The teachers who took part in ‘Fibonacci the Performance’ felt that lesson plans for the project were not necessary at this stage. They wanted background information to help them research their own ways of interpreting the concept. Below is a selection of research material to engage teachers. This was not confined to maths dance and music, but included artwork lyric writing and poetry. Dr Ron Knott invited teachers to use the materials on his website, which is comprehensive and accessible for different key stages.

A short introduction to Fibonacci

Leonardo Fibonacci was a thirteenth-century Italian mathematician who discovered the significance and unique properties of a simple number series, in which each
numeral is added to the previous to create the next one in the series: 1, 1, 2, 3, 5, 8, 13, etc. Fibonacci numbers, and more significantly the ratio of those numbers to each other, can be found throughout nature and cycles.

Leonardo of Pisa (c. 1170 – c. 1250), also known as Leonardo Pisano, Leonardo Bonacci, Leonardo Fibonacci, or, most commonly, simply Fibonacci, was an Italian mathematician, considered by some "the most talented mathematician of the Middle Ages".

Recognizing that arithmetic with Hindu numerals is simpler and more efficient than with Roman numerals, Fibonacci traveled throughout the Mediterranean world to study under the leading Arab mathematicians of the time. Leonardo returned from his travels around 1200. In 1202, at age 32, he published what he had learned in *Liber Abaci* (Book of Abacus or Book of Calculation), and thereby introduced Hindu-Arabic numerals to Europe.
In the *Liber Abaci* (1202), Fibonacci introduces the so-called modus Indorum (method of the Indians), today known as Arabic numerals (Sigler 2003; Grimm 1973). The book advocated numeration with the digits 0–9 and place value. The book showed the practical importance of the new numeral system, using lattice multiplication and Egyptian fractions, by applying it to commercial bookkeeping, conversion of weights and measures, the calculation of interest, money-changing, and other applications. The book was well received throughout educated Europe and had a profound impact on European thought. Nevertheless, the use of decimal numerals did not become widespread until much later.

*Liber Abaci* also posed, and solved, a problem involving the growth of a hypothetical population of rabbits based on idealized assumptions. The solution, generation by generation, was a sequence of numbers later known as Fibonacci numbers. The number sequence was known to Indian mathematicians as early as the 6th century, but it was Fibonacci’s *Liber Abaci* that introduced it to the West.

In mathematics and the arts, two quantities are in the **golden ratio** if the ratio between the sum of those quantities and the larger one is the same as the ratio between the larger one and the smaller. The golden ratio is approximately 1.6180339887.[1]

At least since the Renaissance, many artists and architects have proportioned their works to approximate the golden ratio—especially in the form of the golden rectangle, in which the ratio of the longer side to the shorter is the golden ratio—believing this proportion to be aesthetically pleasing. Mathematicians have studied the golden ratio because of its unique and interesting properties. The golden ratio can be expressed as a mathematical constant, usually denoted by the Greek letter (phi). The figure of a **golden section** illustrates the geometric relationship that defines this constant.
A visual image of Fibonacci. A tiling with Fibonacci number sized squares.

A **Fibonacci spiral** created by drawing arcs connecting the opposite corners of squares in the Fibonacci tiling; this one uses squares of sizes 1, 1, 2, 3, 5, 8, 13, 21, and 34; see Golden spiral

The Golden Spiral
Fibonacci and Art

Painting
Leonardo da Vinci’s illustrations in *De Divina Proportione (On the Divine Proportion)* and his views that some bodily proportions exhibit the golden ratio have led some scholars to speculate that he incorporated the golden ratio in his own paintings. Some suggest that his *Mona Lisa*, for example, employs the golden ratio in its geometric equivalents.[22] Whether Leonardo proportioned his paintings according to the golden ratio has been the subject of intense debate. The secretive Leonardo seldom disclosed the bases of his art, and retrospective analysis of the proportions in his paintings can never be conclusive.[

Salvador Dalí explicitly used the golden ratio in his masterpiece, *The Sacrament of the Last Supper*. The dimensions of the canvas are a golden rectangle. A huge dodecahedron, with edges in golden ratio to one another, is suspended above and behind Jesus and dominates the composition. Mondrian used the golden section extensively in his geometrical paintings.

Interestingly, a statistical study on 565 works of art of different great painters, performed in 1999, found that these artists had not used the golden ratio in the size of their canvases. The study concluded that the average ratio of the two sides of the paintings studied is 1.34, with averages for individual artists ranging from 1.04 (Goya) to 1.46 (Bellini).[22]

Fibonacci and Music.
James Tenney reconceived his piece *For Ann (rising)*, which consists of up to twelve computer-generated upwardly glissandoing tones (see Shepard tone), as having each tone start so it is the golden ratio (in between an equal tempered minor and major sixth) below the previous tone, so that the combination tones produced by all consecutive tones are a lower or higher pitch already, or soon to be, produced.

Ernő Lendvai analyzes Béla Bartók's works as being based on two opposing systems, that of the golden ratio and the acoustic scale, though other music scholars reject that analysis. In Bartok's *Music for Strings, Percussion and Celesta* the xylophone progression occurs at the intervals 1:2:3:5:8:5:3:2:1. French composer Erik Satie used the golden ratio in several of his pieces, including *Sonneries de la Rose+Croix*. His use of the ratio gave his music an otherworldly symmetry.

The golden ratio is also apparent in the organisation of the sections in the music of Debussy's *Image, Reflections in Water*, in which "the sequence of keys is marked out by the intervals 34, 21, 13 and 8, and the main climax sits at the phi position."

The musicologist Roy Howat has observed that the formal boundaries of *La Mer* correspond exactly to the golden section. Trezise finds the intrinsic evidence "remarkable," but cautions that no written or reported evidence suggests that Debussy consciously sought such proportions. Also, many works of Chopin, mainly Etudes (studies) and Nocturnes, are formally based on the golden ratio. This results in the biggest climax of both musical expression and technical difficulty after about 2/3 of the piece.

*This Binary Universe*, an experimental album by Brian Transeau (aka BT), includes a track entitled "1.618" in homage to the golden ratio. The track features musical versions of the ratio and the accompanying video displays various animated versions of the golden mean.

Pearl Drums positions the air vents on its Masters Premium models based on the golden ratio. The company claims that this arrangement improves bass response and has applied for a patent on this innovation.

One of the joys of playing music is achieving an understanding of
how the music is organized. On many occasions I have been struck by the beauty of a melody or the logic with which a piece of music progresses. No doubt we have all experienced similar experiences, for it was moments like these that attracted us to become performers in the first place. Yet often we are totally unable to determine exactly what in the music attracts us. What are these mystical strands that a composer weaves into the fabric of his music? Is it possible for us to reach an understanding about how this music is constructed? This article is an attempt to search for answers to such questions. In particular, I have chosen the bassoon solos in opening of Bartók's Dance Suite because of the striking balance they contain and the beautiful, mysterious coherence they possess.

**Background on Bartók's Compositional Methods**

Erno Lendvai provides some useful insights into Bartók's unique method of composition. Lendvai takes note of Bartók's fascination with formations occurring in nature:

He was constantly augmenting his collection of plants, insects and mineral specimens. He called the sunflower his favourite plant, and was extremely happy whenever he found fir cones placed on his desk. According to Bartók "also folk music is a phenomenon of nature. Its formations developed as spontaneously as other living natural organisms: the flowers, animals, etc." ("At the Sources of Folk Music": 1925).[1]

Fir cones, sunflowers, and certain sea shells are constructed with a spiral that has been described by the geometric series which is called the "Fibonacci series." Starting with a "0," the Fibonacci series progresses 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55... Each succeeding number is obtained by adding the previous two numbers. (For instance 0 + 1 = 1; 1 + 1 = 2.) Lendvai has noticed that aspects of the Dance Suite are patterned after the Fibonacci series:

The first movement arises from major seconds (2); the second is built on minor thirds (3); the third summarises these former elements (2 + 3 + 2 + 3 + 2), presenting a pure pentatonic scale. The harmonies of this movement are based on 5 + 5. Finally, the melody of the fourth movement follows the pattern 8 = 5 + 3, where 5 = 3 +
This gives a segment of the Fibonacci series: 2, 3, 5, 8. It is Lendvai's contention that Bartók is using the Fibonacci series to provide an overall coherence to the Dance Suite.

The Fibonacci Series in the 1st Movement Bassoon Solos

Perhaps the most significant use of the Fibonacci series in the First Movement can be found in the tonal and rhythmic organization of the melody presented by the bassoons. The succession of intervals (in half-steps) in the melody in measures 2 through 9 is: 1 2 3 2 1 2 3 2 1 2 3 2 0 1 2 3 2 0 1 2 5 3 3 (Figure 2). There is an undulating pattern up and down the Fibonacci series with occasional skips. The climactic number "5" is presented towards the end of the phrase. Notice that the number "4," which is not a member of the Fibonacci series, is not present. Though the listener (or performer) may not recognize that the Fibonacci series is being used in this passage, nevertheless I believe that the movement from smaller to larger melodic intervals is heard. There is a logic that is pleasing to the ear. The phrase makes "musical sense" when we hear it.

Bartók also uses the Fibonacci series rhythmically in this passage. If we allow groups of notes to be initialized by the starts of ties or slurs the number of members in each group follow the Fibonacci series (Figure 3). I have ignored the grace note in measure 9 and counted the G in that measure as part of the group since it is an arrival point. The 1 + 4 groupings in measures 5 to 7 are a variation on the 5 grouping starting in measure 4 and therefore should also be considered a 5 grouping. Figure 4 is a continuation of this analysis of articulated groupings. The 1 + 5 groupings in measures 18 to 20 are another variation on the five grouping starting in measure 4. The last two groupings of 4 could be joined as components of a single group of 8, which is the next number in the Fibonacci series after 5.

Is all of this just playing with numbers? I think not. Listen to the music and keep in mind the Fibonacci series. Bartók has masterfully created these melodies in conformance with musical and numerical logic. The strength of its organic whole lies in the remarkable synthesis Bartók achieves between the Fibonacci series and his
musical ideas.

About the writer...

Terry Ewell, bassoonist, was the winner of the first annual Fernand Gillet performance competition. He was principal bassoon of the Hong Kong Philharmonic Orchestra for seven years, and has been a soloist under the direction of Jahja Ling, Gerard Schwarz, and Vilem Sokol. He received his Master of Arts in music theory in 1988. Currently, Mr. Ewell is on the faculty of Pacific Lutheran University. In addition, he is pursuing a Ph.D. in music theory at the University of Washington.

ENDNOTES

2. Ibid., p. 49.

Beating a path between music and maths
Times Education Supplement.
Diana Hinds
Published: 08 December 2006

Music based on the famous Fibonacci number sequence is performed by an orchestra of broomsticks and beaters. Diana Hinds is impressed

Standing in a circle with tall wooden broomsticks and beaters in their hands, and with red xylophones at their feet, pupils from Chesterton Community College, Cambridge, are rehearsing the Fibonacci sequence. On the count of "one", they stomp their broomsticks on the floor, then, in time with each other, they strike the broomsticks with the beaters.

"Remember, 'one' is always on the floor," Damien Harron, composer, tells them. "Between now and the concert, my plan is to brainwash you with this rhythm."

This was the third rehearsal for a public performance of his new work, Dance of Geometry, at the Cambridge Music Festival, whose theme this year was Mozart, Music and Maths.

The yoking of musical and mathematical ideas strikes the Chesterton group as something of a novelty. "I didn't know you could do the Fibonacci sequence with rhythm - it's a maths thing," says Meisha Lawrence, 14. "It makes it more interesting because you've got to pay attention to what you're doing."
"It's kind of cool," says Jackson Ritchie, 13. "It was a bit weird at first because I would normally associate maths with smart people in white overcoats. Now when I go to maths lessons, I'll think you can use maths in more creative ways, not just counting out how much change someone needs."

When Damien Harron was told of the music and maths theme of this year's festival, he remembered a Stephen Hawking phrase - the "dance of geometry".

He set about constructing a percussion piece for young people which explored different mathematical ideas based around cycles and orbits.

As well as the Fibonacci number sequence, Dance of Geometry incorporates polyrhythms (that is, three and four-beat cycles which regularly converge) and elongated sequences of notes which groups of pupils play simultaneously on xylophones, each group's sequence slightly longer than that of their neighbours.

There are also free-form sections in which pupils create their own sequences on gongs and finger-cymbals, adding a layer of exotic sound over the drums and tuned percussion.

"Music is a complex art form which engages our imaginations, emotions and physical energies, yet it's an equally complex science," says Damien.

"Rhythms have mathematical relationships as they loop and interact, and harmonies can blend sonorously if the constituent sounds relate mathematically. Percussion instruments are a wonderful medium for exploring both the art and the science."

The composer says he didn't much enjoy maths at school. "But since then, having performed a lot of new music, I've had to sit down and work out polyrhythms and I've spent more time thinking mathematically about percussion playing than I ever thought I would."

Yvonne Williamson, head of music at Chesterton Community College, is delighted with the cross-fertilisation of subjects that Dance of Geometry provides - highlighting for pupils the logical, mathematical elements in music and showing them that maths involves creativity and imagination. She hopes that Chesterton's music and maths departments can collaborate more in the future.

"Children are conservative and tend to pigeon-hole things, but the more links we can make between curriculum areas, the better. If we can make the link between maths and music from Year 7, that will really get them thinking. Much of the music we hear through the media is unadulterated four beats in a bar, but a project like this shows pupils that there are other ways of making music."

The Cambridge Music Festival was held last month

NOTES FOR MUSIC TEACHERS

* Introduce and make explicit the link between maths and music in rhythm work from Year 7 onwards. Perhaps build a group composition based on rhythmic playing of the Fibonacci sequence. Explore three and four-beat rhythmic cycles, played at the same time, and see when the patterns converge.
* Use mathematically based rhythms to demonstrate that not all music has four beats in a bar. This will help pupils when they come to study music from other cultures.

* When composing simple four-bar answering phrases, make explicit the underlying mathematical structure.

* Broomsticks make a satisfying clunk when stomped rhythmically on the floor as part of a percussion orchestra - and they're cheap.

FIBONACCI NUMBERS

A sequence of numbers where, after two starting values, each number is the sum of the two preceding numbers: 0,1,1,2,3,5,8,13,21,34,55 etc. It was named after Leonardo of Pisa, the 13th-century mathematician also known as Fibonacci, and has been applied to create architecture, art, poetry and music.

Jazz and Math: The Fibonacci Keyboard

**Estimated Time of Completion:** Depending on students' familiarity with Fibonacci Sequence, one to two 50-minute class periods will allow plenty of time to explore the main concept. In-depth exploration of vibrations per minute and other musical relationships will require additional time.

- Objectives
- Materials Needed
- Standards
- Procedures and Activities
- Assessment Suggestions
- Extensions/Adaptations

**Objectives**

- To demonstrate understanding of the relationships of the Fibonacci Sequence.
- To apply the Fibonacci Sequence and find its relationship to a piano keyboard.
- To explore various relationships between music and the Fibonacci Sequence.

**Materials Needed**
• Access to a piano keyboard or to a picture for reference
• One or more episodes of the PBS Ken Burns JAZZ documentary
• Access to the Internet

Standards

This lesson correlates to the following math standards established by the National Council of Teachers of Mathematics at http://www.nctm.org/standards/:
• Understand patterns, relations, and functions.
• Analyze and evaluate the mathematical thinking of others.
• Recognize and apply mathematics to contexts outside of mathematics.

Procedures and Activities

1 Begin by asking students how many of them know how to play the piano. Challenge students to draw or describe an exact representation of a piano keyboard.

2 Ask students to identify different types of music that prominently feature the piano. What types of music come to mind—rap? country? jazz? classical? etc.

3 Explain to students that they'll be learning how jazz musicians use the piano, and also about how the piano relates to a famous mathematical concept: the Fibonacci Sequence. View clips from various episodes of the PBS JAZZ documentary that emphasize the role of the piano in jazz and provide visual access to the piano keyboard.

Suggested clips:
- Episode Four, 49:12 - 50:02—Fats Waller
- Episode Five, 1:00:35 - 1:01:21—Teddy Wilson
- Episode Ten, 47:22 - 48:20—Herbie Hancock
- Episode Ten, 1:36:00 - 1:36:47—Gonzalo Rubalcaba

4 Remind students that the piano is technically a percussion instrument. What other instruments are grouped as percussion? What is the "responsibility" of the percussion section? Lead into a
discussion of rhythm and tempo. How does a band establish rhythm and tempo? Who decides each? What is the difference between rhythm and tempo? Students might find useful information by accessing the PBS JAZZ Web site's Jazz Lounge which features a "virtual piano" application, and the Music Theory section of the site which explains different musical terms like rhythm and tempo.

5 Ask students how rhythm, tempo, and the piano keyboard connect to math. Brainstorm a list on the board. (Possible answers include: rhythm and tempo can connect to fractions and rates; the keyboard has a certain pattern of black keys and white keys at regular intervals, etc.) Tell students they're going to learn about another relationship between music and math, and that it involves the famous Fibonacci Sequence.

6 To learn more about the history of the Fibonacci Sequence and its different manifestations in the world around us, have students access the following web site (or print out prior to class if access to the Internet is limited): Isaac Newton Institute for the Mathematical Sciences
http://www.newton.cam.ac.uk/wmy2kposters/january

This Web site has a poster from the London Underground asking viewers to spot the pattern (Fibonacci Sequence). The Web site goes on to give the history behind the Fibonacci Sequence. For more advanced math classes, the site provides a more detailed analysis as well as additional links.

For more information concerning Fibonacci numbers you might check out the book Fascinating Fibonacci: Mystery and Magic in Numbers by Trudi Hammel Garland (published by Dale Seymou Press) or the following Web sites:

University of Minnesota: Technology in the Geometry Classroom
http://www.geom.umn.edu/~demo5337/s97b/fibonacci.html

Mission College Math Department
http://www.wvmccd.cc.ca.us/mc/Depts/Math/beard/pleasant.htm

Ask students to share what they've learned about the Fibonacci Sequence. How did it get its name? What's the pattern or rule behind it? What are some examples of the pattern?

7 Given a visual of the piano keyboard, challenge students to find
examples of the Fibonacci Sequence in the keyboard.

Students should easily see a repeating pattern with the keyboard: the pattern should begin with the white key immediately preceding the set of two black keys and continue to the white key immediately following the set of three black keys.

Hopefully students, perhaps with guidance, will find some or all of the following:

Starting at C and proceeding to the next C gives us an octave. In this octave you will find two black keys grouped together and then three black keys grouped together. Surrounding the two black keys are three white keys and surrounding the three black keys are five white keys. In the octave are eight white keys. Counting the white and black keys, you have 13 notes. These thirteen notes are known as a chromatic scale.

These numbers are the first numbers (after 1) in the Fibonacci Sequence.

8 Students can go on to research (at the previously mentioned Web sites) the vibrations per second of the notes in the chromatic scale beginning with middle C on the keyboard. Middle C vibrates at 264 vibrations per second, while A (the sixth) vibrates at 440 vibrations per second. This ratio reduces to 3/5, a Fibonacci ratio.

9 Students may also explore the Pentatonic, Diatonic and Chromatic scales. (Five, eight, and 13 notes respectively.) Additional research could include where these scales appear in the various styles of jazz—fusion, swing, blues, etc.

**Assessment Suggestions**

This activity can be used to assess the student's ability to extend patterns as well as the student's ability to see patterns in areas outside of mathematics.

The student's contribution to class discussion, research into the history and manifestation of the Fibonacci Sequence, and ability to identify (verbally or in writing) other examples of the Fibonacci Sequence may be used to evaluate student understanding of the concepts presented.

**Extensions/Adaptations**
Students can explore other occurrences of the Fibonacci Sequence in nature, such as pine cones, flowers, etc.; in art; and architecture (such as the Golden Ratio). Additional exercises using the Fibonacci Sequence may be found at the following sites:

PBS Mathline: Challenges
http://www.pbs.org/teachersource/mathline/challenges/jun00/puzzle1.shtm

PBS Mathline: Peddling Petals
http://www.pbs.org/teachersource/mathline/lessonplans/esmp/petals/petals_extensions.shtm

PBS Mathline: Squares Within Squares
http://www.pbs.org/teachersource/mathline/lessonplans/hsmp/squares/squares_extensions.shtm

The Golden Section in Art, Architecture and Music
http://www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/fibInArt.html

Fibonacci Rap.
Lyrics By Freq. Hip Hop

Stand up and lose the pretense
i'm about to rap about the Fibonacci sequence
before you start to rat on my old man fib
know that his numbers make the curve of your rib
Yeah I know it's a lot of work
but roll out the numbers and watch em all TWIRK
in the zero one one in the two three five
you want to have some fun then let me test drive
this point strait into you toolshed
the effects of the sequence are quite widespread
like the stems and the leaves of green plants
to the notes sung in Gregorian chants
so stand up you stiff natzi
its time to dance to the beat of Fibonacci - acci- acci- acci-
she was 13 21 34
her hand tappin out the rhythm on my door
a girl scout selling cookies oooh so good
they were all stacked up if you catch my driftwood
i ordered a box of carmel delites
as a way to make peace in my gansta fights
about Fibonacci and the golden mean
you gatta know your math if your riding on my team
so dust off the book and front the paper
when i'm done your gonna need a stapler
you start a zero and you add it to one
mathematical doctrine like an automatic gun
one on one brings it up to-to
unless you eat a lot of breast cancer causing tofu

Don't hate,
three five eight comes next
you keep the muscle flexed
and your mind unvexed
you got the rythem you can take it from here
let me get out the way and let you steer

Stand up and lose the pretense
i'm about to rap about the Fibonacci sequence
before you start to rat on my old man fib
know that his numbers make the curve of your rib
Yeah I know it's a lot of work
but roll out the numbers and watch em all TWIRK
in the zero one one in the two three five
you want to have some fun then let me test drive
this point strait into you toolshed
the effects of the sequence are quite widespread
like the stems and the leaves of green plants
to the notes sung in Gregorian chants
so stand up you stiff natzi
its time to dance to the beat of Fibonacci - acci- acci- acci-
Fibonacci and Dance.

T shirt design
Bruce King, Choreographer.
You didn't have to start counting to enjoy "Dancing the Numbers," the intricate solo Polly Motley performed on Thursday night as part of the City/Dans series of the Danspace Project at St. Mark's Church.

Her inspiration was the Fibonacci Series, a numerical progression developed by the 13th-century mathematician Leonardo Fibonacci, in which each new number is the sum of the two previous ones: for instance, 1, 1, 2, 3, 5, 8, 13, 21, etc. The sequence has long fascinated scientists, philosophers and artists and is a major clue in "The Da Vinci Code," Dan Brown's best-selling novel about mysticism and murder.

Ms. Motley, wearing a white T-shirt and black slacks, began with simple pointing and circling arm gestures. As phrases grew increasingly longer, Ms. Motley did such things as stare contemplatively, crouch and hug herself, roll on the floor and raise
herself from it using one arm as a hinge.

In a program note Ms. Motley wrote that she let the Fibonacci series help determine the length of each section of the work. But sections flowed by without sharp breaks and only mathematicians or dancegoers with stopwatches might know with certainty where she was in the series at any point during the 45-minute piece.

Numbers became irrelevant. What made the solo mesmerizing was Ms. Motley's rapt concentration, her total absorption in every step. Her slightest details commanded attention: her stiffening and relaxing hands, for instance, or the curlings of her arms about her head.

Dance and mathematics united to create a sense of mystery, which was enhanced by Paul Geluso's sound collage, which blended electronic music with ordinary noises like bells, auto horns, train whistles and cricket chirps. All those familiar sounds began to seem wondrous.

However erudite her conceptions may have been, Ms. Motley always gave the impression that she knew what she was doing and where she was going. As a result even math dummies could happily let their imaginations follow her.

The program repeats tomorrow night at St. Mark's Church, Second Avenue at 10th Street, East Village.

The Alban Elved Dance Co.  
/www.albanelved.com/fibonacci.html

The dance/the choreography:
“Fibonacci & Phi”, like life, is complex. Worlds exist within worlds, layers upon layers –  
Music, dance, science and the audience are tightly interwoven. The audience interaction adds a layer of unpredictability and chance to the experience and to the meaning of the piece. The choreography is based on the Fibonacci sequence. Numbers of steps and floor patterns are based on the Fibonacci spiral. However, dance and choreography go beyond mathematical rules and become more complex by means of emotional content. A number sequence and the golden ration are the
basis from which the piece evolved, just like a simple equation is the basis for immensely complex and stunning fractal images. Fibonacci & Phi takes places on an early fall Sunday, about how we experience Fibonacci & Phi every day. It is a piece about us, now.

**Fibonacci and poetry**

A Fibonacci poem (or Fib) is a multiple-line verse based on the Fibonacci sequence so that the number of syllables in each line equals the total number of syllables in the preceding two lines.

The Fibonacci sequence begins with either zero or one, followed by one, and proceeds based on the rule that each number (called a Fibonacci number) is equal to the sum of the preceding two numbers. Technically, the first line in a Fibonacci poem with \( n = 0 \) has no syllables, and therefore constitutes a moment of silence. This is an important consideration, just as standard syllable and rhythm patterns are critical to other forms of verse such as haiku, limerick, and iambic pentameter. (If \( n = 1 \), then there is no initial moment of silence.)

Here’s an example:

**What is a Fib?**

A poem mathematical
Syllables are arranged in lines
according to Fibonacci's sequence of numbers:
One, one, two, three, five, eight, thirteen, twenty-one, thirty-four, fifty-five and so on.

Because the lines have ever-increasing syllables, the composition of long Fibonacci poems is very challenging. As a result, most have only six or seven lines. The last syllable in each line may rhyme with the last syllable in one or more other lines, although rhyme is not a requirement.

Fibs have become popular among geeks as well as literati. According to some enthusiasts, this new poetic structure has the capacity to spark
communication among mathematicians, physicists, chemists, biologists and poets, despite the gulfs that often seem to prevail between their disciplines in other respects.

Examples of Fib poetry.

...of Math

As
math
teachers
our struggle
to try and explain
the wonder and the mysteries

One
Fish
Two Fish
A red fish
And a big blue fish.
My, what a lot of fish there are!

ey,
hey!
yes, you!
are you a
mathematician?
then tell me if this is a fib.
I applied Fibonacci to sequencing arrangements of art.

**Fibonacci and Art.**

*Here are some interpretations of the sequence*

Sequencing can relate to colour or shape.
There are many paintings both contemporary and historical that use Fibonacci principles.