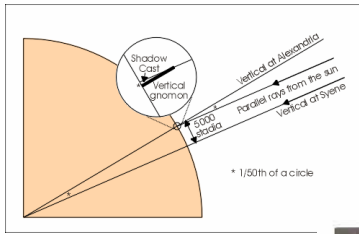
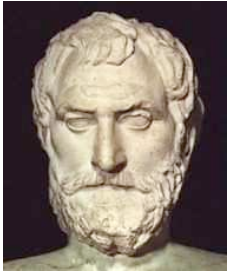
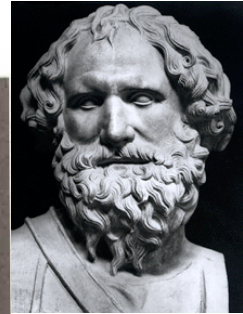


Who is Eratosthenes?



... Archimedes

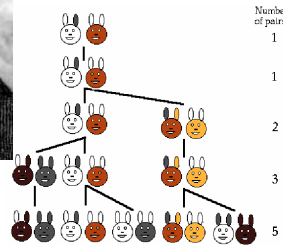


... Napier

... Pascal



... Fibonacci



... and Lovelace



AMS Conference Presentation

March 2, 2007

by

Peter and Rosann Larrow

Co-Directors of

Montessori Opportunities Inc.

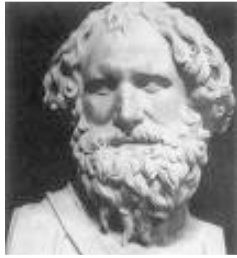
3281 Plymouth Lane

Cuyahoga Falls, Ohio 44221-3542

Phone/ Fax: 330-929-5581

E-mail: rlarrow@gmail.com

www.montessori-opportunities.com



Archimedes of Syracuse

Man of incredible mathematical talent with great concentration

*Archimedes of Syracuse
To get into the news
Called out "Eureka"
And became the first streaker*

Dec. 1974 Australian Mathematical Society Gazette

Born: 287 B.C.

Birth: Greek city of Syracuse on the island of Sicily

Son of: An Astronomer who was a good friend of King Hieron of Syracuse

Education: University of Alexandria, Egypt

Associates: Conon, Dositheus, Eratosthenes (successors of Euclid)

Died: 212 B.C. during the Pillage of Syracuse

Stories:

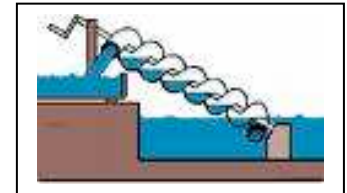
King Hieron gave his goldsmith gold for a crown, after receiving the crown the king was concerned that the goldsmith had substituted some silver in the crown. Not wanting to break the crown the King asked Archimedes to find out. One day while bathing at the public baths, Archimedes figured out how to solve the problem - the First law of Hydrostatics - A body immersed in a fluid is buoyed up by a force equal to the weight of the displaced fluid - "Eureka" he yelled as he ran naked through the streets.

It was Archimedes cunning contrivances that assisted in the defense of Syracuse during the 2 year siege by Rome under General Marcellus

- ◆ Catapults with adjustable ranges
- ◆ Projecting poles on bases that wheeled quickly to any part of the city wall and dropped heavy weights on ships
- ◆ Huge movable grappling cranes that would lift any ship and shake it to pieces
- ◆ Huge burning glasses to set the sail of enemy ship afire (probably a myth, but a great story)
- ◆ Archimedes Screw a device to lift water from the bilge of a ship (still use today in some countries to lift water from irrigation canals to water fields)

Accomplishments:

Area of curvilinear plane figures
Area and volume of curved figures
Began integral Calculus
Measurement of π



Archimedes made many of his geometric discoveries from figures drawn in the ashes of his fireplace or in the coating of the after bathing oil that he smeared on his body. Roman historians say he met his end while preoccupied with a geometric diagram drawn on a sand tray. During a careless relaxation of the watch for the enemy, Marcellus and his troops broke into the besieged city and according to the story, when the shadow of a pillaging Roman soldier fell across his diagram, Archimedes waved the intruder back with a command not to disturb his figure, where upon the incensed looter ran a spear through the old man.

Archimedes was so fond of his treatise "On the Sphere and Cylinder" that he wanted it engraved on his tombstone. Marcellus built up such admiration and respect for his long successful adversary, that when he learned of Archimedes death, he had Archimedes buried with great pomp and ceremony and the sphere inscribed in a cylinder put on the tombstone.

The tombstone with the "sphere inscribed in a cylinder" was later unearthed by Cicero, a Roman quaestor and again later in 1965 while excavating for a foundation of a hotel.

Peter and Rosann Larrow, Montessori Opportunities Inc.



Eratosthenes of Cyrene

The Librarian who measured the earth!

Born: 276 B.C.

Birth: Cyrene (now Shahhat, Libya) Greek city on the coast of Africa

Son of: Greek parents

Education: in Alexandria and Athens

Associates: King Ptolemy III

Died: 197 B.C. in Alexandria, Egypt (said to have become blind and committed suicide by starvation)

Stories:

Liked math but Geography was his favorite subject.

Eratosthenes made a surprising accurate measurement of the circumference of the earth. He knew that on the first day of summer - June 21 - the sun cast no shadow in a well in Syene. Picturing the earth as a grapefruit, he reasoned that if he could figure out the distance of one sector, arc, and calculate how many equal sectors, he would know the circumference of the earth and thus complete his geography book. Knowing that all circles contain 360° , Eratosthenes concluded that if he could find the angle of the sun's rays at a distance from the well, he could calculate the number of sectors. He measured the angle at 7.2° . Then he divided 360° by 7.2° , which equals 50. He now knew that it would take 50 Alexandria-to-Syene sectors to make up the circumference of the earth. Using surveyors trained to walk with equal steps. He measured the Alexandria-to-Syene sector to be 5,040 stades. The stade that Eratosthenes used was 515 feet, or just under one-tenth of a mile. Multiplying 5,040 stades by 50 equals 252,000 stades or 24,662 miles. Today's modern calculation measure the circumference of the earth to be 24,662 miles. Eratosthenes measurement was off by less than 200 miles. Quite a feat!

Eratosthenes tutored King Ptolemy III's son and became librarian at the large library in Alexandria where he classified and tagged the scrolls

Accomplishments:

Director of the Library in Alexandria

Geometry

Prime numbers - Sieve of Eratosthenes

Measurement of the circumference of the Earth - 24,662 miles

Distance to the sun - 804,000,000 stades

Distance to the moon - 780,000 stades

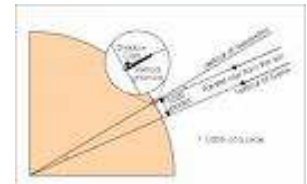
measured the tilt of the earth's axis - $23^\circ 51' 15''$

Calculated the diameter to be 7,850 miles

- today's correct polar diameter is about 7,900 miles.

Wrote first complete geography book

Talented astronomer, athlete, historian and poet



X	2	3	X	5	X	7	X	X	X
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71	72	73	74	75	76	77	78	79	80
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Multiples of _____

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Multiples Patterns

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71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Sieve of Eratosthenes

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11	12	13	14	15	16	17	18	19	20
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91	92	93	94	95	96	97	98	99	100



John Napier

Scottish Nobleman



Name: John Napier

Born: 1550-1617

Place of Birth: Merchiston Castle at Edinburgh, Scotland

Father: 16 years old Sir Archibald Napier - aristocracy / gentry - Master of the Mint

Mother: Janet Bothwell

Wife: 1571 Elizabeth Sterling - 2 children – died, and in 1579 Agnes Chisholm - 10 children

Education: St. Andrews University one year - about age 13, then studied in Europe

Contemporaries: Henry Briggs (1561 - 1631)

Occupation: Public office - price controller of boots and shoes in Edinburgh

Accomplishments: Logarithms (1614), rule of circular parts, trigonometric formulas - Napier's analogies, Napier's rods or Napier's bones for mechanically multiplying, dividing and extracting square roots of numbers, suggested the decimal system, based on the number 10, would show any number, either greater or less than 1, by using a decimal point to separate the whole number from the fractional part

Stories:

- Amused himself with the study of mathematics and science to relax from political and religious arguments
- Ardent Presbyterian who tried to demonstrate that the Catholic Church was the Beast. Wrote "A Plaine Discovery of the Revelation of Saint John - the Pope was an anti-Christ and the world would end between 1688 and 1700. With 21 editions, ten published during his life, Napier thought he would be remembered for this
- Science-fiction author - infernal war engines with plans and diagrams
 - ★ Artillery that could "clear a field of four miles circumference of all living creatures exceeding a foot of high - machine gun (WWI)
 - ★ "Devices for sailing under water" - submarine (WWI)
 - ★ a chariot with "a living mouth of mettle that would scatter destruction on all sides" - army tank (WWI)
 - ★ Burning mirrors to set enemy ships afire
- Logarithms are a restatement of the laws of exponents, but they were discovered before exponents were in use. Logarithms it is said "by shortening the labors, doubled the life of the astronomer".
- As a land owner, John worked to improve crops and cattle. He used fertilizer made of manure and salts. He also improved the hydraulic screw to control the water in coal pits.
- John Napier's property abutted lands of the king. Napier was making heroic efforts at cultivation his lands, but his seeding efforts were constantly thwarted by huge flocks of doves which were kept on the adjacent royal property. John repeatedly advised his neighbor to keep the doves at home or he would catch them. Finally John soaked pieces of bread overnight in good whisky. About half of the quantity he scattered around a newly seeded area and the other half was used as bait in a series of small paper cones which Napier had lined with "bird lime." Of course, the inebriated, birdbrained doves managed to stick their beaks into the wrong places and Napier collected several score and held them at ransom until he was paid the full value of all the seed he had lost.
- Napier believed one of his servants was taking his things. To expose the culprit said that his Black Rooster would identify the transgressor. He ordered his servants into a dark room and asked them to pat the roosters back. He had soaked the back of the rooster with lamp black. On leaving the servants must show their hands. The guilty servant was afraid of touching the rooster and therefore had clean hands.

Napier's Bones

Fill in missing multiplication facts, then cut the columns apart on the lines.

	1	2	3	4	5	6	7	8	9	0
1	0 1	0 2	0 3	0 4	0 5	0 6			0 9	0 0
2	0 2	0 4	0 6	0 8	1 0	1 2			1 8	0 0
3	0 3	0 6	0 9	1 2	1 5	1 8			2 7	0 0
4	0 4	0 8	1 2	1 6	2 0	2 4			3 6	0 0
5	0 5	1 0	1 5	2 0	2 5	3 0			4 5	0 0
6	0 6	1 2	1 8	2 4	3 0	3 6			5 4	0 0
7	0 7	1 4	2 1	2 8	3 5	4 2			6 3	0 0
8	0 8	1 6	2 4	3 2	4 0	4 8			7 2	0 0
9	0 9	1 8	2 7	3 6	4 5	5 4			8 1	0 0

Napier's Bones

Cut the columns apart on the lines.

	1	2	3	4	5	6	7	8	9	0
1	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	0 0
2	0 2	0 4	0 6	0 8	1 0	1 2	1 4	1 6	1 8	0 0
3	0 3	0 6	0 9	1 2	1 5	1 8	2 1	2 4	2 7	0 0
4	0 4	0 8	1 2	1 6	2 0	2 4	2 8	3 2	3 6	0 0
5	0 5	1 0	1 5	2 0	2 5	3 0	3 5	4 0	4 5	0 0
6	0 6	1 2	1 8	2 4	3 0	3 6	4 2	4 8	5 4	0 0
7	0 7	1 4	2 1	2 8	3 5	4 2	4 9	5 6	6 3	0 0
8	0 8	1 6	2 4	3 2	4 0	4 8	5 6	6 4	7 2	0 0
9	0 9	1 8	2 7	3 6	4 5	5 4	6 3	7 2	8 1	0 0

Napier's Bones

Fill in the multiplication facts, then cut the columns apart on the lines.

	1	2	3	4	5	6	7	8	9	0
1										
2										
3										
4										
5										
6										
7										
8										
9										



Blaise Pascal

A creative mathematician, inventor, gifted writer and religious philosopher, and physicist!

Born: 1623

Birth: Clermont, France, but lived in Paris, France

Son of: Etienne Pascal, a recognized mathematician himself, third child, only son
His mother died when he was 3

Education: at home by his father - did not teach him mathematics until one day when Pascal was 12 his father found him in the playroom drawing lines and circles. Young Pascal was trying to prove that the sums of the angles of a triangle is two right angles (Euclid's Proposition 32). His Father quickly gave him a copy of Euclid's Elements to study.

Associates: Pierre de Fermat, Rene Descartes, Thomas Hobbes, Carcavi, Wren, Laloubere, Leibniz, Huygens, Wallis, Sluze, Ricci, Roberval

Died: 1662 at age 39

Stories:

One night, at a dinner party, someone clinked silverware against a plate. Blaise was so fascinated by the sound that it made, that he went all over the house tapping different items with his fork. He then retired to his room, only to emerge a while later having written an essay on vibration and sound.

1642 - Invented a calculating machine (called the Pascaline) to help his father in his tax work - the size of a shoe box, using gears and shafts to turn numbers so they could be added and multiplied. Its high price made it more of curiosity than a useful tool.

In 1646 Blaise attended weekly discussion groups with scientists and mathematicians. At 16, Pascal wrote his first major work Essay four les coniques. A one page paper containing general theorems, his mystic hexagon theorem, and his work on conic section which he read at the Mersenne's meetings. His sister said that it was "considered so great an intellectual achievement that people said that they had seen nothing as mighty since the time of Archimedes."

Blaise began a series of experiments on atmospheric pressure. By 1647 he had proved to his satisfaction that a vacuum existed. Descartes visited Pascal on September 23. In the two day visit the two argued about the vacuum which Descartes did not believe in. After his visit Descartes wrote a letter to Huygens saying that Pascal ". . . had too much vacuum in his head." By 1648 Pascal had observed that pressure of the atmosphere decreases with the height and deduced that a vacuum existed above the atmosphere. Descartes wrote to Carcavi in June 1647 about Pascal's experiments saying - "It was I who two years ago advised him to do it, for although I have not performed it myself, I did not doubt of its success. . ."

In 1654 a friend of Pascal asked him about certain problems in gambling. Pascal communicated with Pierre de Fermat on the rules governing games of chance. Out of this exchange came the arithmetical triangle (Pascal's Triangle) and ways of calculating probability which Pascal called "the mathematics of chance." Pascal did not originate the triangle, for this triangular array of numbers was known by the Arabian poet and mathematician Omar Khayyam (c.1044 - 1123) as well as by Chinese mathematicians some 250 years before Pascal. His name is associated with the triangle because he was the first to make a systematic study of its relationships.

Accomplishments:

Theory of Probability

Second person to invent a calculator - Schickard manufactured one in 1624

Conic sections

Number Theory

Leonardo Pisano - Fibonacci

The Greatest European mathematician of the middle ages



*Seven houses contain seven cats.
Each cat kills seven mice.
Each mouse had eaten seven ears of grain.
Each ear of grain would have produced seven baskets of wheat
What is the total of all of these?*

Born: 1170 AD

Birth: Pisa (now in Italy)

Son of: Guilielmo Bonacci, secretary of the Republic of Pisa and responsible for directing the Pisan trading colony in Bugia, Algeria

Education: in North Africa

Associates:

Died: 1250 AD in Pisa - now Italy

Stories:

Father intended for Leonardo to become a merchant and so instructed him in calculational techniques, especially those involving the Hindu-Arabic numerals not yet used in Europe. Eventually Bonacci enlisted his son's help in carrying out business for the Pisan Republic and sent him on trips to Egypt, Syria, Greece, Sicily, and Provence, where Leonardo took the opportunity to study and learn the mathematical techniques used in these regions.

Leonardo is better known as Fibonacci short for "filius Bonacci" which means "son on Bonacci" or perhaps "son of good fortune".

The Fibonacci numbers are related to the "Golden Section", also called the "Golden Ratio" which is denoted by the Greek letters phi (ϕ) or tau (τ) and is equal to $+/- 1.61803 39887...$ or $+/- 0.61803 39887...$. This "Golden Ratio and Fibonacci's numbers are found in art, in architecture and in music. They also appear in nature in all types of seeds, leaves and petal arrangements, and pine cones,

Accomplishments:

Introduced Hindu-Arabic place-valued decimal system with its decimal point and zero

Pioneered the use of Arabic numerals in Europe

Published Liber abaci (Book of the Abacus or Book of Calculating) explaining how to do arithmetic in the decimal system in 1202

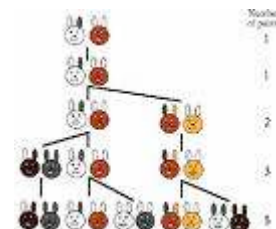
Published 4 other works

Fibonacci number sequence

Calculated the root of a cube - answer with decimal notation correct to 9 places

Simultaneous solution of equations quadratic in two or more variables

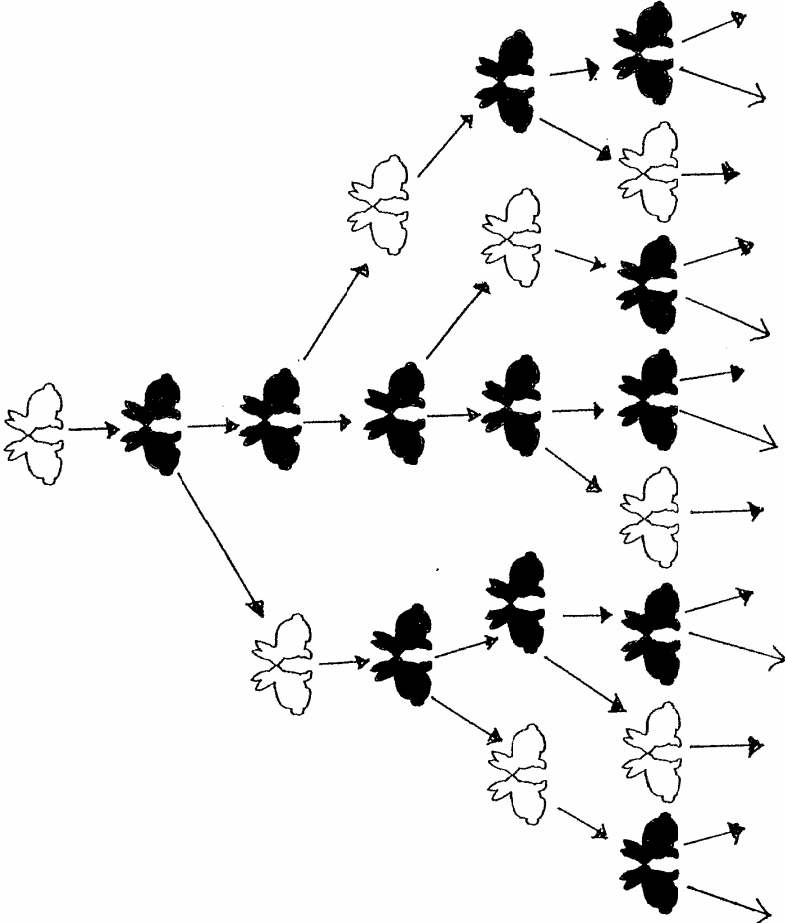
Introduced the beginnings of Trigonometry



The Fibonacci Sequence

The Rabbit Problem

Month	Newborn Pairs	Mature Pairs	Total Pairs
January	1	0	1
February	0	1	1
March	1	1	2
April	1	2	3
May	2	3	5
June	3	5	8
July	5	8	13

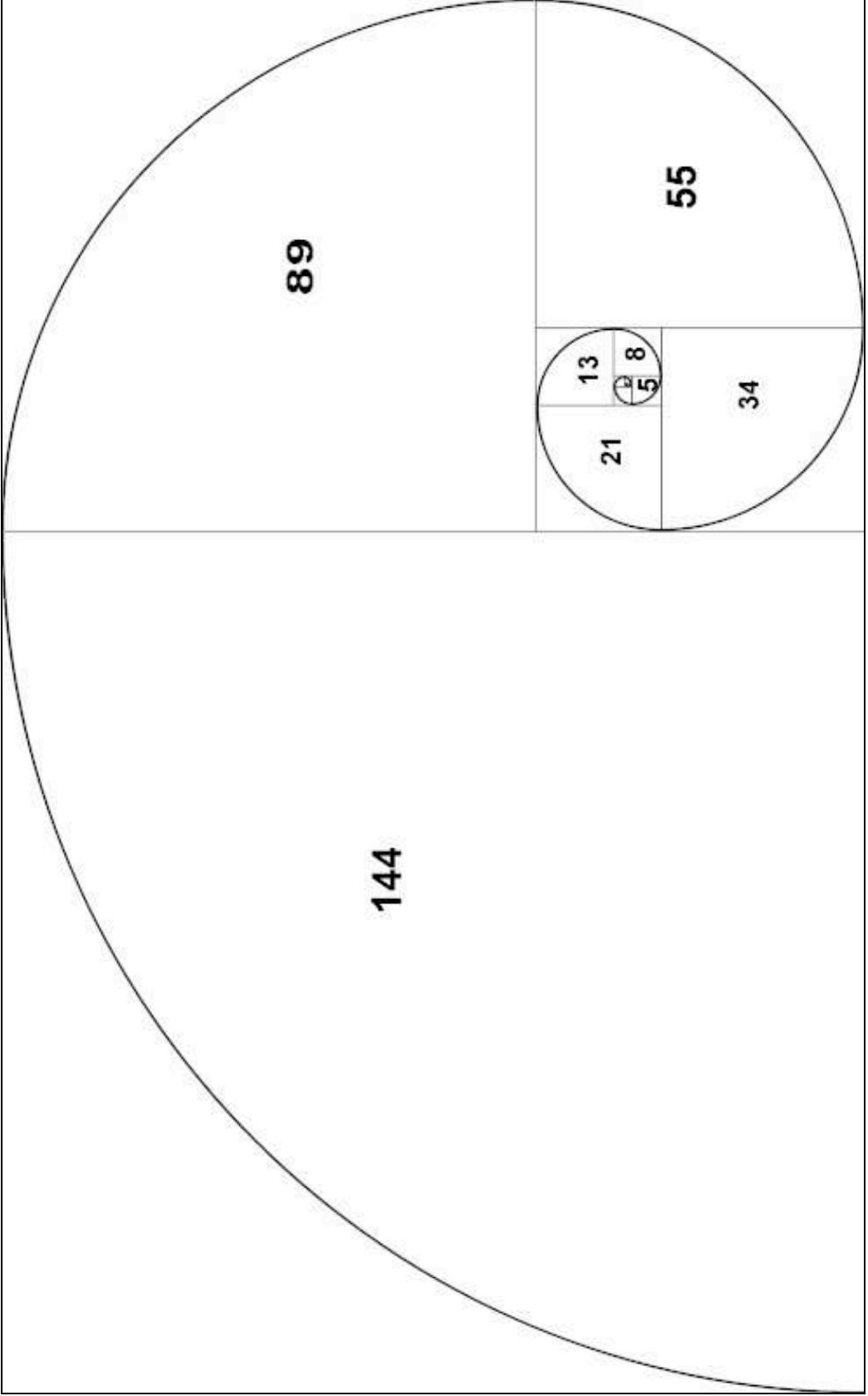


The Fibonacci Sequence

The Rabbit Problem

Month	Newborn Pair	Mature Pairs	Total Pairs	Fibonacci Sequence
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
January				
February				
March				
April				
May				

Fibonacci Spiral



Ada King (Countess of Lovelace)

Analyst, Metaphysician and Founder of Scientific Computing



Name: Augusta Ada Byron

Born: December 10, 1815

Place of Birth: London, England

Father: Lord Byron

Mother: Annabella Milbanke (Lady Byron)

Husband: William King (1st Earl of Lovelace) – 3 children

Education: Home schooled

Contemporaries: Mary Somerville, Augustus De Morgan, Charles Babbage

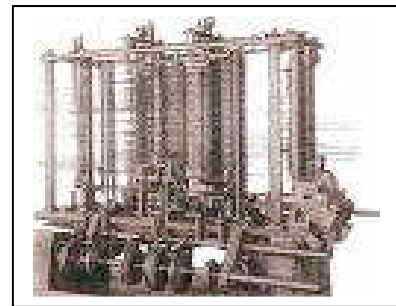
Died: November 27, 1852 (from blood letting used to treat uterine cancer)

Occupation: Noble woman

Accomplishments: Expounded upon Charles Babbage's notes on the Analytical Engine

Stories:

- Ada was home schooled by her mother, but continued her studies of mathematics under Mary Somerville, who had written the book "The Mechanism of the Heavens", which dealt with mathematical astronomy. Lady Byron encouraged her daughter's interest in music as opposed to mathematics. In the nineteenth century, it was believed that women were too frail for intellectual endeavors and a woman who ventured to study or think too deeply was in danger of losing her health. Lady Byron sheltered Ada's health problems throughout her life. As a child, Ada suffered from migraine headaches and occasionally a mysterious illness would leave her paralyzed for weeks at a time.
- Ada seemed to almost be able to read Charles Babbage's mind as she translated an article on the analytical engine from Italian to English. She took his notes and added her notes. As her writing progressed the notes became more and more extensive and by the time the paper was finished it was almost three times the length of the original article. In this important paper, not only outlined how the analytical engine would work, but also gave a range of programming techniques by which many mathematical operations could be solved. Ada would not allow the article to be published using her name, only her initials.
- Interest in horses. Ada enjoyed riding horses as a child. This interest became a passion when coupled with her interest in mathematics during later life. Ada enjoyed going to horse races and wagering on the outcome of the races. She used many different mathematical formulas to try to determine the winner of the horse race. Ada bet the horses using her jewels. Lady Byron, Ada's mother, paid out over 5,000 pounds to cover the gambling losses and regain family property.
- As she was dying, Ada continued to think about Babbage's engine. She dreamed of using punch cards, as were used in weaving looms of the day, to program the engine to write and play music, which was another favorite pastime. Just think about it, a computer that can compose and play music. What a concept!



Number ₁₀	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
62	256	128	64	32	16	8	4	2	1
34				1	1	1	1	1	0
2				1	0	0	0	1	0
14						1	1	1	0
14						1	1	1	0
2								1	0
34				1	0	0	0	1	0
62				1	1	1	1	1	0

Number ₁₀	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
62	256	128	64	32	16	8	4	2	1
34				1	0	0	0	1	0
2								1	0
14						1	1	1	0
14						1	1	1	0
2								1	0
34				1	0	0	0	1	0
62				1	1	1	1	1	0

Number ₁₀	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
56	256	128	64	32	16	8	4	2	1
108			1	1	0	1	1	0	0
56				1	1	1	0	0	0
145		1	0	0	1	0	0	0	1
210		1	1	0	1	0	0	1	0
86			1	0	1	0	1	1	0
52				1	1	0	1	0	0
24					1	1	0	0	0

Number ₁₀	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
56	256	128	64	32	16	8	4	2	1
108			1	1	0	1	1	0	0
56				1	1	1	0	0	0
145			1	0	1	0	0	0	1
210			1	0	1	0	0	1	0
86			1	0	1	0	1	1	0
52				1	1	0	1	0	0
24					1	1	0	0	0

Number ₁₀	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
28	256	128	64	32	16	8	4	2	1
20					1	0	1	0	0
28					1	1	1	0	0
9						1	0	0	1
126			1	1	1	1	1	1	0
72			1	0	0	1	0	0	0
20					1	0	1	0	0
34				1	0	0	0	1	0

Number ₁₀	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
28	256	128	64	32	16	8	4	2	1
20					1	0	1	0	0
28					1	1	1	0	0
9						1	0	0	1
126			1	1	1	1	1	1	0
72			1	0	0	1	0	0	0
20					1	0	1	0	0
34				1	0	0	0	1	0

Who is Eratosthenes?

Presenters: Rosann Larrow and Peter Larrow

Co-Directors

Montessori Opportunities Inc.

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References:

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