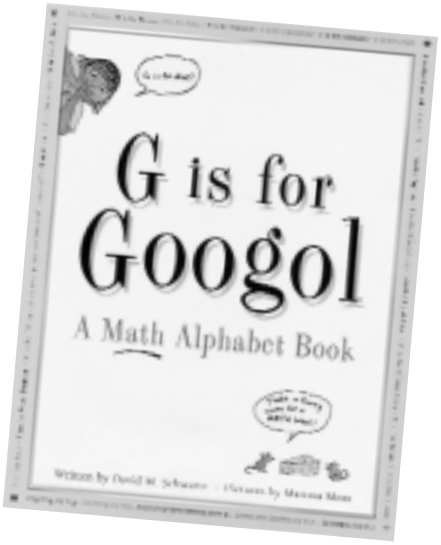
Tricycle Press

G IS FOR GOOGOL
A Guide for Teachers



Based on the book
G is for Googol: A Math Alphabet Book
by David M. Schwartz
Illustrated by Marissa Moss

ABOUT THE BOOK AND THE TEACHERS' GUIDE

Math-phobes and -philes unite! *G is for Googol: A Math Alphabet Book*, the book that dared to make math fun, was *made* for the classroom. *G is for Googol* introduces an alphabet full of math topics with a delightful combination of humor, curiosity, and information. Students will be instantly engaged in the conversational text, the interactive pictures, the puzzling problems, and the desire to learn more.

Use that enthusiasm to jump-start standards-based math activities in your classroom.This guide provides six fun, easy-to-use activities that fulfill selected National Council of Teachers of Mathematics (NCTM) standards for grades 3-5 and 6-8. Students will have a hands-on opportunity to learn about light years, tessellations, probability, music, algebra, and measurement.

SUGGESTIONS FOR TEACHING

Before beginning the in-class activities, share the book with your class, perhaps spending a few minutes daily going over selected sections of the book. Most of the guide's activities can be easily adapted for your class's own level and abilities. Suggestions for more advanced activities are included where appropriate. Helpful Web sites have also been included, but access to the Internet is not crucial and information can alternately be found in your school or community library.

The NCTM guidelines report that "nearly 3/4 of the U.S. fourth graders report liking math. They find it practical and believe that what they are learning is important." Our challenge is to help them maintain that positive outlook, all the while increasing their level of achievement. Let's get phobes and philes alike clammering for a googol more fun ways to learn math.

C is for Cubit–Time for a Change

Cubits, digits, palms, hands, heads, paces…quantifying one's world used to be a pretty personal prerogative. In the exact science and bustle of our modern world let's make measuring time an up-close-and-personal experience once again!

PURPOSE:

Awareness of the value of standard units of measure through the creation, application, and comparison of unique time measuring units.

NCTM STANDARD for Measurement (Grades 3-5):

- Understand the need for measuring with standard units
- Carry out simple unit conversions

(Grades 6-8):

- Understand relationships among units and convert from one unit to another within the same system

TIME:

Time unit activity: 60 minutes
Schedule activity: throughout 1 day

ADVANCE PREPARATION:

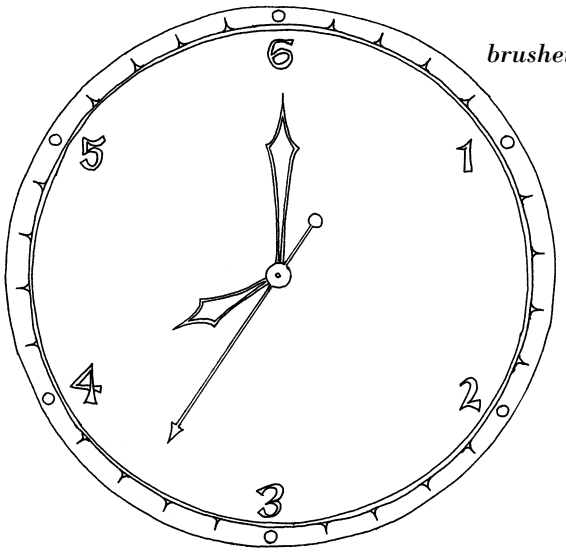
Take a look at the great Web sites about the history and measurement of time listed on the Yahooligans directory:
www.yahooligans.com/School_Bell/Reference/Time/

MATERIALS:

- stopwatches
- timers
- paper plates
- a clockworks assembly
- pencils, crayons, markers

PROCEDURE:

- Ask students to choose a way to measure time that has some personal value or meaning. Brainstorm possibilities, i.e., the time it takes to brush teeth (our example), time it takes to walk to school, time is takes to do a page of math excercises.
- This activity will be easiest if these new time units are equivalent to minutes between 1 and 60. To add difficulty, have students choose a unit shorter than 1 minute or longer than 1 hour.
- Ask students to create a name for their unit of time (i.e., brushets).
- Ask students to time their activity (rounded to the nearest minute) with stopwatches and timers, express their unit in minutes, and calculate the fraction of their unit equal to 1 minute (1 brushet=2 minutes; 1 minute=.5 brushets).
- Ask students to design a clock face on a paper plate with markings for their unit of measurement. How many of their units equal 1 hour? How will they mark their clock? Cut a hole in the center of each plate that fits the clockworks assembly.
- Have students develop a schedule of their school day using their own time units. Choose 5 or 6 student clock faces to use in class the following day. Use a different clock face each hour of the school day and measure time in the various units. Hold a discussion at the end of the day about the effectiveness of the new units of time and the value of standard units.



brushets clock face

EXTENSION ACTIVITIES:

Ask students to invent a tool to measure 1 unit of their time. They might get ideas by researching how time has been measured throughout history. For example, an hourglass might inspire student to measure time by dripping liquid, marbles, beads, etc., from one container to another. Students would refine their choice of containers, size of hole, etc., to make a reliable timing tool.

P is for Probability—A Chance the Meteorologist is Wrong

Whether they are right or wrong, we blame meteorologists whenever the weather isn't to our liking. How well *do* they do their jobs? Make it your students' job to find out.

PURPOSE:

To collect and study predictions about daily temperatures from a variety of sources and use that information to make predictions.

NCTM STANDARD for Data Analysis and Probability (Grades 3-5):

- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
- Develop and evaluate inferences and predictions that are based on data
- Understand and apply basic concepts of probability

TIME :

Introduction: 20 minutes
Daily data collection: 10-15 minutes/day for 1 week
Reports and discussion: 20 minutes

ADVANCE PREPARATION:

Find a variety of sources for predictions and recordings of daily temperatures for your community (see below).

MATERIALS:

- weather Web sites such as weather.com (www.weather.com) or National Weather Service (www.nws.noaa.gov/)
- local newspapers
- TV news/weather show
- local NWS station phone number
- paper and pencils or spreadsheet

PROCEDURE:

- Make available to students at least 2 sources of daily temperature predictions and weather information. Have students work with partners to gather daily data from one source.
- Set up a chart for gathering and organizing the following information:
  1. Prediction from source of temperature high and low
  2. Actual high and low temperature
  3. Calculations of difference between the predicted and actual temperatures
  4. Weather notes: precipitation, wind, weather front movement
- At the end of the week, chart the differences and compare the accuracy of the different sources. Which was most accurate overall? Was any source more accurate with high or low temps? Note and discuss any other patterns in the accuracy of the predictions.
- Review the concepts and vocabulary of probability to help guide your discussion. What is the probability of a given source being accurate for one or both temperature predictions? What is the probability of their predictions being within 1 degree? Within 2 degrees? To calculate as a percentage: # days the source was accurate / # of total days recorded. If the newspaper was accurate for the high temperature within 1 degree on 2 days out of 7: 2 / 7 = .29, or 29% accuracy.
- Ask students to write a report of their findings and share with the class.
- Send the student reports to the newspaper or any of the other original sources.

EXTENSION ACTIVITIES:

- Add a new column to the data chart: Student predictions. Based on the accuracy of the predictions of the different sources, each team makes their own prediction for the following day's high and low temperature. Students justify and explain their predictions in writing. (The idea is for students not to match predictions, but to calculate and merge information from all sources to make original, and justified, predictions of their own.)
- Students calculate the differences between the actual temperatures, source predictions, and their own predictions. Did the accuracy of the source predictions change? How accurate were student predictions? Discuss, refine, and modify statements of probability based on the new data.

T is for Tessellate—Not Just for Bees

Bees are math-smart. Escher makes fine art. What is this all about? Tessellate your heart out!

PURPOSE:

To explore the basic concepts of tessellation in geometry and art.

NCTM STANDARDS for Geometry and Connections (Grades 3-5):

- Investigate, describe, and reason about the results of combining and transforming shapes
- Predict and describe the results of slides, flips, and turns
- Build and draw geometric objects
- Recognize and apply mathematics in contexts outside mathematics

(Grades 6-8):

- Examine the congruence, similarity, and line or rotational symmetry of objects using transformations
- Describe sizes, positions, and orientations of shapes under informal transformations such as flips, turns, slides, and scaling

TIME:

60 minutes

ADVANCE PREPARATION:

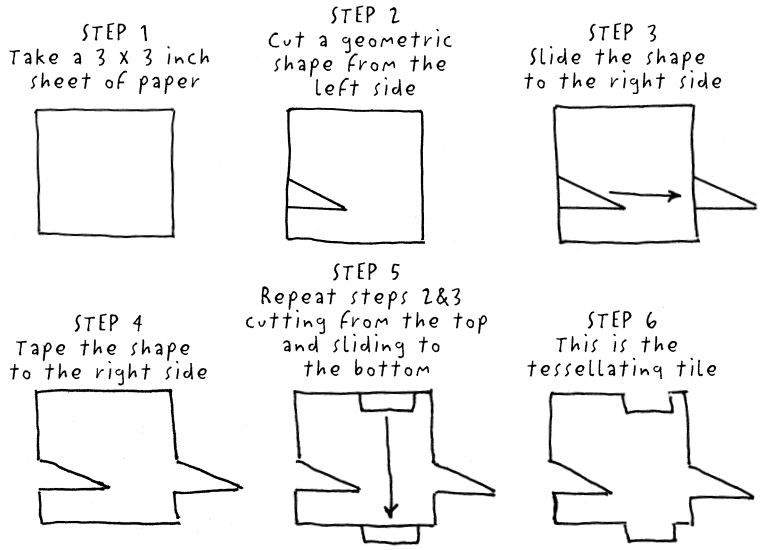
- Learn about tessellations by reading the section "T is for Tessellate" or check out Tessellations (www.tessellations.com), Tessellation Tutorials by Suzanne Alejandre (forum.swarthmore.edu/sum95/suzanne/tess.intro.html), and World of Escher (www.WorldOfEscher.com)
- Become familiar with basic terminology: transformations (slide, flip, turn), tile (the repeated shape)

MATERIALS:

- paper and cardboard
- safety scissors and tape
- coloring supplies (crayons, markers, paints)
- If your school has the resources, you might want to try these computer programs for further practice: Tessellation Exploration (Tom Snyder), TesselMania Deluxe (MECC), Geometer's Sketchpad (Key Curriculum Press).

PROCEDURE:

- Share "T is for Tessellate" with the class. Clarify and write out the definition of tessellation: "When shapes cover a surface with no gaps in between, we say the shapes tessellate."
- Begin by exploring with simple shapes. Ask students to choose a regular polygon and cut or use multiple copies of the shape to cover the surface of a small sheet of paper without gaps. Have them predict the outcome before they begin and write a short description of their results. Discuss how they have transformed the shapes in their attempt to make tesselations.
- Tessellations get more interesting and artistic when you use more complicated shapes, either geometric or derived from real objects. You could also make this activity more challenging by taping the cut shapes to the same (rather than opposite) side of the paper.
- Using a 3 × 3-inch sheet of paper, follow the instructions below:



- Students use the paper tile created above to make a pattern out of heavier cardboard. Students create nine copies of the tile using the cardboard pattern. Check to make sure they all fit together. They can make each tile attractive and distinct with color and artistic flourishes, using paints, crayons, markers, etc.
- Ask students to put the colored tiles together in a tessellating pattern and mount them on heavy paper. They can give their creations a title. Display and enjoy!
- Dicuss: How is this activity related to math? Where have you used this kind of math before? When and how could tessellations be used in the world outside mathematics? Go back through the steps of the activity using the vocabulary of tessellation transformations (slide, flip, turn).

EXTENSION ACTIVITIES:

Learn more about tessellations and how they have been used to make both practical and artistic creations. Look for information on tessellations, M.C. Escher, and Islamic art. Check out books, encyclopedias, Web sites, computer programs, or even your math book!

W is for "When are we ever gonna to use this stuff, anyway?"—Music, Maestro!

Music and math may seem unconnected, but look closer and discover otherwise. Music is a wonderful example of math in action in a medium we enjoy everyday.

PURPOSE:

Explore the connections between music and math and identify some of the mathematical concepts found in different forms of music.

NCTM STANDARD for Connections and Communication (Grades 3-5 and 6-8):

- Recognize and apply mathematics in contexts outside mathematics
- Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
- Organize, consolidate, and communicate mathematical thinking coherently and clearly

TIME :

- Group lesson: 20 minutes
- Team activity and discussion: 40 minutes
- Written work: 30 minutes

ADVANCE PREPARATION:

To gather a variety of sheet music samples, use books, students' own sheet music, and the music resources in your school. Also check the Web sites of Online Math Applications (tqjunior.thinkquest.org/4116/Music/music.htm) and Historical American Sheet Music (odyssey.lib.duke.edu/sheetmusic).

MATERIALS:

- sheet music samples (one sample on an overhead transparency)
- overhead projector
- chalk or dry-erase board
- metronome (to determine tempo beats per minute)
- paper and pencils

PROCEDURE:

- Choose one sheet music sample to use for a class demonstration.
- Ask students to identify as many examples of the use of numbers and math as they can find. List these on the board. Students can use their background knowledge of music and instruments as well as observation. Some possibilities: the number of measures, counting the different kinds of notes, the number of beats per measure (time signature), the value of different notes and rests: whole, half, eighth, sixteenth, the beats per minute of various tempos (from lento to presto), five lines, four spaces on a music staff, whole steps and half steps up and down the staff, 7 notes in a scale (A to G).
- Create a chart with each of their findings as the heading for one column on the chart. Discuss and include only the headings they are able to measure in a piece of music. On each row of the chart, list each piece of sheet music students explore. Use the class sample for entries on the first row.
- Have students work in pairs to select and examine other sheet music samples. Ask them to determine the value for each of the identified headings.
- Enter all information on a class chart. Discuss findings, looking for similarities, differences, and patterns. Which pieces of music had similar features? Are there similar patterns of notes, tempo, rhythm evident in similar pieces of music (popular, classical, etc.)?
- Have students write a short paper about their discoveries regarding the connection between math and music.

EXTENSION ACTIVITIES:

Find out more about how some of these musical measurements actually determine the type of music. Invite the music teacher or a guest speaker to go into more detail. Or invite a musician to your classroom to play and demonstrate how math is part of music making.

X is for *x*—ALGEBRA: The Math of the Unknown

If "X is for *x*," what does David equal? We all celebrate our uniqueness and know our names are special to us. Find out how much your name is worth, and how you can increase its value.

PURPOSE:

Students predict, explore, and practice the variables, equations, and patterns that change the value of their own names when the letters are matched with different numbers.

NCTM STANDARDS for Algebra (Grades 3-5):

- Describe, extend, and make generalizations about numeric patterns
- Represent the idea of a variable as an unknown quantity using a letter
- Analyze change in various contexts

(Grades 6-8):

- Develop an initial conceptual understanding of the different uses of variables
- Relate and compare different forms of repre sentation for a relationship

TIME :

Basic lesson: 30 minutes (allow more time for additional patterns and practice)

ADVANCE PREPARATION:

Make alphabet cards—one letter on each card—with magnet or sticky tack on the back

MATERIALS:

- lined paper with a line down the middle (for predictions) and pencils
- alphabet cards (see above)
- chalk or dry-erase board
- scratch pads

PROCEDURE:

- At each stage of this lesson, students write their predictions on the left side of the lined paper. Use the right side to record the outcome.
- Give each letter of the alphabet a numerical value beginning with the number 1. Write the value of each letter next to the corresponding alphabet card on the chalkboard.
- Students find the number that matches each letter of their first name and write equations for each letter on a scratch pad.
  D=4, A=1, V=22, I=9, D=4 for David
  M=13, A=1, R=18, I=9, S=19, S=19, A=1 for Marissa
- Students record predictions, then add the numbers corresponding to their names to find the total value.
  D+A+V+I+D=x
  Write the total on the scratch pad.
  4+1+22+9+4=40 (for David)
  13+1+18+9+19+19+1=80 (for Marissa)
- Discuss who had the highest and lowest totals? Why? What are the patterns of letters that account for the high and low totals?
- Match numbers to the letters of the alphabet in a different pattern, reversing the order of the numbers as matched to the letters. Change their value on the board. A=26, B=25, C=24, etc. Ask students to predict then recalculate the total value of their name. Discuss the changes. Are their names worth more or less? Why?
  D=23, A=26, V=5, I=18, D=23 (for David)
  23+26+5+18+23=95

  M=14, A=26, R=9, I=18, S=8, S=8, A=26 (for Marissa)
  14+26+9+18+8+8+26=109
- Have students work with a partner to find the name of a famous person whose name has the highest value, using one or both of the methods listed.

EXTENSION ACTIVITY:

Discuss how the activities above involved some kind of pattern in the matching of numbers to letters. If there is no pattern (random matching), then the numbers assigned to letters can be used as a code that is difficult to solve. Have students research codes and their uses. Groups of students can invent their own codes, to be exchanged and solved by their classmates.

L is for Light-Year—The Long View of Space

Stars—so close on a dark moonless night and yet sooo far! As new technology gives us an ever better view of our universe, new stars are still being discovered. Your turn!

PURPOSE:

To invent a new star and create a detailed star map to locate and define stars within an existing constellation.

NCTM STANDARDS for Measurement, Geometry & Representation (Grades 3-5):

- Select and apply the appropriate unit for measuring the attributes of length (distance)
- Draw a 2-dimensional representation of a 3-dimensional object
- Create and use representations to organize, record, and communicate mathematical ideas

(Grades 6-8):

- Recognize and apply geometric ideas and relationships in areas outside the mathematics classroom, such as art, science, and everyday life
- Use geometric models to represent and explain numerical relationships

TIME:

Research: 60 minutes
New star lesson: 60 minutes
Presentations: across 1 week

ADVANCE PREPARATION:

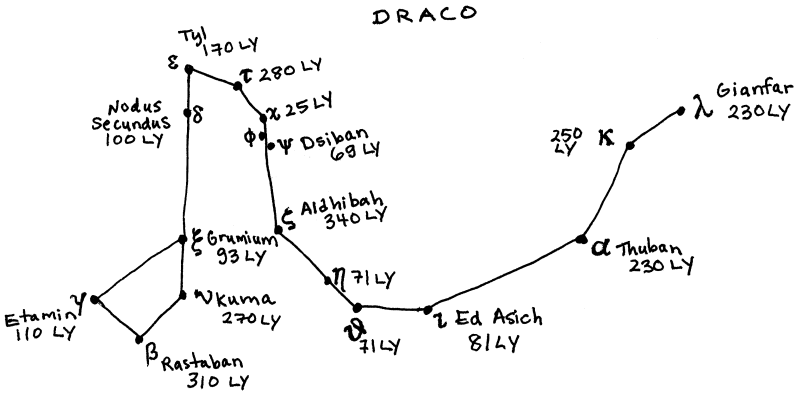
- Review the meaning and value of the light-year unit:186,282 miles/second = speed of light; 5,878,512,843,200 (approx. 6 trillion) miles in a light-year
- Research how stars and constellations were first named, discovered, and measured

MATERIALS:

- Books about mythology and the legends of stars and constellations.
- Web sites such as The Constellations and their Stars (www.astro.wisc.edu/~dolan/constellations/ constellations.html) or the NASA "Imagine the Universe" site (imagine.gsfc.nasa.gov/docs/homepage.html). To find light-year distances try (www.dibon-smith.com/constel.htm), click on the desired constellation, then, for a detailed star chart, click keyword "stars" or "Bayer stars." Another good Web site is The Dome of the Sky (einstein.stcloudstate.edu/Dome).
- Posterboard, markers, crayons, scissors, colored pencils, and glue for star map.

PROCEDURE:

- Ask students to research a constellation of their choice, discovering the origin of the constellation's name and the myths surrounding it. Have them create a star map labeling the major stars in this constellation.



- Ask students to invent a new star for their constellation, placing it in a position that improves the definitive shape of the constellation. (Sometimes constellations don't look much like the character they are supposed to represent.)
- Ask students to name their star and invent a story of how it got its name and how it was discovered.
- Have students create a chart for their constellation, listing each of the major stars. See diagram on the next page for what to include. The travel time column can be included for extra credit. Students include their new star on the chart, estimating the distance of their new star from earth in light-years by averaging the distances of the other stars in the same constellation.
- Ask students to calculate the travel time to their star. Begin by using the speed of 1 mile/sec (10 times faster than a jet airplane). The formula: Travel time in years= # of light years × 186,282 miles

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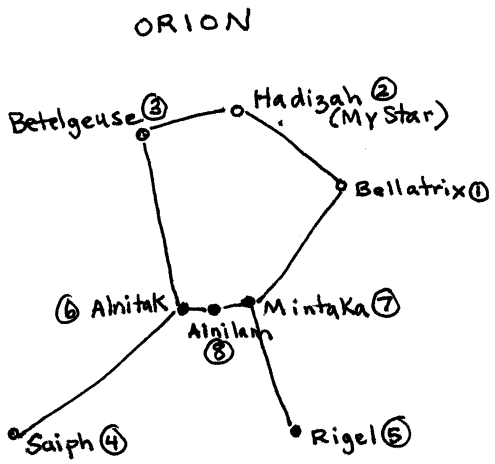
L is for Light-Year—The Long View of Space *(continued)*



- For more of a challenge, ask students to determine the formula for other speeds. Students can compare the distances of each of the stars in their constellation determinig their order from the earth, from closest to farthest away. Use numbers to indicate relative distance.
- Ask students to create a new star map, using some method to illustrate the relative distance of each star. Think about varying the color, shape, size, or labeling. Or use a key if necessary. Students present their findings to the class pretending to be official presenters at the American Astronomical Society.

EXTENSION ACTIVITIES:

Older students can go into more detail in their charts with descriptions of the constellation and the star itself: what kind of star, its origin and life cycle, detailed measurements of distance, temperature, and a more sophisticated model.

STAR CHART FOR THE CONSTELLATION ORION

Name	Distance (in light years)	Travel Time (years)	Order (closest to farthest from earth)	Color	Type	Relative Size (times that of our Sun)
Alnilam	1340	249,617,880	8	blue	super giant	30
Alnitak	820	152,751,240	6	blue	double star	15
Bellatrix	243	45,266,526	1	blue	normal giant	5.7
Betelgeuse	427	79,542,414	3	red	super giant	650
Mintaka	920	171,379,440	7	blue	binary	
Rigel	770	143,437,140	5	blue	super giant	60
Saiph	720	134,123,040	4	blue	super giant	11
HADIZAH	350	65,198,700	2	yellow	bright giant	10

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We hope you enjoyed this guide. If you would like to purchase additional copies of either the teachers' guide or *G is for Googol: A Math Alphabet Book*, please write us at: Order Department, P.O. Box 7123, Berkeley, CA 94707
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