keyboard.	I	D	D
K-2: 1.17 Recognize the functions of basic file menu commands (e.g., New, Open, Close, Save, Print).	I	D	D
K-2: 1.18 Identify the home row in the keyboard.		I	D
1.2 Word Processing and Desktop Publishing	K	1	2
K-2: 1.21 Use a simple word processing program to enter, edit, and delete letters and numbers.	I	D	D
K-2: 1.22 Insert and size a graphic in a word processing document.	I	D	D
K-2: 1.23 Use word processing to write, edit, print, and save assignments.		I	D

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1.3 Database and Spreadsheet (Tables/Charts and Graphs)	K	1	2
K-2: 1.31 Explain that that a simple computer graphing application can be used to create a table or chart to display data.	I	D	D
K-2: 1.32 Explain that computers can store and organize information so that it can be searched.	I	D	D
1.4 Internet and Multimedia	K	1	2
K-2: 1.41 Demonstrate an understanding that the Internet links computers around the world, allowing people to access information and communicate.	I	D	D
K-2: 1.42 Demonstrate the ability to use tools in painting and/or drawing programs.	D	D	D
K-2: 1.43 Identify different components and capabilities of multimedia (i.e., text, sound, images, color).	I	D	D

Massachusetts Technology Standards			
Grades K through 2 - Technology Exploratory Skills and Expectations			
2. Ethics, Society, and Safety	Grade		
	<i>I = Introduce D = Develop M = Master E = Extend</i>		
2.1 Ethics	K	1	2
K-2: 2.11 Show responsible use and care of computers, peripheral devices and resources.	M	E	E
K-2: 2.12 Explain ownership of creative works found on the Internet, as well as the importance of giving credit to the creators of those works when using them in student projects.	I	D	M
2.2 Classroom/Society	K	1	2
K-2: 2.21 Demonstrate respect for others when sharing computers.	M	E	E
K-2: 2.22 Follow classroom rules for the responsible use of computers.	M	E	E
K-2: 2.23 Describe acceptable and unacceptable uses of technology (e.g., computers, phones, 911, Internet, email) at home and at school.	M	E	E
K-2: 2.24 Work independently as well as collaboratively with a partner or group when using technology.	D	M	E
2.3 Health and Safety	K	1	2
K-2: 2.31 Follow the school rules for safe and ethical Internet use. (Use of Internet in this grade span is determined by district policy.)	I	D	M
K-2: 2.32 Identify procedures for safely using basic communication tools (e.g., e-mail, telephones) with assistance from teachers.	D	M	E
K-2: 2.33 Explain that a password helps protect the privacy of information.	I	D	M
K-2: 2.34 Demonstrate knowledge of ergonomics and electrical safety when using computers.	I	D	D

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Massachusetts Technology Standards			
Grades K through 2 - Technology Exploratory Skills and Expectations			
3. Research, Problem-Solving, and Communications	Grade		
	<i>I = Introduce D = Develop M = Master E = Extend</i>		
<i>3.1 Research (Gathering and Using Information)</i>	K	1	2
K-2: 3.11 Recognize web browsers and associate them with accessing resources on the Internet; compare the capability of a computer that is connected to the Internet to one that is not.	I	D	D
K-2: 3.12 Use various age-appropriate technologies to locate and collect information (e.g. audio/video players, CD-ROMs, DVDs, teacher-selected web sites, databases in the school library or in a public children's library).	I	D	D
K-2: 3.13 Use teacher-selected Internet resources to identify and discuss the elements that make an online resource useful and appropriate.	I	D	D
K-2: 3.14 Use application programs (e.g. age-appropriate word processing, graphic organizer, database, spreadsheet) to organize and analyze information.		I	D
<i>3.2 Problem Solving</i>	K	1	2
K-2: 3.21 Select the most appropriate type of technology to use for a specific task.	I	D	D
K-2: 3.22 Use curriculum-specific tools to enhance understanding of curriculum content (e.g., interactive manipulatives, simulation software, electronic books, etc.).	I	D	D
<i>3.3 Communication & Collaboration</i>	K	1	2
K-2: 3.31 Use a variety of age-appropriate technologies (e.g., drawing program, graphic organizer, presentation software) to communicate, exchange ideas, and illustrate concepts.	I	D	D
K-2: 3.32 Communicate interactively with other students and other classes using appropriate technology, including email if the district allows it.	I	D	D

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Grades 3 through 5 – Technology Standards and Expectations

By the end of fifth grade, all students should have had the opportunity to become familiar with the tools they will be expected to use with proficiency later on. Through this exposure, they will have gained a positive view of computers as tools 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.

1. Basic Operations and Productivity Tools	Grade		
	<i>Continue to address earlier skill as needed. I = Introduce D = Develop M= Master E= Extend</i>		
1.1 Basic Operations	3	4	5
G3-5: 1.11 Demonstrate proper care in the use of hardware, software, and peripherals.	M	E	E
G3-5: 1.12 Recognize, explain, and use basic input and output devices and other peripherals (e.g. digital cameras and printers, etc.).	M	E	E
G3-5: 1.13 Select a printer, use print preview, and print a document with the appropriate page setup and orientation.	M	E	E
G3-5: 1.14 Use basic accessibility features of computers and software (e.g., text-to-speech, variable font sizes).	I	M	E
G3-5: 1.15 Use various operating system features (e.g., opening more than one application/program, working with menus, using the taskbar/dock).	I	D	M
G3-5: 1.16 Demonstrate intermediate keyboarding skills and proper keyboarding techniques.	I	D	M
1.2 Word Processing/Desktop Publishing	3	4	5
G3-5: 1.21 Copy and paste text and images from one document to another.	M	E	E
G3-5: 1.22 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.	D	M	E
G3-5: 1.23 Proofread and edit writing using appropriate resources (dictionary, spell-checker, grammar resources).	D	M	E
G3-5: 1.24 Import/insert text, graphics, tables, and files into word processing documents.	D	M	E

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<i>1.3 Database</i>	3	4	5
G3-5: 1.31 Be able to define the term “database” and provide examples from everyday life (e.g., a geographic map, library catalogues, table of contents, book indexes), and identify potential and common uses of databases.	M	E	E
G3-5: 1.32 Be able to define database terms, such as “record,” “field,” and “search.”	M	E	E
<i>1.4 Spreadsheet</i>	3	4	5
G3-5: 1.41 Demonstrate an understanding of the spreadsheet as a tool to report, organize, and graph information.	M	E	E
G3-5: 1.42 Identify and explain spreadsheet terms and concepts (i.e., cell, column, row, values, labels, chart, graph).	M	E	E
G3-5: 1.43 Identify, discuss, and explore how spreadsheets are used to calculate and graph in a variety of settings (e.g., schools, government, business, industry, scientific research labs).	D	M	E
G3-5: 1.44 Identify and discuss how data are collected (data mining).	I	D	D
<i>1.5 Internet, Networking, and Online Communication</i>	3	4	5
G3-5: 1.51 Explain and use age-appropriate online tools and resources (e.g. tutorial, assessment, web browser).	M	E	E
G3-5: 1.52 Save and retrieve files on a hard drive or school network.	M	E	E
G3-5: 1.53 Manage and maintain (i.e., create and delete) electronic files on a hard drive or school network.	M	E	E
G3-5: 1.54 Recognize, access, and use local storage devices or network servers using correct terms (i.e., username, password, network, file server).	M	E	E
G3-5: 1.55 Identify and use Internet terms (i.e. web browser, URL, keyword, World Wide Web, search engine, links).	M	E	E
G3-5: 1.56 Identify and describe collaborative tools (e.g., email, online discussion forums, videoconferencing, wikis).	M	E	E
G3-5: 1.57 Use age-appropriate Internet-based search engines to locate information, selecting appropriate keywords.	D	M	E
<i>1.6 Multimedia and Software Applications</i>	3	4	5
G3-5: 1.61 Identify the components of an electronic slide show or multimedia presentation (i.e., title, text, graphics, sound, video, animation).	M	E	E
G3-5: 1.62 Insert, edit, and format text on a slide. Copy/paste or import graphics, and change their size and position on a slide.	M	E	E
G3-5: 1.63 Create a series of slides and organize them to present research or convey an idea.	M	E	E
G3-5: 1.64 Use painting and drawing applications to create products and edit work.	M	E	E

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**Massachusetts Technology Standards
Grades 3 through 5 – Technology Standards and Expectations**

2. Ethics, Society and Safety	Grade		
	<i>Continue to address earlier skill as needed. I = Introduce D = Develop M = Master E = Extend</i>		
2.1 Ethics	3	4	5
G3-5: 2.11 Explain and demonstrate compliance with school rules (Acceptable Use Policy) regarding responsible use of computers and networks (e.g., careful use of equipment, respect for other people's work, and appropriate collaborative behavior).	M	E	E
G3-5: 2.12 Explain responsible, safe and ethical uses of technology and digital information (e.g., Internet resources, computers, digital cameras, mobile phones, handheld computers, wireless connectivity), and describe possible consequences of inappropriate use.	M	E	E
G3-5: 2.13 Explain Fair Use Guidelines for the ethical use of copyrighted materials (e.g., text, images, music, video, written materials, etc.) in multimedia projects and presentations.	I	D	M
G3-5: 2.14 Explain that some websites may include sponsored commercial links.	M	E	E
2.2 Society	3	4	5
G3-5: 2.21 Identify ways in which technology is used in the workplace and in society.	D	M	E
G3-5: 2.22 Identify and demonstrate the use of technology to support communication (e.g., with peers, family, school personnel).	M	E	E
G3-5: 2.23 Work independently as well as collaboratively with a partner or group, face-to-face or online.	E	E	E
2.3 Health and Safety	3	4	5
G3-5: 2.31 Recognize and describe the potential risks and dangers associated with various forms of online communications, including blogs, chat rooms, personal web pages, photo-sharing, and social networking.	D	M	E
G3-5: 2.32 Demonstrate safe email practices and appropriate email etiquette (if the district allows student email use).	D	M	E
G3-5: 2.33 Recognize, explain, and demonstrate ergonomically sound and safe use of equipment.	M	E	E
G3-5: 2.34 Identify and explain the strategies used for the safe and efficient use of computers, (e.g., passwords, virus protection software, spam filters, popup blockers) in order to keep them free from viruses, intrusion, and vandalism.	I	D	M
G3-5: 2.35 Explain the potential problems posed by computer viruses and reasons why students must exercise caution in opening email attachments.	I	D	M

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Massachusetts Technology Standards Grades 3 through 5 – Technology Standards and Expectations			
3. Research, Problem Solving and Communications	Grade		
	<i>Continue to address earlier skill as needed. I = Introduce D = Develop M = Master E = Extend</i>		
3.1 Research	3	4	5
G3-5: 3.11 Download and organize content from digital media collections for specific purposes, citing sources.	I	D	M
G3-5: 3.12 Use online collaborative tools (e.g., email, online discussion boards, forums such as those in MassONE, blogs, wikis, and other collaborative tools) to gather information and collaborate on projects with other students.	I	D	M
G3-5: 3.13 Evaluate Internet resources using criteria for usefulness, authenticity, authority, value, absence of bias, and prejudice.	I	D	D
G3-5: 3.14 Perform basic queries on databases (e.g., library card catalogue, encyclopedia) and, using two or more criteria, locate, organize, and report information.	D	M	E
G3-5: 3.15 Use content-specific technology tools (e.g., environmental probes, sensors, measuring devices, simulations) to enhance understanding of curriculum content.	I	M	E
3.2 Problem Solving	3	4	5
G3-5: 3.21 Enter data into spreadsheets, create graphs, and do basic calculations to make predictions, solve problems, draw conclusions and communicate those conclusions.	D	M	E
G3-5: 3.22 Use appropriate technology tools to define a problem, propose hypotheses, validate information, test conclusions, and present findings and proposed solutions.	D	M	E
3.3 Communication	3	4	5
G3-5: 3.31 Determine the most effective format for communicating the results of problem-solving activities (e.g., desktop publishing program, multimedia presentations, graphic organizers, charts, graphs, and web pages).	D	M	E
G3-5: 3.32 Create projects that use writing and various forms of graphic sources (e.g., photographs, digital images, clip art, graphs, and tables) with proper citations to communicate an idea; explain the rationale behind each design choice.	M	E	E
G3-5: 3.33 Develop and use guidelines to evaluate multimedia presentations for organization, content, design, presentation, and appropriate use of citations.	D	M	E
G3-5: 3.34 Communicate interactively with other students and other classes using appropriate technology, including email if the district allows it.	D	D	M

**Massachusetts Technology 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 email, 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 use 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. Technology should be incorporated into their everyday learning activities, both inside and outside the classroom.

1. Basic Operations and Productivity Tools	Grades <i>Continue to address earlier skill as needed.</i> <i>I = Introduce</i> <i>D = Develop</i> <i>M = Master</i> <i>E = Extend</i>		
1.1 Basic Operations	6	7	8
G6-8: 1:11 Identify and use the basic features of a computer operating system to access information on the size and format of a file and to create folders on a local hard drive.	M	E	E
G6-8: 1.12 Identify successful troubleshooting strategies for minor hardware and software issues/problems.	M	E	E
G6-8: 1.13 Select a printer and print a document with the appropriate page setup and orientation.	E	E	E
G6-8: 1.14 Operate peripheral equipment (e.g., scanner, digital camera, camcorder), if available in the school.	M	E	E
G6-8: 1.15 Demonstrate keyboarding techniques that result in accuracy, speed, and general efficiency in computer operation. (For students with disabilities, demonstrate alternate input techniques (e.g., word prediction	E	E	E

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software, specialized keyboards, and mouse alternatives.)			
G6-8: 1.16 Identify and use a variety of information storage media (i.e., CDs, DVDs, flash drives, school servers, and online storage spaces), and provide a rationale for using a certain medium for a specific purpose.	D	M	E
1.2 Word Processing/Desktop Publishing	6	7	8
G6-8: 1.21 Demonstrate use of intermediate features in word processing applications (e.g., tabs, indents, line spacing, headers and footers, end notes, bullet and numbering, tables, symbols/special characters).	M	E	E
1.3 Database	6	7	8
G6-8: 1.31 Describe the structure and function of a database, using related terms appropriately (e.g., record, field, query, reports, layout, format, tags, keywords, etc.).	M	E	E
G6-8: 1.32 Create a simple database, defining field formats and adding new records.	M	E	E
G6-8: 1.33 Perform simple operations in a database (i.e., browse, sort, filter, search on selected criteria, delete data, enter data).	M	E	E
G6-8: 1.34 Plan and develop database reports to organize and display information.	D	M	E
1.4 Spreadsheet	6	7	8
G6-8: 1.41 Create an original spreadsheet, entering simple formulas.	M	E	E
G6-8: 1.42 Produce simple charts and graphs from a spreadsheet.	M	E	E
G6-8: 1.43 Describe the structure and function of a spreadsheet, using correct terminology (i.e., cells, rows, columns, and formulas).	M	E	E
G6-8: 1.44 Distinguish among different types of charts and graphs (e.g., bar graphs, circle graphs, line graphs), and choose the most appropriate chart/graph to represent given data.	I	D	M
G6-8: 1.45 Describe the use of spreadsheets to calculate, graph, organize, and present data in a variety of settings (e.g., universities, government, business, industry).	M	E	E
G6-8: 1.46 Apply advanced formatting features to customize tables, charts, and graphs.	I	D	M
1.5 Internet, Networking, and Online Communication	6	7	8
G6-8: 1.51 Identify and use correct terminology to explain common terms associated with the Internet (e.g. browser, search engine, URL, hyperlink, site map).	M	E	E
G6-8: 1.52 Add and organize bookmarks/favorites on a web site for future reference.	M	E	E
G6-8: 1.53 Identify probable types and locations of web sites by examining their domain names (e.g., .edu, .com, .org, .gov, .au).	M	E	E
G6-8: 1.54 Use email functions and features including replying, forwarding, attachments, subject lines, signature, and address book. (Use of e-mail is at district discretion and may be a class-wide activity if students do not have individual accounts.)	M	E	E

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G6-8: 1.55 Recognize, explain, and correctly use terms related to networks (LANs, WANs, servers, and routers), Internet connectivity (DSL, T1, T3), and online learning (e.g., IP address, post, thread, Intranet, discussion forum, drop box, account, password).	D	M	E
1.6 Multimedia and Software Applications	6	7	8
G6-8: 1.61 Use a variety of technology tools (e.g., dictionary, thesaurus, grammar-checker, calculator) to maximize the accuracy of technology-produced products.	M	E	E
G6-8: 1.62 Demonstrate knowledge by creating a multimedia presentation utilizing appropriate media (e.g. audio, video, animations, etc.).	D	M	E

Massachusetts Technology Standards Grades 6 through 8 – Technology Standards and Expectations			
2. Ethics, Society, and Safety	Grades <i>Continue to dress earlier skill as needed. I = Introduce D = Develop M = Master E = Extend</i>		
2.1 Ethics	6	7	8
G6-8: 2.11 Explain and demonstrate ethical and legal behavior in copying files, applications, and media.	M	E	E
G6-8: 2.12 Explain how media and technology can be misused to distort or exaggerate information.	M	E	E
G6-8: 2.13 Explain how Copyright Law protects the ownership of intellectual property, and explain consequences of violating the law.	M	E	E
G6-8: 2.14 Explain issues of privacy, security, copyright, plagiarism, spam, viruses, file sharing, passwords, and personal information.	M	E	E
G6-8: 2.15 Explain fair use guidelines for using copyrighted materials (e.g. images, music, video, text) in school projects, as well as consequences of misuse.	M	E	E
G6-8: 2.16 Evaluate information from various online resources for accuracy, bias, appropriateness, and comprehensiveness.	D	M	E
2.2 Society	6	7	8
G6-8: 2.21 Identify and discuss the technology proficiencies needed in the workplace and how students can prepare themselves to meet these demands.	M	E	E
G6-8: 2.22 Identify and describe the effect technological changes have had on business, transportation, communications, industry, and agriculture in a global society.	M	E	E
G6-8: 2.23 Explain how technology can support communication and collaboration, personal and professional productivity, and lifelong learning.	M	E	E
G6-8: 2.24 Demonstrate the use of technology to identify and explore	D	M	E

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various occupations or careers.			
G6-8: 2.25 Explain and demonstrate the use of technology to support communication (e.g., with peers, family, school personnel) and compare it with other ways of communicating.	M	E	E
G6-8: 2.26 Explain various ways that consumers use technology (e.g., creating budgets, making purchases, conducting financial transactions, and accessing product information).	D	M	E
2.3 Health and Safety	6	7	8
G6-8: 2.31 Explain why computers, networks, and information must be protected from viruses, intrusion and vandalism.	M	E	E
G6-8: 2.32 Demonstrate knowledge of responsible, safe, and ethical use of networked digital information (i.e., Internet, mobile phones, wireless, LANs).	M	E	E
G6-8: 2.33 Demonstrate knowledge of the potential risks and dangers associated with online communications. Provide examples of safe and unsafe practices for sharing personal information via e-mail and the Internet.	M	E	E
G6-8: 2.34 Demonstrate an understanding of terms/concepts associated with the safe, effective, and efficient use of telecommunications/Internet (i.e., password, firewalls, spam, security, Acceptable Use Policy).	M	E	E

Massachusetts Technology Standards Grades 6 through 8 – Technology Standards and Expectations			
3. Research, Problem-Solving, and Communications	Grades <i>Continue to address earlier skill as needed. I = Introduce D = Develop M = Master E = Extend)</i>		
3.1 Research	6	7	8
G6-8: 3.11 Collect, organize, and analyze digital information from a variety of sources (e.g. survey data, data gathered online, data from science experiments).	M	E	E
G6-8: 3.12 Use content-specific technology tools (e.g., environmental probes, sensors, measuring devices, simulations) to enhance understanding of curriculum content.			
3.2 Problem Solving	6	7	8
G6-8: 3.21 Use a variety of computing devices (e.g. probeware, handheld computers, digital cameras, scanners) to collect, analyze and present information for curriculum assignments.	M	E	E
G6-8: 3.22 Use and modify databases and spreadsheets to organize, analyze, interpret, and evaluate findings.	M	E	E
G6-8: 3.23 Develop guidelines to evaluate the content, organization, design, use of citations, and presentation of technologically enhanced projects.	D	M	E

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3.3 Communication	6	7	8
G6-8: 3.31 Demonstrate knowledge of the advantages of using a specific technology (e.g., word processing, desktop publishing, presentation software) to develop and communicate information to a variety of audiences.	M	E	E
G6-8: 3.32 Identify and demonstrate differences between writing and design of print and screen media (e.g., font size, aspect ratio, resolution). Explain some of the difficulties associated with the repurposing of information across several distinct media.	M	E	E
G6-8: 3.33 Use a variety of telecommunication tools (e.g., e-mail, discussion groups, web pages, blogs, web conferences) synchronously and/or asynchronously to collaborate and communicate with peers, experts, and other audiences (at district's discretion).	I	D	D
G6-8: 3.34 Plan, design, and develop a multimedia product using information (e.g., text, graphics, charts) to present research findings in the most effective way, citing sources.	D	M	E

**Massachusetts Technology Standards
Grades 9 through 12 – Technology Standards and Expectations**

Throughout high school, as students take courses to prepare themselves for college and the working world, 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.

During high school, students also 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 of technology resources, 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.

1. Basic Operations and Productivity Tools

1.1 Basic Operations

G9-12: 1. 11 Identify the platform, version, properties, function, and interoperability of computing devices.

G9-12: 1.12 Explain differences between formats that are open specification and proprietary, giving situations in which one is more appropriate than the other.

G9-12: 1.13 Install and uninstall software; compress and expand files (with district’s permission).

G9-12: 1.14 Resolve commonly occurring error messages and simple hardware and software problems as they occur (e.g., frozen screen, disk error, printing problems).

G9-12: 1.15 Use online help and other support to learn about features of hardware and software, as well as to assess and resolve problems.

G9-12: 1.16 Demonstrate skills for evaluating appropriate hardware and software (e.g., features, versions, capacity) for a given task.

G9-12: 1.17 Demonstrate effective backup and recovery strategies.

G9-12: 1.18 Identify the capabilities and limitations of emerging technologies.

1.2 Word Processing/Desktop Publishing

G9-12: 1.21 Save, retrieve, load, and import a word processing document in different file formats (e.g., RTF, HTML).

G9-12: 1.22 Import, export, and link data between word processing documents and other applications.

G9-12: 1.23 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: 1.24 Use special features appropriately (e.g., footnotes, track changes, insert

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comments, search and replace, keyboard shortcuts).
G9-12: 1.25 Identify the use of word processing and desktop publishing skills in various careers.
1.3 Database
G9-12: 1.31 Describe the importance of designing the structure of a database to meet its intended goals.
G9-12: 1.32 Duplicate the structure of a database without data.
G9-12: 1.33 Use database features to create mailing labels, form letters, and perform mail merges.
G9-12: 1.34 Save database files in various formats.
G9-12: 1.35 Manipulate non-alphanumeric digital data (e.g., geospatial data from MassGIS ⁷ , images, audio) within a database.
G9-12: 1.36 Identify the use of database skills in various careers.
G9-12: 1.37 Define the term “metadata,” and explain how metadata describes the structure and workings of an organization's use of information.
1.4 Spreadsheet
G9-12: 1.41 Define and use functions of a spreadsheet application (e.g., sort, filter, find).
G9-12: 1.42 Enter formulas and functions; use the auto-fill feature in a spreadsheet application.
G9-12: 1.43 Explain and use advanced formatting features of a spreadsheet application (e.g., reposition columns and rows, add and name worksheets).
G9-12: 1.44 Use various number formats (e.g., scientific notation, percentages, exponents) as appropriate.
G9-12: 1.45 Differentiate between formulas with absolute and relative cell references.
G9-12: 1.46 Customize formatting of charts or graphs created in spreadsheet applications.
G9-12: 1.47 Use multiple sheets within a workbook, and create links among worksheets.
G9-12: 1.48 Import and export data between spreadsheets and other applications.
G9-12: 1.49 Create and use pivot tables.
G9-12: 1.410 Identify the use of spreadsheet skills in various careers.
1.5 Internet, Networking, and Online Communication
G9-12: 1.51 Explain how to select and use search engines and online directories. Explain the differences among search engines and how they rank results.
G9-12: 1.52 Explain the differences between searching and browsing a collection of data, identify when one technique is more appropriate than the other, and explain how the two can work together.
G9-12: 1.53 Explain and demonstrate effective search strategies for locating and retrieving electronic information (e.g., using syntax and Boolean logic operators).

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

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G9-12: 1.54 Describe good practices for password protection and authentication.
G9-12: 1.55 Complete at least one online credit or non-credit course or tutorial; discuss the benefits and disadvantages of this method of learning.
G9-12: 1.56 Plan and implement a collaborative project using telecommunications tools with students in other classrooms and schools (e.g., email, discussion forums, groupware, interactive web sites, videoconferencing).
G9-12: 1.57 Demonstrate basic understanding of addressing schemes (i.e., IP addresses, DHCP, DNS).
G9-12: 1.58 Identify career options in network technologies.
G9-12: 1.59 Present data to multiple audiences using the most appropriate tools (e.g., spreadsheet, database, graphing, and concept-mapping tools).
G9-12: 1.510 Explain how various formatting options are used to convey information when formatting of charts or graphs created in spreadsheet applications.
1.6 Multimedia and Software Applications
G9-12: 1.61 Identify technology tools (e.g., authoring tools and other software resources) that can be used to create a multimedia product.
G9-12: 1.62 Compare differences between multimedia, hypertext, and static media; classify everyday items (e.g., DVDs, web sites, household appliances, books, posters) according to their use of multimedia, hypertext, and static presentations.
G9-12: 1.63 Demonstrate the ability to use a variety of applications to plan, create, and edit multimedia products (e.g., slide presentations, videos, animations, simulations, podcasts).
G9-12: 1.64 Identify career options in multimedia and software applications.
G9-12: 1.65 Link multiple pieces of information residing in different applications (e.g., linking a chart in a word-processing document to the spreadsheet where it was created, so that the chart is automatically updated when data are changed in the spreadsheet).
1.7 Web Authoring
G9-12: 1.71 Understand terminology necessary for web page authoring (e.g., HTTP, HTML, tags, links, browsers, plug-ins, web servers).
G9-12: 1.72 Distinguish between effective and ineffective designs in web sites.
G9-12: 1.73 Use text, images, design elements, and media effectively to create unified, well organized sites with effective navigation.
G9-12: 1.74 Use HTML or web-authoring tools to create and edit web pages (e.g., add/edit text, graphics, links, buttons).
G9-12: 1.75 Demonstrate an understanding of practices that contribute to a web site's accessibility to people with disabilities (e.g., tab order, keyboard equivalents, clear navigation mechanisms, alt tags describing images, captioning for multimedia).
G9-12: 1.76 Create and save web pages using appropriate file structure; upload and publish web pages.
G9-12: 1.77 Understand how to test and debug web files for quality assurance.
G9-12: 1.78 Identify career options in web design, development, and management.

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Massachusetts Technology Standards Grades 9 through 12 – Technology Standards and Expectations	
2. Ethics, Society, and Safety	
<i>2.1 Ethics</i>	
G9-12: 2.11	Demonstrate compliance with the school's Acceptable Use Policy.
G9-12: 2.12	Explain laws restricting the use of copyrighted materials.
G9-12: 2.13	Demonstrate the ability to evaluate the authenticity, accuracy, appropriateness, and bias of electronic resources, including web sites.
G9-12: 2.14	Identify examples of plagiarism, and discuss the possible consequences of plagiarizing the work of others.
G9-12: 2.15	Write correct in-text citations and reference lists for text and images gathered from electronic sources, as stated in the Massachusetts English Language Arts Framework.
G9-12: 2.16	Discuss and demonstrate issues related to acceptable and responsible use of technology (e.g. privacy, security, copyright).
G9-12: 2.17	Discuss misuse of technology for personal and commercial reasons (e.g., spam, viruses, personal identity and information theft); discuss related consequences and possible solutions.
G9-12: 2.18	Understand the appropriate and responsible use of communication tools such as chats, instant messaging, blogs, and wikis.
<i>2.2 Society</i>	
G9-12: 2.21	Design and implement a personal learning plan that includes the use of technology to support lifelong learning goals.
G9-12: 2.22	Analyze the effect of technological change on areas such as business, transportation, communications, industry, agriculture, and the arts, both locally and globally.
G9-12: 2.23	Explain the penalties for illegal practices such as software piracy, unauthorized file sharing/downloading, virus spreading, and hacking.
<i>2.3 Health and Safety</i>	
G9-12: 2.31	Evaluate school and work environments in terms of ergonomically sound practices.
G9-12: 2.32	Demonstrate ways that individuals can protect their technology systems from unethical or unscrupulous users.
G9-12: 2.33	Explain the use of appropriate protective technologies (e.g. firewalls and virus protection software).
G9-12: 2.34	Describe and use safe and appropriate practices when participating in online communities, such as discussion groups, blogs, and social networking sites.
G9-12: 2.35	Explain and use practices to protect one's personal safety online (e.g., not sharing personal information with strangers, being alert for online predators, and reporting suspicious activities to parents, teachers, or law enforcement personnel).

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**Massachusetts Technology Standards
Grades 9 through 12 – Technology Standards and Expectations**

3. Research, Problem-Solving, and Communications

3.1 Research

G9-12: 3.11 Compare, evaluate, and select appropriate online tools to locate information and conduct research using all appropriate electronic resources (e.g., web sites, online periodical databases, online catalogs, search engines, specialized directories, RSS feeds, and email alerts).

G9-12: 3.12 Formulate a research question or hypothesis, use appropriate technology resources to collect relevant information, analyze the findings, and report the results.

3.2 Problem Solving

G9-12: 3.21 Explain and demonstrate how specialized technology tools can be used for problem solving, decision-making, and creativity (e.g. simulation software, environmental probes, computer-aided design, geographic information systems, dynamic geometric software, graphing calculators, art and music composition software).

3.3 Communication

G9-12: 3.31 Present information using a variety of media (e.g., reports, research papers, presentations, newsletters, web sites, podcasts, blogs).

G9-12: 3.32 Present ideas using a variety of formats that are appropriate for various audiences.

G9-12: 3.33 Use online communication tools such as bulletin boards, discussion forums, listservs, and web conferencing to collaborate with peers, community members, and field experts when appropriate.

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Gaining Technology Skills
While Learning the Content of the Curriculum

Anyone who has taken a training course in the use of spreadsheet, for example, knows how quickly we forget the skills unless we can apply them in our work. 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 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 Department of Education in its technology toolkit, were drawn from school districts that participated in Project MEET, from districts that received instructional technology grants from the Massachusetts Department of Education, 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 aligned with the state's Curriculum Frameworks, and it had to integrate learning technology skills with learning the curriculum content. 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 fourteen more, are available on the Department's web site (<http://www.doe.mass.edu/edtech/toolkit/practices/index.htm>). The online version includes links to sample student work, classroom photographs, videos, multimedia presentations, and digital artwork.

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Integrated Learning Scenario Reciprocating Art⁸ Grades 1-4 Art

Instructional objective: The student will be able to use the principles and elements of design to collaboratively create artwork 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 email 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 the 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 email. The completed artwork was sent back to the original schools.

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 student'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 learn and accept. This was accomplished through discussion and student activities.

Technology performance indicators addressed

Standard 3. Research and Information Fluency; Critical Thinking, Problem Solving & Decision Making; Communication and Collaboration; and Creativity and Innovation

Demonstrate the ability to use technology for research, problem solving, and communication.

K-2: 3.32 Communicate interactively with other students and other classes using appropriate technology, including email if the district allows it.

⁸ Robert Wilson at the Floral Street School in Shrewsbury Public Schools developed reciprocating Art.

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Integrated Learning Scenario

Becoming Scientists⁹

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 the friendly letters for the concert and greenhouse scenarios. 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 performance indicators addressed

Standard 3. Research and Information Fluency; Critical Thinking, Problem Solving & Decision Making; Communication and Collaboration; and Creativity and Innovation

Demonstrate the ability to use technology for research, problem solving, and communication.

G3-5: 3.15 Use content-specific technology tools (e.g., environmental probes, sensors, measuring devices, simulations) to enhance understanding of curriculum content.

G3-5: 3.21 Enter data into spreadsheets, create graphs, and do basic calculations to make predictions, solve problems, draw conclusions and communicate those conclusions.

G3-5: 3.22 Use appropriate technology tools to define a problem, propose hypotheses, validate information, test conclusions, and present findings and proposed solutions.

G3-5: 3.32 Create projects that use writing and various forms of graphic sources (e.g., photographs, digital images, clip art, graphs, and tables) with proper citations to communicate an idea; explain the rationale behind each design choice.

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, and Chris Hershiser, and Wendy Abramson.

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Integrated Learning Scenario

SELECT Math¹⁰
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 performance indicators addressed

Standard 3. Research and Information Fluency; Critical Thinking, Problem Solving & Decision Making; Communication and Collaboration; and Creativity and Innovation

Demonstrate the ability to use technology for research, problem solving, and communication.

G6-8: 3.12 Use content-specific technology tools (e.g., environmental probes, sensors, measuring devices, simulations) to enhance understanding of curriculum content.

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

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Integrated Learning Scenario

Africa¹¹

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 use 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 us to share a lot of what the kids did with their parents.

Technology performance indicators addressed

Standard 3. Research and Information Fluency; Critical Thinking, Problem Solving & Decision Making; Communication and Collaboration; and Creativity and Innovation

Demonstrate the ability to use technology for research, problem solving, and communication.

G6-8: 3.11 Collect, organize, and analyze digital information from a variety of sources (e.g. survey data, data gathered online, data from science experiments).

G6-8: 3.22 Use and modify databases and spreadsheets to organize, analyze, interpret, and evaluate findings.

G6-8: 3.34 Plan, design, and develop a multimedia product using information (e.g., text, graphics, charts) to present research findings in the most effective way, citing sources.

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

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Integrated Learning Scenario

The Greyhound Bus® Depot¹²
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 performance indicators addressed

Standard 2. Digital Citizenship, Ethics, Society, and Safety

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: 2.15 Write correct in-text citations and reference lists for text and images gathered from electronic sources, as stated in the Massachusetts English Language Arts Framework.

G9-12: 2.13 Demonstrate the ability to evaluate the authenticity, accuracy, appropriateness, and bias of electronic resources, including web sites.

Standard 3. Research and Information Fluency; Critical Thinking, Problem Solving & Decision Making; Communication and Collaboration; and Creativity and Innovation

Demonstrate the ability to use technology for research, problem solving, and communication.

G9-12: 3.12 Formulate a research question or hypothesis, use appropriate technology resources to collect relevant information, analyze the findings, and report the results.

G9-12: 3.31 Present information using a variety of media (e.g., reports, research papers, presentations, newsletters, web sites, podcasts, blogs).

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

**DRAFT
Appendix A**

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Technology Standards Update Committee		
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The following organizations and people 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
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- MassCUE, Inc. (Massachusetts Computer Using Educators)
- Representatives from the Board of the Massachusetts Technology Leadership Council

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Appendix B

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

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 is:

- 0. Creativity and Innovation
- 0. Communication and Collaboration
- 0. Research and Information Fluency
- 0. Critical Thinking, Problem-Solving, & Decision-Making
- 0. Digital Citizenship
- 0. 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 standards into the three standards of the *Revised K – 12 Instructional Technology Recommended Standards* as follows:

UPDATED K – 12 INSTRUCTIONAL TECHNOLOGY STANDARDS	CORRESPONDING NETS FOUNDATION STANDARDS	CORRESPONDING REFRESHED ISTE NETS
Standard 1	Standard 1, 3	Standards 1, 2, 3, and 4
Standard 2	Standard 2	Standards 5
Standard 3	Standards 3, 4, 5, and 6	Standards 6