

“Scaling Up” Student Learning
for English Language Learners

TODOS 2014
Beyond Awareness ~ Equity, Access and Achievement for
ALL

Thursday, June 26, 2014, 4:30 PM to Saturday, June 28, 2014,
4:30 PM
Chandler, AZ

Tarleton State University

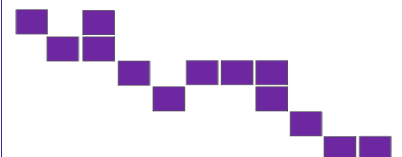
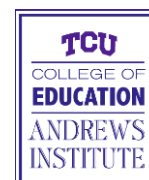
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Article to read for more information regarding children’s literature and math:

Shatzer, J. (2008). Picture book power: Connecting children’s literature and mathematics. *The Reading Teacher*, 61(8), pp. 649–653. DOI:10.1598/RT.61.8.6

Online resource for a more comprehensive list of Elementary Mathematics Children’s Literature: <http://www.tarleton.edu/team/resources/childrenlist.html>

**Bibliography of Middle School Mathematics Books
Appropriate for Grades 4-8**

Note: Some of the books on fractions may seem too young for most fourth through eighth graders. I work with some students who have been unschooled due to difficult situations. These books are good for those students as they give an introduction to fractions. As always, check out books online before ordering them to see if they fit your particular needs.

Algebra

- Adler, D. A. (2012). *Mystery math: A first book of algebra*. New York, NY: Holiday House, Inc.
- Glass, J. (1998). *The Fly on the ceiling*. Random House Books for Young Readers
- Hathout, L. (2007). *Crimes and mathdemeanors*. Wellesley, MA: A K Peters, Ltd. (Chapter book that uses algebra, geometry, and physics to solve crimes)
- Lichtman, W. (2007). *Do the math: Secrets, lies, and algebra*. New York, NY: HarperCollins Publishers. (Chapter Book)
- Lichtman, W. (2008). *Do the math: The writing on the wall*. New York, NY: HarperCollins Publishers. (Chapter Book)
- McMillan, D. (2011). *Learning algebra with pizza*. Mankato, MN: Capstone Press.
- Skurzynski, G, & Ferguson, A. (2007). *Wolf stalker*. National Geographic Society. (Uses math and science to solve a mystery. Chapter Book)
- Yoder, E., & Yoder, N. (2010). *One Minute Mysteries: 65 Short Mysteries You \ Solve with Math!* Washington, DC: Science, Naturally! LCC.

Data, Statistics, and Probability

- Einhorn, E. (2008). *A very improbable story: A math adventure*. Watertown, MA: Charlesbridge Pub Inc.
- Leedy, L. (2006). *The great graph contest*. Holiday House, Inc.
- Murphy, S. J. (1999). *Lemonade for sale (MathStart 3)*. Steck-Vaughn.
- Nagda, A. W. & Bickel, C. (2002). *Tiger math: Learning to graph from a baby tiger*. Square Fish.
- Neuschwander, C. (2013). *Sir Cumference and the off-the-Charts dessert*. Watertown, MA: Charlesbridge Pub Inc.
- Rand, Casey. (2010). *Graphing sports (real world data)*. Heinemann-Raintree.
- Wingard-Nelson, Rebecca. (2004). *Data, graphing, and Statistics*. Enslow Publishers, Incorporated.

Fibonacci Series

- Campbell, S. C. (2010). *Growing Patterns*. Boyds Mill Press.
- D'Agnese, J. (2010). *Blockhead: The life of Fibonacci*. New York, NY: Henry Holt and Company, LLC.
- Enzensberger, H. M. (1997). *The number devil: A mathematical adventure*. New York, NY: Henry Holt and Company, LLC.
- Gravett, E. (2010). *The Rabbit Problem*. Simon & Schuster Books for Young Readers.
- Hulme, J. (2005). *Wild Fibonacci: nature's secret code revealed*. Tricycle Press.
- McCallum, A. & Kendall, G. (2007). *Rabbits rabbits everywhere: A Fibonacci tale*. Watertown, MA: Charlesbridge Pub Inc.
- Scieszka, J. (1995). *Math Curse*. Viking Juvenile.

Fractions, Decimals, Ratios, Percentages, Scale Factor, & Proportions

- Adler, D. A. (1997). *Fraction fun*. Holiday House, Inc.
- Caron, L. & St. Jacques, P. M. (2000). *Fractions and decimals*. Enslow Publishers.
- Clements, R. (1994). *Counting on Frank*. Houghton Mifflin Harcourt
- Dobson, C. (2002). *Pizza counting*. Watertown, MA: Charlesbridge Publishing, Inc.
- Ellis, J. (2010). *Pythagoras and the ratios: A math adventure*. Charlesbridge Publishing, Inc.
- Fritz J. (2001). *Leonardo's horse*. New York: G.P. Putnam's Sons
- Headstrom, R. (1977). *Adventures with a microscope*. Mineola, NY: Dover Publications.
- Heide, F. P. (1992). *The shrinking of Treehorn*. Holiday House Publishing.
- Hulme, J. (2006). *Mary Clare likes to share*. Random House Books for Young Readers. (Introduction to Fractions. Good for unschooled students with little English mastery.)
- Lavine, S. (1997). *The ultimate guide to microscope book*. New York, NY: Sterling. (scale factor)
- Leedy, L. (1996). *Fraction action*. Holiday House, Inc.
- Levy, J. (2009). *The silk road: Using a map scale to measure distances*. Rosen Publishing Group. (scale factor)
- Murphy, S. J. (1997). *A fair bear share*. HarperCollins
- Murphy, S. J. (1996). *Give me half*. (MathStart 2). HarperCollins.
- Murphy, S. J. (1998). *Jump kangaroo, jump*. (MathStart 3). HarperCollins.
- Osborne, M. P. (2005). *Kate and the beanstalk*. New York: Simon & Schuster.
- Pallotta, J. (2003). *Apple Fractions*. Cartwheel Books.
- Pallotta, J. (1999). *He Hershey's Milk Chocolate Bar Fractions Book*. Cartwheel Books.
- Pilegard, V. (2003). *The warlord's puppeteers*. Pelican Publishing Company, Inc.
- Schwartz, D. M. (1999). *If you hopped like a frog*. Scholastic, Inc.
- Selsam, M. (1963). *Greg's microscope, a science I can read book*. New York, NY: HarperCollins Publishers, Inc. (scale factor)

- Silvestein, A., & Silvestein, V. (1969). *A world in a drop of water: Exploring with a microscope*. New York, NY: Atheneum. (scale factor)
- Stanford, J. B. (2003). *Go fractions!* Penguin Young Readers.
- Sundby, S. (2000). *Cut down to size at high noon*. Watertown, MA: Charlesbridge Publishing (scale factor)
- Wingard-Nelson, R. (2005). *Fractions and decimals made easy*. Enslow Elementary Publishers.

Geometry

- Adler, D.A. (2012). *Perimeter, area, and volume: A monster book of dimensions*. New York, NY: Holiday House, Inc.
- Coerr, E. (1997). *Sadako and the thousand paper cranes*. Hampton Brown Publishers.
- Ellis, J. (2004). *What's your angle, Pythagoras?: A math adventure*. Watertown, MA: Charlesbridge Pub Inc.
- Murphy, S. J. (2001). *Captain invincible and the space shapes*. (MathStart 2). HarperCollins.
- Neuschwander, C. (2009). *Mummy math: An adventure in geometry*. Watertown, MA: Charlesbridge Pub Inc.
- Neuschwander, C. (1999). *Sir Curmference and the dragon of Pi*. Watertown, MA: Charlesbridge Pub Inc.
- Neuschwander, C. (1997). *Sir Curmference and the First Round Table*. Watertown, MA: Charlesbridge Pub Inc.
- Neuschwander, C. (2001). *Sir Curmference and the Great Knight of Angleland*. Watertown, MA: Charlesbridge Pub Inc.
- Neuschwander, Cindy. (2006). *Sir Curmference and the Isle of Immeter*. Watertown, MA: Charlesbridge Pub Inc.
- Neuschwander, C. (2003). *Sir Curmference and the Sword in the Cone*. Watertown, MA: Charlesbridge Pub Inc.
- Neuschwander, C. (2012). *Sir Cumference and the viking's map*. Watertown, MA: Charlesbridge Pub Inc.
- Tompert, A. (1990). *Grandfather Tang's story*. New York: Crown Publishers, Inc.

Measurement

- Adler, D. A. (1999). *How tall, how short, how far away*. Holiday House, Inc.
- Jenkins, S. (2011). *Actual size*. Houghton Mifflin Harcourt.
- Laksky, K. (2005). *The librarian who measured the earth*. Boston, MA: Houghton Mifflin.
- Myller, R. (1991). *How big is a foot*. Yearling.
- Neuschwander, C. (2009). *Pastry school in Paris: An adventure in capacity*. Henry Holt and Co.
- Pinczes, E. J. (2003). *Inch Worm and a half*. HMH Books for Young Readers.
- Pluckrose, H. A. (1995). *Capacity*. Children's Press.
- Pluckrose, H. A. (1995). *Length (Math Counts)*. Children's Press.
- Pluckrose, H. A. (1995). *Weight*. Children's Press.
- Polacco, P. (1997). *Thunder cake*. Puffin Books.

Sweeney Joan. (2002). *Me and the measure of things*. Random House Children's Books.

Wells, R. E. (1997). *What's faster than a speeding cheetah?* New York: Albert Whitman & Company.

Miscellaneous

Ash, R. (1999). *Factastic book of 1001 lists*. New York: DK Publishing, Inc.

Berger, M. & Berger, G. (2002). *Does it always rain in the rainforest?* Scholastic.

Burns, M. (1975). *The I hate mathematics book*. Little, Brown Books for Young Readers.

Pappas, T. (1993). *Fractals, googols, and other mathematical tales*. San Carlos, CA: Wide World Publishing/Tetra.

Pappas, T. (1997). *Mathematical scandals*. San Carlos, CA: Wide World Publishing/Tetra

Reimer, L. (1995). *Mathematicians are people, too: Stories from the lives of great mathematicians*, vol. 2. Palo Alto, CA: Dale Seymour Publications.

Schwartz, D. M. (1998). *G is for googol: A math alphabet book*. Tricycle Press.

Seymour, D. (1994). *Mathematicians are people, too: Stories from the lives of great mathematicians*. Palo Alto, CA: Dale Seymour Publications.

Tahan, M. (1972). *The man who counted: A collection of mathematical adventures*. New York, NY: W.W. Norton & Company, Inc.

Money

Curtis, C. P. (2005). *Mr. Chickee's funny money*. NY, NY: Yearling/Random House Children's Books.

Numbers

Ball, J. (2005). *Go Figure: A totally cool book about numbers*. New York: DK Publishing, Inc.

Broach, E. (2005). *Shakespeare's secret*. NY, NY: Henry Holt and Company.

Enzensberger, H. M. (2000). *The number devil: A mathematical adventure*. Holt Paperbacks.

Harshman, M. (1993). *Only one*. New York: Penguin Young Readers Group.

Lee, C. (2007). *The great number rumble: A story of math in surprising places*. Ontario, Canada: Annick Press. (Chapter Book)

Pappas, T. (1997). *The adventures of Penrose the mathematical cat*. San Carlos, CA: Wide World Publishing/Tetra.

Pappas, T. (2004). *Further adventures of Penrose the mathematical cat*. San Carlos, CA: Wide World Publishing/Tetra.

Pluckrose, H. A. (1995). *Counting*. Children's Press.

Schwartz, D. M. (2006). *Millions to measure*. HarperCollins Publishers.

Schwartz, D. M. (2004). *How much is a million?* HarperCollins Publishers.

Schwartz, D. M. (1994). *If you made a million*. HarperCollins Publishers.

Schwartz, David M. (2001). *On beyond a million*. Dragonfly Books.

Number Patterns

- Birch, D. (1993). *The king's chess board*. Puffin Books
- Demi. (1997). *One grain of rice*. Scholastic Press.
- Kido, Y. (2007). *A dozen dozens*. Sterling Publishers.
- Masaichior, A. & Mitsumasa, A. (1999). *Anno's mysterious multiplying jar*. Penguin Putnam Books for Young Readers.
- Sachar, L. (1994). *Sideways Arithmetic from Wayside School*. Scholastic Paperbooks.

Operations

- Calvert, P. (2006). *Multiplying menace: The revenge of Rumpelstiltskin*. Watertown, MA: Charlesbridge Pub Inc.
- Calvert, P. (2011). *The multiplying menace divides*. Watertown, MA: Charlesbridge Pub Inc.
- Hutchins, P. (1989). *The doorbell rang*. Greenwillow Books.
- Neuschwander, C. (1998). *Amanda bean's amazing dream: A mathematical story*. New York, NY: Scholastic Press.
- Pinczes, E. J. (1999). *One hundred hungry ants*. HMH Books for Young Readers.
- Pinczes, E. J. (2002). *A remainder of one*. HMH Books for Young Readers.

Patterns

- Johnston, T. & DePaola, T. (1985). *The quilt story*. Putnam Juvenile.
- Neuschwander, C. (2007). *Patterns in Peru: An Adventure in Patterning*. Henry Holt and Co.
- Polacco, P. (2001). *The keeping quilt*. Simon & Schuster/ Paula Wiseman Books

Poetry

- Hopkins, L. B. (2001). *Marvelous math: A book of poems*. Aladdin Picture Books.
- Pappas, T. (1991). *Math talk: Mathematical ideas in poems for two voices*. San Carlos, CA: Wide World Publishing/Tetra.
- Prelutsky, J. (1994). *A pizza the size of the sun*. New York: Harper Collins Publishers
- Silverstein, S. (2006). *The missing piece*. Harper & Row.
- Tang, Greg. (2003). *Math Appeal*. Scholastic Press.
- Tang, Greg. (2003). *Mathterpieces*. Scholastic Press.
- Tang, Greg. (2004). *The grapes of math*. Scholastic Press.

COMMON CORE STANDARDS

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
5. Use appropriate tools strategically.
6. Attend to precision.

GRADE 5: COMMON CORE STANDARDS

Operations and Algebraic Thinking 5.OA

Apply and extend previous understandings of multiplication and division to multiply and divide fractions.

3. Interpret a fraction as division of the numerator by the denominator ($a/b = a \div b$). Solve word problems involving division of whole numbers leading to answers in the form of fractions or mixed numbers, e.g., by using visual fraction models or equations to represent the problem.
4. Apply and extend previous understandings of multiplication to multiply a fraction or whole number by a fraction.
 - a. Interpret the product $(a/b) \times q$ as a parts of a partition of q into b equal parts; equivalently, as the result of a sequence of operations $a \times q \div b$.
5. Interpret multiplication as scaling (resizing), by:
 - a. Comparing the size of a product to the size of one factor on the basis of the size of the other factor, without performing the indicated multiplication.
 - b. Explaining why multiplying a given number by a fraction greater than 1 results in a product greater than the given number (recognizing multiplication by whole numbers greater than 1 as a familiar case); explaining why multiplying a given number by a fraction less than 1 results in a product smaller than the given number; and relating the principle of fraction equivalence $a/b = (n \times a)/(n \times b)$ to the effect of multiplying a/b by 1.
6. Solve real world problems involving multiplication of fractions and mixed numbers, e.g., by using visual fraction models or equations to represent the problem.

Measurement and Data 5.MD

Convert like measurement units within a given measurement system.

1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

GRADE 6: COMMON CORE STANDARDS

Ratios and Proportional Relationships 6.RP

Understand ratio concepts and use ratio reasoning to solve problems.

1. Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities.
2. Understand the concept of a unit rate a/b associated with a ratio $a:b$ with $b \neq 0$, and use rate language in the context of a ratio relationship.
3. Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
 - c. Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means $30/100$ times the quantity); solve problems involving finding the whole, given a part and the percent.
 - d. Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.

GRADE 7: COMMON CORE STANDARDS

Ratios and Proportional Relationships 7.RP

Analyze proportional relationships and use them to solve real-world and mathematical problems.

1. Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.
2. Recognize and represent proportional relationships between quantities.
 - a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.
 - b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.
 - c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p , the relationship between the total cost and the number of items can be expressed as $t = pn$.*
 - d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$ where r is the unit rate.

The Number System 7.NS

Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.

2. Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers.
 - a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as $(-1)(-1) = 1$ and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts.
 - b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If p and q are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real world contexts.
 - c. Apply properties of operations as strategies to multiply and divide rational numbers.
 - d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.
3. Solve real-world and mathematical problems involving the four operations with rational numbers.

Expressions and Equations 7.EE

Use properties of operations to generate equivalent expressions.

1. Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.
2. Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, $a + 0.05a = 1.05a$ means that “increase by 5%” is the same as “multiply by 1.05.”*

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

3. Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.
4. Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.
 - a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p , q , and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

Statistics and Probability 7.SP

Use random sampling to draw inferences about a population.

1. Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

GRADE 8: COMMON CORE STANDARDS

Expressions and Equations 8.EE

Understand the connections between proportional relationships, lines, and linear equations.

5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.

Analyze and solve linear equations and pairs of simultaneous linear equations.

7. Solve linear equations in one variable.

a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where a and b are different numbers).

b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Functions 8.F

Define, evaluate, and compare functions.

1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.¹

2. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

3. Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

Use functions to model relationships between quantities.

4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the

rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Statistics and Probability 8.SP

Investigate patterns of association in bivariate data.

1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
2. Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
3. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

Cut Down To Size At High Noon Book Club 2
5th – 8th Grades

Summary of Content:

Students will read *Cut Down to Size at High Noon* and discuss unfamiliar vocabulary as well as make predictions about how the story will turn out.

Lesson Objective: After reading *Cut Down to Size at High Noon* students will discuss the idea of scale factor.

Assessment Tools: Journal Entry – What mathematics did the two major characters use in the book?

Materials/Resources: *Cut Down to Size at High Noon* by Scott Sunby, Journal, Pencil or Pen

Lesson Cycle	Time	Checks for Understanding, Monitor and Adjustment, Assessment
What are your students doing?		What are you doing as a teacher?
Focus Students will look over cover and make connections with information known about “westerns”. They will then write in their journal a prediction of how the story will play out.	5-7 min. 2-5 min.	Ask how the cover reminds them of cowboys they have seen. Point out differences students may not have observed. Ask the students to provide a prediction in their journals about how they think the story will unfold or what it will be about.

Lesson Cycle	Time	Checks for Understanding, Monitor and Adjustment, Assessment
<p>Guided Application/ Processing</p> <p>Read the story.</p>	10-15 min.	<p>Have the students take turns reading the story, stopping to discuss unknown vocabulary and to make predictions at the climax of the story.</p> <p>Folk, Cowlick, Varmint, Cranium, Noggin, Scale,</p>
<p>Independent Application/ Processing</p> <p>Have the students make predictions about what will happen in the showdown between Buzzsaw Bart and Louis.</p> <p>Have the students predict what Buzzsaw Bart, and Louis sees in their reflections in the mirror.</p>	2-5 min. Each prediction.	<p>Allow the students to have adequate time to make a prediction and then allow each student to share their prediction with the group.</p>
<p>Closure</p> <p>Discuss how their predictions about the story came out.</p> <p>Write a response in their journals to the story.</p>	5-10 min.	<p>Have students retell their earlier predictions and see how they came out with the story.</p> <p>Then have students respond to the story in their journals.</p> <p>Give them ideas to write about such as, new vocabulary learned, predictions before and during the reading, and a summary of the book.</p>

Reflective Practice: Post Instructional Evaluation – Read journal entries and respond to their thoughts.

Tangram Scaling
5th - 8th Grades

Summary of Content: Students create their own set of paper tangrams and using the book *Grandfather Tang’s Story* by Ann Tompert, they will construct figures with the tangrams. The students will then trace their figure in their journals on the graph paper. They will then scale down their drawing by a factor of $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$ based upon teacher discretion.

Lesson Objective: At the end on this lesson students will be able to construct different figures using tangrams and scale objects on graph paper.

Assessment Tools: Correct scale in students’ journals

Materials/Resources: *Grandfather Tang’s Story*, Square paper, rulers/tape measures, scissors, journal with graph paper/graph paper.

Lesson Cycle	Time	Checks for Understanding, Monitor and Adjustment, Assessment	Reteach, Extensions
What are your students doing?		What are you doing as a teacher?	
Focus Students cut out tangrams from the square paper and spend some time investigating	5 min	Teacher should assist students in folding and cutting out tangrams	Some student may need help reading or understanding some of the words in the instructions. Teacher should assist these students.
Structured Inquiry/Discovery Experience Students begin to construct figures and trace in their journal	5 min	Teacher assigns figures for students to create as well as the appropriate scale factor for students to scale down their drawing	

Lesson Cycle	Time	Checks for Understanding, Monitor and Adjustment, Assessment	Reteach, Extensions
<p>Guided Application/ Processing Students now can begin to draw their scaled down figure</p>	10 min	Teacher reminds students what their scale factor was and checks to make sure that students are performing task properly.	Some students may not get the concept of scaling right away so the teacher should explain this concept to the students in need.
<p>Closure Students write in their journals about what they did and what they learned</p>	5-10 min	Teacher reads comments in journals to make sure that students fully grasp the concept of scaling.	

Reflective Practice: Post Instructional Evaluation – Check scaled drawings in the students’ journals for accuracy of scaled drawing and scale factor.

Can You Hop Like a Frog?

5th – 8th Grades

Content Summary: Students determine scale factor for each problem presented and then apply that scale factor to their personal measurements to solve the problem.

Materials: *If You Hopped Like a Frog* by David Schwartz, Calculators, Measuring tape, Bathroom Scale, *If You Hopped Like a Frog* task list

Objectives:

Students will use proportions to discover ratios with different animals and what would happen if they had the same proportions.

Assessment: *If you Hopped like a frog* task list – answers will vary

Lesson:

1. Read *If You Hopped Like a Frog* to the class. Do not engage in discussion yet.
2. Read the letter from the author at the front of the book.
3. Ask the students "What is the author's purpose for writing this book?"
4. Split students into small groups to conduct an investigation. Handout calculators and task lists to each student.
5. Students will read the task list and determine which task interests them the most and start with that task. It is ok if the groups do not go in order to complete the tasks.
6. Conduct a class discussion about how the groups completed their tasks.

If You Hopped Like a Frog Task List

- (A) A 3-inch frog can jump 60 inches! If you could leap like that, how many inches would you be able to go in one hop?
- (B) A whooping crane that is 4 feet tall has a 16-inch neck! What fraction of a crane's height is neck? If you had the same proportions, what size neck would you have?
- (C) Pygmy shrews are tiny land animals with big appetites. A shrew that weighs $\frac{1}{5}$ of an ounce eats $\frac{3}{5}$ of an ounce of worms and insects each day. How many quarter pound cheeseburgers would you have to eat to eat like a Pygmy shrew?
- (D) A brachiosaurus weighed about 80,000 kilograms! But its brain weighed only 200 grams. If you had the brain of a brachiosaurus, how much would your brain weigh?
- (E) Ants are small and mighty. One ant weighs about $\frac{1}{250}$ of an ounce! It can lift a breadcrumb that weighs about $\frac{1}{5}$ of an ounce. If you were this strong, how much could you lift?

Twice the Cube
5th - 8th Grades

Summary of Content: Students will build 2 cubes and determine the scale factor from the first to the second cube. The students will also determine the difference in the number of cubes from the first cube to the second cube. Even though each side of the initial cube is multiplied by a number, the number of cubes does not increase at the same rate.

Materials: Linking Cubes and Journal

Objectives: Students will change a cube's size by a scale factor of 2.

Lesson:

1. Discuss the definition of a cube. What are the characteristics? How do I know if a 3-d figure is a cube? Similarity? Congruence? Proportionality? Scale Factor?
2. Show the students a single linking cube and explain the dimensions are 1X1X1. Students will draw this in their journal. See Example Journal Page.
3. Discuss that in order to keep shapes proportional they need to be similar (same shape, different size) to the original figure. Discuss that when using scale factor we are creating similar figures.
4. Ask for different ways to tell if the figure is similar.
5. Students will show what they think twice the size of a 1X1X1 cube looks like using the cubes and drawing the figure in their journal. Is your figure similar to the original figure?
6. Do steps 2-5 with 2X2X2, 3X3X3.
7. Do steps 2-5 with 4X4X4, 6X6X6, 8X8X8 with a scale factor of 1/2

Using Cubes to Learn about **SCALE FACTOR** and **RATIO**

Take out a 1" x 1" x 1" Cube. Draw the cube in your journal and label it as Cube #1. Label each side appropriately. Build Cube #2. Increase each side four times the original length. Draw the cube in your journal and label appropriately.

Answer the following questions.

1. The scale factor between Cube #1 and Cube #2 is _____.
2. The ratio of the number of cubes in Cube #1 and Cube #2 is _____,
_____, or _____

Now using the 4" x 4" x 4" Cube. Draw the cube in your journal and label it as Cube #2. Label each side appropriately. Build Cube #3. Decrease each side by one-half the length. Draw the cube in your journal and label appropriately.

Answer the following questions.

1. The scale factor between Cube #2 and Cube #3 is _____.
2. The ratio of the number of cubes in Cube #2 and Cube #3 is _____,
_____, or _____

Using Cubes to Learn about **SCALE FACTOR** and **RATIO Answer Key**

Take out a 1” x 1” x 1” Cube. Draw the cube in your journal and label it as Cube #1. Label each side appropriately. Build Cube #2. Increase each side four times the original length. Draw the cube in your journal and label appropriately.

Answer the following questions.

3. The scale factor between Cube #1 and Cube #2 is 4.
4. The ratio of the number of cubes in Cube #1 and Cube #2 is 1 to 64, 1:64, or $\frac{1}{64}$.

Now using the 4” x 4” x 4” Cube. Draw the cube in your journal and label it as Cube #2. Label each side appropriately. Build Cube #3. Decrease each side by one-half the length. Draw the cube in your journal and label appropriately.

Answer the following questions.

5. The scale factor between Cube #2 and Cube #3 is $\frac{1}{2}$.
6. The ratio of the number of cubes in Cube #2 and Cube #3 is 64 to 8, 64:8, or $\frac{64}{8}$.

Ratio Rumble
5th – 8th Grades

Objective: Students will create given ratios in a puzzle game. The student will earn extra points by collecting equivalent ratios.

Materials: iPad with Ratio Rumble

Lesson:

- (F) Students will get on the game Ratio Rumble.
- (G) They choose a character.
- (H) They start on level one
- (I) The game will provide a ratio that they will need to create in the puzzle.
Example: if given the ratio of 1 green: 2 blue the student will need to choose 1 green and 2 blue that are next to each other. This game is similar to bejeweled.
- (J) As the student advances in the rounds the game becomes more difficult and includes halves and obstacles. When a new objective or object is introduced the game will present a small practice.

Measuring Pictures
Grade 5th – 8th Grades

Summary of Content: Students take pictures and determine the scale factor of the picture from the real object.

Materials: iPads, Sketch Explorer, Graph paper, Notebook paper

Objectives:

Students will discover the scale in a photograph using non-traditional units.

Students will write an equation to solve for a height in a photograph.

Students will graph the equation found to show the relationship between the scale and the height of objects.

Lesson:

1. Students will use a photograph of an object with a known height and an object with an unknown height. This will be provided by the teachers on the iPad to use within sketch explorer
2. The students will need to download the Sketch "Measure a Picture" from the Sketch Exchange website. This can be found within the app, tap the book in the bottom right hand corner and visit the Sketch Exchange Community.
3. The app includes pictures but to use the one provided by the teacher double tap the picture. This will bring up the option to change the photo.
4. Students will use the ruler provided to measure the height of the two objects in units.
5. Have the students use these measures and the known height of the first object to discover the scale and height of the second object.

5/6 Grade

1. The students will take a photo of an object in the room or outside. They will need to measure the object after taking the photo.
2. They will use the app to complete the activity with the new object.
3. The scale may not be the same. Ask the students why this may be since the size of the units did not change.

7/8 Grade

1. The students will create a table to show their findings.
2. Write an equation based on the scale.
3. Fill in their table including 4 different height possibilities using the same scale.
4. The students will create a graph to show their results. Is this a linear function?

Footprints and Their Connection to Height
7th & 8th Grades

Objectives:

Students will discover the ratio of foot length to height, create a scatterplot of the collected data, and create the line of best fit.

Materials/Resources:

- Footwear print
- Rulers, Measuring tape
- TI-Nspire calculators
- Paper and pencils

Vocabulary:

Ratio – comparison of two quantities expressed as the number of times one is greater than or less than the other. Can be expressed as part to whole or whole to part.

Average (mean) – taking a set of data and adding them together then dividing by the number of data provided.

Scatter plot – graph of plotted points that show the relationship between two sets of data.

Slope – change in “y” over the change in “x” and measures the steepness of the line.

Line of Best Fit (line of regression) – best represents the trend that the points in a scatter plot follow.

Proportion – mathematical statement showing that two given ratios are equal.

Data table – contains the organized information used to create a scatter plot.

Data – information in numerical form that can be digitally transmitted or processed.

Lesson Cycle	Checks for Understanding, Questions, Monitor and Adjust, Assessment, What is the learner doing? What is the teacher doing? What content?
<p>FOCUS: (What is the learner doing? What is the teacher doing? What content?)</p> <ul style="list-style-type: none"> • Introduce students to casting and how it can be used in CSI events by showing a video or example of footprint casts being used (Possibly Science. If so, have students review what they have done.) video: http://www.youtube.com/watch?v=C29XEOzi8B0 <p>INSTRUCTIONAL DELIVERY:</p>	<p>Students are in groups.</p> <p>You’ve captured footprints through casting with Dr. W. This is another way to do it. And those prints are here.</p> <p>What might our shoe size tell us about the suspect?</p> <p>Brainstorm and see what students come up with on chart paper. In Journal</p>

(What is the learner doing? What is the teacher doing? What content?)

- Activity 1 – students will create cast of their own foot
 - Possibly have them create the material for the cast which uses measurement skills (Science Class)
 - (Go in hallway) Lay footwear print on floor from smallest to largest and have students stand by their footprint. They should hopefully be lined up shortest to tallest.
 - Students measure themselves (foot length and height)
 - divide foot length by height to find a ratio for themselves.

- Add these ratios and divide by number of students to get the average for class.

- Take data collected from each student and have them create a scatterplot first on graph paper.

Students work together to correctly mix the casting material. Use measurement tools.

What do you see? (everyone lined up by height) What hypothesis can we make about the relationship of shoe size to height? (Hypothesis in journal)

In pairs, students will help each other measure themselves. Teacher help lead them to finding a ratio of foot length to height.

Where have we talked about relationships in mathematics? How in mathematics do we signify these relationships?

Have students tell you one at a time their ratios to write down so they can see on projector.

Bring up the article after they find average: Foot length to Stature ratio: 15% Retrieved from: Robbins, L. M. (1986). Estimating height and weight from size of footprints. *Journal of Forensic Sciences*, 31(1), 143-152.)

If the students are interested and lead it to this point, we will do Activity 2.

Collect data and put into table. Ask students: “When you are trying to reach a conclusion, you collect a lot of information just like you collected information from the crime scene. What is this information called?” (data) “How can we organize the data to make it easier to read and understand?” (in table)

We have created this table ready for you to use.

How can we show the data

graphically? What is a scatterplot? What all is included in a scatterplot? Go through the steps of creating a scatterplot by labeling axes, labeling graph, and creating a scale for the axes. Ask: What are the parts of a graph? What should the graph be labeled? What should the axes be labeled? **Y=footprint and X=height** (rise over run) What is the scale for each axis?

Each student will place their coordinates on the graph. Have students decide where a diagonal line that goes through the middle of the points should go and draw this on the group scatterplot graph. **If we drew a line through the middle of this data, where would it go?**

Ask: What is the name of this line? **(line of best fit)** How many of your classmates measurements fall on this line?

What is the relationship between the two measurements?

What is true about foot length compared to height for the points on this line? Points below the line? Points above the line?

- Next have students enter data on the Nspire. Have them estimate the line of best fit.
- Calculate the line of best fit with the calculator automatically doing it and graph the line.
- This should give the ratio of 15%.

- Activity 2 – Elimination of Suspects
 - By taking the data of what we know the suspect to be, students measure length of

In groups, students will use calculator while teacher demonstrates how to plot the points.

Only add in a few at a time and look at graph, so they can see that the more data added, the closer it gets to the ratio. The more data you

each of the feet. If we know shoe size, students can use shoe size to foot length conversion (from: http://www.ehow.com/way_5183370_inches-shoe-size-conversion.html).

- Then use the found ratio from Activity 1 to calculate the suspect’s height. This will eliminate some of the suspects.

CLOSURE:

(What is the learner doing? What is the teacher doing? What content?)

- Have students explain what mathematical concepts were used. (ratio, data, scatterplot (include parts of graph), average, line of best fit) *Hold up word wall cards and ask what we did that relates to that word.*
- Review any concepts needed for more understanding.

collect, the more accurate you become.

How does knowing the length of a person’s foot, in inches, help to eliminate suspects?

Students will use the data they collected and the chart from eHow to mark off suspects who do not fit the given information of the real suspect.

(This done as a review of using a ratio and proportion.)

Student-led so the teacher can see what they have learned.

How did finding the ratio of a person’s foot length to height help us eliminate suspects?

Footprints

Foot Length: _____

Height: _____

Student Name	Height	Foot Length

Footprints

Foot Length: _____

Height: _____

Student Name	Height	Foot Length