Introduction

The Impact of Math Remediation

In "*Paying Double: Inadequate High Schools and Community College Remediation*," the Alliance for Excellent Education reports the leading indicator that a student will drop out of college is the need for remedial education.[1] Nationally, 35% of college freshmen enroll in remedial math, more than any other subject area.

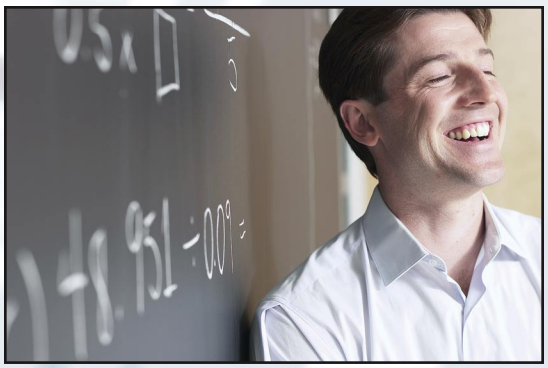
In Washington State, the majority of high school graduates begin higher education at a community or technical college. According to the State Board for Community and Technical Colleges, 49% of students entering a two-year college **directly after** high school must take a pre-college math course before enrolling in a credit math course.

Students who need remediation are more likely to drop out of post-secondary training, thus impacting individual lifetime earnings and career progression opportunities. As the learning gap widens between qualified and unskilled workers, the expense of remediation hurts socially, and economically.

College Readiness Standards: A Clear Vision of Math Expectations in Washington State

The **Transition Math Project** (TMP) is a collaborative of K-12 schools, community and technical colleges and baccalaureate institutions committed to reversing the alarming remediation rates between high school and college-level math. In 2004, TMP developed the **College Readiness Standards** to define the core knowledge and skills expected of students entering college-level mathematics courses.

Locally-driven partnerships are now underway to align these standards between eleventh and twelfth grade math curricula and college introductory curricula, and to increase the professional capacity of instructors through improved instructional course and program design, teaching methods, and classroom assessments.



The term "college readiness" is not exclusive to universities. In fact, the term "work readiness" can be easily inserted in its place, because the end purpose of all post-secondary education is having the personal means to get and progress in a desired job.

Apprenticeships and two-year construction programs at community and technical colleges are dealing with severe math remediation issues. In part, many students and their primary influences – parents, peers, teachers and counselors – do not know enough about the academic preparation needed in post-secondary construction training.

Proficiency in fundamental (basic) math - number sense, geometry, and algebra – is essential to all professions in all phases of construction- from design to building to maintenance.

1 August 2006. "Paying Double: Inadequate High Schools and Community College Remediation," Alliance for Excellent Education Issue Brief, page 3.

(1/07)

Construction Math: A Blueprint for Success

Math is the language of Construction. It is the one "tool" that solves nearly any problem on-the-job involving accuracy, efficiency or safety. Construction workers communicate and make decisions using math. Math is both precision and artistry in construction– without it, the marvels of ancient pyramids and cathedrals to modern stadiums, bridges, and skyscrapers could never have been built.

This toolbox has been created especially to bring fresh and exciting industry math to the classroom. Teachers can use the following lesson plans or examples in ***Laying the Foundation: Construction Math*** (Tab 14) to demonstrate how fundamental math principles are used on the job – rarely at a desk, and often, without paper and pencils! The math "demonstrations" designed for each lesson help students who are having trouble retaining fundamental math concepts.

Learning is satisfying when it makes sense – when there is a good reason to know and be able to apply what is learned. This is especially true for adolescents, who are attempting to "make sense" of their own lives and choices, and where information they receive in school "fits" into their future. More often than not, students discard valuable math skills, not because they may be difficult to master, but because a practical, beneficial use is not made apparent.

Even for students who are not interested in a construction career, construction math can make difficult concepts more sequential and tangible, and thus more likely to be retained and transferred. We think this exposure to construction math will help **all** students:

- consider the range of satisfying career paths in the construction industry; and
- recognize the value of math through real-world application.

Connecting Standards to Academic and Career Planning

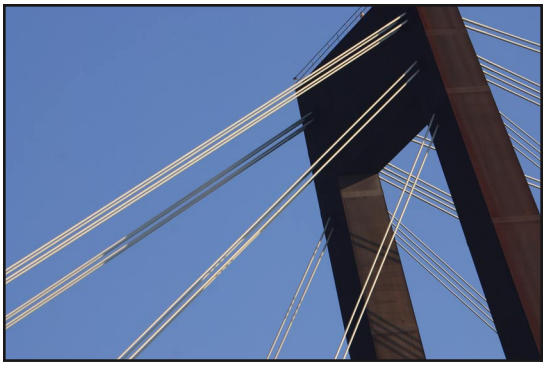
This toolbox offers more than construction math: it provides teachers with additional career guidance tools for students who express interest in construction, **because of this exposure** to construction math. These tools can be incorporated into class lessons and activities, or shared with individuals.

Teachers are often the first – and sometimes, the only – influence who provide information on career training options post high school. Sometimes, this information is limited to the teacher's knowledge of a particular industry, or the resources he or she may have on hand.

When a student plans an academic schedule each semester, he or she may not always consider whether selected courses match the prerequisites of his or her desired career path. Academic course taking is a root issue for students who are under-prepared for post-secondary education. Course selection begins with solid planning that links academic requirements to future goals.

Students who are interested in construction careers need to be advised to take **at least three years of college-preparatory math courses** during high school; optimally, their academic schedule will include math in their senior year.

If your school offers a career-technical education course in construction, or you are connected to a Skills Center, we encourage you to use these materials for creative team-teaching experiences. Tab 12 has a list of construction-related activities you can use to enrich classroom learning.



Construction: The Top Non-Manufacturing Sector in the United States

Did you know Construction is the largest industry in the world? It employs 7.2 million people in the United States alone. Further, the U.S. Bureau of Labor Statistics reports construction is the only non-manufacturing sector with projected employment growth over the next decade, adding at least 1,000,000 new jobs. In Washington, construction has outpaced all other industries in revenue and new business startup since 2004; in fact, most construction firms in state are small specialty craft or contractors. Without a skilled workforce, major commercial and capital projects in Washington will be delayed indefinitely.

Many people associate construction with labor-intensive occupations only, which are perceived as dirty, dangerous, and low-paying jobs. This misperception leads to the assumption that low or no skill workers comprise most of the construction workforce.

This is far from the case.

The technical and academic skills needed to progress in all construction industry jobs are sophisticated. Post-secondary training is essential for anyone who wants to build a satisfying and financially rewarding career in construction.

Nearly all construction-related programs and many apprenticeships are offered through Washington's community and technical colleges. Some apprenticeships are co-located at colleges, and some are located on independent campuses throughout the state. In our state, registered apprenticeship is regulated by the Washington State Apprenticeship Training Council, and is administered by the Washington State Department of Labor and Industries (LNI). Many apprentices in Washington can earn as associate's degree.

Two and four-year degrees can be pursued in other construction professions too, including architecture, design, engineering, maintenance and management at one of Washington's community or technical colleges, or universities. As with trades professionals, there is a high demand for workers in these phases of construction.

It is not uncommon to see a person begin a construction career in a specialty craft, and move into project coordination, safety consulting and even business ownership. There is a world of diverse career choices within this dynamic industry.

This is **good news for young people who are well prepared** to enter the world of construction: unprecedented employment growth, coupled with projected labor shortages, means this group will enjoy career mobility and financial satisfaction for years to come.

How to use this toolbox

This toolbox was designed for middle and high school math teachers to enrich their classes with industry-based lessons and supporting career guidance information.

Tabs 2 – 11: Construction Math Lesson Packages

These packages are based on fundamental math principles important in construction, and include fun, hands-on activities. These packages include:

- One lesson plan (which can be taught in 50 minutes, or divided into segments) designed with suggested hands-on props
- A student test
- An instructor's key
- Support graphics and materials

Each lesson connects to specific content standards of the College Readiness Standards. Content standards define the mathematical concepts a student needs to know before graduating from high school, to be prepared for college and work. All of the lessons connect to the process standards of communication, connections and problem solving. Process standards explain how the content knowledge and skills of math can be applied. ***Note:*** The content standards were defined at 9th and 10th grade level expectations for math, as outlined in the Essential Academic Learning Requirements. These construction math packages were designed to practice and reinforce early and fundamental components of the college readiness standards that are typically taught in the early years of high school.

Tab 12 and Front Binder Pocket: Additional Teacher Resources

This section includes lists of useful online math resources, and a list of suggested activities that can be done in conjunction with a construction math lesson. The front pocket of the toolbox contains:

- College Readiness Standards booklet
- Got Math? Transitions Math Project brochure
- AGC Education Foundation Get Smart brochure

Tab 13 and Back Binder Pocket: Career Guidance Resources

This section equips teachers to help students who express interest in pursuing a construction career. Materials include:

- Construction & Trades Career "Tree" and the Construction & Apprenticeship Trades Career "Forest" graphics
- Construction Trades Job Descriptions, including academic and entrance requirements
- Community and Technical College Training Matrix, with contact directory
- Apprenticeship program contact information, by region

The back flap of the toolbox includes a career planning booklet, a construction brochure, and an apprenticeship DVD for additional individual advising and/or classroom activities.

Tab 14: *Laying the Foundation: Construction Math*

This booklet contains math examples gathered from construction programs and apprenticeships in 2005. This booklet is not copyrighted – you may make derivative works.

For easy printing, *Laying the Foundation* and the Construction Math Lesson Packages are also on a CD-Rom in the front inside pocket of your toolbox binder.

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Associated General Contractors of Washington Education Foundation

New Market Skills Center- the K12 Building Trades Center of Excellence

Office of the Superintendent of Public Instruction of Washington State

Pierce County Construction Partnership

Snohomish County Construction Careers Partnership

South Central Workforce Development Council

Spokane Area Workforce Development Council

Washington State Apprenticeship Training Council

Washington State Building and Construction Trades Council, AFL-CIO

Washington State Department of Labor and Industries

Washington State Workforce Training and Education Coordinating Board

Youth Council of Seattle-King County

Additional Contributions

The Construction Center of Excellence extends its appreciation to the following individuals and organizations for participating in a formative evaluation process of the construction math lesson plans developed for this toolbox. This process included expert curriculum expert reviews, lesson plan pilot tests, and a focus group ensuring the content and layout of this package is user-friendly.

Sandy Christie - Puget Sound Educational Service District
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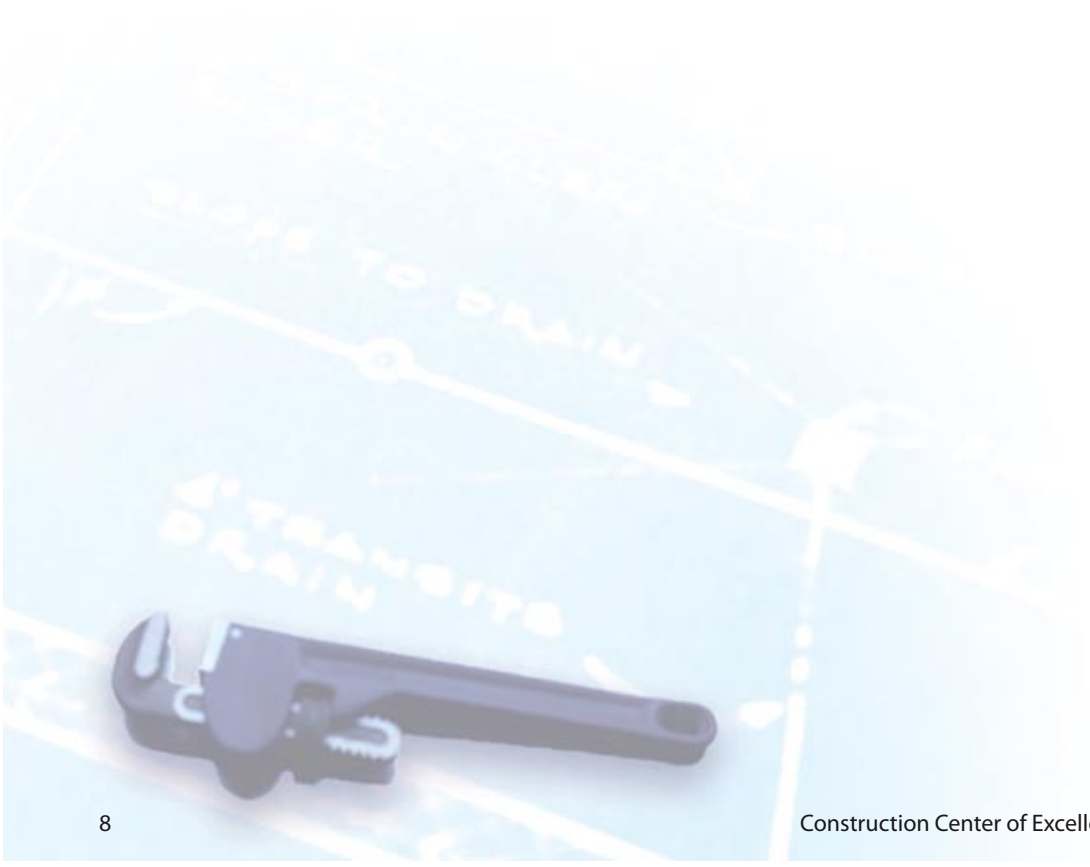

Copyright

The math lesson plans and ***Laying the Foundation*** math book are not copyrighted. You are free to copy, distribute for educational purposes, or make derivative works of these materials. Most of this Toolbox is available for free download at the CCE website, www.rtc.edu/CommunityResources/CCE.

The support materials should not be copied without express permission from the originator.

- The "Apprenticeship: Original 4-Year Degree" DVD included in hard copy Toolboxes is provided courtesy of the Washington State Building and Construction Trades Council, and it is copyrighted. Please do not copy this DVD – if you wish to obtain copies, please call 360.357.5778.

- The "Where Are You Going?" Career Guidance guide is provided courtesy of the Washington State Workforce Training and Education Coordinating Board. To obtain additional copies, please call 360.7543.5662 or go to http://www.wtb.wa.gov.

- The "Construction and Trades Career Tree" and "Construction and Trades Career Forest" documents are provided courtesy of the Snohomish County Workforce Development Council. For more information, please call 425.921.3423. You can download additional copies and view all industry trees at http://www.worksourceonline.com/b/careertrees.htm.

- The construction career job descriptions under Tab 13 are excerpts from the Washington State Registered Apprenticeship Catalog, and are provided courtesy of the Washington State Department of Labor and Industries. Full copies are available online at:

- The "Hot Jobs/Cool Careers" brochure is provided courtesy of the Associated General Contractors of Washington Education Foundation. To order additional copies, and inquire about other career guidance tools, including STEPS magazine, please call 206.284.4500 or go to http://www.agcwa.com/public/education/index.asp.

- The College Readiness Standards booklet and "Got Math?" brochure are provided courtesy of the Transition Math Project, which is managed by the Washington State Board for Community and Technical Colleges. For more information about this initiative, please call 206.870.5906. You can download both at the TMP website, http://www.transitionalmathproject.org/.

About the Authors

Kathy Swan

Kathy Swan was the first female drywall apprentice to join the carpenters union in Tacoma. She completed her training and became a journeyman in May 1984. Ms. Swan worked in the field on a variety of projects including heavy commercial concrete and metal stud /drywall. She was a foreman before teaching for the carpenters' apprenticeship program in 1991. Ms. Swan continued her education and completed her BS in workforce education. Ms. Swan has taught carpentry in high school, to apprentices and journey-level enhancement classes. She also traveled to Japan to teach. Her graduate studies include a certificate in human resource development from Chapman University, a Masters Degree in Education from Southern Illinois University, and a Doctorate in Workforce Education and Training is from Pennsylvania State University. Swan's research has been published. She has written and reviewed carpentry books and instructional guides. She remains an adjunct professor for both SIUC and PSU. She is currently an organizer and representative for the Pacific Northwest Regional Council of Carpenters'. She continues to work with area school districts presenting apprenticeship information and serving on advisory councils.

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Heather Winfrey is the Director of the Construction Center of Excellence at Renton Technical College. With 14 years expertise in workforce and economic development programming and policy, Ms. Winfrey served as the Manager of Training and Education Partnerships at the Washington State Workforce Training and Education Coordinating Board; the Pierce County Program Manager for Apprenticeship and Non-Traditional Employment for Women and Men; and as Center Vocations Supervisor at the Cascades Job Corps Center in Sedro Woolley, Washington. In these roles, Ms. Winfrey has been a member of the Department of Labor's Western States Youth Dialog group; the national Work Readiness Credential project; and a proxy member to the Washington State Apprenticeship Training Council. She coordinated statewide and nationally-recognized workforce events, including the first statewide Youth Council conference; numerous statewide and regional construction workforce events; the Workforce Strategies conferences in 2002, 2003, 2004 and 2005; and the One-Stop/One-System national conference in 2002. She has worked with state leaders and elected officials to launch the state's dropout prevention and intervention initiative, and to increase articulations from high schools to construction training and apprenticeships.