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NARRATION

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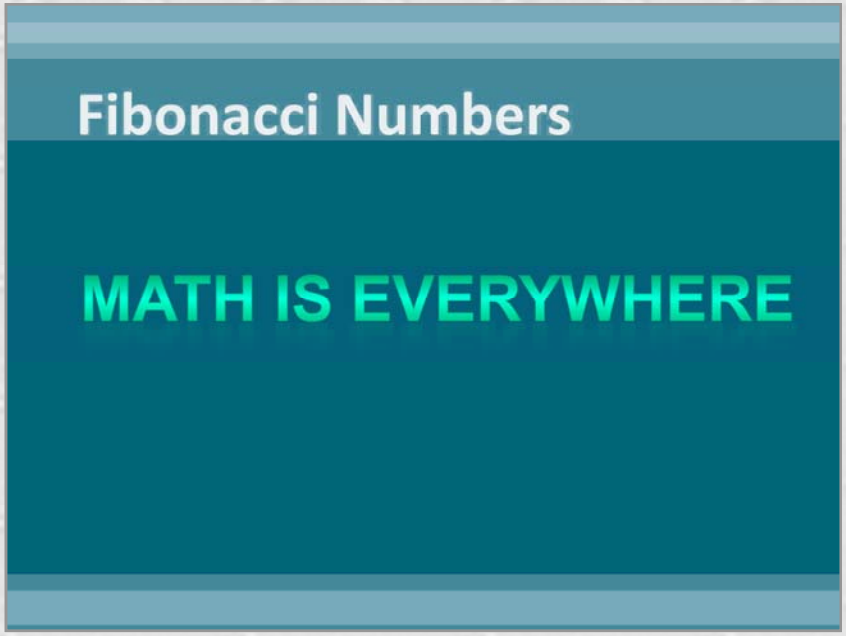

PROGRAMMING NOTES

- **Math is everywhere (only text on screen)**
- **Animation of numbers moving across screen**
- **Morphing into art, architecture, music and nature scenes moving onto screen and stopping**
- **Fibonacci series numbers and golden rectangles appear on pictures**
- **Fibonacci Numbers text appears**

Math is everywhere in the world

Not just the numbers you see around you and use when doing calculations

Math is also in art, architecture, music, and nature.

Once you know where to look, you will see one special series of numbers, the Fibonacci numbers, everywhere around you.

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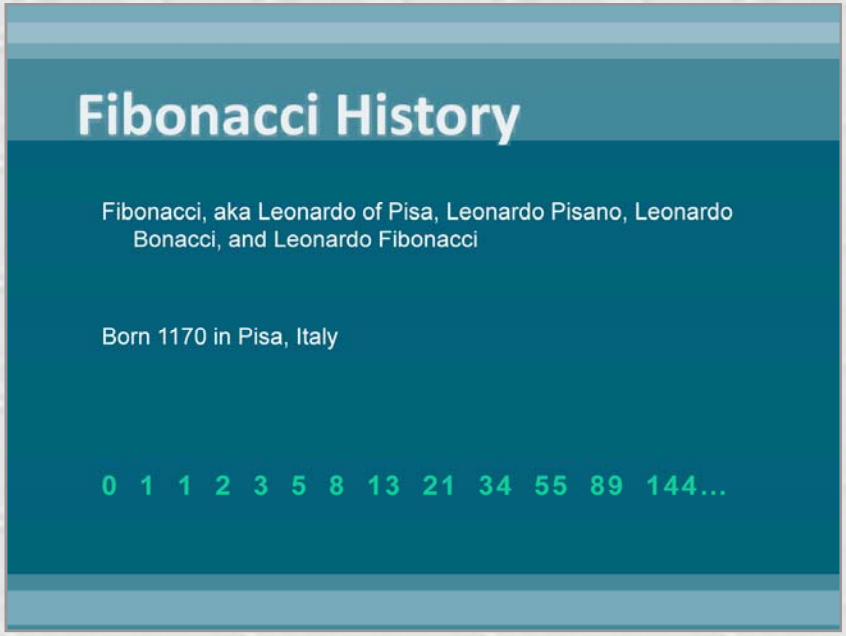

Fibonacci was also known as Leonardo Pisano (Leonard of Pisa), Leonardo Bonacci, and Leonardo Fibonacci.

Fibonacci was an Italian mathematician born in Pisa near the end of the twelfth century

His father, a public notary representing the merchants of Pisa, was appointed to a post in northern Africa, where Arabic numerals (the numbers we use today) were used rather than the Roman numerals in use at the time in Italy.

Fibonacci wrote a famous book, *Liber abaci*, that was influential in introducing Arabic numbers to Europeans.

In the same book, he described a series of numbers, already known in Indian mathematics, but unknown in Europe, which is now commonly known throughout the world as “Fibonacci numbers.”

PROGRAMMING NOTES

On the first screen:

1. Picture of the Leaning Tower of Pisa
2. Picture of Fibonacci
3. Link on Pisa to Pisa on Google Earth or to a description of Pisa

- Arabic numbers appear when mentioned
- Roman numbers appear when mentioned
- First 13 numbers in Fibonacci series appears at the bottom (one at a time) when mentioned

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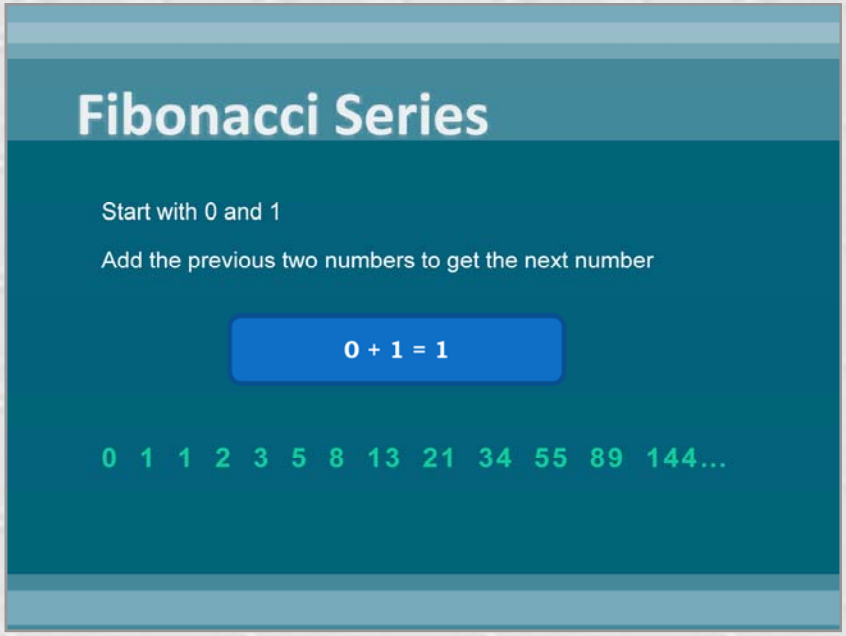

PROGRAMMING NOTES

Leave Fibonacci series numbers from previous screen visible

- When “0” and “1” are mentioned erase all the numbers except for those two
- Put the rule in large bold time centered when mentioned
- Generate the rest of the series of numbers, showing both the formula (calculation) and then the result into the series
- Clip art rabbits appear rapidly during explanation

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What is so special about the Fibonacci series of numbers? And why should you care?

The series of numbers begins with 0 and 1. After that, you can calculate the rest of the numbers following one very simple rule:

Add the previous two numbers to get the next number

Fibonacci used this series to win a math competition at a tournament by answering a question calculating the number of rabbits born over time following certain rules.

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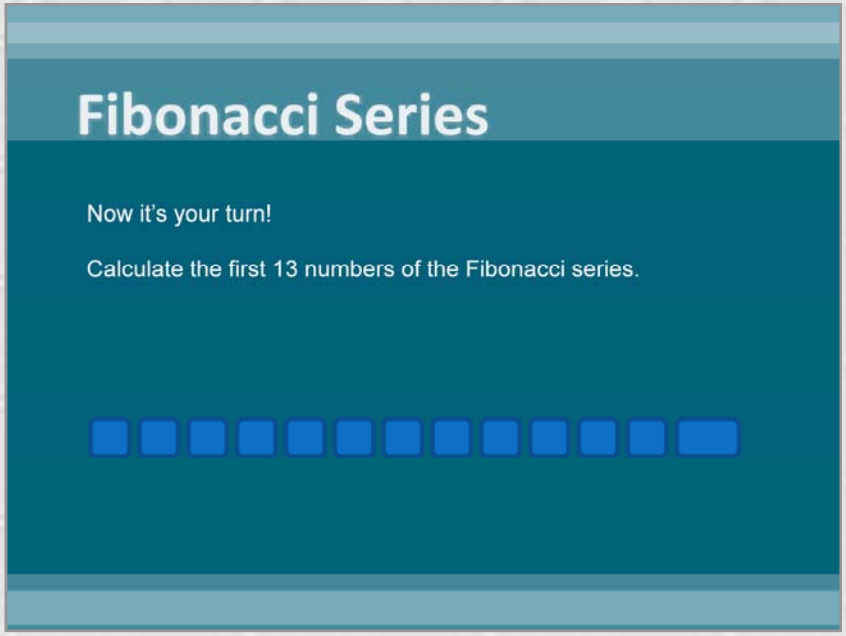

Now it's your turn!

Fill in the blanks below with the first 13 numbers of the Fibonacci series.

Click on the "Reminder" button if you need a reminder about how to do it.

Click the "Check Answer" button when you are finished to make sure you got it all right.

PROGRAMMING NOTES

- Add "Reminder" button which when clicked shows rule from previous screen
- Add "Check Answer" button which shows positive feedback if correct and shows correct answer if incorrect.

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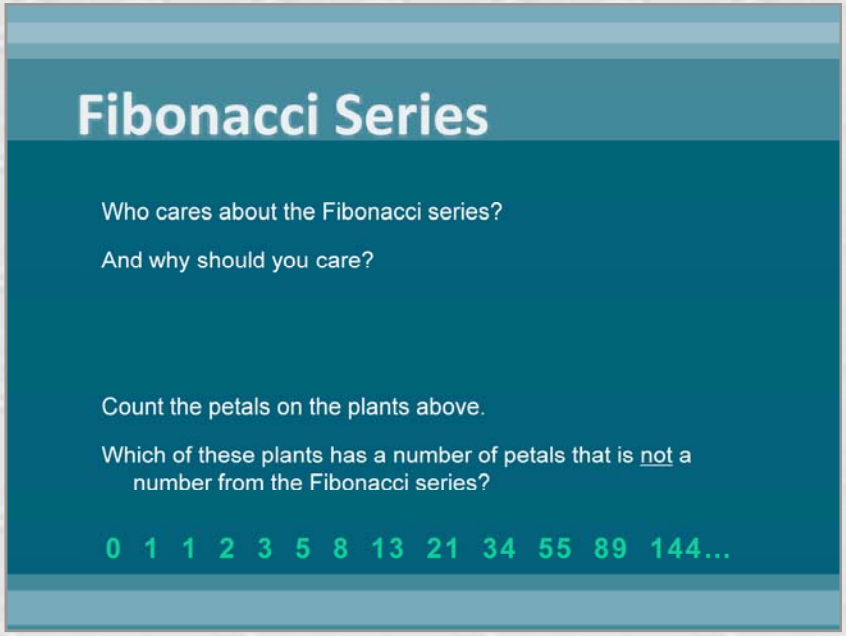

But unless you are entering a math competition, why should you care about the Fibonacci series?

There are lots of different answers to that question. Artists, architects, biologists, and many others use the Fibonacci series in their work.

And others, like me, enjoy seeing the Fibonacci series in nature, understanding more about the numbers and patterns that create the beauty we see in the world around us.

Take a look at these plants and count their petals. Which of these plants has a number of petals that is not part of the Fibonacci series?

PROGRAMMING NOTES

- "Who cares about the Fibonacci series? "and the number series at the bottom are the only things on the screen at the beginning.
- "And why should you care" appears on a time delay during narration.
- During narration of third paragraph, both lines of text at the top disappear and photos of plants appear.
- Instructions for activity appear at the bottom when narration gets to fourth paragraph.
- Give correct/incorrect feedback depending upon answer selected.

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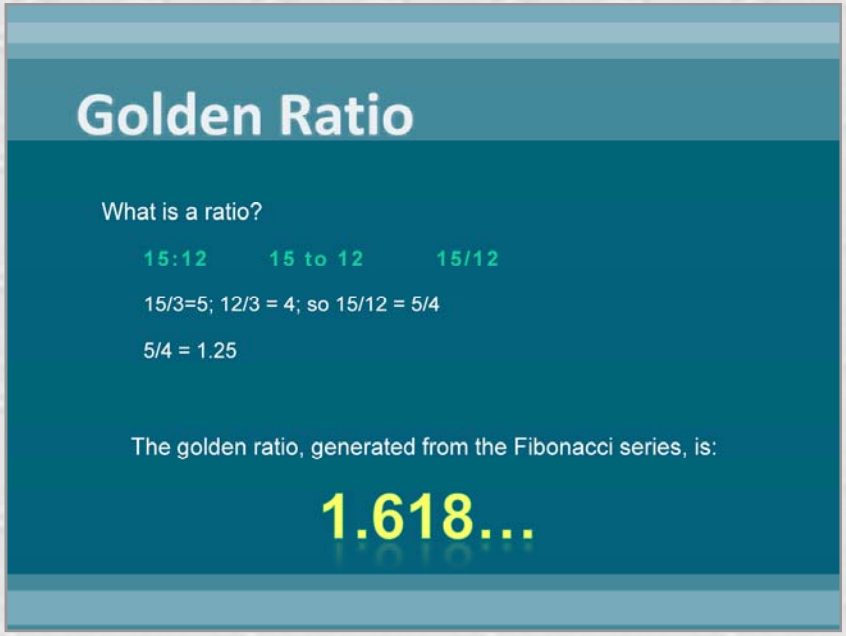

PROGRAMMING NOTES

- Start with only header (Golden Ratio)
- Have greek letter “phi” appear in the header during second paragraph of narration.
- First line of text appears with 3rd paragraph of narration
- Ratio samples appear with 5th paragraph of narration
- Calculations simplifying ratio fraction appear with 6th paragraph of narration
- Change of fraction to decimal appears with 7th paragraph of narration

Now that you know about the Fibonacci series of numbers, you can learn about a fascinating characteristic of the series.

The Fibonacci series was used to identify a special number called the “Golden Ratio” which is also represented by the greek letter “phi.”

First, you need to understand what a ratio is.

Simply, a ratio is a comparison between the size of two numbers. Ratios can be written in several ways.

For example, if you were examining a class with 15 girls and 12 boys, you could show the ratio between girls and boys in these ways.

The third way shown here of expressing that ratio is a fraction. That fraction can be simplified of course by dividing both the top and bottom of the fraction by the same number.

And the fraction can also be turned into a decimal by dividing the top by the bottom.

The golden ratio, generated from the Fibonacci series, is: 1.618…

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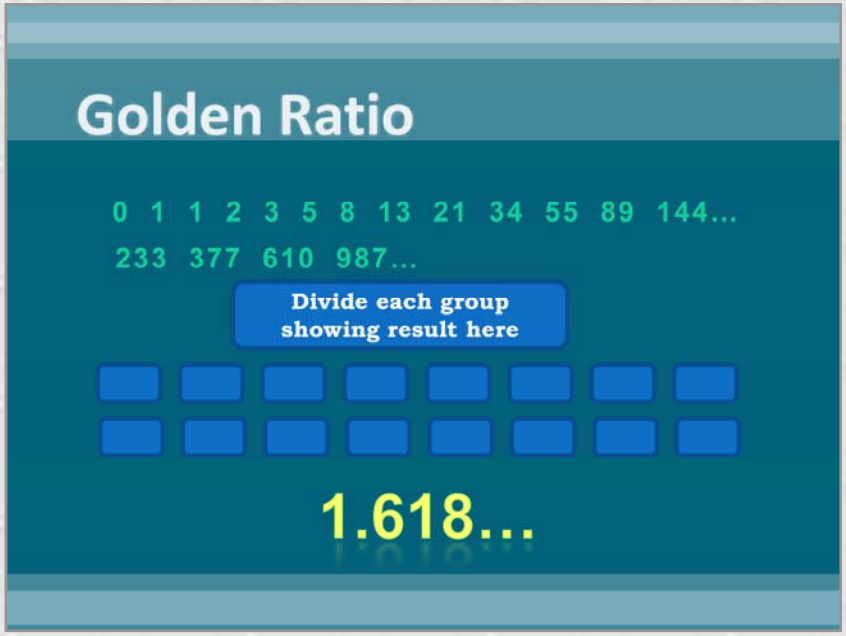

PROGRAMMING NOTES

- Cross out 0 and 1 with narration of 4th paragraph
- Show calculations in center blue box, with results out to 5 decimal places
- Put results into smaller blue boxes below
- Show next 5 numbers in Fibonacci series with 6th paragraph of narration, and get rid of three dots after 144
- Highlight three dots after 1.618 during 7th paragraph
- Highlight three dots after 987 during 8th paragraph

Notice that the golden ratio ends with three dots. We'll learn more about why that is true in just a few minutes.

First…let's look at how the golden ratio was calculated using the Fibonacci series.

As you now know, a ratio is a comparison of the size of two numbers. It can be calculated by dividing the larger number by the smaller number.

Ignoring the ratio of 1 to 0, since we can't divide a number by zero, let's figure out the ratios between the next 12 numbers in the series.

What do you notice about these ratios?

Let's continue by calculating the ratios of the next 5 numbers in the series.

If we continued this forever, calculating the ratios between the never-ending number of the Fibonacci series, the result would get closer and closer to, but never exactly reach 1.618. That is why the golden ratio is displayed with three dots after it.

Likewise, notice the three dots after the numbers in the Fibonacci series. Those dots indicate that you could never reach the last number in the Fibonacci series. You can always calculate another number by adding together the two previous numbers.

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PROGRAMMING NOTES

- Show stick figure drawing with arms and legs out of proportion at the beginning of the 2nd paragraph
- Then have real person photo appear next to it at the end of 2nd paragraph
- Show block or Lego building with windows and doors out of proportion at the beginning of 3rd paragraph.
- Show photo of house at the end of 3rd paragraph.
- With the 5th paragraph, show several photos of art and architecture with the golden ratio identified and labeled.
- Fade out images and leave one rectangle.
- Bring up “Golden rectangle” text

Where do you notice ratios in the world? And why does it matter if the ratio is “golden” or something else?

Think about when you draw a person. If you draw the arms longer than the legs, the person will look a bit funny since the ratio between the arms and legs is different than what occurs on real people.

Likewise, when you build a house with blocks or Legos, if the windows are bigger than the doors, the ratio between those two objects will be different than what is common, and the house will look a little strange.

When the ratios between two objects or two parts of an object are different than expected, we say that they are “out of proportion.” Our brains are constantly measuring and comparing things, and we know when the ratios or proportions don’t match our expectations.

Apparently, one ratio is particularly pleasing to our eyes. The golden ratio appears over and over in art and architecture around the world. Sometimes the artist or architect has made a conscious decision to use the ratio. Other times, it happens unconsciously, with the discovery and measurement of the ratio being noticed by critics and scientists, even though the artist or architect wasn’t aware of it.

Rectangles in which the ratio of the sides is 1.618 are referred to as golden rectangles.

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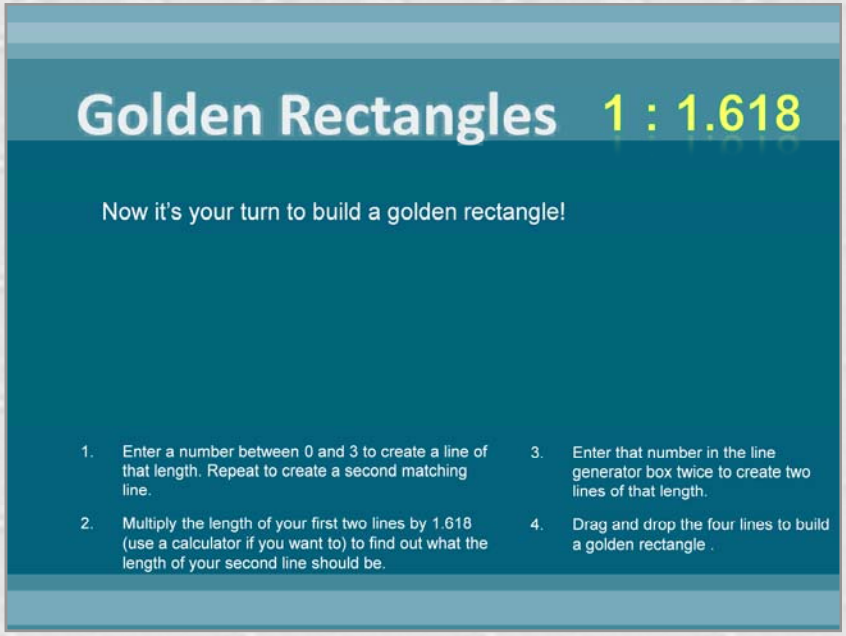

Now it's turn. Build a golden rectangle following the directions on the screen.

PROGRAMMING NOTES

- Need to create a function where when a number is entered, a line of that many inches is drawn on screen.
- Also need to give learners ability to drag and drop lines, permitting them only to intersect at right angles.

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Now that you have built your own golden rectangle, see if you can recognize golden rectangles in art and architecture.

Take a look at the pictures and see where you can find golden rectangles, ones whose sides, if you measured and compared them, would result in the golden ratio of 1.618.

When you think you have found a golden rectangle in one of these pictures, hover your mouse over the image to find out if you are correct.

PROGRAMMING NOTES

- Show pictures from art and architecture with golden rectangles.
- When learner hovers mouse over pictures, display overlay of rectangles.

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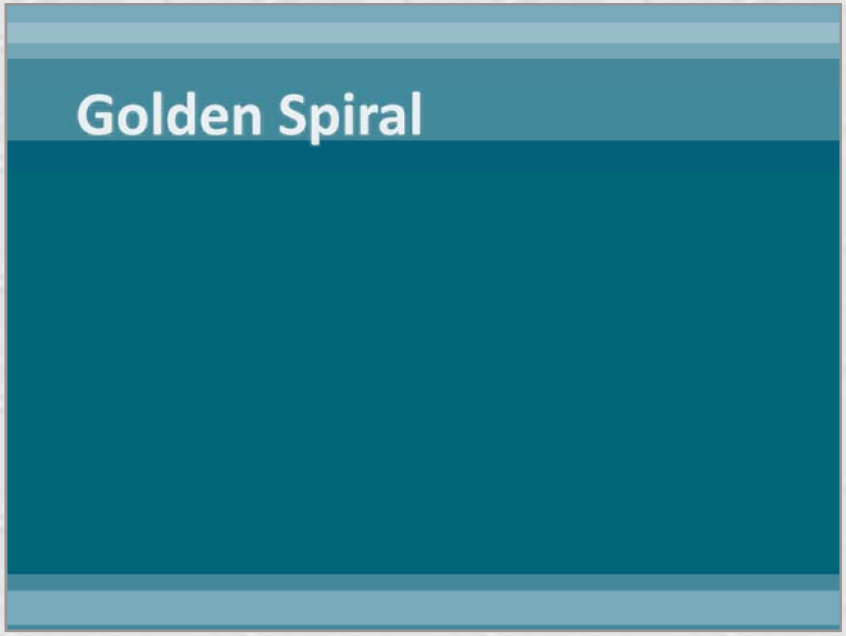

Take a look at what happens when squares whose sides follow the Fibonacci series are assembled in a certain way.

If you connect all these squares, drawing a line that creates a fourth of a circle in each square, the result is the golden spiral.

PROGRAMMING NOTES

- Demo showing squares of Fibonacci series appearing and being assembled next to each other; then a quarter circle being drawn through all of the squares.
- **Use this video as a model:** http://library.thinkquest.org/27890/theSeries6a.html

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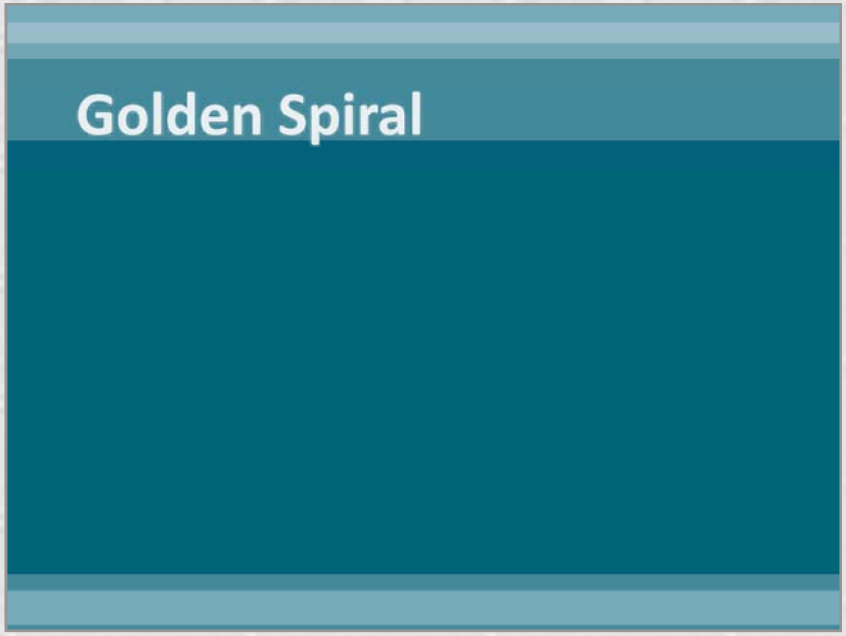

You can find golden spirals in seashells, birds' beaks, tigers' claws, and many other places in nature.

PROGRAMMING NOTES

- Show nature photos
- Overlay with golden spirals drawn on a time delay
- Play music throughout this screen

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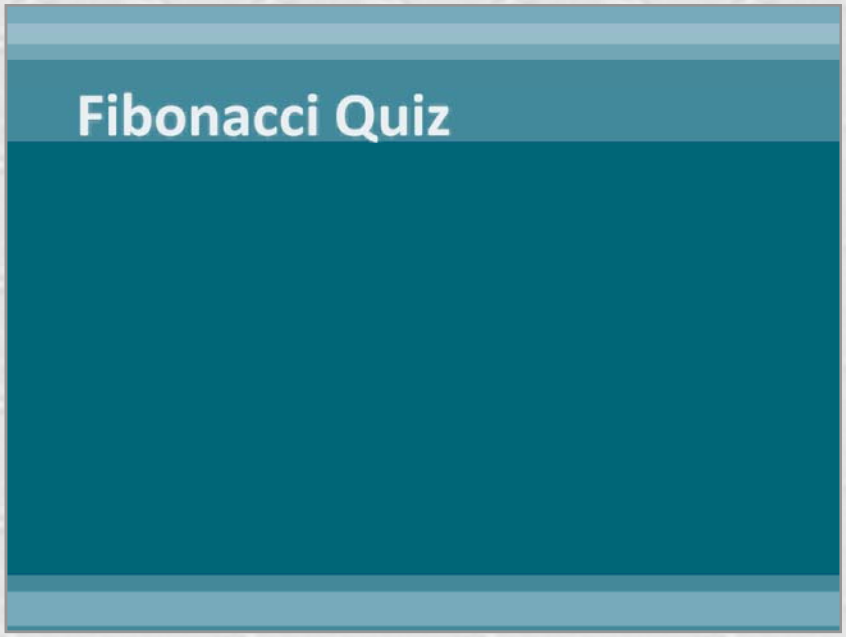

Click on each petal of this flower to answer a question about Fibonacci numbers.

When you have correctly answered all the questions, click on the Next button to continue.

PROGRAMMING NOTES

- Show picture or flower with either 5 or 8 petals.
- Click on each petal to answer a question addressing one of the learning objectives
- Give correct/incorrect feedback on each (with “try again” for incorrect answers), and add highlight color to petal once question has been answered correctly.

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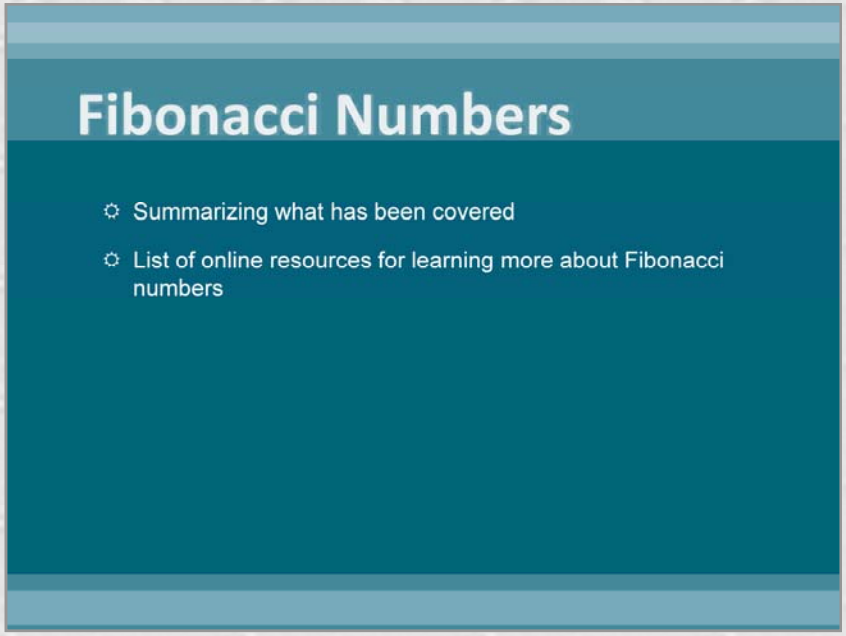

PROGRAMMING NOTES

- Resources to consider including:
  - http://www.youtube.com/watch?v=fuCPXzAhNM4&feature=related

What you have learned about the Fibonacci series of numbers, the golden ratio and golden rectangles is just the beginning of all that you could learn about Fibonacci numbers.

You have learned:

- Who Fibonacci was
- How to calculate the Fibonacci series
- Where you can find Fibonacci series numbers in nature
- What a ratio is
- What the Golden ratio is
- Where you can find the Golden ratio in art and architecture
- What the Golden spiral is
- Where you can find the Golden spiral in nature

If you are interested in learning more about Fibonacci numbers, take a look at some of the resources listed on this screen.

If you want to go back to the beginning of this lesson to review what you have learned, click the “Start Over” button.