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Massachusetts Community Colleges
& Workforce Development
Transformation Agenda

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Contextualized Curriculum

for Adult Learners in Math and Literacy

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Design with Ratios in Mind

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How ratios and proportions can be used by [web developers](#) *to design a website*

Industry Sector: [Information Technology](#)
Content Area: [Mathematics](#)
Core Topic: [Ratios, rates and proportions](#)

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Common Core State Standards

Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
6. Attend to precision.

High School—Number & Quantity: Quantities

N-Q.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

High School—Modeling

High School—Geometry: Modeling with Geometry

G-MG.3: Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Adult Basic Education Standards

Geometry and Measurement

- **4G-4:** Understand measurable attributes of objects and the units, systems, and processes of measurement and apply appropriate techniques, tools and formulas to determine measurements.
- **4G-4.1:** Convert units of measure in different systems by using own informal methods.

- **4G-4.1.3:** Know how to solve ratio and proportion problems.

Industry Overview

From computer programmers to web developers, and from network administrators to technical support specialists caring for the IT infrastructure, there are information technology (IT) careers available in every sector of the economy. While some people in this field work for IT companies, IT skills and services are needed in fields as wide-ranging as financial services, medical services, biotechnology, engineering and environmental services[1]. The IT industry designs, develops, manages and supports the hardware, software, multimedia and networks we depend on in our daily lives and businesses. IT has revolutionized our world—from the ways we communicate to how we find information to how businesses operate. Job growth in the US IT industry is high and is projected to continue for many occupations within the industry. The field is constantly growing and changing and there are high levels of competition which makes it important for IT workers to keep updating their skills and to understand the latest technologies.

Careers in Information Technology[2]

Information technology careers are divided into four pathways: Network Systems, Information Support and Services, Programming and Software Development, and Web and Digital Communications.

Careers in Network Systems involve network analysis, planning and implementation, including design, installation, maintenance and management of network systems. Examples of network systems occupations include: network administrator, network technician, PC support specialist, telecommunications network technician, data communications analyst, and security administrator.

Careers in Information Support and Services involve IT deployment, including implementing computer systems and software, providing technical assistance, and managing information systems. Successful IT deployment is critical to the success of most organizations—the management and sharing of information depends on non-IT workers having functional computers, software and databases that meet their needs, and support when things aren't working. Information systems and support occupations include database administrator, enterprise systems engineer, help desk specialist, technical support specialist, and technical writer.

Careers in Programming and Software Development involve the design, development, implementation and maintenance of computer systems and software and require knowledge of computer operating systems, programming languages and software development. While many of the career opportunities in this area are in software companies, large organizations of other types—such as financial services—also offer many opportunities. Programming and software development careers include: software applications architect, operating systems designer/engineer, computer programmer, video game developer, applications engineer, and applications developer.

Careers in Web and Digital Communications involve creating, designing and producing interactive multimedia and social media products and services and include development of digitally-generated or computer-enhanced media used in business, training, entertainment, communications and marketing. Organizations of all types and sizes use digital media (such as the Internet and social media platforms) to communicate with existing and potential customers, to track transactions, and to collaborate with colleagues. Occupations in this pathway include web designer, webmaster, 3D animator, virtual reality specialist, and multimedia producer.

Mathematics and Literacy Skills Needed in Information Technology

The complexity of the IT industry, including the rapid pace of change in technology, requires workers to continuously upgrade their skills. Jobs in this industry require good problem-solving, critical-thinking, and reasoning; clear and professional communication; and a strong background in mathematics. Thus, in addition to technical skills specific to each job, mathematics and literacy skills are crucial for success in all occupations across the industry. Literacy is essential in this field as it is heavily dependent on written and oral communication, and workers need to be able to read, understand, and implement highly-technical content. Workers in this industry must communicate with clients, colleagues, and other departments and staff, including executives.

Regardless of how technologies change, a strong foundation in mathematics, particularly with such core areas as mathematical operations and number sense, measurement and estimation, ratios and proportions, and data analysis is very useful in this industry. For example, programmers and developers must be able to employ quick and competent computation and have the ability to select and apply the best mathematical model or formula to solve problem at hand.

Career Opportunities in IT with Education from Community Colleges

Massachusetts Community Colleges play a crucial role in preparing students for careers in IT across all sectors of the industry. The fifteen community colleges offer associate degree and certificate programs that prepare students to enter occupations across all sectors of the industry, from network administrators to technical support specialists to computer programmers to Web designers. For example, Cape Cod Community College's Department of Business has an IT program that prepares students for a range of positions through both the Information Technology A.S. degree and certifications that offer skills in specific concentrations in this field, such as networking and web design.

Recent Career Opportunities in Massachusetts

The following is a sample of IT job listings in Massachusetts that require associate's degree or certificate:

- Help Desk Technician [show]
- PC Technician [show]

The following is information about hires of recent IT graduates from Massachusetts community colleges:

- Bristol Community College, Computer information Systems: Computer Networks
- Mount Wachusett Community College, Computer Information Systems

Employment Outlook for Information Technology

Given the ubiquity of IT in the U.S. and the world today, employment in this industry continues to boom. Even during the current recession, there has continued to be high demand for workers with good technical, problem-solving and critical-thinking, and communication skills in the IT industry. The U.S. Bureau of Labor Statistics reported in its 2012-13 edition of the Occupational Outlook Handbook that employment in the industry is expected to grow "much faster than the average" of all occupations through 2020. Massachusetts has very high levels of employment and numbers of job openings in many IT occupations across the state. In 2011, it was one of the top seven states for employment opportunities in the industry. Furthermore, Middlesex and Suffolk counties were among the top 20 counties nationally listing IT positions.

However, within the IT industry, job growth and openings vary due to technological changes and competition (especially foreign). For example, employment for computer programmers in Massachusetts and nationally continues to be high, but is declining—future jobs will go to people with strong technical, cognitive, intrapersonal, and interpersonal skills. Likewise, lower-skilled jobs such as computer support specialists will have lower employment growth due to outsourcing (though help desk personnel are always needed in larger firms to assist non-IT staff with maintenance, troubleshooting, and repair). The highest growth areas in IT—nationally and in Massachusetts—are in such occupations as computer and information systems managers, computer systems analysts, and computer specialists.

Resources

Employment Outlook

- Massachusetts Career Information System
- U.S. Bureau of Labor Statistics: Occupational Outlook Handbook, Computer and Information Technology
- Jobs for the Future: An Examination of the Information Technology Job Market (2012)

Occupational Information

- [Massachusetts Career Information System](#)
- [U.S. Bureau of Labor Statistics: Occupational Outlook Handbook, Computer and Information Technology](#)
- [WorkKeys Occupational Profiles](#)
- [WorkKeys: Occupations and Key Skills](#)
- [Information Technology Career Clusters](#)
- [Information Technology Career Frames](#)

[1]http://www2.edc.org/ewit/materials/ITCCBRO.pdf

[2]As cited in http://www2.edc.org/ewit/materials/ITCCBRO.pdf

Workplace Scenario (8th Grade Level)

This scenario is based on the work of a web developer. For more information, view [this video](#).

You are a [front-end](#) web developer in a medium-sized publishing firm in Massachusetts. Your company develops websites for new products. Staff from the [IT department](#) supports this work. You are part of a small team of [web developers](#). Your task is to develop the layout of a new website. Your first priority is to make the website look great on computer [browsers](#). Your team also wants to make the website work for tablets and smartphones. You know that it is important for ratios to be used in the design process. Otherwise the quality of the final product will suffer. This means users will not have a good experience.

Once the final product is rolled out, there is more work to do. The site development team uses [web analytics](#) to track web traffic. This helps them get a sense of a web site's strengths and weaknesses. It allows them to see the number of hits per page. It also shows them how long people stay on pages. Finally, it lets them know where users are clicking on each page. This data can help the team know when the site needs to be updated.

Workplace Scenario (High School Level)

This scenario is based on the work of a web developer. For more information, view [this video](#).

You are a [front-end](#) web developer in the [IT Department](#) of a medium-sized publishing firm in the Metrowest area of Massachusetts. The firm develops websites in house for each new product they launch with the support of staff from the [IT department](#). You are working with a small team of [web developers](#) to develop the layout of a new website. In addition to making the website look great on computer [browsers](#), your team also wants to [optimize](#) it for tablets and smartphones. You know that if ratios are not used in the design process, then the quality of the final product, and thus the user experience, will be compromised.

Once the final product is rolled out, the site development team uses [web analytics](#) to track web traffic. Seeing the number of hits per page, how long people stay on certain pages, where users are clicking on each page can give the team a sense of a web site's strengths and weaknesses. Depending on the size of the site traffic and the actions completed by users, it may be necessary to update the design of a site periodically to improve users' experience.

Core instructional context

Ratios, rates, and proportions are used when making comparisons between different quantities. A ratio is a comparison between two quantities, and a rate is a special kind of ratio that compares the change in one measurement to the change in another measurement. Proportions are two ratios that have been set equal. These mathematical comparisons allow people to understand and communicate about how quantities are related to each other, such as how long it takes to perform certain tasks (for

example, extruding one mold takes 1.25 minutes on average if 48 molds are produced each hour), or the cost per unit for an item (for example, $7.99 per pound for one brand of sliced deli cheese versus $5.99 per pound for another brand). Proportional reasoning and understanding the relative way quantities change (for every 5 units up we move 3 units over), is an important building block of algebraic thinking. Developing a student's proportional reasoning skills, will help students differentiate between processes that are additive and multiplicative, interpret graphs that represent proportional relationships, and open pathways to further mathematical understandings.

Web developers use math daily to solve the problems they encounter in their work—from providing an estimate of the time and resources it will take to build a website to clients, to designing of the site so that it is visually appealing and easy to navigate, and then to translate a design into a finished product.

The first stages of web design are usually not done in code; designers mock-up what the individual pages will look like using a program like Photoshop or Fireworks. Here, ratios are important in determining the dimensions of each element that shows up on the website, such as the main navigation bar, the primary content area, and graphics. For each major element, designers choose an acceptable width-height ratio, and determine how the ratio may be modified on different devices.

Designers also think about the ratio of one element's width to that of other elements, as well as the ratio to the entire page. For instance, what will be the ratio of the width of the navigation bar to the main content area? Will this ratio change when the browser is enlarged or reduced? How would this ratio vary across computers, smartphones, and tablets? An example of a tool developed for web designers is the design grid, which helps the designer map out the web page. The Grid System website is a great resource for this type of design method.

Worked Examples

1. The dimensions of an iPad tablet screen are 1024 x 768 px:

   a. In portrait view, the iPad screen has a width of 768 px. The ratio of the width of the vertical navigation bar (or nav bar) to the entire screen is 1:4. What is the width of the nav bar in iPad portrait view?

      x:768 has a 1:4 ratio

      x = 768 / 4 = 192 px

   b. In landscape view, the width of the screen is 1024 px and has the same 1:4 ratio. What is the width of the nav bar here?

      x = 1024 / 4 = 256 px

2. You are designing the navigation bar for the website. Your page is 1024 px wide, but you only have 980 px to use for the navigation bar.

a. There will be 6 main menu items, all the same width. What is the maximum width you could use for each item?

980 / 6 = 163.33 which would round to 163 px

Note: Although it is possible to have fractional pixels, different [browsers](#) will work with the fractions differently, so generally [web developers](#) use whole pixels [dimensions](#). When rounding pixels it is usually safer to round down, as rounding up could cause the menu items total width to be larger than the container.

b. Suppose you want to separate each menu item by 15 px, and you want the bar to stretch across the entire 980 px. How wide would each menu item have to be?

Calculate the available pixel space:

980 - (15 * 5) = 980 - 75 = 905

Calculate maximum width:

905 / 6 = 150.83 = 150 px

Once again, round down, so that the total menu length does not get larger than the container (980 px)

Contextualized learning activities

Reading the Scenario

Have students read the scenario and job overview and identify any mathematical terminology or concepts.

Optional Extension:

Have students break up into groups, and assign each group to look at a set of vocabulary terms under a different part of the alphabet at this [site.](#) Each team should then prepare a presentation on web design vocabulary.

Ratios in Everyday Objects

Determine the [dimensions](#) of everyday objects, such as desks, windows, books, and the room; determine the ratio of height to width in each object. One of these objects could be the screen of a computer, tablet, or smartphone.

Designing on the Grid

Have your students read one or more of the following resources on the grid system. Then, have them discuss how a grid system supports organized web design.

- [The 960 Grid System Made Easy](#)
- [The Grid System](#)
- [Golden Grid System](#)
- [Grid System](#)

Contextualized Problems

1. You're testing your website on two different tablets. Tablet A has a resolution of 1366 x 768, and Tablet B has a resolution of 1600 x 1200. Determine the height to width ratio of each of these tablet displays. Are they the same?

Answer: They are not the same: Tablet A has a ratio of 1.78:1 or 16:9, while Tablet B has a ratio of 1.33:1 or 4:3

2. An HD monitor has a resolution of 1920 x 1080, and a smartphone has a resolution of 720 x 1280. What is the ratio of the monitor's total pixels to that of the smartphone? (HINT: multiplying the two pixel <u>dimensions</u> will give the total pixels)

   Answer: 2.25:1 or 9:4

3. On the smartphone, the navigation bar's width would be at the bottom of the page, and would take up 80% of the screen. If a smartphone screen is 280 pixels wide, what would be the width of the navigation bar?

   Answer: 224 px

4. The size of the header text is 1.5 em, which means that the header is 150% of the standard size. Write a ratio expression that describes the ratio between the size of the header text and the size of the standard body text.

   Answer: 1.5:1 or 3:2

5. Now suppose the font size of the navigation link text is 1.2 em, which is 120% the standard size. What is the ratio of the navigation link text to the header text?

   Answer: 1.5:1.2 or 5:4

Contextualized test items

1. You are given a video in HD format that needs to be resized for your website. (Note: the aspect ratio for HD video is 16:9.) Your page design has a width of 980 px, but you'd like to fit the video in a space that is only 750 px wide. Which of the following could be the pixel <u>dimensions</u> of the re-sized video? Check all that apply.

   a. 976 x 549
   b. 800 x 450
   c. 600 x 450
   d. **720 x 405**
   e. **640 x 360**

2. The fold, also known as the scroll, is the position on a website where the <u>browsers</u> will begin to scroll down. Within the fold on an iPad in portrait view, the ratio of the height of the top banner to the height of the remaining space is 1:7. If the banner is 128 px in height, what should be the height of the rest of the space?

   Answer: 896 px

Contextualized project

This project involves making either a website or a website mock-up. Think about how you would like to place each step into your module. For instance, the initial steps lend themselves to introductory ratio activities.

Step 1: Students may do some initial explorations of their favorite websites, recording notes on their layout.

Step 2: Students have to design a site layout using construction paper based on math concepts, such as the golden rectangle.

Step 3: After this, students may proceed to designing a site page in PowerPoint or Photoshop.

Step 4: For extra credit or as one of several options for a project, students would apply their math skills to designing a real website or blog layout.

Additional or extension activities, multimedia, readings and/or resources

1. To give your students a better idea of the role of CSS in web design, have them visit Zen Garden: The Beauty of CSS Design, which allows you to select different layouts for a single web page. Students can pick one or more styles and measure the page elements.
2. Unit definition vocabulary activity in which students learn the definition of pixels, points, and percents in the context of web design. Have students practice converting these different measurements.
3. Use Firebug or another browser-based developer tool to edit the width and height properties of a very basic website and see how the dimensions change.
4. Using Firefox, have students visit several websites they typically go to. Once they reach the site, have them right click and then go to 'inspect element'. Then, upon clicking '3D view' in the lower right corner, they will be able to see the different elements of a web page to see how a typical web page is broken up. After doing this, you can have them measure the height and width of several different elements on the page they have visited.

   Have students explore these resources:

   - Mathematics, Seashells, and Web Design
   - The Golden Ratio in Web Design
   - Applying Mathematics to Web Design

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