MAKING STANDARDS WORK!

A TEACHER'S GUIDE TO INTEGRATING ACADEMIC CONTENT STANDARDS AND ASSESSMENTS WITH WORKPLACE COMPETENCIES AND SCHOOL-TO-CAREER ACTIVITIES.

Developed By . . .
The Colorado Department of Education

In Conjuction With . . .
The Colorado School-to-Career Partnership

". . . I have become convinced that it [school-to-career] is . . . a way of helping all students, including the college-bound, assess their abilities, plan realistically for their future and develop basic skills that will serve them in whatever they may undertake."

- Frances Moore, Vice President
Thompson Board of Education

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MAKING STANDARDS WORK
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INTRODUCTION

As educators we strive to reach every student in our classrooms. We measure our success when students grasp a new concept, move successfully to the next grade level or achieve recognition for their skills and abilities. However, the ultimate test is often when we see former students as adults. We want to know about college, their job and family and if they are happy with their lives. When students are successful, we are proud of the role we played in their development. When students struggle with the transition from school to post-secondary education and/or work, we often step back and reflect: Did we do enough to prepare students for life after school? What makes the difference between those students who are successful and those who are not?

Making Standards Work is a tool to help educators weave academic content standards, assessments and school-to-career methods into an integrated and comprehensive educational strategy that prepares all students to meet their future goals. The examples contained in this publication were created by Colorado educators to provide a vision of how teachers can deliver instruction in ways that help students reach high academic standards, develop effective work habits and gain career knowledge. Handbooks for other academic content areas are currently under development.

Standards and Assessment

Colorado enacted legislation in 1993 to adopt a standards-driven system of education. Public support for this reform is high and 48 other states have developed, or are in the process of developing, standards for what students should know and be able to do at various points in their schooling.

Standards-driven reform is based on the premise that students can achieve more if the expectations for learning are clearly defined, if students know in advance the criteria for meeting those expectations and if teaching and assessment support the expectations and reinforce student effort. Standards enhance accountability by focusing on student results, not on the curriculum, educational program or other "inputs" used by a particular school.

Colorado's model content standards represent the consensus of thousands of parents, educators, administrators, employers and interested community members. The standards were developed through a two-year process that involved three publicly reviewed drafts, approximately 10,000 responses to these drafts and a series of regional meetings across the state.

The standards reflect a "thinking" curriculum - one that requires students to know basic skills, to communicate effectively to solve problems, and to understand and apply academic principles and tools. They define a set of skills and knowledge that will prepare Colorado students for employment, citizenship and life-long learning in the new century.

Changes in the Workplace

The national economy is undergoing major changes that have an impact on both the opportunities available to workers and the expectations and needs of their employers:

- The number of jobs that employ unskilled workers is rapidly diminishing. Those jobs that do exist increasingly fail to pay a living wage.
- The income gaps among workers who dropped out of high school, those who graduated from high school, those who have an associate degree and those with a bachelor's degree are significant and growing.
- New technologies and services continue to emerge rapidly. Nearly 50% of employers use equipment less than four years old. On average, 42% of non-managerial employers now use computers in their work.
- The growth of new information and knowledge is exploding, doubling in a span of ten to fifteen years.

Schools must change as well to ensure that they are preparing students who can succeed in this dynamic environment.

Colorado School-to-Career Partnership

The Colorado School-to-Career Partnership is a statewide effort assisting local schools and communities to develop a K-16 learning system that promotes attainment of high academic standards, career development and workforce preparation for every student.

Academics and career development are integrated in classrooms and worksite experiences, and aligned with content standards and assessment. There are currently 91 local School-to-Career Partnerships in Colorado representing 140 school districts. An estimated 209,000 K-16 students have already participated in one or more school-to-career activities and the momentum continues to build in communities around our state.

Using this Handbook

Making Standards Work is divided into four sections:

I. Workplace Competencies: This section presents the Colorado General Workplace Competencies, which were developed by a business task force of the Colorado Association of Commerce and Industry. These competencies describe the skills and knowledge students need to be successful in most careers and in college. The competencies are organized into the following categories:
- Communication
- Organization
- Thinking
- Technology
- Worker Qualities

These workplace competencies must be intentionally taught and assessed to assist students in transferring classroom learning to the world of work and to post-secondary education.

II. *Opportunities for Success*: This section offers guidelines for educators as they help special populations of students, who have diverse and sometimes very unique needs, meet academic content standards and participate in school-to-career opportunities.

> In Colorado, Access Skills are those skills that all students must demonstrate in order to succeed with academic content standards and in the workplace. Access Skills are a combination of the Colorado General Workplace Competencies and the Essential Learning Principles defined in *Opportunities for Success*.

III. Integration Matrices and Classroom Activities: This section features grids that provide examples of how the Colorado General Workplace Competencies cross-reference with the Colorado Model Content Standards for mathematics. To help educators think about how to integrate the workplace competencies into their mathematics instruction, the grids are followed by examples of classroom strategies that combine a specific academic content standard, career development activity, general workplace competency and assessment strategy.

Quotes and Resources: Through the quotations, Colorado educators, business leaders and students (with parental consent) offer their perspectives on integrating workplace competencies and academic content standards. The featured resources provide a starting point in locating additional integrated curriculum, work-based learning opportunities or connecting activities. They also may offer helpful information for expanding current educational strategies.

Activities and resources included in this handbook are intended for use at the discretion of local districts. They have not been endorsed or ratified by any official Colorado State body.

IV. Sample Rubric: A rubric is a descriptive measurement for defining what a student knows and can do. An assessment rubric, aligned with the integrated learning activity on page 24b, is included in this section. Educators can use this example to create additional rubrics to assess student learning.

I. WORKPLACE COMPETENCIES

The Colorado General Workplace Competencies were developed by a business task force of the Colorado Association of Commerce and Industry, in conjunction with the Colorado Department of Education and the Colorado School-to-Career Partnership. These competencies represent the skills that post-secondary students and workers need in most jobs regardless of the specific occupational area.

These competencies will help educators and students understand the skills and knowledge students need to succeed in higher education and the workforce. The competencies also provide Colorado businesses with a consistent set of standards that promote a skilled workforce.

Communication Skills - Demonstrates the ability to receive and relay information clearly and effectively

Listening - receives, attends to, understands and responds to verbal and non-verbal messages
Speaking - clearly organizes and effectively presents ideas orally
Reading - locates, understands and interprets written information in prose and documents to perform tasks
Writing - organizes and effectively presents ideas and information in writing
Interpreting - delineates and analyzes oral and written information and synthesizes information into a conclusion
Negotiating - works toward agreement while maintaining position
Persuading - communicates ideas to justify position, overcome resistance and convince others

Organizational Skills - Demonstrates the ability to work effectively and efficiently

Planning - devises and outlines a process to achieve a goal and timeline
Time Management - applies appropriate time to task and manages multiple priorities
Using Resources - identifies, organizes, plans and allocates resources
Systems Thinking - understands the nature of systems, develops and adapts systems to meet organizational needs
Evaluating - collects, evaluates and uses data to monitor and improve performance

Thinking Skills - Demonstrates the ability to use reasoning

Problem Solving - identifies and recognizes a problem, considers alternatives, devises and implements a logical plan of action
Decision Making - uses a process to identify goals and constraints, evaluates alternatives and reaches a conclusion
Creative Thinking - generates new and innovative ideas
Learning - uses efficient techniques to acquire and apply new knowledge and skills
Analyzing - identifies bias of information sources, evaluates contradictory information and effectively manages information
Mathematics - performs basic computations and solves practical problems by applying appropriate mathematical techniques

Worker Qualities - Demonstrates the characteristics of an effective worker

Self-Management - demonstrates punctuality, readiness to work, initiative and the capacity for life long learning and personal growth
Team Member - contributes to group effort through cooperation and consensus
Responsibility - follows through consistently with honesty and integrity
Flexibility - shows versatility and the ability to change
Leadership - creates a direction/vision for others to follow, aligns management methods with vision and implements a system of accountability
Works with Diversity - accepts differences and works well with individuals from a variety of backgrounds and/or with divergent philosophies or ideas

Technology Skills - Demonstrates the ability to work with a variety of technologies and equipment

Demonstrates Computer Literacy - uses keyboarding skills, computer programs and understands basic computer operations
Selects Technology - chooses appropriate procedures, tools or equipment
Applies Technology - understands overall intent of and proper procedures for using selected technology and equipment
Uses Technical Information - interprets and uses data generated from a variety of technological devices

Note: Technology refers to any device, tool or piece of equipment that facilitates or supports efficient completion of work, including machinery, computers, scientific equipment, fax machines, voice mail, overhead projectors, VCRs, cash registers, and calculators.

II. OPPORTUNITIES FOR SUCCESS

GUIDELINES FOR BRINGING OUT THE BEST IN ALL OF OUR STUDENTS

"*Opportunities for Success*" was created through a process that engaged over 2,100 Colorado educators, parents and citizens from across the state and drew on the expertise of national professional organizations. Its purpose is to provide guidelines for educators as they help special populations of students, who have diverse and sometimes very unique needs, meet academic content standards.

These guidelines may be useful to:

- Curriculum directors as they coordinate and develop curriculum and instruction around standards
- Classroom teachers as they plan for their students
- Assessment professionals as they develop district and classroom assessments
- Building level planning committees as they work on school improvement efforts

A. GENERAL PRINCIPLES

The four areas described below (Essential Learnings, Classroom Practices, Assessment Practices and Service Options) are designed to assist special needs students gain the skills necessary to reach high academic standards.

Essential Learnings - the knowledge and skills that special needs students require to maximize their educational growth and development.

Students who are diverse learners need to learn:

1. Communication skills to express and understand thoughts and opinions in a variety of settings, situations and with diverse populations.

2. Decision making and problem solving skills and strategies.

3. Basic language skills and a broad vocabulary to use as building blocks in developing reading, writing and critical thinking.

4. Self-advocacy skills to make their needs and wants known in socially constructive ways in learning, work and social situations.

5. Personal strengths and capabilities and the ability to use this knowledge to act responsibly at school and work.

6. Social skills to develop positive relationships with peers and adults in a variety of settings and situations and with diverse populations.

7. Organizational skills and study strategies for school and work. Important skills include, but are not limited to:
   - Time management
   - Goal setting
   - Management and use of materials/resources
   - Learning strategies

8. Career development skills to make, pursue and maintain personal employment choices.

9. The use of tools and technology to augment learning and access information.

Classroom Practices - the range of instructional practices and strategies that teachers employ to help a special population of students learn. These include, but are not limited to:

- Time
- Space
- Modality
- Grouping
- Presentation
- Classroom organization and behavior management
- Materials
- Equipment
- Technology
- Environment

With the needs of diverse learners in mind, educators need to employ appropriate:

1. Student Self-Management Strategies

   - Use strategies designed to promote student self-management and independence.

   - Provide consistency, structure and clear expectations.

   - Provide appropriate positive learning reinforcement, feedback and recognition for student accomplishment.

2. Setting for Instruction and Learning

   - Promote supportive and responsive climates that facilitate social and cultural learning and allow students to take risks and learn from failure.

   - Provide opportunities and environments that allow all students to participate meaningfully in instructional and social activities.

- Adapt physical environments to match the learning needs of students.

3. Instructional Practice

   - Incorporate life skills, social and affective skills and self-advocacy skills throughout the curriculum.
   - Choose teaching and learning methods that match the learning needs and styles of the students.
   - Incorporate direct instruction of how-to-learn skills and thinking skills throughout the curriculum.
   - Ensure the language of instruction effectively communicates and promotes student understanding for students with special needs.
   - Use methods to promote active learning, including hands-on learning, real-world and experiential learning, community-based learning and learning involving student choice.
   - Use learning materials, equipment and media tailored to the unique learning needs of students.
   - Design and implement specific opportunities for students to apply and transfer learning to a variety of situations, both familiar and new.
   - Use varied and flexible grouping strategies for instructional purposes.
   - Use flexibility in pacing instruction, scheduling and the use of time based on the needs of individual students.
   - Communicate and collaborate with other teachers, specialists, students, families and appropriate agencies in planning and implementing effective instruction.

Assessment Practices - the accommodations and adaptations necessary for a special population to adequately demonstrate knowledge and skills.

In assessing the learning of diverse learners, educators need to:

1. Allow for a variety of assessments that evaluate what is being taught, including:

   - Portfolios
   - Assessment of daily work
   - Observations
   - Self and peer evaluations
   - Demonstrations and projects
   - Oral tests
   - Cooperative group assessments
   - Family, community and employer evaluations/observations

2. Ensure that the language used in assessment is consistent with the language used during instruction and reflects the student's preferred mode of communication, considering the:

   - Student's culture/preferred language
   - Clarity of instructions
   - Verbal and non-verbal options (i.e., sign language)

3. Consider the student's unique needs when determining the content of the assessment.

   - Identify the skills and content to be assessed and ensure that assessments test only the content that was taught.

- Design assessments to determine what the student knows as opposed to what the student does not know.

- Utilize student's prior knowledge to determine instruction and subsequent assessments.

- Identify individual learning styles and design assessments to elicit a variety of thinking and application skills.

4. Design assessment procedures and accommodations to meet individual student needs.

   - Assess in the student's primary communication mode (i.e., Braille, sign language, picture board).

   - Use a variety of people (i.e., family, peers, employers, other professionals) in the assessment process.

   - Use technology for presentation of assessment and student response.

5. Allow flexibility in the time and scheduling of assessments.

   - Allow extended time.

   - Allow the student to take breaks.

   - Divide assessments into smaller segments.

   - Schedule assessments when students can perform best.

   - Use untimed assessments.

6. Allow for a variety of assessment environments. Consider the purpose of the assessment and the student's unique needs and choose the environment that fits best.

   - Consider the student's physical condition, endurance, attention span, distractibility, emotional state and medical condition, at the time of assessment.

   - Control for distractions.

   - Create supportive settings that encourage student participation.

   - Use preferential seating.

   - Use real life settings and other alternative environments.

7. Consider the evaluation criteria that will be used when designing assessments and set the criteria prior to assessment.

   - Involve others in determining realistic expectations and goals for the student.

   - Provide family and others the opportunity to assist in interpreting assessment results.

   - Make expectations and criteria clear and explicit.

   - Provide a variety of grading methods, including:
     - Individual grading scale
     - Narrative reports
     - Group grades

Service Options - systems of organizing people and materials to supply and deliver educational opportunities, accommodations and supports in order for students or given populations to become successful learners.

For diverse learners to have adequate opportunities to learn, schools will:

1. Involve families, community members and peers integrally in the design and implementation of educational services for all children and youth.

2. Use shared and flexible resources, including personnel, money, facility, program, time and administrative processes to meet students' needs and to offer appropriate services by providers with specific expertise.

3. Offer curriculum and instruction that is diversified through a variety of modifications, including alternative scheduling, accessibility, optimal learning environments, grouping, accommodation of multiple learning styles, setting appropriate expectations, student-teacher ratios and a variety of instructional techniques.

4. Support collaborative planning with individual students, team members, family members, the community and other agencies with the management of time and resources.

5. Design support services for students that help them with life management, including safety, health, wellness, social relationships and learning.

6. Assure students the opportunity to plan and prepare for successful life adjustment after high school, including career development, community involvement, post-secondary education, recreation and leisure choices, and daily living activities.

7. Maximize the use of technology for learning. School professionals, families, and students use technology competently.

8. Offer a menu of educational opportunities to students, families and school personnel for continuous improvement of services to students.

9. Offer support services to assist students in managing behavior, expressing needs, developing friendships, resolving conflicts, making choices and planning their lives.

B. ADAPTATIONS

Adaptations are changes made to the environment, curriculum, instruction and/or assessment practices in order to help a student become a successful learner. Adaptations are based on the strengths and needs of individual students and may vary in intensity and degree.

Adaptations include:

1. **Accommodations:**
   Accommodations are adjustments made in *how* a student accesses and demonstrates learning. They do not substantially change the instructional level, content or the performance criteria. The changes are made in order to provide students equal access to learning and an equal opportunity to demonstrate what they know. Accommodations include changes in and/or provisions for the following:

   - Presentation and/or response format and procedures
   - Instructional strategies
   - Time/scheduling
   - Attitudes
   - Architecture
   - Environment
   - Equipment

2. **Modifications:**
   Modifications are substantial changes in *what* a student is expected to learn and demonstrate. They are made to provide students with opportunities to participate meaningfully and productively in learning experiences and environments. Modifications include changes in the following:
   - Instructional level
   - Content
   - Performance criteria

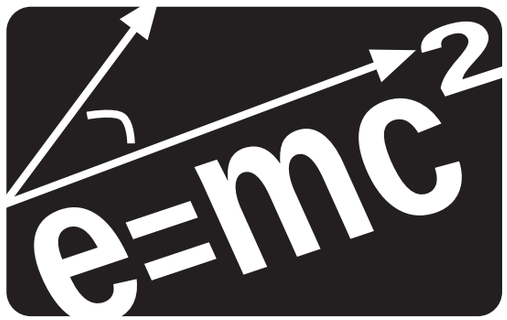
** Note: Under Colorado Law 22-7-407 et. seq. C.R.S., a student must have a Special Education Individualized Education Plan (IEP) to qualify for modifications to the standards, unless the modifications exceed those of district/state content standards.*

Opportunities for Success contains many strategies for specific special population groups including:

- Attention Deficit Disorder
- Chapter I (Title 1)
- Deaf/Blind
- Deaf/Hearing Impaired
- Gender
- Gifted Individuals
- Language Minority Students
- Learning Disabilities (Perceptual/Communicative)
- Migrant Students
- Physically Disabled and 504
- Prevention Initiatives (High-Risk)
- Race
- Significant Cognitive Challenges
- Significant Identifiable Emotional Disabilities
- Speech/Language Needs
- Traumatic Brain Injury
- Visual Disabilities

The complete version of *Opportunities for Success* can be purchased for $18.00 by contacting:
The Colorado Department of Education
Special Education Services Unit
(303) 866-6690

GRADES K-4



III. INTEGRATION MATRICES AND CLASSROOM ACTIVITIES

INTEGRATING MATHEMATICS STANDARDS WITH WORKPLACE COMPETENCIES

MATHEMATICS

Academic Content Standard

1. Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES K-4 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. demonstrating meanings for whole numbers, and commonly-used fractions and decimals, and representing equivalent forms of the same number through the use of physical models, drawings, calculators, and computers					●				●			●			●		●			●								
b. reading and writing whole numbers and knowing place-value concepts and numeration through their relationships to counting, ordering, and grouping			●	●						●							●											
c. using numbers to count, to measure, to label, and to indicate location										●	●	●				●	●	●											
d. developing, testing, and explaining conjectures about properties of whole numbers, and commonly-used fractions and decimals			●	●	●							●		●			●	●					●						
e. using number sense to estimate and justify the reasonableness of solutions to problems involving whole numbers, and commonly-used fractions and decimals			●	●			●					●	●		*		●	●											

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

1. Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

e. using number sense to estimate and justify the reasonableness of solutions to problems involving whole numbers, and commonly used fractions and decimals

WORKPLACE COMPETENCY

Thinking Skills: Learning
uses efficient techniques to acquire and apply new knowledge and skills

RESOURCE

CONNECT

Everyone Can Do Math and Science

Colorado Statewide Systemic Initiative
for Mathematics and Science

CONNECT is charged to provide support and leadership to increase the achievement of all Colorado students in science and mathematics, kindergarten through baccalaureate (K-16)

1580 Logan Street, Suite 740
Denver, CO 80203
(303) 894-2140

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students create a bulletin board that contains a “100 chart” (10X10 squares). The class discusses “100’s” (100 pennies in a dollar, 100 years in a century, 100 centimeters in a meter, etc.). Students add a penny to the 100 chart each day, comparing the value to 100 (25/100, .25, 25%). This work can be applied to other concepts (money exchange, addition, subtraction, etc).

WORKPLACE COMPETENCY

THINKING SKILLS: LEARNING

In groups of three, students estimate the 100th day of school. Then using calendars, students determine the 100th day. They also must express numerically the current day out of 100 (fraction, percentage, etc.).

CAREER DEVELOPMENT/COMMUNITY

Students identify three careers that use fractions, percents, decimals, or estimation and discuss how these skills are used on the job. This can be done by interviewing parents, neighbors, or other community members or using internet resources or study trips (for any subject).

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Students demonstrate an understanding of 100 and parts of 100 (decimals, fractions, and percents) by accurate calculations in the 100th day of school activity.

WORKPLACE COMPETENCY

THINKING SKILLS: LEARNING

Evaluate the students on their ability to:

- present to the class their 100th day of school activity
- identify the process/justification for their answer, and describe how and what they learned.

EXTENSIONS

- This activity can be applied to money exchanges, using currencies from different countries as part of a geography class.
- Communication skills may be practiced and assessed in the classroom presentation of this activity.
- This activity also addresses benchmark “a” of this standard (demonstrating meanings for whole numbers, and commonly used fractions and decimals, and representing equivalent forms of the same number through the use of physical models, drawings, calculators, and computers).

MATHEMATICS

Academic Content Standard

2. Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES K-4 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
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a. reproducing, extending, creating, and describing patterns and sequences using a variety of materials	●		●						●	●		●	●	●		●	●			●								
b. describing patterns and other relationships using tables, graphs, and open sentences	●		●								*	●					●			●								
c. recognizing when a pattern exists and using that information to solve a problem										●		●			●	●	●											
d. observing and explaining how a change in one quantity can produce a change in another		●	●	●							●	●				●	●											

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

2. Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

b. describing patterns and other relationships using tables, graphs, and open sentences

WORKPLACE COMPETENCY

Organizational Skills: Systems Thinking
understands the nature of systems, develops and adapts systems to meet organizational needs

QUOTATION

"Math makes you smart -- you need to be smart to get an education and to get a job."

- Chris, 3rd Grader
Jefferson County R-1

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

As a class, students brainstorm uses of numbers in the community (license plates, street numbers, time, etc.). Students go on a "math walk" in the community and become aware of different ways numbers are used. While on the "math walk," students notice the use of street addresses and identify any number patterns associated with these. Students take notes during the "math walk" and, as a class, discuss any questions that may arise.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: SYSTEMS THINKING

As a class, students discuss how the system of mail delivery works. The discussion includes the process that each piece of mail must go through to get to its final destination (use of a zip code, city and state, and street address). Students identify elements of a system.

CAREER DEVELOPMENT/COMMUNITY

Invite a guest speaker to the classroom or take a study trip to a place of business to explore patterns used in the workplace. For example, a postal worker, or delivery person may discuss how he/she uses patterns in addresses to find their destinations. Students identify businesses they saw on the "math walk" and determine the types of careers involved. Math concepts should be tied to this discussion.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Students work together in small groups to write short stories incorporating information obtained during the "math walk" and guest speaker/study trip. The stories must include two number patterns using mathematical language. Students are assessed on the accuracy of their use of numbers and patterns in the short stories.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: SYSTEMS THINKING

In the short stories, students refer to how systems are used in the community or workplace. The "math walk" and the guest speaker/study trip may be used as resources in developing the stories. Students identify three criteria of a system.

EXTENSIONS

- Students create story problems using information and ideas they obtained during the "math walk" or from the guest speaker/study trip. Other students present their solution to the problems to the class.

MATHEMATICS

Academic Content Standard

3. Students use data collections and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES K-4 BENCHMARKS	COMMUNICATION SKILLS Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES Demonstrates the characteristics of an effective worker					
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a. constructing, reading, and interpreting displays of data including tables, charts, pictographs, and bar graphs			●	●	●							●			●	●	●					●						
b. interpreting data using the concepts of largest, smallest, most often, and middle					●					●		●				●	●											
c. generating, analyzing, and making predictions based on data obtained from surveys and chance devices					●							●	●			●	●									●		
d. solving problems using various strategies for making combinations											●	●	●			●	●						*					

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

3. Students use data collections and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

d. solving problems using various strategies for making combinations

WORKPLACE COMPETENCY

Worker Qualities: Team Member
contributes to group effort through cooperation and consensus

QUOTATION

"Math is the most important part of music, even more important than notes. If you play any music with a beat, you've got to have math."

- Dizzy Gillespie
Jazz Trumpet Player

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students work in pairs as co-managers of a business to create an employee work schedule in the form of a matrix or chart. Four employees need to be included in the work schedule for a week (Renee, Daniel, Amy and Jeff). The schedule must accommodate these needs:

- the business is open Monday through Saturday
- Amy cannot work on weekends
- Daniel cannot work on days that start with "T"
- Renee prefers to have two days off in a row (this includes Sunday)
- Jeff likes to have a day off in the middle of the week
- each day must have exactly three workers
- all employees do not have to work the same number of days

WORKPLACE COMPETENCY

WORKER QUALITIES: TEAM MEMBER

Have a class discussion on the meaning of team work including consensus and group norms such as treating each other with respect, listening to each other's ideas, agreeing on the outcome, etc. Students identify other places teamwork is used (at work, at home, in sports, etc.).

CAREER DEVELOPMENT/COMMUNITY

Share with the class several examples of actual employee work schedules from community businesses, such as fast food restaurants, department stores, gas stations, etc.

Students visit a business with their family in a career area of interest. Students look at the worker schedule and also ask about job requirements and how employees use math in their jobs. Students report their findings to the class.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Assess students on the schedule matrix they create. The information must be presented in the form of a matrix or chart and it must accommodate the employees' needs. The matrix also will be evaluated on the accuracy of the students' mathematical computations.

WORKPLACE COMPETENCY

WORKER QUALITIES: TEAM MEMBER

Students write a summary of how they worked together as co-managers including:

- how decisions were made
- how disagreements were resolved
- identification of two places outside the classroom that use teamwork.

EXTENSIONS

Students solve logic puzzles that use matrices in order to become familiar with different types of matrices.

MATHEMATICS

Academic Content Standard

4. Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES K-4 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies					WORKER QUALITIES: Demonstrates the characteristics of an effective worker				
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. recognizing shapes and their relationships using a variety of materials									●			●	*				●											
b. identifying, describing, drawing, comparing, classifying, and building physical models of geometric figures			●	●	●					●	●	●	●	●	●	●	●						●		●			
c. relating geometric ideas to measurement and number sense										●		●				●	●											
d. solving problems using geometric relationships and spatial reasoning											●	●			●		●								●			
e. recognizing geometry in their world					●						●			●	●		●					●						

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

4. Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

a. recognizing shapes and their relationships using a variety of materials

WORKPLACE COMPETENCY

Thinking Skills: Creative Thinking
generates new and innovative ideas

QUOTATION

"I think you need to know math to do everything. If you need something to eat and it costs $10.50, then you will know how much to give and how much change to expect. Also, you tell time with math."

- Ashley, 3rd Grader
Jefferson County R-1

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Teacher introduces tangrams by reading the book entitled *Grandfather Tang's Story* by Ann Tompert and Robert Andrew Parker. Students will explore tangrams and tangram puzzles.

WORKPLACE COMPETENCY

THINKING SKILLS: CREATIVE THINKING

Teacher leads a discussion on creativity. Students identify when they have been creative, what enhances or limits creativity. While the students explore tangrams, encourage creativity by describing something (i.e., a monster) and asking the students to create a picture of the thing using the shapes from the tangrams. Primary students can design their own tangrams with puzzle pieces in shapes determined by the teacher.

CAREER DEVELOPMENT

Invite parents to discuss how they use creative thinking either at home or in the workplace. Create a list of questions for parents to address when speaking to the class.

COMMUNITY

Identify occupations in the community that involve work with shapes and creativity. Students identify how creativity may be used in career areas of interest to them.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Teacher evaluates finished tangram projects with the class, identifying how they are alike or different from the ones in the story. Students identify by name, the shapes they used in their tangram projects.

WORKPLACE COMPETENCY

THINKING SKILLS: CREATIVE THINKING

Evaluate the tangram pictures, scoring points for creativity and use of all the shapes. Students identify three ways in which they demonstrated creativity.

EXTENSIONS

- Students could write a story about their special tangram creations.
- Students could create something from tangrams that would be useful in their everyday life.

MATHEMATICS

Academic Content Standard

5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES K-4 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning						TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. knowing, using, describing, and estimating measures of length, perimeter, capacity, weight, time, and temperature			●	●						●		●				●	●					●		*				
b. comparing and ordering objects according to measurable attributes										●		●			●	●	●											
c. demonstrating the process of measuring and explaining the concepts related to units of measurement			●	●						●			●			●	●						●					
d. using the approximate measures of familiar objects to develop a sense of measurement										●		●	●		●	●	●					●						
e. selecting and using appropriate standard and non-standard units of measurement in problem-solving situations										●		●	●		●		●					●						

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

BENCHMARK

a. knowing, using, describing and estimating measures of length, perimeter, capacity, weight, time, and temperature

WORKPLACE COMPETENCY

Worker Qualities: Responsibility
follows through consistently with honesty and integrity

QUOTATION

". . . Integration makes learning relevant. School-to-Career has provided an avenue for relevancy in content standards. All of this helps students make positive choices for their future."

- Tori Merrits, Vice President
Jefferson County School Board

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students apply a variety of math concepts in activities that use spelling or vocabulary words.

(1) Students complete an assignment on money.
- Students have $100 to spend.
- Each letter of the alphabet is assigned a monetary value
- Students calculate the value of various words or sentences, using calculators as well as a paper and pencil.

(2) Students complete an assignment on area by writing each letter of a word in a square on a piece of graph paper. Students total up the filled squares to determine the area of the word. They count the sides of each square used to total up the perimeter.

WORKPLACE COMPETENCY

WORKER QUALITIES: RESPONSIBILITY

Students work in groups of four collaborating on the task of measuring the classroom or cafeteria. The class will discuss why precision in measurements is so important (design of a bridge, etc.). The Teacher will then move the discussion to the topic of responsibility. The class will make a list of responsible behavior that might include:
- paying attention to detail
- behavior response in a group
- and completing tasks in a timely manner.

CAREER DEVELOPMENT

Invite building architects, farmers, landscapers, etc. to discuss how they use the concept of area and perimeter as well as the skill and education requirements for their careers. They also might discuss their responsibility to measure accurately and the possible consequences of inaccuracy .

COMMUNITY

Arrange a study trip to the cafeteria to measure tables, trays, etc. to figure out the largest number of students that can sit in the cafeteria. Interview the food service workers to determine how various measurement tools are used in their profession.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Assess students individually on the area and perimeter measurements of words. Assess student groups on the accuracy of area and perimeter measurements of the assigned room, as well as on behaving responsibly in a group.

WORKPLACE COMPETENCY

WORKER QUALITIES: RESPONSIBILITY

Students self evaluate the group using the list of responsible behaviors. Students identify the responsibilities of individual group members and how their work affected the group as a whole. Students also determine what aspects of group cooperation and responsibility worked or did not work and why.

EXTENSIONS

Use this activity for spelling practice by assigning a value to each letter in the alphabet (i.e., A=1, B=2, etc.).

example: 3 1 20
C A T = 24

Use spelling words to evaluate the students' understanding of time, measurement, number facts or money. Each letter may equal a value of time, measurement, or money (i.e., seconds, inches, or dollars).

MATHEMATICS

Academic Content Standard

6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

G / R	COMMUNICATION SKILLS Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. demonstrating conceptual meanings for the four basic arithmetic operations of addition, subtraction, multiplication, and division	●		●	●								●		●			●								●			
b. adding and subtracting commonly-used fractions and decimals using physical models												●					●								●			
c. demonstrating understanding of and proficiency with basic addition, subtraction, multiplication, and division facts without the use of a calculator												●					●											
d. constructing, using, and explaining procedures to compute and estimate with whole numbers	●	●										●	●			●	●											
e. selecting and using appropriate methods for computing with whole numbers in problem-solving situations from among paper-and-pencil, mental arithmetic, estimation, calculator, and computer methods			●						*			●	●		●	●	●	●	●	●		●			●			

K-4

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

e. selecting and using appropriate methods for computing with whole numbers in problem-solving situations from among paper-and-pencil, mental arithmetic, estimation, calculator, and computer methods

WORKPLACE COMPETENCY

Organizational Skills: Using Resources
identifies, organizes, plans and allocates resources

RESOURCE

Curriculum materials in mathematics, science, technology, history, multicultural, at risk students, special education, and reading/literature, can be ordered through the following non-profit organization:

Saddleback Educational, Inc.
3505 Cadillac Avenue, Building F-9
Costa Mesa, CA 92626-1443
(714) 540-4010
(714) 545-1108 (fax)
info@sdlback.com (e-mail)

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Teacher introduces the concept of a budget and the use of a check register by:

- allowing guided practice on check register
- having the class create a budget which includes these items:
  - rent (a desk, desk with chair, chair only)
  - transportation (bus, parent, bike)
  - food (sack lunch or school lunch)
  - recreation (recess, games, television, movie).

Students estimate their expenses for a week. At the end of the week, they calculate how close their estimation was to the actual cost.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: USING RESOURCES

Have a class discussion on the concept or research the importance of a budget. Class compiles questions concerning the need for and use of a check register. Students identify resources that are needed to set up a budget.

Students set up a budget for one week using the same categories as in the estimation activity (furniture rental, transportation to school, food, and recreation).

CAREER DEVELOPMENT/COMMUNITY

- Students interview parents regarding how they budget for their household expenses.
- Each student will identify something they would like to buy and apply for a “loan”. Invite a loan executive from a local bank to discuss whether each student would receive a “loan” based on their weekly expenses and their income (allowance).

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Students turn in their budgets, their estimate of expenses, and accurately completed check registers for a week’s worth of transactions. Students accurately develop a budget and mathematically reconcile a check register, staying within their budget.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: USING RESOURCES

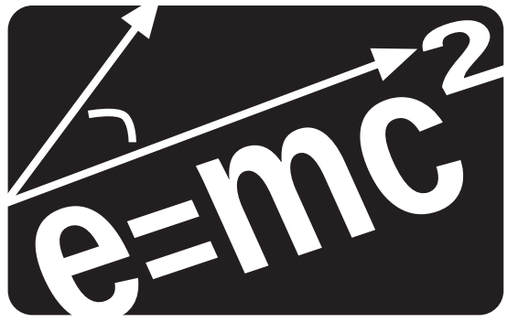
Evaluate the students on their ability to:

- define the word resources
- list what resources were used to develop a budget and use a check register
- list what resources are needed to prepare for class.

EXTENSIONS

- Expand the activity to include a process for loans when students have emergency expenses. Students can draw miscellaneous expenditures out of a hat each day (i.e., flat tire, need cold medicine, etc.).

GRADES 5-8



III. INTEGRATION MATRICES AND CLASSROOM ACTIVITIES

INTEGRATING MATHEMATICS STANDARDS WITH WORKPLACE COMPETENCIES

MATHEMATICS

Academic Content Standard

1. Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 5-8 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively									ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace			THINKING SKILLS: Demonstrates the ability to use reasoning						TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. demonstrating meanings for integers, rational numbers, percents, exponents, square roots, and pi (Π) using physical materials & technology in problem-solving situations	●	●		●					●			●					●	●	●	●		●						
b. reading, writing, and ordering integers, rational numbers, and common irrational numbers such as √ 2, √ 5, and pi (Π)			●	●						●							●											
c. applying number theory concepts to represent numbers in various ways				●						●		●			●	●	●								●			
d. using the relationships among fractions, decimals, and percents, including the concepts of ratio and proportion, in problem-solving situations									*	●		●					●						●					
e. developing, testing, and explaining conjectures about properties of integers and rational numbers		●	●	●	●					●		●		●		●	●					●						
f. using number sense to estimate and justify the reasonableness of solutions to problems involving integers, rational numbers, and common irrational numbers such as √ 2, √ 5, and pi(Π)										●		●			●		●					●						

GRADE LEVEL

5-8

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

1. Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

d. using the relationships among fractions, decimals, and percents, including the concepts of ratio and proportion, in problem-solving situations

WORKPLACE COMPETENCY

Organizational Skills: Using Resources
identifies, organizes, plans and allocates resources

RESOURCE

Math at Work: Thirteen women who work in non-traditional careers, ranging from a helicopter pilot, an architect, a police officer, and a firefighter, to machinists and welders, show how they use mathematics as part of their work. (Color Video, Resource Guide)

This and other resources can be ordered through:

Center on Education and Work
School of Education
University of Wisconsin - Madison
1025 West Johnson Street, Room 964
Madison, WI 53705-1796
(800) 446-0399
www.cew.wisc.edu

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Introduce a planning scenario and identify the steps involved in designing a bathroom. Have the students design a bathroom (to scale) that includes a sink, toilet, tub, ceramic tiles and linoleum. Discuss how math concepts are used to measure the materials and design a layout for the bathroom. Students present their designs by completing a teacher-provided form (which will show a way to compute square feet).

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: USING RESOURCES

Class discusses the methods used in scale models and the students then:

- draw a scale model of the bathroom
- compile a list of contractors and the materials needed to complete their project by using available resources (i.e., newspapers, ads, stores, phone books, etc.)
- determine how to allocate resources for their design
- identify types of resources needed for the project and providers of these resources are discussed.

CAREER DEVELOPMENT

Students contact hardware stores to determine the cost of materials. Students contact contractors to determine labor costs (plumber, electrician, carpenter, drywaller, painter, ceramic or linoleum installer, etc.). Students contact the city for information on permits, inspections, and the cost of the permits. Students also will gather information on careers in the construction field including qualifications, training and the use of math.

COMMUNITY

Invite contractors to visit the classroom to discuss how they bid a job and the tools they use. Invite city inspectors to discuss aspects of their job. The class could visit a construction site, participate in Habitats for Humanity; build the school a fence, garden, etc. Career information should also be gathered through these activities.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- accurately complete a scale drawing of the bathroom (blue print)
- accurately calculate the ratios and proportions used for the scale drawing
- calculate the cost of materials and labor needed for the bathroom
- accurately measure the materials to be used in the bathroom.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: USING RESOURCES

Evaluate students on their ability to:

- identify resources
- accurately and completely list of resources such as materials, suppliers, contractors, city officials
- identify the method used to gather data
- identify the method used for allocating resources.

EXTENSIONS

Create a 3-dimensional scale model of the design.

MATHEMATICS

Academic Content Standard

2. Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 5-8 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. representing, describing, and analyzing patterns and relationships using tables, graphs, verbal rules, and standard algebraic notation	●		●	*						●	●	●	●			●	●											
b. describing patterns using variables, expressions, equations, and inequalities in problem-solving situations										●		●	●			●	●											
c. analyzing functional relationships to explain how a change in one quantity results in a change in another				●								●			●	●	●											
d. distinguishing between linear and nonlinear functions through informal investigations				●							●	●				●	●											
e. solving simple linear equations in problem-solving situations using a variety of methods	●		●									●		●		●	●	●	●	●								

GRADE LEVEL

5-8

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

2. Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

a. representing, describing, and analyzing patterns and relationships using tables, graphs, verbal rules, and standard algebraic notation

WORKPLACE COMPETENCY

Communication Skills: Interpreting
delineates and analyzes oral and written information and synthesizes information into a conclusion

QUOTATION

"Math is the most universal of all subjects and is spoken in one form or another by everyone. It ranges from simple functions like measuring ingredients for recipes, to full systems performance analysis of the most complex computers systems. In working with design engineers on product development, I use math on a daily basis. It is critical to be accurate in calculations of component performance, as well as cost projections for systems production."

- Mike Palmer
Sales Associate
Kent Electronics, Inc.

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students discuss the pros and cons of high insurance rates for teenagers. Using different resources, students research actuarial tables and data. Student teams construct a table that displays insurance rates for teenagers for the past 10 years with a written conclusion of what the rates indicated.

WORKPLACE COMPETENCY

COMMUNICATION SKILLS: INTERPRETING

Students discuss the skills used in interpreting including cause and effect. Students then research insurance rates in the media center. In a summary paper or presentation, students explain why teenagers' insurance rates are higher, providing several reasons. Based on current insurance rates for teenagers, students analyze patterns from the last three years (either rising, falling or stable) to predict future insurance rates.

CAREER DEVELOPMENT

Invite professionals such as an insurance agent, police officer, or police detective to discuss the hazards of drinking and driving, aggressive behavior, mortality concepts (life and death decisions) and tickets. Have the speaker discuss how he/she uses the skill of interpreting information on the job. Information on job requirements, skills and training should also be described.

COMMUNITY

Visit an insurance agent and investigate how math is used to establish insurance rates. Incorporate career information into these visits.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate students on their summary paper and/or presentation. The paper and/or presentation must include:

- supporting facts
- a graph (including the interpretation of that graph)
- statistics
- mathematical patterns in insurance rates from year to year
- any other reasons to support their findings.

WORKPLACE COMPETENCY

COMMUNICATION SKILLS: INTERPRETING

Based on the summary paper and/or presentation, evaluate students on their:

- ability to analyze information
- interpretation of cause and effect
- supporting facts for predicting future insurance rates
- development and conclusion with supporting data
- identification of two other aspects where interpreting is required in their life.

EXTENSIONS

- Students select an issue presented during the police station visit and create a presentation (poster, transparency, video, etc.) addressing the pros and cons of that particular issue.

- Visit a police station, jail or holding cell to discuss what procedures the police use regarding drinking and driving.

MATHEMATICS

Academic Content Standard

3. Students use data collections and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 5-8 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. reading and constructing displays of data using appropriate techniques and appropriate technology			●	●	●				●		●	●	●			●	●	●	●	*				●				
b. displaying and using measures of central tendency, such as mean, median, and mode, and measures of variability, such as range and quartiles																●	●			●								
c. evaluating arguments that are based on statistical claims					●						●	●	●		●	●	●					●		●				
d. formulating hypotheses, drawing conclusions, and making convincing arguments based on data analysis		●		●			●						●	●	●	●	●	●				●	●	●	●	●		
e. determining probabilities through experiments or simulations													●			●	●	●										
f. making predictions and comparing results using both experimental and theoretical probability drawn from real-world problems					●								●	●		●	●	●							●	●		
g. using counting strategies to determine all the possible outcomes from an experiment													●	●				●										

GRADE LEVEL

5-8

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

3. Students use data collections and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

a. reading and constructing displays of data using appropriate techniques and appropriate technology

WORKPLACE COMPETENCY

Technology Skills: Applies Technology understands overall intent and proper procedures for using selected technology and equipment

RESOURCE

National Council of Teachers of Mathematics (NCTM) has been dedicated to improving the teaching and learning of mathematics. NCTM is the largest nonprofit professional association of mathematics educators in the world. NCTM offers vision, leadership, professional development, and avenues of communication for mathematics educators at the elementary school, middle school, high school, and college and university levels.

National Council of Teachers of Mathematics
1906 Association Drive
Reston, Virginia 20191-1593
(703) 620-9840
(703) 476-2970 (fax)
infocentral@nctm.org (e-mail)
www.nctm.org

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Through quick class surveys, using various survey techniques (raise hands, venn diagram, student surveys), practice and define uses for line, bar, and pie graphs. Practice writing questions and responses for a survey, interpreting graphs and making predictions from given graphs.

Students decide how best to survey the entire 7th grade class by creating a survey with the appropriate questions to define the "average" 7th grader (i.e., amount of time spent watching television, playing sports, interests, etc.).

WORKPLACE COMPETENCY

TECHNOLOGY SKILLS: APPLIES TECHNOLOGY

Describe and discuss the types of technology that can be used for data analysis and display. Students enter data into a computer database and learn to display data in graphic form and in written form, explaining which form is most appropriate for the given data. Students use the graphing calculator and computers for data displays and manipulations.

CAREER DEVELOPMENT

Students collect graphs from a variety of sources and define the type of career that would produce that graph (population studies, stock market, health statistics, market sales, etc.).

Invite a "polling" or "survey group" to class to describe how they create fair surveys and present data fairly. They also could describe and demonstrate how data can be skewed to support any argument and how graphs and statistics can distort "the truth".

COMMUNITY

Through an organized presentation, either oral with supporting data or written using data and graphs, introduce the new seventh grade class to area businesses to promote opportunities for job shadowing.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate the students on:

- creating a survey with appropriate questions
- tallying results
- drawing three meaningful conclusions from the data and graphs.

WORKPLACE COMPETENCY

TECHNOLOGY SKILLS: APPLIES TECHNOLOGY

Evaluate students on their use of a computer to:

- enter data from a survey in a previously established database
- use data in database to select the most appropriate graph for the information
- produce a quality graph appropriate for the information.

MATHEMATICS

Academic Content Standard

4. Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 5-8 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. constructing two- and three-dimensional models using a variety of materials and tools							●		●			●		*			●			●		●						
b. describing, analyzing, and reasoning informally about the properties of two- and three-dimensional figures		●	●	●	●											●	●								●			
c. applying the concepts of ratio, proportion, and similarity in problem-solving situations					●							●				●	●						●					
d. solving problems using coordinate geometry												●				●	●											
e. solving problems involving perimeter and area in two dimensions, and involving surface area and volume in three dimensions												●				●	●											
f. transforming geometric figures using reflections, translations, and rotations to explore congruence											●	●				●	●											

GRADE LEVEL

5-8

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

4. Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

a. constructing two- and three-dimensional models using a variety of materials and tools

WORKPLACE COMPETENCY

Thinking Skills: Creative Thinking
generates new and innovative ideas

QUOTATION

"You need math for lots of things. If you are going to put up a fence, you would have to know the area and perimeter. If you were going to build a box to put things in, you would have to know the volume. I think math is really fun once you get the hang of it."

- Douglas, 5th Grade
Jefferson R-1

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students use shapes and angles to create a vertical structure using 16 ounces of spaghetti noodles and glue. Students will test the structures to determine the weight they will hold. Students will:

- work in small groups
- design a blue print design
- devise as many solutions as possible.

WORKPLACE COMPETENCY

THINKING SKILLS: CREATIVE THINKING

Students brainstorm on the elements of creative thinking and list basic solutions for structures in architecture. Students also determine the pros and cons to each solution and select the best design solution using structural concepts and creative thinking.

CAREER DEVELOPMENT

Bring in resource persons such as a structural engineer or an architect. Discuss how geometric concepts are used in these careers and the skills needed to be successful.

COMMUNITY

Students take a study trip to a construction site to meet with a structural engineer, architect or examiner with the city. Incorporate career information into the study visits.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- design a blue print of the structure to scale
- build a structure out of spaghetti and glue
- evaluate the structure by the amount of weight it holds
- identify ways to strengthen the structure
- explain in writing why they made the structure the way they did, why it will be stronger than other designs and provide justification.

WORKPLACE COMPETENCY

THINKING SKILLS: CREATIVE THINKING

Evaluate the students on their ability to:

- describe how creative thinking is used in the design of architectural structures
- brainstorm possible solutions
- select and implement a solution
- evaluate effectiveness and creativity of structure
- team participation
- identify three elements of creative thinking used to design architectural structures
- identify two other times that creative thinking was used outside of school to solve a problem.

EXTENSIONS

This activity could be integrated with a science class activity to explore laws of gravity, science, etc.

MATHEMATICS

Academic Content Standard

5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 5-8 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively									ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace			THINKING SKILLS: Demonstrates the ability to use reasoning						TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies					WORKER QUALITIES: Demonstrates the characteristics of an effective worker				
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. estimating, using, and describing measures of distance, perimeter, area, volume, capacity, weight, mass, and angle comparison			●	●						●		●	●			●	●						●	●				
b. estimating, making, and using direct and indirect measurements to describe and make comparisons										●		●	●		●	●	●							●				
c. reading and interpreting various scales including those based on number lines, graphs, and maps					●				●	●		●				●	●					●						
d. developing and using formulas and procedures to solve problems involving measurement									●	●		*	●		●	●	●						●					
e. describing how a change in an object's linear dimensions affects its perimeter, area, and volume		●		●								●					●											
f. selecting and using appropriate units and tools to measure to the degree of accuracy required in a particular problem-solving situation									●	●	●	●	●		●	●	●			●		●		●	●			

GRADE LEVEL

5-8

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

BENCHMARK

d. developing and using formulas and procedures to solve problems involving measurement

WORKPLACE COMPETENCY

Thinking Skills: Problem Solving
identifies and recognizes a problem, considers alternatives, devises and implements a logical plan of action

QUOTATION

"Math is like a puzzle. You have something exciting you want to do, you use the rules of mathematics to find the answer. In school, the answer is an answer everybody got before because you are learning -- you only solve problems that were solved before. In careers in science and engineering that answer is a discovery because nobody's found the answer before."

- Dr. Amar Bose
Chairman, BOSE Corporation

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Student teams problem solve how to find the best way to determine the volume of their classroom by finding the volume of some other object. For example, students may measure the volume of a shoebox or some other object and then calculate how many of those objects will fit into the classroom. Students:

- work in small groups as a team member
- convert everything to cubic inches or feet
- use many math skills to complete this task.

WORKPLACE COMPETENCY

THINKING SKILLS: PROBLEM SOLVING

Teacher reviews the steps in problem solving. Each team develops a process that incorporates the steps and shares these with the class. Similarities and differences among the processes are discussed and the class comes to a consensus on the best problem solving process.

CAREER DEVELOPMENT

As a class, brainstorm careers that require workers to calculate volume, area, weight, mass, etc. and why this ability is important on the job. (For example, a nurse calculates dosage of medication based on weight of patient; a shipping company workers determines the size of the fleet needed to transport goods; industrial engineers design containers to hold a variety of objects).

COMMUNITY

- Invite someone from the Environmental Protection Agency (EPA) to the classroom to discuss air pollution and how agency employees measure the volume of particles.
- Invite a pharmacist, nurse or medical professional to discuss medication and measurement issues.
- Visit a manufacturing plant to see how goods are put into containers.
- Incorporate career information into the presentation or visit, including qualifications, skills and working conditions.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- identify the process to determine volume
- determine volume of a classroom
- discover the volume of the chosen object
- write a summary of the activity.

WORKPLACE COMPETENCY

THINKING SKILLS: PROBLEM SOLVING

Evaluate the students' ability to:

- identify the steps for problem solving
- identify problems using volume
- identify two ways that problem solving is used in the workplace.

EXTENSION

This activity also address benchmark a.

a. estimating, using, and describing measures of distance, perimeter, area, volume, capacity, weight, mass, and angle comparison

MATHEMATICS

Academic Content Standard

6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 5-8 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace				THINKING SKILLS: Demonstrates the ability to use reasoning						TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. using models to explain how ratios, proportions, and percents can be used to solve real-world problems	●		●									●		●		●	●											
b. constructing, using, and explaining procedures to compute and estimate with whole numbers, fractions, decimals, and integers	●	●	●									●	●			●	●											
c. developing, applying, and explaining a variety of different estimation strategies in problem-solving situations, and explaining why an estimate may be acceptable in place of an exact answer	●	●	●				*					●	●	●	●	●	●						●					
d. selecting and using appropriate methods for computing with commonly used fractions and decimals, percents, and integers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods, and determining whether the results are reasonable.									●			●	●			●	●		●	●		●			●			

GRADE LEVEL

5-8

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

c. developing, applying, and explaining a variety of different estimation strategies in problem-solving situations, and explaining why an estimate may be acceptable in place of an exact answer

WORKPLACE COMPETENCY

Organizational Skills: Planning
devising and outlining a process to achieve a goal and timeline

QUOTATIONS

"Math is important because you will need it your whole life."

- Eric, 5th Grade
Jefferson County R-1

"You use math everyday. When teachers teach math, they're helping prepare you for your future."

- Taylor, 5th Grade
Jefferson County R-1

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students use a map to plan a trip in the state of Colorado making three required stops. To estimate the time and money required to complete the trip, students create a travel log for documenting car mileage, price of gas, cost for lodging and meals etc.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: PLANNING

The teacher presents the steps involved in planning. Then, students pick a destination and devise a step-by-step plan for how to get there (including what to pack, arranging the mode of transportation, making required reservations).

CAREER DEVELOPMENT

Invite a travel agency representative to describe how he/she plans trips, and to discuss requirements and opportunities in their field.

COMMUNITY

Class produces a travel brochure for the neighborhood, city or state, including color graphics and mileage information for interest points, as well as information about lodging and restaurants (with estimated price ranges).

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate the student travel logs on:

- accuracy of mileage, gas prices, and totals
- appropriate estimation of meals and lodging
- descriptions of exact/estimate costs of gas, meals, lodging with an accurate explanation of why each would be appropriate.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: PLANNING

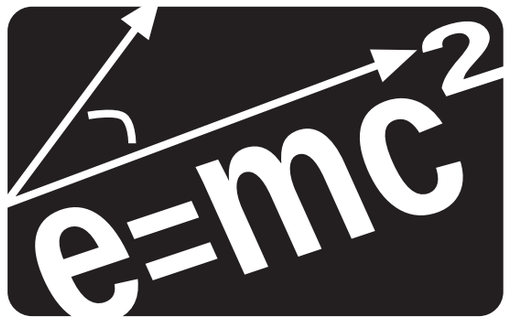
Using the travel log activity, students:

- write the steps in the planning process used to complete the task
- identify how changes were made
- describe how the planning process could be improved
- give two other examples of when a planning process should be used.

EXTENSIONS

Expand the above project to include travel to other states and the cost of flying compared to driving. Incorporate airline services in the community/career development areas.

GRADES 9-12



III. INTEGRATION MATRICES AND CLASSROOM ACTIVITIES

INTEGRATING MATHEMATICS STANDARDS WITH WORKPLACE COMPETENCIES

MATHEMATICS

Academic Content Standard

1. Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 9-12 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. demonstrating meanings for real numbers, absolute value, and scientific notation using physical materials and technology in problem-solving situations									●			●		●			●		●	●								
b. developing, testing, and explaining conjectures about properties of number systems and sets of numbers		●	●	●				●		●		●		●		●	●								●			
c. using number sense to estimate and justify the reasonableness of solutions to problems involving real numbers											●	●	*		●	●	●					●						

GRADE LEVEL

9-12

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

1. Students develop number sense and use numbers and number relationships in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

c. using number sense to estimate and justify the reasonableness of solutions to problems involving real numbers

WORKPLACE COMPETENCY

Thinking Skills: Decision Making
uses a process to identify goals and constraints, evaluates alternatives and reaches a conclusion

QUOTATION

"We were asked to develop a marketing plan for a local business. Not only was the assignment interesting, it also brought our class work to life. Now I really know why it's important to have good writing skills, and I actually used what I've learned in Math. Contributing to a real business also heightened our confidence, and it was gratifying. When we experienced the work world, we saw how we needed to strengthen our basic skills. Those skills are so important!"

- Student, Loveland High School

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students estimate the current market value of a real estate property. The estimate will be based on analysis of similar properties with respect to features, age, location, condition, and amenities.

WORKPLACE COMPETENCY

THINKING SKILLS: DECISION MAKING

Students develop a decision making model and use this model to establish criteria for estimation of property value. Students discuss the factors and processes that impact their estimate using the data collected and criteria.

CAREER DEVELOPMENT

Invite an appraiser, realtor, and/or assessor to discuss current practices of their profession and answer students' questions.

COMMUNITY

Conduct a walk-through tour of properties that are on the market with an appraiser or realtor.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Compare the students' itemized evaluation of property to that of a professional's. Students can articulate or list the mathematical concepts used.

WORKPLACE COMPETENCY

THINKING SKILLS: DECISION MAKING

Evaluate students on their ability to:

- identify the decision making process
- collect data
- organize of information
- manage time.

EXTENSIONS

This activity could be linked to social studies by discussing the politics behind the value of land. Students could provide a cost analysis and a scaled sketch of the property.

MATHEMATICS

Academic Content Standard

2. Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 9-12 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. modeling real-world phenomena using functions, equations, inequalities, and matrices					●							●	●	●		●	●							●				
b. representing functional relationships using written explanations, tables, equations, and graphs, and describing the connections among these representations				●						*		●				●	●						●	●				
c. solving problems involving functional relationships using graphic calculators and/or computers as well as appropriate paper-and-pencil techniques				●					●			●	●				●		●	●								
d. analyzing and explaining the behaviors, transformations, and general properties of types of equations and functions		●	●	●												●	●						●					
e. interpreting algebraic equations and inequalities geometrically and describing geometric relationships algebraically		●		●	●							●				●	●											

GRADE LEVEL

9-12

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

2. Students use algebraic methods to explore, model, and describe patterns and functions involving numbers, shapes, data, and graphs in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

b. representing functional relationships using written explanations, tables, equations, and graphs, and describing the connections among these representations

WORKPLACE COMPETENCY

Organizational Skills: Systems Thinking
understands the nature of systems, develops and adapts systems to meet organizational needs

QUOTATION

"I'm not just a woodcarver carving a hunk of wood. I design skateboards. It's [the design] got to be perfect and to make it perfect, you have to use math and geometry. There are several different angles used in designing a skateboard as well as figuring stress points to ensure it doesn't snap under a skateboarders feet and all of that is done because of mathematics."

- Tim Piumarta
Director, New Product Development
Santa Cruz Skateboards

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students research any topic that features exponential growth (such as population growth) and do the following:

- use the data they find to make tables and graphs by hand and by using a graphing calculator
- develop equations to fit their graphs using graphing calculators
- make predictions using their graphs and equations

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: SYSTEMS THINKING

Discuss the concept of a system and brainstorm elements of a system. Students identify systems in the school, community and businesses.

Explore systems in the context of human population growth. Students retrieve census data from the Internet or library and then create tables and graphs that track data over time. Discuss the following questions:

- Does the data demonstrate exponential growth?
- Is the population growing exponentially at this time?
- How does population growth affect systems in our world (for example, environmental, business and industry, technological, sociological)?

CAREER DEVELOPMENT

Invite guest speakers from the community (traffic engineers, city planners, environmentalists, etc.) to discuss the system in which they work and how population growth may affect the system. Have the speakers discuss their jobs and career paths, including skills needed and training required.

COMMUNITY

Students research the growth of their neighborhoods, obtaining plans or descriptions of the community from the past and comparing them to the present. Discuss the implications regarding this growth and how various systems affecting the community have changed over time.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:

- accurately use algebraic methods
- find and use an example of exponential growth from their research
- accurately create tables and graphs from the data they use
- develop accurate equations that fit their graphs using graphing calculators
- give valid predictions based on their graphs and equations.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: SYSTEMS THINKING

Students list three criteria of a system. Students pairs then present verbally or in written form the following:

- identification of three systems that may be affected by population growth
- a list of other systems that affect their community.

MATHEMATICS

Academic Content Standard

3. Students use data collections and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 9-12 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace				THINKING SKILLS: Demonstrates the ability to use reasoning						TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker				
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. designing and conducting a statistical experiment to study a problem, and interpreting and communicating the results using the appropriate technology			●	●	●			*		●			●	●	●	●	●	●			●			●		●		
b. analyzing statistical claims for erroneous conclusions or distortions					●						●		●			●	●	●						●				
c. fitting curves to scatter plots, using informal methods or appropriate technology, to determine the strength of the relationship between two data sets and to make predictions										●		●	●	●			●	●			●						●	
d. drawing conclusions about distributions of data based on analysis of statistical summaries										●			●	●		●	●	●				●						
e. using experimental and theoretical probability to represent and solve problems involving uncertainty													●	●		●	●	●					●	●			●	
f. solving real-world problems with informal use of combinations and permutations													●				●	●					●					

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

9-12

STATE STANDARD

3. Students use data collections and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

a. designing and conducting a statistical experiment to study a problem, and interpreting and communicating the results using the appropriate technology

WORKPLACE COMPETENCY

Organizational Skills: Planning
devising and outlining a process to achieve a goal and timeline

RESOURCE

Eisenhower National Clearinghouse (ENC) is a non-profit organization that offers K-12 teachers and other educators free information about mathematics and science curriculum resources available through the Internet or toll-free modem access to ENC Online, in print through a variety of publications, and on CD-ROM.

Eisenhower National Clearinghouse
1929 Kenny Road
Columbus, OH 43210-1079
800/621-5785
(614) 292-2066 (fax)
(800) 362-4448 (modem)
info@enc.org (e-mail)
www.enc.org

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

In groups of 3-4, students design a survey that includes at least 10 questions aimed at a specific topic that interests the group. The group then distributes the survey to a random sample of students in the school. After the data is collected, the group organizes and analyzes the results using appropriate statistical applications and creates a variety of graphs to display the results.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: PLANNING

The class discusses elements of planning and student teams devise and record a plan and timeline for their survey project. The plan includes a day-by-day report of how long it will take to:

- design the survey
- distribute the survey
- organize and analyze the results
- create tables and graphs for display.

CAREER DEVELOPMENT

Using the Internet or phone interviews, students research a variety of companies that use surveys for marketing, public opinion, employee/customer satisfaction, etc. Students examine how statistics and other mathematic concepts are used in these companies. The students also explore the skill and experience requirements for careers in the market research field.

COMMUNITY

Students create a bulletin board or newsletter to share the results of their surveys with the school community. Students participate in a job shadowing experience that connects math, data collection and analysis.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Assess students on:

- the design and distribution of the survey
- organization and analysis of the results
- appropriateness and accuracy of the graphs.

WORKPLACE COMPETENCY

ORGANIZATIONAL SKILLS: PLANNING

Students self evaluate their:

- plans and timelines
- ability to make adjustments where necessary
- ability to identify the steps in a planning process
- ability to identify examples of how the planning process is used in specific businesses that work with market research.

EXTENSION

Students use a computer spreadsheet application to create the tables and graphs for the project.

(Note: The sample rubric on page 28 corresponds with this activity)

MATHEMATICS

Academic Content Standard

4. Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 9-12 BENCHMARKS	COMMUNICATION SKILLS Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. finding and analyzing relationships among geometric figures using transformations in coordinate systems										●		●				●	●											
b. deriving and using methods to measure perimeter, area, and volume of regular and irregular geometric figures										●		●	●	●			●							●				
c. making and testing conjectures about geometric shapes and their properties, incorporating technology where appropriate									●			●	●			●	●		●	●		●						
d. using trigonometric ratios in problem-solving situations												●				●	●						*					

GRADE LEVEL

K 1 2 3 4 5 6 7 8 9 10 11 12

9-12

STATE STANDARD

4. Students use geometric concepts, properties, and relationships in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

d. using trigonometric ratios in problem-solving situations

WORKPLACE COMPETENCY

Worker Qualities: Team Member
contributes to group effort through cooperation and consensus

QUOTATION

"School-to-Career encourages educators and community to come together to teach our children essentials and assist them in becoming productive citizens. We must not fail our children. If we do, we have failed as a society."

- Roger Phelps
Member of Ignacio School Board

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students receive instruction on how to determine distances and angles of elevation by measuring and using triangulation. Students find the altitude of various items around school, (bleachers, football goal posts, etc.) by measuring angles and lengths and using trigonometric ratios. Students sketch the information and prepare a final presentation to the class. (See bleachers example in figure 1.)

WORKPLACE COMPETENCY

WORKER QUALITIES: TEAM MEMBER

In teams, students decide who will do the following:

- measure items
- solve any problems encountered
- complete different aspects of the presentation (written report, oral presentation, sketch).

Students discuss what it is like to work on a team, identifying the pros and cons of this approach as well as the attributes of an effective team member.

CAREER DEVELOPMENT

Students learn how to do self-evaluation on the problems they encounter during the project, a skill that is required in any occupation. Students interview several people in various careers to determine how they use problem solving and math on the job.

COMMUNITY

Invite a local surveyor to share information about surveying, the manner in which reports are prepared, and recommendations on how to adjust the students' reports to conform to an actual survey report. The surveyor also can share information about his/her field and his/her own experiences with team work on the job.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Assess students on the accuracy of their measurements, computations using trigonometric ratios and sketches. The presentation may be evaluated by other members of the class and/or self-evaluated.

WORKPLACE COMPETENCY

WORKER QUALITIES: TEAM MEMBER

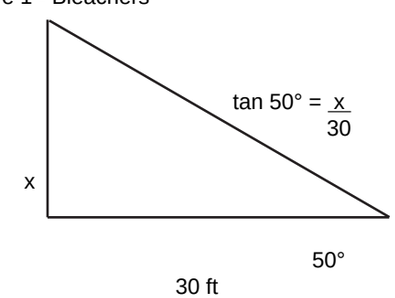
Students write a summary of their efforts that answers the following questions:

- What was each team member's responsibility?
- What process (steps) did the team use to complete the assigned project?
- What problems did the team encounter during the project and how were they solved?
- What are the pros and cons to working on a team?
- What score should the team receive and why? (This score should be based on a rubric given to each student prior to beginning the assignment)
- In what kind of situations is the team approach most effective?

EXTENSIONS

Survey the school property.

Figure 1 - Bleachers



MATHEMATICS

Academic Content Standard

5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 9-12 BENCHMARKS	COMMUNICATION SKILLS Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. measuring quantities indirectly using techniques of algebra, geometry, or trigonometry												●				●	●							●				
b. selecting and using appropriate techniques and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements									●	●		●	●		●	●	●		*	●		●			●			
c. determining the degree of accuracy of a measurement											●	●				●	●							●				

GRADE LEVEL

9-12

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

5. Students use a variety of tools and techniques to measure, apply the results in problem-solving situations, and communicate the reasoning used in solving these problems.

BENCHMARK

b. selecting and using appropriate techniques and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements

WORKPLACE COMPETENCY

Technology Skills: Selects Technology chooses appropriate procedures, tools or equipment

QUOTATION

". . . Because of School-to-Career, our curriculum is more focused. We have more community involvement with over 120 partners assisting. We believe our students are better prepared for the working world as well as for higher education."

- Harvie Guest, Superintendent
Salida School District

MATHEMATICS

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Using a variety of measuring tools, students measure the diameter of a cylindrical object. Students note and record the various degrees of precision for each tool and determine its tolerance.

WORKPLACE COMPETENCY

TECHNOLOGY SKILLS: SELECTS TECHNOLOGY

Students learn about a variety of measuring tools and are provided with several industrial sample problems requiring various levels of precision. Students select the appropriate technology (measuring tool). Discuss and justify appropriateness of each.

CAREER DEVELOPMENT

Invite a doctor, scientist, auto mechanic, machinist, carpenter or others whose work requires high degrees of precision or accuracy to discuss the tools, techniques and equipment they use on the job. These speakers also will share information about their careers and the education, skills, experience required to work in their fields.

COMMUNITY

Invite a local construction worker to come in and help the class use their measurement skills to build the classroom a bookcase, table, etc.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Students complete a performance assessment that requires them to choose from a variety of instruments to measure several different objects. Students perform and record the measurements within stated tolerances (levels of precision).

WORKPLACE COMPETENCY

TECHNOLOGY SKILLS: SELECTS TECHNOLOGY

Students identify the process used to select appropriate technology for the job. This includes explaining why one precision tool works better for a specific measuring task than another. Students identify an occupation that uses measuring tools and the skills required for the occupation.

MATHEMATICS

Academic Content Standard

6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

Workplace Competencies

GRADES 9-12 BENCHMARKS	COMMUNICATION SKILLS: Demonstrates the ability to receive and relay information clearly and effectively							ORGANIZATIONAL SKILLS: Demonstrates skills to effectively and efficiently operate within a workplace					THINKING SKILLS: Demonstrates the ability to use reasoning							TECHNOLOGY SKILLS: Demonstrates the ability to work with a variety of technologies				WORKER QUALITIES: Demonstrates the characteristics of an effective worker					
	Listening	Speaking	Reading	Writing	Interpreting	Negotiating	Persuading	Planning	Time Management	Using Resources	Systems Thinking	Evaluating	Problem Solving	Decision Making	Creative Thinking	Learning	Analyzing	Mathematics	Computer Literacy	Selects Technology	Applies Technology	Uses Technical Info.	Self Management	Team Member	Responsibility	Flexibility	Leadership	Diversity
a. using ratios, proportions, and percents in problem-solving situations												*					●						●					
b. selecting and using appropriate methods for computing with real numbers in problem-solving situations from among mental arithmetic, estimation, paper-and-pencil, calculator, and computer methods, and determining whether the results are reasonable				●	●				●		●	●	●		●	●	●		●	●		●		●				
c. describing the limitations of estimation, and assessing the amount of error resulting from estimation within acceptable limits			●	●							●	●	●		●	●	●							●				

GRADE LEVEL

9-12

K 1 2 3 4 5 6 7 8 9 10 11 12

STATE STANDARD

6. Students link concepts and procedures as they develop and use computational techniques, including estimation, mental arithmetic, paper-and-pencil, calculators, and computers, in problem-solving situations and communicate the reasoning used in solving these problems.

BENCHMARK

a. using ratios, proportions, and percents in problem-solving situations

WORKPLACE COMPETENCY

Thinking Skills: Problem Solving
identifies and recognizes a problem, considers alternatives, devises and implements a logical plan of action

RESOURCE

The Annenberg Foundation and the Corporation for Public Broadcasting is a non-profit organization who's mission is to help schools and communities improve their math and science education programs for all students in kindergarten through 12th grade. A collection of math and science videos, software, and materials are available through:

Annenberg/CPB Math & Science Project
Department C-96
P.O. Box 2345
South Burlington, VT 05407-2345
(800) 965-7373
(802) 864-9846 (fax)
www.learner.org

LEARNING ACTIVITIES

ACADEMIC CONTENT STANDARD

Students use ratios, proportions and percents to calculate one of the following:
- the appropriate medication dosage for a variety of patients
- the individual statistics of a ball player
- the amount of ingredients needed to feed various numbers of people.

WORKPLACE COMPETENCY

THINKING SKILLS: PROBLEM SOLVING

Students learn and use the following problem solving process to do the above activity:
- identify the problem
- identify all available resources (internet, nurses, teachers, calculator, etc.)
- brainstorm ideas for solving the problem, accepting all ideas
- discuss the appropriateness and usefulness of each idea
- try the technique and make any adjustments necessary
- evaluate the technique
- identify alternatives if necessary and apply it to a concrete problem.

CAREER DEVELOPMENT

Invite a doctor, veterinarian, nurse, lab technician, or hospice care provider into the classroom as a guest speaker to discuss how he/she uses ratios, proportions, percents, and problem solving on the job. The speakers also can share information about their own career paths and the skills/experience requirements for jobs in their fields.

COMMUNITY

Students shadow a doctor, nurse or other health care provider and write a paper reflecting how ratios, proportions, percents, and problem solving are used in that profession.

ASSESSMENTS

ACADEMIC CONTENT STANDARD

Evaluate students on their ability to:
- accurately calculate ratios, proportions and percentages
- identify two other areas that use ratios, proportions and percentages.

WORKPLACE COMPETENCY

THINKING SKILLS: PROBLEM SOLVING

Assess students on their ability to successfully follow the problem solving process. Students will describe, in writing, the work completed in and the outcome of each step of the process.

EXTENSIONS

Take a study trip to a hospital or veterinary clinic to observe the application of these skills.

IV. SAMPLE RUBRIC

Standard 3 - Grades 9-12
This rubric is associated with the activity on Page 24b

Assessment	In Progress	Essential	Proficient	Advanced
Academic Standard: Students use data collections and analysis, statistics, and probability in problem-solving situations and communicate the reasoning used in solving these problems. Benchmark c. designing and conducting a statistical experiment to study a problem, and interpreting and communicating the results using the appropriate technology	Academic Standard: • The survey questions lack clarity. The statistical analysis and graphs are nonexistent or need many improvements.	Academic Standard: • Survey includes at least 5 questions on the same topic. The questions are fairly clear and understandable. The statistical analysis of each survey question may have several errors. The graphs are included but may have errors.	Academic Standard: • Survey includes at least 7 questions on the same topic. A written description of the distribution process is included. The questions are clear and understandable. The statistical analysis of each survey question may have 1-2 minor errors. The graphs are displayed neatly, colorfully and accurately.	Academic Standard: • Survey includes at least 10 questions on the same topic. A written description of the distribution process is included showing that the sample was random. The questions are clear and understandable. The statistical analysis of each survey question is accurate. The graphs are displayed neatly, colorfully and accurately.
Workplace Competency: Organizational Skills: Planning Planning, devising, and outlining a process to achieve a goal and timeline.	Workplace Competency: • The group has an incomplete plan without a timeline.	Workplace Competency: • The group has a very basic plan and the student does not always adhere to the timeline.	Workplace Competency: • The group has a complete plan and follows a timeline.	Workplace Competency: • The group has a complete plan and the plan and timeline are adjusted as needed.

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School-to-Career Partnership
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Colorado School-to-Career Partnership
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