

# Living Math!

"One can invent mathematics without knowing much of its history.  
One can use mathematics without knowing much, if any of its history.  
But one cannot have a mature appreciation of mathematics without a  
substantial knowledge of its history." Abe Schenitzer, *Five Fingers to Infinity*.

## LIVING MATH THROUGH HISTORY LESSON PLANS

### Cycle 1, Unit 1 (C1U1)

#### Primary Level SAMPLE LESSON PLAN

#### Early Cultures Through the Classical Age

Lesson 2: Ancient Roots of Mathematics in Africa and Mesopotamia

Lesson 3: Ancient Roots of Mathematics in Asia

Lesson 4: Ancient Roots of Mathematics in the Americas

Lesson 5: Thales and the Egyptians

Lesson 6: Pythagoras and the Early Greeks

Lesson 7: Archimedes' Geometry

Lesson 8: Eratosthenes, and Archimedes' Large Numbers

Review Activities

# Living Math Through History

## C1U1 Primary Level Lesson Plans

### Early Cultures Through the Classical Age

If you are not familiar with the format of the Living Math lesson plans, please refer to the Parent Introduction Letter for detailed notes on how to use these plans and resources.

#### Icon key



To be used or done with two or more people



Writing or drawing activity



Book resource in print and/or online



Quote to think about or discuss



Highly visual resource, pictures



Discussion questions



Printable handout



Internet website




Hands on activity



Calculator recommended



Primary,  Intermediate or



Video resource



Advanced level

## Living Math Through History

### Thales, The Egyptians and Measurement - SAMPLE LESSON

#### Primary Level Lesson 5

**Synopsis** - **Thales of Miletus** lived his life during an age in which few written works survived the ravages of time. We know much about him, however, because he was written of in multiple ancient accounts, and he was referred to as one of the "Seven Wise Men" or "Sages" of ancient times.

Thales is the first ancient known to use the process of observing patterns and deducing logical conclusions that could be applied to other problems. Reading about his life, we find several problems he tackled that are world famous: predicting crop production from weather cycles, measuring the height of the Great Pyramid (so great it covered 12 acres), and solving the entertaining "donkey and the salt mine" problem.

Thales made great contributions to mathematics and astronomy. He proved that if an angle is drawn in (inscribed) in a half circle, it will always be a right triangle. It's one thing to be able to observe something that appears to be true, but quite another matter to logically **prove** it will work every time.

It is not believed that Thales left any writings of his own, although there are a few works scholars debate may have been written by him. Most of what we know about Thales is from ancient writers such as Herodotus, Diogenes and Sosicrates. Because of the second and third hand nature of the sources, much of what we know about Thales is considered "anecdotal," based on stories handed down, of which we are not sure all the details are true. That Thales lived, however, and produced many highly original ideas in mathematics, science and even business is widely accepted to be true.

For more, visit: <http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Thales.html>



#### **Joy of Mathematics** (*vignettes to inspire exploration*):

p. 36 Thales and the Great Pyramid    p. 93, Cannon Balls and Pyramids  
p. 119 The Penny Puzzle                      p. 214 Triangular, Square, Pentagonal Numbers



#### **Math Talk Poetry in Two Voices:** "Triangles" pp. 41-42



**Mathematicians Are People, Too Vol. 1** pp. 1-8 Pyramids, Olives and Donkeys. Fun story about Thales, and his famed deductive reasoning and problem solving skills.



**Pythagoras and the Ratios** by Julie Ellis - Picture book version of a young Pythagoras' adventures, format for re-enacting math discoveries.

# Living Math Through History


## Thales, The Egyptians and Measurement - SAMPLE LESSON

### Primary Level Lesson 5

 *Math History Readers*, one or more as desired:


**The History of Counting** to end, especially good follow up to the past lessons

**The Secret Life of Math**  by Ann McCallum pp. 84-85 the Rhind Papyrus

**Why Pi?**  by Johnny Ball: pp. 18-21. The Right Angles and Measuring Land; pp. 36-37 *Why Measure Any Body?*

**Mathematics: The World of Science** by Irene Fekete: pp. 24 - 27 - excellent

**The Wonderful World of Mathematics**, pp 15 - 25, advanced text

 **MathFocus: Mr. Base Ten Invents Mathematics** by Bethany H. Tucker. Very simple story-based math. Chapter 2: Mr. Base Ten Invents Addition. If teaching subtraction with this lesson, refer to the **Addition Teaching Resources**

 **MathFocus Readers**

**Mummy Math, An Adventure in Geometry** by Cindy Neuschwander

**The Greedy Triangle** by Marilyn Burns, see activity in math section

**Think of a Number** by Johnny Ball: pp. 52-53 *Shapes with Three Sides*; pp. 82-83, *Logic*

**aMaze Adventures: The Secrets of the Pyramids** by National Geographic - great maze book based on Egyptian theme.

  **Pyramid and Unbuilding** by David Macaulay and/or **Kingfisher World of Pyramids** (all have great visuals)

  **Science in the Past - Ancient Egypt** Chaps. 3 / 4 coincide well with reading

 Optional Historical Context:

**SOTW Vol. 1** - Chap 18 *Life in Early Crete*; Chap 19 *The Early Greeks*; Chap 20, *Greece Gets Civilized Again*; Chap 21 *The Medes and the Persians*

**The 5,000 Year Old Puzzle**, *Solving a Mystery of Ancient Egypt* by Claudia Logan

**Seeker of Knowledge, The Man Who Deciphered Egyptian Hieroglyphs**, by James Rumford, very nice picture book for older children in this level


**The Egyptian News** by Scott Steedman (fun tabloid-style "newspaper" book)

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#### Addition Math Teaching Resources

 **MathFocus** Addition: Any that you have access to for learning addition concepts.

For the youngest in this age group:

**One More Bunny**, Adding from One to Ten by Rick Walton - Excellent reader, this book shows the different ways you combine addition facts in a simple way

**The Mission of Addition** by Brian Cleary

MathStart by Stuart Murphy: **Animals on Board** (Adding L.2)

**How Many Feet? How Many Tails?** Math Riddles by Marilyn Burns

**Five Silly Fisherman** by Robert Edwards

**12 Ways to Get 11** by Eve Merriam

Greg Tang's **Math Fables**

**Domino Addition** by Lynette Long

More complex addition presentation:

**Mission Addition** by Loreen Leedy


**Each Orange Had 8 Slices** by Paul Giganti (adding / skip counting book)

**Sea Sums** by Joy N. Hulme

**The Hershey's Kisses Addition Book** by Jerry Pallotta

Greg Tang's **Math For All Seasons, Math-Terpieces**,


(Any addition book can be used for subtraction by following the opposite operation.)

 **Dr. Wright's Kitchen Table Math Book 1** by Chris Wright, PhD, Art of Problem Solving. Chapter 2 covers easy addition and subtraction, Chapter 3 covers more advanced addition concepts.

 Nice five-minute video on **measurement history**:

[http://www.youtube.com/watch?v=DQPQ\\_q59xyw&feature=related](http://www.youtube.com/watch?v=DQPQ_q59xyw&feature=related)

*Suggested for parents self-educating:*

 **History of Science: Antiquity to 1700** (Teaching Company Series) Lecture 3, the Pre-Socratics - Adult level parent resource

# Living Math Through History

## Thales, The Egyptians and Measurement - SAMPLE LESSON

### Primary Level Lesson 5

#### **Mathematical Ideas associated with Thales:**

Measurement

Geometry of triangles

Problem Solving

Area, perimeter

Egyptian multiplication

Mathematical Reasoning

#### **Vocabulary related to this lesson:**

Triangle

Angle


Pyramid

Mathematician

Eclipse


In a previous lesson we learned about mathematical symbols. "Hieroglyphic" is special kind of symbol often associated with ancient Egyptian writing.

#### **Quotes to think about and discuss:**

 "Know Thyself." Thales is given credit for this, and for being one of the Seven Sages. What is a "Sage"?


Do you think you are on the road to "knowing yourself"?


#### **Discussion or journaling questions**

 **Thales** was considered a **philosopher**, **mathematician** and a **scientist**. Today we think of people who become masters at philosophy, mathematics or science to be very different people. How do you think one person could be all of these?

Thales' story is an example of mathematical ideas being exchanged through one person's travels. He probably learned geometry from the Egyptians and astronomical science from the Babylonians, and took this knowledge back to his native Asia Minor.

Why were the Egyptians such good geometers (literally, "earth measurers")?

 **Geography and Timeline:** When reading about Thales, follow his path through his birthplace of Miletus (a Greek colony in what is now Turkey / Asia Minor) through Babylonia and Egypt, and correspond these with our modern day countries.


 **What Was Happening When . . .** What major event do ancient writings say that Thales predicted in 585 B.C.?

# Living Math Through History


## Thales, The Egyptians and Measurement - SAMPLE LESSON

### Primary Level Lesson 5



#### Mathematical Activities

 Try modeling and playing with the *Joy of Mathematics* puzzles. Any ways you can model these to play out answers will be beneficial.

In the case of the **Penny Puzzle** from the *Joy of Math*, we played with strategies for solving puzzles. The key is to move the peak of the triangle from the top to the bottom. Then, you look at the configuration - can you see the upside down triangle? Those that could were able to see right away they needed to move the 2 pennies on the outside of the original base to the new upside down base. Some kids could not see the triangle upside down, and I had to nudge them by sliding the 2 pennies out a tad so they could see it.

 Focus on counting by threes .What comes in threes? Look around your home, garden and neighborhood. Triangles are obvious, if they have a tricycle they can see it . . . Notice the repetition of the prefix "tri" which means three. What else then begins with "tri"? Some may be old enough to understand a "trilogy" is a three book series, "trinity" means three in one, etc.

Experiment with arrays of threes with beans, pennies or other items. How do we have a tendency to arrange them? (likely in equilateral triangles). If you array them in rows of 2 and 1 , then 1 and 2, you can show the odd and even pattern of skip counting - each 3 is odd (has an unpaired partner), but combining two threes, the matchless odds join up to make it all even. I've made up fun stories as I've shown this to kids. It is a concrete demonstration of a property of all odd numbers, and it shows why every time you add two odds together, you'll always get an even number.


  **The Secret Life of Math**, by Ann McCallum - "Problem-Solving Made Oh-So\_Easy (Finally!) p. 106; pp. 86-87 has instructions on how to make an Eye of Horus Amulet; pp. 107 "Do Some Math in the Egyptian Style!" is for older kids in this level.

  **Science in the Past - Ancient Egypt** introduces Egyptian numerals. Compare these to the numeral systems studied in the previous lessons. It can be a lot of fun writing some of the larger numbers; the "surprised man" for 1 million is a hoot. **Think of a Number** by Johnny Ball also has very nice pictures of many types of ancient writing, including Egyptian hieroglyphs.


## Living Math Through History


### Thales, The Egyptians and Measurement - SAMPLE LESSON

#### Primary Level Lesson 5


 Read Marilyn Burns' **The Greedy Triangle** out loud. This is a great book for this age group. It's about a triangle that is dissatisfied with the number of sides it has. It goes about progressively increasing its number of sides to try and be happy. By about the third time the shape visits the shapeshifter, kids often have the pattern of "one more side and one more angle" down. The fun part of the story comes when the triangle realizes his original shape is the best.

You can include a discussion of types of triangles. An equilateral triangle is made from three equal sides - this can be modeled.

 Where do our word roots come from? Tri, quad, lateral - equilateral means equal sides, etc. These ideas lead into Archimedes; the increasing polygon approaches the shape of a circle, which is the method Archimedes used to approximate pi. **Rummy Roots** is a game that can be played by upper Primary kids for a number of word roots we find in our math vocabulary.

 Very young children can notice the prevalence of **triangles** in structures all around us. If you observe the world around you, you will notice that triangles are everywhere. This is particularly true of structures - buildings, bridges, towers - all are supported by triangles. Since Thales and the Egyptian pyramids were a focal point of the reading, seeing the structure in David Macaulay's books, **Pyramid** and **Unbuilding** is suggested. These books show the insides of structures, and you can see that triangles are built into all structures, even seemingly square or rectangular structures.

Find or create several forms of squares, cubes, triangles and pyramids. These can be constructed from Zome Tools (<http://www.zometool.com/>), K'nex or other building sets. Test the forms to show the strength of the triangle structure compared to the square. This is an excellent way to demonstrate why triangles are engineering marvels.

 A **Straw Tower project** is a fantastic activity, particularly if you do a complete activity including designing and testing the model. We have done this several times with a group and had competitions with kids as young as five or six years of age. Supplies are very inexpensive, all that is required is straws, paperclips and tape. Here is one version of this project, it is best done in a group where different designs can be tested, so that you can see which designs hold the most weight. I suggest if you like this project that you save a copy of the plans.

<http://www.ces.ncsu.edu/depts/fourh/old/greenlight/afterschool/StrawTowers.pdf>



## Living Math Through History

### Thales, The Egyptians and Measurement - SAMPLE LESSON

#### Primary Level Lesson 5



**Measuring Egyptian Cubits:** In ancient times, people measured things with the measuring sticks they took with them everywhere - their hands, arms, fingers, and feet of course!

A **cubit** is the length of a forearm, from the elbow to the fingertips.

A **palm** is the width of your four fingers excluding the thumb.

A **finger** is the width of, well, a finger.

In Egypt, a royal cubit was equal to the length of seven of Pharaoh's palms.

Try measuring your own personal cubit, and your own palm this way. If you measure it with a piece of string and cut the string the length of your cubit and palm, you can then compare the length of the palm to the cubit. How many times can you stretch the palm along the cubit, is it close to seven times?

If you can do this with one or more persons, compare your measurements. Are they the same? If the cubits are different, what about the **ratio** (number of times you can stretch the palm along the cubit length) of the palm to cubit - is that the same?



**Hands-on Math and Literature with MathStart** by Don Balka has many additional hands-on activities for MathStart readers listed in the math reading section.



More activities and information may be found on the Thales page at Living Math <http://www.livingmath.net/> Math Sites: C1U1 Ancients and Cultures.



#### Living Math Handouts

Great Pyramid Math instructions and templates - focus on building the pyramid for Primary, and only do the math portion if they have the interest and ability.

Shadow Math - includes instructions to bring the math down to **P**+



**Additional enrichment reading** if you have time and interest

**Twelve Snails to One Lizard: A Tale of Mischief and Measurement**  
**How Tall, How Short, How Faraway** by David Adler