Schools Can be Highly Effective in Promoting Learning for Students With Disabilities in Mathematics

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What Are You Going to Do Different?

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Where Should We Start?

- Resources
- Teacher Preparation
- Classroom Structure
- Teacher Attitude

What Can We Do To Prepare Teachers?

Content Specialist

- Content Knowledge
- Instructional Strategies
- Manipulatives training
- Standards Based Classroom
- Differentiation Training
- Provide training to work with diverse learners
- Progress Monitor
- Data Collection

Learning Strategy Specialist

- Content Knowledge
- Instructional Strategies
- Manipulatives training
- Standards Based Classroom
- Differentiation Training
- Accommodations
- Assistive Technology
- Progress Monitor
- Data Collection

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AFTER TRYING TO FLY BY THE SEAT OF HIS PANTS. FRED LEARNED THAT GOOD TEACHING REQUIRES GOOD PLANNING.

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Teacher Professional Development

- Teachers should directly experience exemplary classroom practice, creative applications to a wide variety of state-of-the-art technology, and multiple forms of authentic assessment.

- County wide training opportunities

- Create learning communities (district/school)

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Paul Riccomini

- Paul Riccomini Workshops
  - Building Strategies to Help Students with Disabilities Graduate: Improving Academic Success in Math (SPDG)
  - Strategies for Making AYP for Math (SPDG)
  - Elluminates
  - Error Analysis Procedures
  - Video

Elluminates

- Special Education with General Education
  - 10-15-08 Improving Academic Performance of SWD's for Elementary Mathematics
  - 11-12-08 Improving Academic Performance of SWD's for Secondary Mathematics
  - 01-14-09 SIA Mathematics Vocabulary & Interleave Strategies
  - 02-11-09 SIA Mathematics 1 and Mathematics Support, Space Learning
  - 03-18-09 SIA Mathematics: Graphic representation & Flexible groups (PAL)
  - ETC…

PBS TeacherLine

PBS TeacherLine is an online tool that offers low-cost, high-quality professional development classes to teachers so they can improve their abilities and earn the Professional Learning Units -- or PLUs -- they need to maintain their certification.

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GPB npr

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Teacher Attitude

- “A man who doubts himself is like a man who would enlist in the ranks of his enemies and bear arms against himself. He makes his failure certain by himself being the first person to be convinced of it.“

- Alexandre Dumas

Purpose

The Goal of Mathematics Support Classes is to help students successfully complete their regular grade level Mathematics course.

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Instructional Practices

Foundations For Success

- **Research on students who are low achievers have difficulties in mathematics, or have learning disabilities related to mathematics tells us that the effective practice includes:**
  - ✓ **Explicit methods** of instruction available on a regular basis (large effect)
  - ✓ Clear problem solving **models** (moderate effect)
  - ✓ Carefully orchestrated **examples**/sequences of examples (moderate effect)
  - ✓ **Concrete objects** to understand abstract representations and notation (large effect)
  - ✓ Participatory **thinking aloud** by students and teachers (large effect)

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What *Works*

- ACCELERATION (with remediation in context)
- Multiple VOCABULARY representations
- High ENGAGEMENT strategies
- SCAFFOLDING to move students forward
- FORMATIVE Assessments (adjusting instruction based on daily data)
- Teacher COLLABORATION

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What *Doesn't* Work

- Competitive environments in which students are compared to peers
- Rigid instruction
- "Do you need help?"
- "Gotcha" grading practices
- Lecturing
- Worksheets

Components of Mathematics Support Class

- All students in a particular Mathematics Support Class should be concurrently enrolled in the same regular math course.
- The course should focus on mastery of the standards being taught in the regular mathematics class.
- Continual progress monitoring should be used to assess and diagnose each student's strengths and weaknesses.
- Opportunities should be provided for students to review content with a focus on standards not previously mastered as well as preview upcoming topics.

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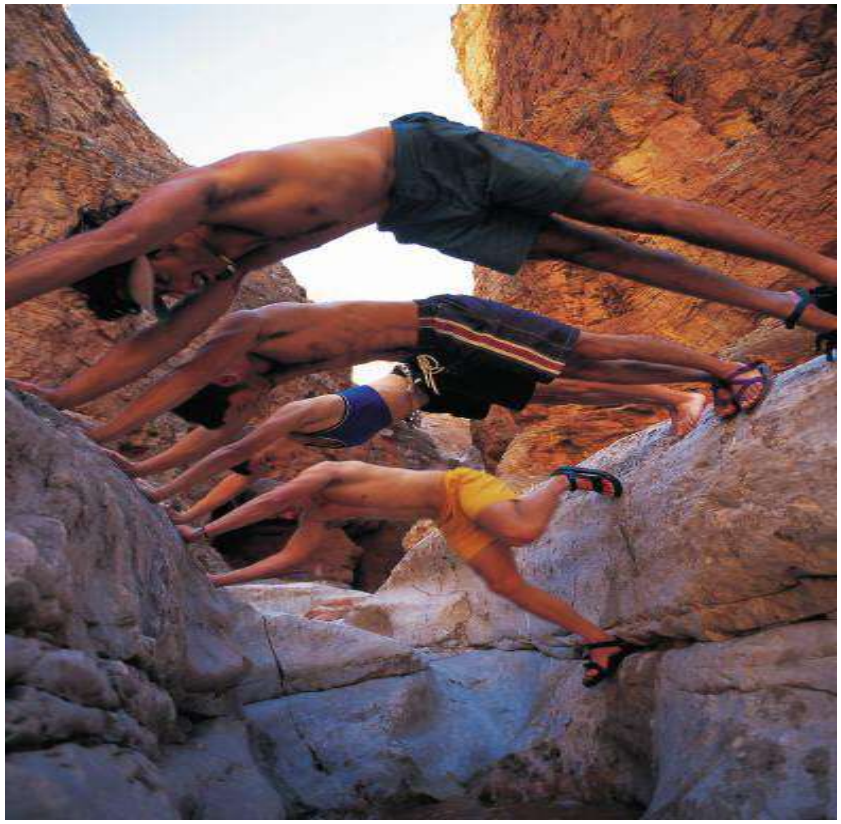
Critically Important

These gaps have to be closed in tandem:

1. Self-efficacy
2. Processing deficits
3. Math knowledge



Self-Efficacy…

- “If a learner’s sense of self-efficacy can be increased, their likelihood of academically performing well in that class will also increase.”
- Providing opportunities for learners to achieve success early in the course helps increase self-efficacy.

- *The Impact of Teaching Strategies on Intrinsic Motivation*
- *Lisa Bomia*

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Self-Efficacy & Tasks

- “those who feel self-efficacious about learning or performing a task competently are apt to participate more readily, work harder, persist longer when they encounter difficulties, and achieve at higher levels.”

Scfhunk & Meece, Self-Efficacy Beliefs of Adolescents, 2005

Characteristics of an Environment that Builds Self-Efficacy

- Choices (Provides a sense of autonomy & control)
- Non-competitive (evaluated on task, not compared to other students.)
- Accommodate processing deficits (Stimulate all the senses , but not necessarily all at once)
- Descriptive, quick feedback
- Builds success early
- Models of success (vicarious success)
- Samples of work provided
- Safe to struggle (Mistakes are part of the process and expected.)
- Promote an active participant rather than a passive observer.

Psychological Processing Deficits

- Visual perception
- Auditory perception
- Memory (short and long term)
- Attention and Distractibility Organization
- Haptic Discrimination
- Conceptualization/Reasoning
- Social Perceptions
- Psychomotor skills/ Visual-Motor Integration

Acceleration/Previewing CAN Close Both Gaps

- Students move forward, not backward
- Gaps in math education filled in context while moving forward
- The largest indicator of student success is self-efficacy, not I.Q. Acceleration builds success!
- Scaffolding, vocabulary, & remediation "Just in time," not "Out of Context"
- Two days ahead, not years behind
- Remediation in context when they need the skill, rather than in isolation.

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What is Acceleration/Previewing?

- Scaffolding for future learning
- Gives learners advance structure
- Organizes learning support
- Only accelerate those “most essential” concepts/skills

Learning-Focused Schools Strategies Notebook ,Learning Concepts and Assessments Inc. Learning That Works! Dr. Max Thompson, Dr. Julia Thomason

Planning Mathematics Support

- 60-70% of the instructional time on acceleration/previewing
- 30-40% of the instructional time on remediation/reviewing

Learning-Focused Schools Strategies Notebook ,Learning Concepts and Assessments Inc. Learning That Works! Dr. Max Thompson, Dr. Julia Thomason

Acceleration/Previewing

1. Concept Map from Standard (advance organizer)
2. Activating Strategy/Opener

   a. To stir intellectual curiosity, tap into prior knowledge, create a desire to know more.)

   b. Examples: video clips, manipulatives, anticipation guides, strips, demonstration, brainstorm, sorts, etc.)
3. Vocabulary

   a. Preview it

   b. Multiple opportunities

   c. Hands-on strategies

   d. Make it visual

   e. Strategies

Assessment Instruction Cycle

Initial Assessment

- Collect historical data
- Formal standardized assessment
- Diagnostic assessment

Instructional Design

- Analyze content for sameness
- Select range of examples
- Select language of instruction(LOTS)
- Sequence language and examples
- Organize into daily lessons
- Schedule practice of examples
- Provide for cumulative review

Instructional Delivery

- Secure attention
- Pace briskly(actively engaged)
  - frequent responses
  - adequate think time
- Monitor student performance
- Provide timely feedback
  - systematic corrective
  - specific reinforcement

Progress Monitoring

- Determine appropriate starting level
- Monitor progress frequently
- Graph student scores
- Evaluate progress
- Determine need for instructional modifications

Medger, Hall, Glang (1997)

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Progress Monitoring

- Pause and reflect
- Walk Abouts
- Read Aloud Think Aloud
- Explain and justify work
- Student Conferencing
- Exemplars

Where Do We Get That DATA From?

- CRCT results
- EOCT results
- Classroom performance (SPREAD SHEET)
- Teacher recommendation
- Progress monitoring

Explicit Instruction

- The National Research Council (Kilpatrick, et at., 2001) calls for a mix of explicit instruction with opportunities to apply principles using real-life word problems.
- As teachers we recognize that students do and should construct their own knowledge. However, we must provide structured guidance through questions for understanding to support them in their learning especially for students who struggle in their learning of math.

Explicit Instruction

- **Feedback and Correctives**
  - Students should know when their answers are incorrect and that mistakes are a part of learning
- **Distributive Practice (Weekly & Monthly Reviews, Spaced Learning. Interleave)**
  - Effective review promotes transfer of learning by requiring application of content at different times

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Ten Effective Teaching Principles

1. Engaged Time
2. Success Rate
3. Content Coverage/Opportunity to Learn
4. Grouping for Instruction
5. Scaffold Instruction

Paul J. Riccomini 2008

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Ten Effective Teaching Principles

6. Addressing Forms of Knowledge
7. Activating & Organizing Knowledge
8. Teaching Strategically
9. Making Instruction Explicit
10. Teach Sameness

Paul J. Riccomini 2008

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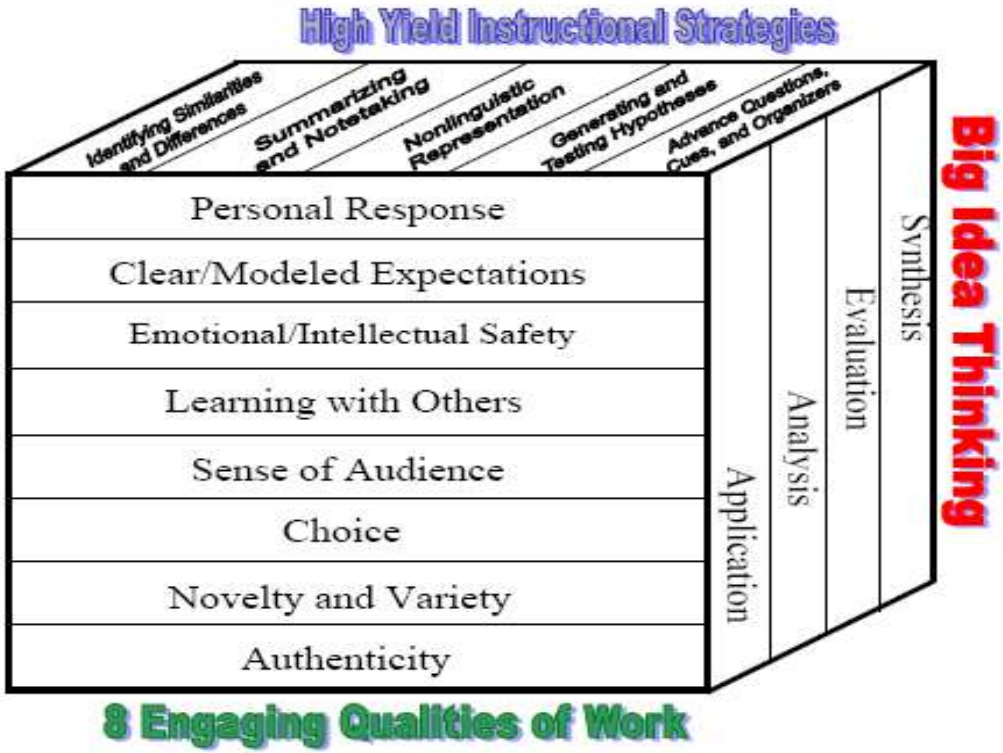
Strategies Are A Must!



Marzano, R., Pickering, D. & Pollock, J. (2001). *Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement.* Alexandria, VA: Association for Supervision and Curriculum Development.

Bloom, B., Englehart, M. Furst, E., Hill, W., & Krathwohl, D. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain.* New York, Toronto: Longmans, Green.

Schlechty, P. (2002) *Working on the Work.* San Francisco, CA: Jossey-Bass.

Strategies

- Advance Organizers
- Vocabulary
- Mnemonics
- Interleave
- Spaced Learning Over Time
- Graphic representation
- Flexible Groups

Determining The Optimal Tool(s)

- **Student abilities and needs**

- **Required tasks**

- **Available supports**

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Benefits of Math Aids

- Productivity
- Independence
- Achievement

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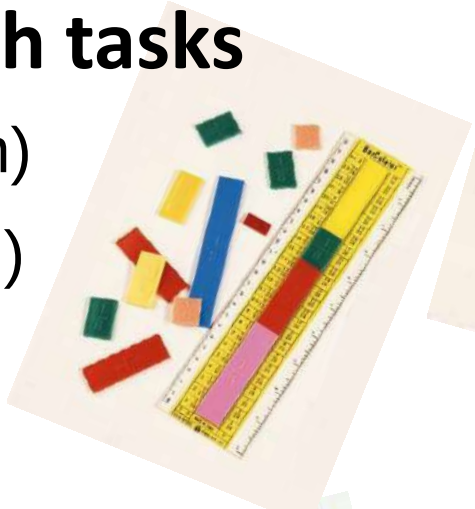
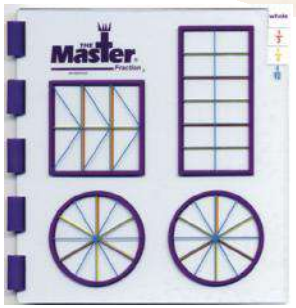
Manipulatives

- **Provides concrete materials that can be used when performing math tasks**
  - BarCulator (mathfun.com)
  - PieCulator (mathfun.com)
  - Master Fraction (Onion Mountain Technology)
  - MathLine (Onion Mountain Technology)





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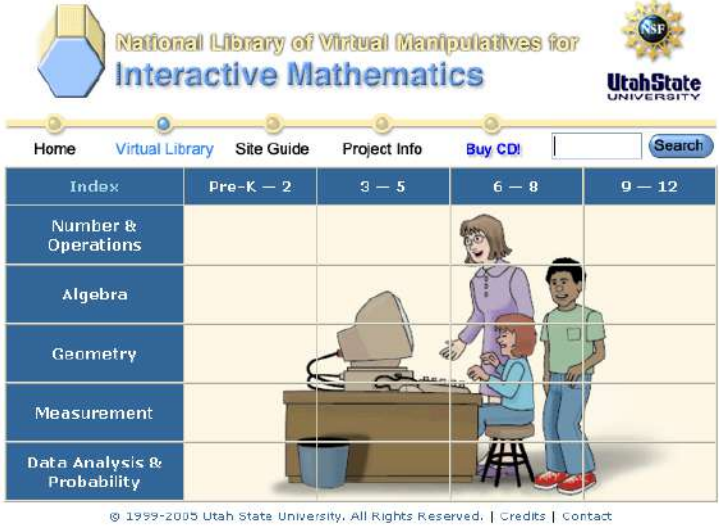
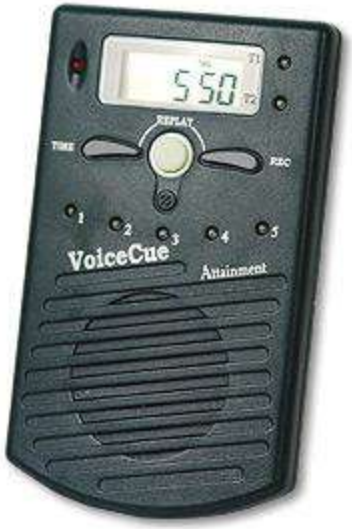
Virtual Manipulatives

- **Allows for access to electronic manipulatives**
  - IntelliMathics (Intellitools)
  - National Library of Virtual Manipulatives (http://nlvm.usu.edu/en/nav/)



Process Aids

- **Provide auditory prompts for solving multi-step problems**
  - StepPad (Attainment)
  - VoiceCue (Attainment)



Calculators

- **Large Button - Provide large buttons and/or large display for physical access**
  - Jumbo Display Folding Calculator (Independent Living Aids)

- **Talking Calculator – Provide speech feedback of numbers entered and numbers on display**
  - Desktop Talking Calculator (Maxi-Aids)

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Talking Scientific Calculators

- **Provides speech feedback for solving higher level math equations**
  - Talking Scientific Calculator (Independent Living Aids)
  - Orion T136X Talking Scientific Calculator (MaxiAids)
  - TI-36X Solar (Independent Living Aids)

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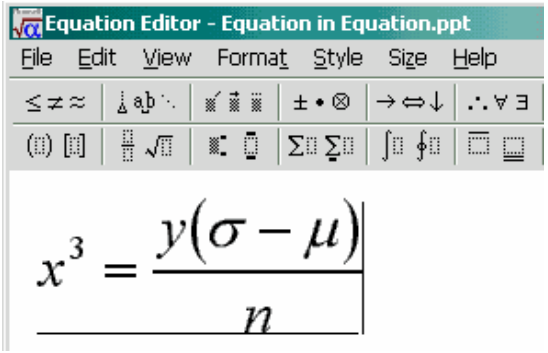
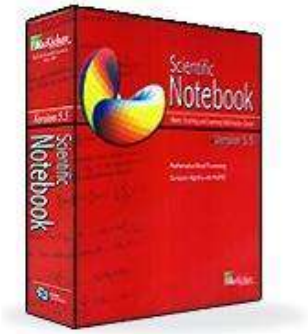
Electronic Math Processing Software

- **Allows for completion of higher level math functions in an electronic format**
  - Equation Editor (free download from MS Office CD)
  - Scientific Notebook (MacKichen Software)
  - Geometer's Sketchpad (Key Curriculum Press)





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Teacher Resources

- Interactive White Board
- I Pad
- Student Response Systems
- I Pod
- Document Camera
- Graphing Calculator
- Manipulatives

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Mathematics Support

Collaboratively Developed and Monitored by Mathematics and Mathematics Support Teachers

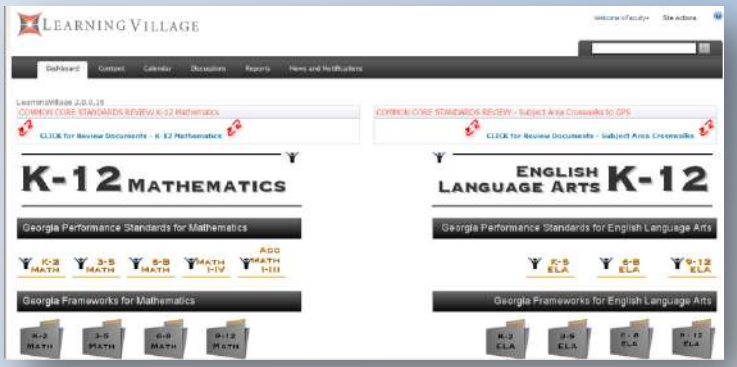
Strategies	Assessment/Grades
Previewing Vocabulary: ▪ Vocabulary words for the next unit/lesson are researched (perhaps online) by students. Students should be able to write definitions of the words, use them in appropriate contexts, represent them pictorially, and specify non-examples of them. Graphic organizers should be used with these student-made vocabulary representations. ▪ Use Reading Mazes* that incorporate the vocabulary to monitor student achievement. ▪ Six Step Process for Building Academic Vocabulary (Marzano)	▪ Grades may be assigned for proper use of the vocabulary words in all the formats described. Support teachers should monitor the student work in progress and give feedback (formative assessment) through questioning to guide students to proper use and application of the words. ▪ Reading Mazes may be used as pre- and post-tests as well as benchmarks of student comprehension of the pertinent vocabulary. Grades may be assigned based on growth in comprehension.
Student Reporting of Mathematical Understanding: ▪ Students will articulate their mathematical conceptual understanding developed during lessons in the Mathematics 1 class to the instructor in the Support class in both in verbal and written formats. ▪ The Support class teacher will use this articulation to diagnose student misunderstanding so that other strategies can be applied for student achievement.	▪ Support teachers will use the verbal and written student articulation to inform the use of other strategies to support student understanding. ▪ Grades may be assigned based on the completion of these articulations.
Previewing Tasks: ▪ Students will preview tasks from the Mathematics class by working similar teacher-developed tasks (scaffolding tasks) that focus on building conceptual understanding.	▪ Support teachers will use the scaffolding tasks to provide commentary to students about their understanding of focused concepts. ▪ Grades may be assigned based on the completion of these scaffolding tasks.
Extended Time for Tasks from the Mathematics Class: ▪ Mathematics teachers may send unfinished tasks to the Mathematics Support teacher for students to complete either individually or in newly developed small groups in the Support class.	▪ Support teachers may provide feedback to students as they complete the Mathematics tasks through questioning. ▪ Grades may be assigned based on the completion of these Mathematics tasks.

Learning Village

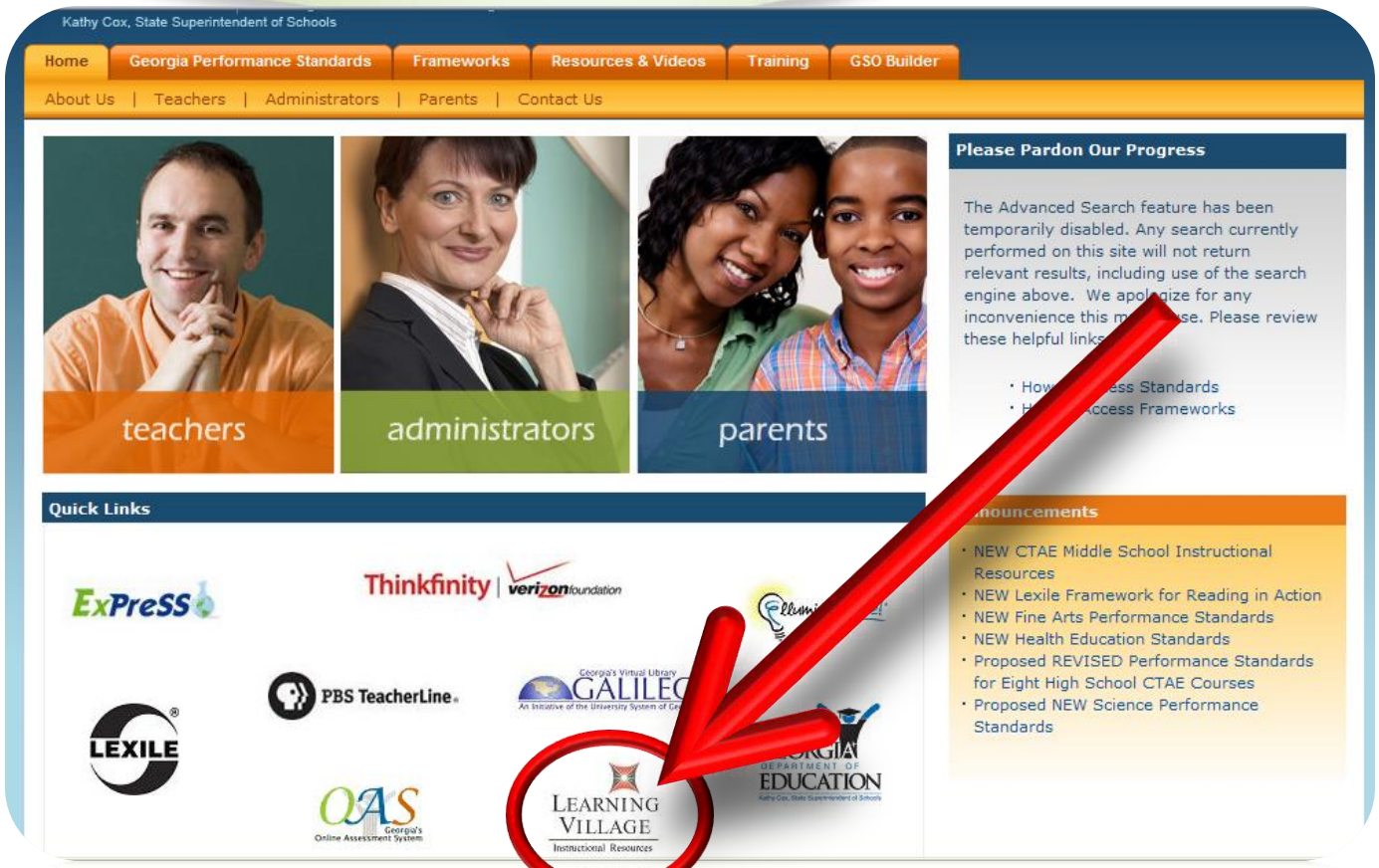
Learning Village, a resource in alignment to the Georgia Performance Standards, has been designed to achieve a balance among concepts, problem solving, and skill development in Georgia's Mathematics classrooms. This resource stresses rigorous concept development, presents realistic and relevant tasks, and keeps a strong emphasis on computational skills.

This website includes:

- standards
- REVISED framework units
- classroom and training videos
- mathematics parent letters
- vertical alignment charts
- webinars
- middle school mathematics webcasts
- PowerPoint unit overviews (coming soon)



GeorgiaStandards.org…



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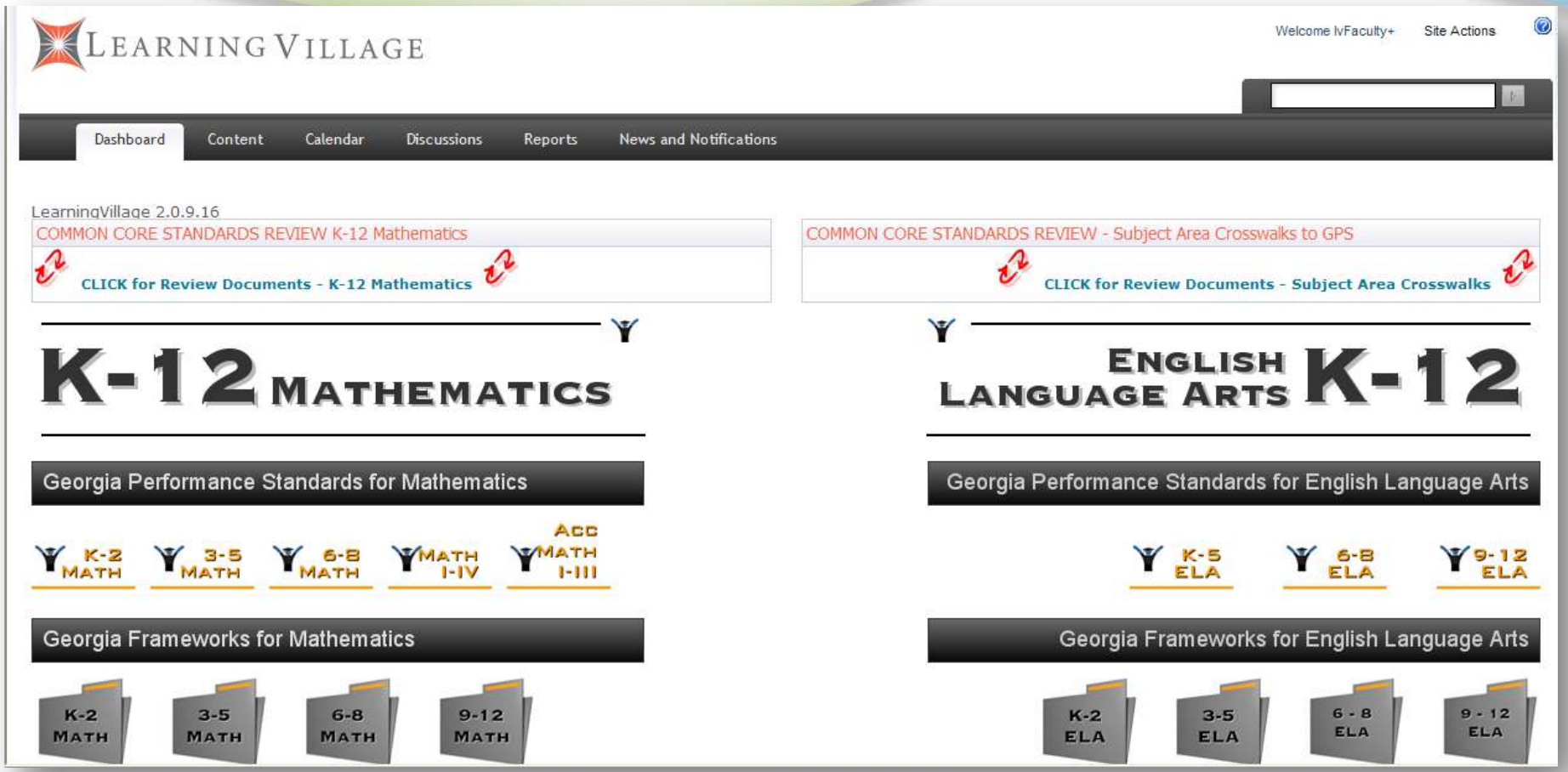
Accessing Learning Village

Dashboard of Instructional Sources …



Revised Elementary Frameworks

Revised frameworks include:

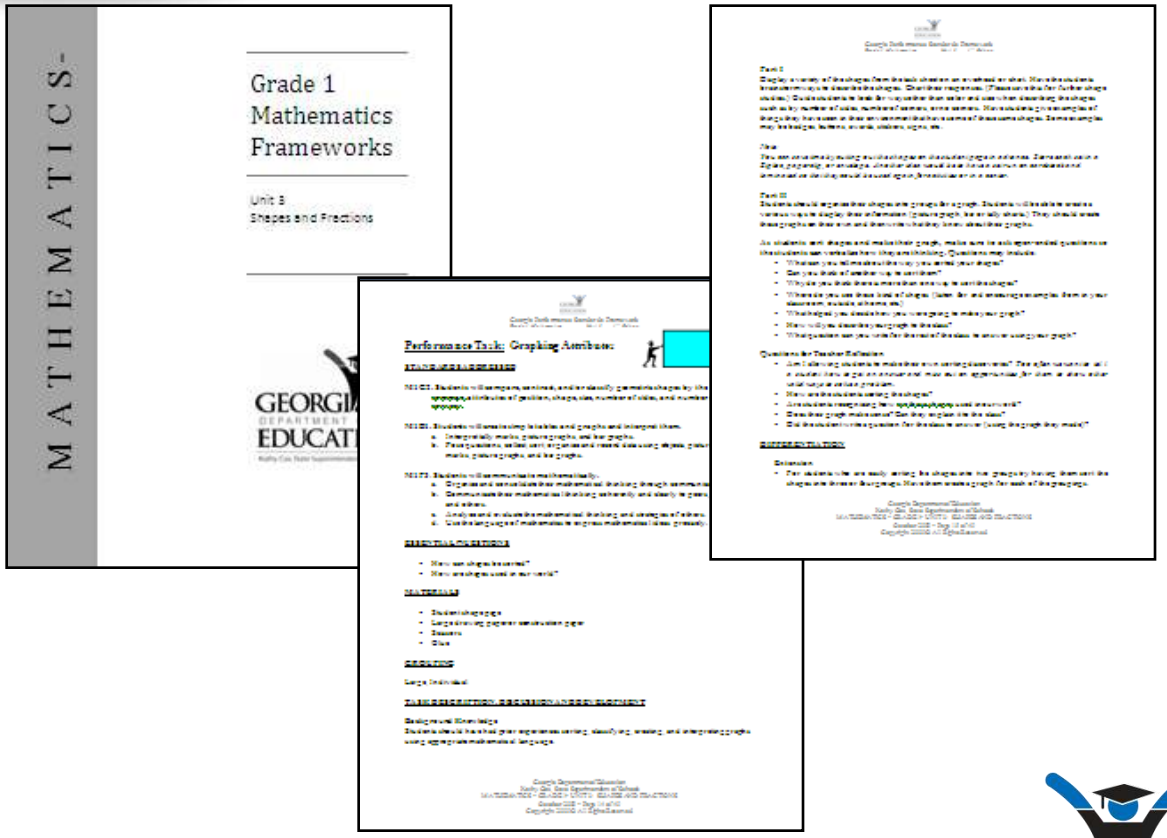
Updated Standards

Differentiation

Essential Questions

Updated Tasks

Background Knowledge



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Revised Middle School Frameworks

Revised frameworks include:

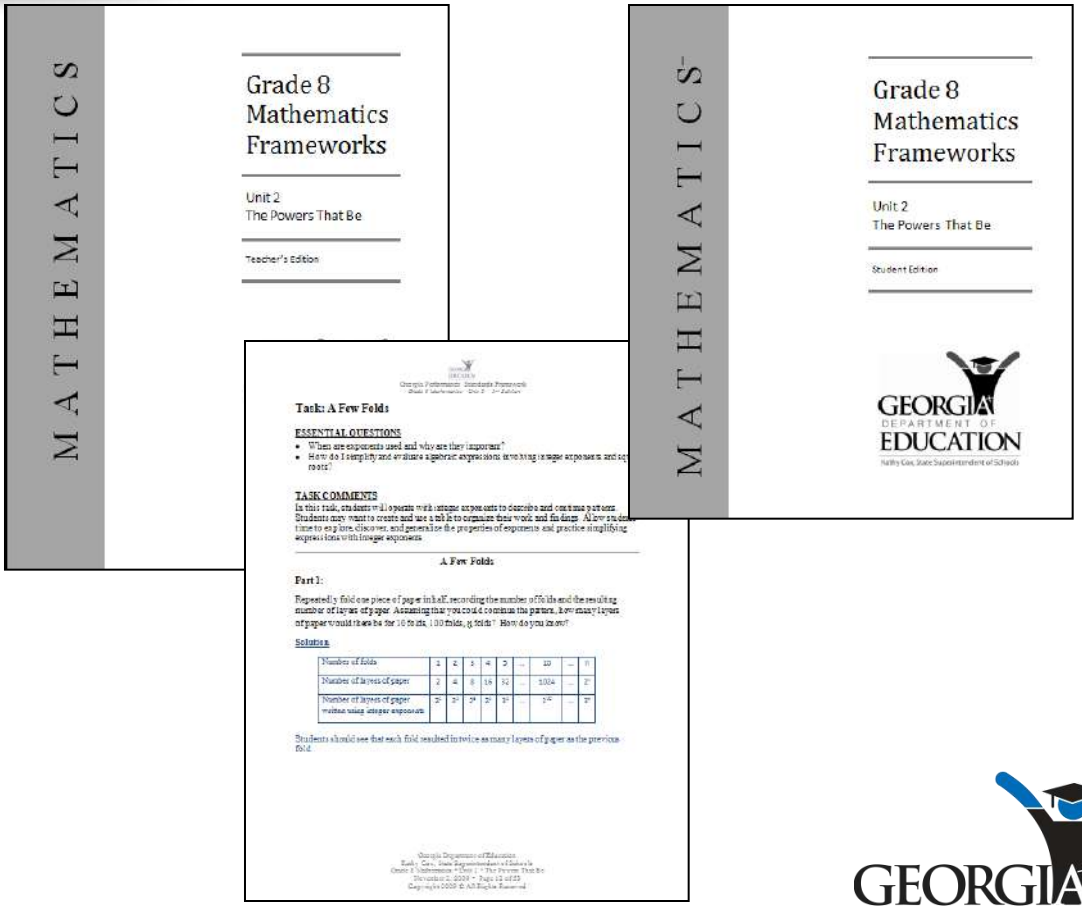
Teacher's Edition

Student Edition

Essential Questions

Updated Tasks

Background Knowledge



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Mathematics Newsletters

Mathematics Newsletters include:

Content Articles

Resources

Elluminate Calendar

Professional Learning Opportunities

Assessment Articles

Instructional Articles

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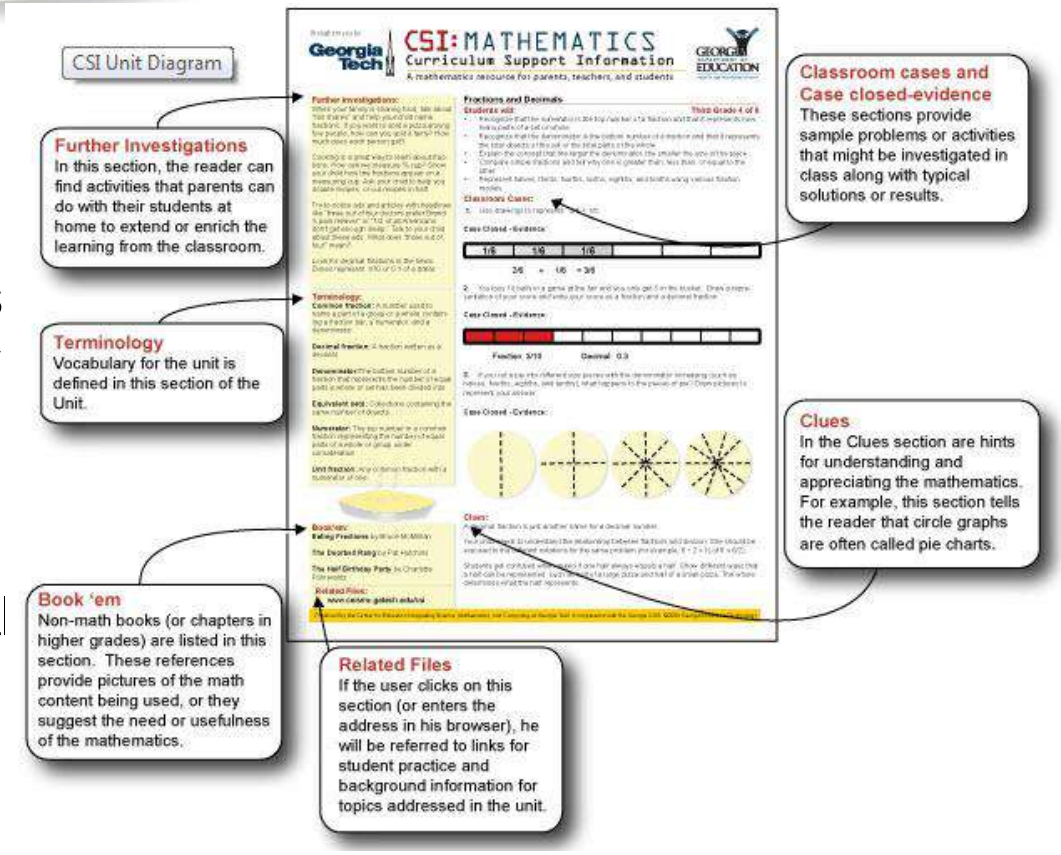
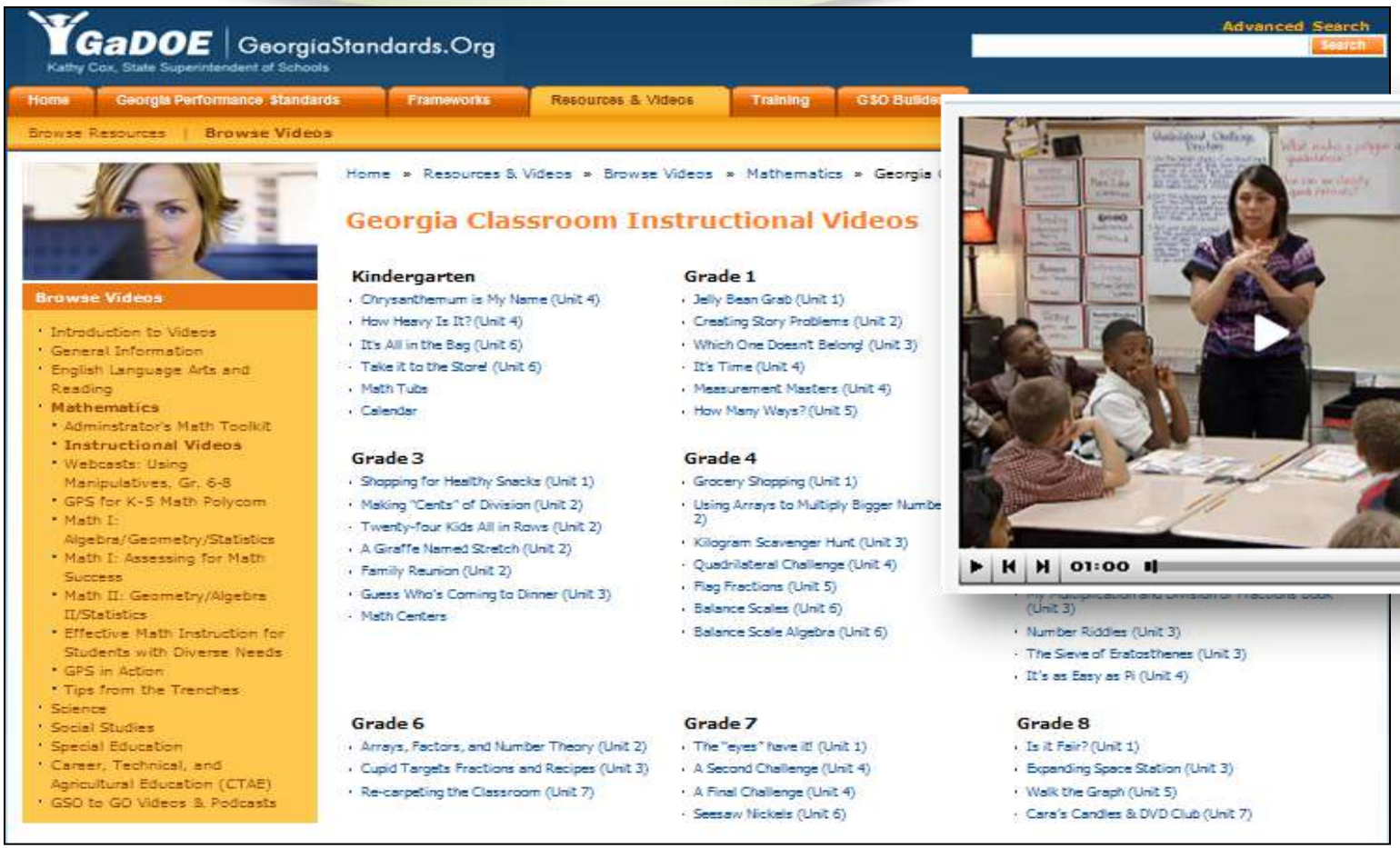
Parent Letters

Mathematics Parent Letters include:

Each letter provides glimpses of the content investigated in class, suggestions for activities to explore at home, vocabulary used in the unit, grade-appropriate readings related to the math content, and links to websites that contain additional background information or practice opportunities for skills development.



GPS Mathematics Classroom Videos



Mathematics Videos

www.georgiastandards.org

- Administrator's Mathematics Toolkit
- Georgia Classroom Instructional Videos
- Webcasts: Using Manipulatives, Gr. 6-8
- GPS for K-5 Math Polycom, March, 2009
- Mathematics I: Algebra/Geometry/Statistics
- Mathematics I: Assessing for Mathematics Success
- Mathematics II: Geometry/Algebra II/Statistics
- Effective Mathematics Instruction for Students with Diverse Needs
- Georgia Performance Standards In Action
- Tips From the Trenches

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CSI: MATHEMATICS
Curriculum Support Information

A mathematics resource for parents, teachers, and students

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Further Investigations:

Show your student graphs in newspapers, journals, or on the Internet. Identify the domains and ranges and discuss whether they represent discrete or continuous data.

When watching television with your student, pick statements from the commercials and restate them as conditional statements. Then state the converse, inverse, and contrapositive. Evaluate the truth value of each statement.

Look for sequences in your world such as hours worked or number of seats at a theatre. Ask your student to represent them recursively, in closed form, and in function notation.

Terminology:

Contrapositive: A conditional statement that negates and reverses the hypothesis and the conclusion.

Converse: A conditional statement that reverses the hypothesis and the conclusion.

Continuous: A set of data that can include any real-numbered value in a given interval such temperature, time, and length.

Discrete: A set of data that represents a situation where the possibilities are distinct and separated from each other such as counts of people.

Domain: The set of all possible values for the independent or input variable in a function.

Hypothesis: In a conditional statement, the part that follows "if."

Inverse: A conditional statement that negates the hypothesis and the conclusion.

Range: The set of all possible values for the dependent or output variable in a function.

Clues:

To a large extent, applied mathematics consists of modeling various phenomena by functions, using mathematics to analyze these functions, and then using this mathematical analysis to obtain insight into the phenomena. We can model more and more things if we have a larger repertoire of functions.

Book'em:

Through the Looking Glass
by Lewis Carrol

Related Files:

www.ceismc.gatech.edu/csi

Function Families

Students will: **Math I - 1 of 8**

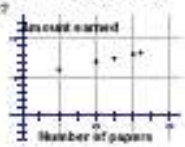
- Explore properties of basic quadratic, cubic, absolute value, square root, and rational functions
- Determine the range given the domain and rule of correspondence for a function
- Represent functions with function notation and use the notation to ask and answer questions about relationships
- Read and draw graphs of functional relationships
- Recognize and evaluate logical relationships between a statement and its converse, its inverse, and its contrapositive.

Classroom Cases:

1. Ina has a job after school delivering papers. She is paid $5 per week plus $.10 for each paper delivered. Make a table and a graph to show the relationship between the number of papers delivered and amount earned each week. Write a formula in function notation to represent the relationship. What is the domain? What is the range?

Case Closed - Evidence:

Number of papers delivered, n	10	20	25	30	32
Weekly earnings, $E(n)$	6	7	7.50	8	8.20



$E(n) = 5 + 0.10n$

The domain is the number of papers delivered, n. It can be represented $\{n \in \mathbb{R} \mid n \geq 0\}$. The range includes all the amounts Ina could earn in a week. It can be represented $\{E(n) \in Q \mid E(n) \geq 0\}$. Since the number of papers must be whole numbers, the points on the graph should not be connected.

2. Write the sentences below in "if-then" form. Give the converse of each statement and tell whether its truth value is true or false.
   - I cry at weddings.
   - A rectangle is a quadrilateral with 4 right angles.
   - $f(9) = 3$ when $f(x) = \sqrt{x}$

Case Closed - Evidence:

Statement	Converse	Truth value
If I am at a wedding, then I cry.	If I cry, then I am at a wedding.	False. I also cry at the movies.
If a quadrilateral is a rectangle, then it has 4 right angles.	If a quadrilateral has 4 right angles, then it is a rectangle.	True
If $f(x) = \sqrt{x}$, then $f(9) = 3$.	If $f(9) = 3$, then $f(x) = \sqrt{x}$	False. $f(x)$ could be $27\sqrt{x}$.

3. Uncle Hank is building a shop. He needs a floor space of 1200 square feet. Make a table to show some of the possible lengths and widths for the shop. Draw a graph to show the relationship between width and length and represent the relationship in function notation. Write a function rule to calculate the length of the floor for any given width. Use your rule to determine the length of the floor when the width is 28 feet.

Case Closed - Evidence:

Width	Length
10	120
20	60
30	40
40	30
50	24
60	20
80	15
100	12

Let w = width and $L(w)$ = length. Then $L(w) = 1200/w$.
If $w = 28$, then $L(28) = 1200/28$ or $42\ 6/7$ feet

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Resources

- “Learning from NAEP: Professional Development Materials for Teachers of Mathematics”, NCTM, edited by Catherine A. Brown and Lynn V. Clark.
- “Ed Thoughts What We Know About Mathematics Teaching and Learning” 2nd Edition, McREL, edited by Vicki Urquhart with Carmon Anderson, Linda Brannan, Kathleen Dempsey, and Matt Kuhn.
- “Differentiation in Practice A Resource Guide for Differentiating Curriculum Grades 5-9”, ASCD, by Carol Ann Tomlinson and Caroline Cunningham Eidson.
- “Differentiating Math Instruction Strategies That Work for K-8 Classrooms” second edition with updates based on the National Mathematics Advisory Panel Report, Corwin, by William N. Bender.

What's Next?

- How can you as an ADMINISTRATOR make a difference for SWD or our at Risk Students?
- What can you do to promote/strengthen teacher knowledge?

❖**Turn and Share 1 thing you can do differently to promoting learning for students with disabilities in mathematics!**

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The Opportunity YOU have is…

…to empower your teachers to create an environment that fosters math self-efficacy while utilizing instructional strategies and assistive technology that will maximize math potential.