**The Fibonnaci Sequence**

Right. Good morning everybody. How are you today? Today, I'm going to try and talk to you for 10 minutes about the Fibonacci sequence. This is actually very interesting. Right. Here we go.

Ok. What do these numbers have in common? 1 1 2 3 5 8 13 21 34 55 and so on. What do they have in common? Well, that is the Fibonacci sequence. How do those numbers go together? What's the pattern? Well, you probably already know. One one. One plus one is two. One two. One plus two is three. Two three. Two plus three is five. Three five. Three plus five is eight and so on and so on, ad infinitum. You can work these numbers out easily. Well, you have this formula which I'm going to put here. Fn=Fn-1+Fn-2. Basically, any Fibonacci number equals the sum of the two numbers in the sequence before it. It's pretty easy to work out. You can work out any Fibonacci number you like.

Now, this sequence was discovered in India, about 200 B.C., by a mathematician called Pingala. A lot of maths that we know comes out of India, of course. The numbers we use today, even though they’re called Arabic numbers, actually came from India. And, sine, cosine and tangent also come from India, of course. Maybe we should do that as a talk one day. Anyway, the sequence was known about of course, but it was popularized by Leonardo da Pisa. He was also known as Filius Bonacci. “Filius” means “son”, “son of the Bonacci family”. Filius Bonacci, who was also called Fibonacci. He published a book in 1202, which had … it was a big book, full of mathematical questions and problems and solutions. One of the thought … one of the thought experiments he posed was the Fibonacci sequence. It was only a very small section on one page, but since then it became well known as the Fibonacci sequence.

Now, his thought experiment was this. It involved rabbits. Now what are rabbits well known for? Rabbits are known for breeding of course. So, this is how his Fibonacci sequence goes. He has a field and in that field he has two rabbits, a boy and a girl. Male and female. Okay? Now, these … this pair of rabbits breeds … reproduces at the rate of one set of children every month. Okay? And, each time they reproduce they have one boy and one girl in a pair. Those are the rules of the experiment. Okay. So, let's put that over to the side, over here. I’m going to put that right here. Hope you can see it. So, if we look in the beginning, we have the pair … the male and the female. They don't do anything for the first month. So, in the first month we have one. In the second month we still have the same pair, which is one again. Now, in the second month, of course, they mate. They have their children. So, when we come down to the third month, we now have the original pair, plus we have their children. So, now we have two pairs of rabbits. Then we go into the third … fourth month of course. The original pair have another set of children, but their original children are not ready to have children yet, so they stay the same. And now we have three pairs of rabbits. We have the original rabbits, the original rabbits’ children, and the original rabbits’ second set of children. Then we go down to the fifth month. Now, here it starts to get a bit confusing. We have the original rabbits again. They have another set of children. We have the original rabbits’ children. They have a set of children. We have the original rabbits’ second set of children. They have a set of children. So, now we have five sets of rabbits. And then we come down to the sixth month. Well, I'm not going to explain it. You can see very clearly from looking at this, we now have eight pairs of rabbits. And if we carry this on down, we have 8 13 21 34 and so on, ad infinitum. Now, of course this wouldn’t actually work. It's a thought experiment. It wouldn’t actually work because with rabbits, rabbits … well rabbits die, of course. So, this number would never keep going up. It would reach a point where it would stabilize, obviously, but that's not part of the thought experiment.

Okay. So, let's try and work out how this is calculated. Okay, if we put all of these numbers into squares and we lay them out like this, you’ve probably seen this before. You’ve probably seen it with the spiral line on it as well. It’s quite a famous image. Now, if we take these squares, we can use this to work out a formula. What we do is, we add the a and the b side. So, a is 55 here, and the b is 13 plus 21. So, we get 55 plus 13 plus 21, divided by the a side, divided by 55, which gives us … you ready? Quick calculation … 1.618033988 and onwards. Which we can shorten to 1.61. This 1.61 is actually known as the Golden Ratio. The Golden Ratio is written as this symbol, which is the Greek letter phi. Why phi? Well, it's given the letter phi because it comes from the sculptor … the Greek sculptor Phidias, who made a lot of famous sculptures. One of them, of course, was the Statue of Zeus. If you've heard my talk about the Seven Wonders of the World, one of them, of course, was the Statue of Zeus, and Phidias made that. He was a famous sculptor, so he used the Golden Ratio a lot in his work. So, it's been given his name. Phi. Okay. Now, with the Golden Ratio, you can calculate any Fibonacci number of course, but we're not going to talk about that.

So, let's talk about the Golden Ratio itself. Have you seen it? You have. You just don't know you have, probably. The Golden Ratio is everywhere around us. Architecture. If we look at some buildings. Notre Dame. The Eiffel Tower. The Taj Mahal. All of these buildings are built with the Golden Ratio in mind. What about nature? It occurs in nature. Look at this. A typhoon. A sunflower. A snail shell. A pinecone. And then, of course, what about people? It occurs in our bodies. If you look at a person's body: from the ground to the belly, from the belly to the neck, and the neck to the top of the head, it's the Golden Ratio. If you look at your arm, it's the Golden Ratio. If you look at your fingers, it's the Golden Ratio. In fact, because of the Golden Ratio you can curl your hand like that. If these fingers weren’t proportioned … if the bones weren't proportioned as they are, you couldn't make a fist with your hand. The Golden Ratio. Faces. Faces tend to follow the Golden Ratio. People that we think are beautiful. Ha. No. Probably not. Famous Hollywood stars, models, people that we think are beautiful, their faces actually match the Golden Ratio almost perfectly. In fact, if you go online, there is … I’ll put a link in the description down here …. there is a site you can go to which allows you to upload a photograph of your face and it will calculate how closely your face matches the Golden Ratio. My score was not very high. I won't tell you exactly what I got, but it wasn't very good. Never mind. Don't worry about that. Art of course. Artists famously used the Golden Ratio. If you want to make a good photograph, you're supposed to follow the Golden Ratio. Logos. A lot of companies use the Golden Ratio in the design of their logos. Many, many logos in the world are designed specifically with the Golden Ratio in mind. Why? Because it gives us comfort. Because it's something we see all around us. Because we associate it with beauty.

Now, why does the Fibonacci sequence occur in nature? Well because it is the best position. Let's look at the sunflower again. It is the most economical position … it’s the best position for all of the petals on the sunflower, for all of the seeds in the center of the sunflower, to get access to sunlight. If it was any other sequence of numbers, they would cover themselves, but because it's 1 1 2 3 5 8 13, there is always enough space between them for them to get sunlight, of course. With anything like that it's not … obviously it's just evolved that way. So, why do we use the golden number in our architecture? Why do we use it in our art? Is it because we knowingly put it there? Or is it because we unconsciously put it there? We see this Golden Ratio all around us and we know if something fits the Golden Ratio perfectly it puts us at ease, it gives us a sense of calm, and we associate it with beauty. So, of course, it's obvious that we see this all around us, we want to put it into our buildings. We want to put it into our art. We want to put it into our logos. We want people to associate the things we make with beauty. We do it consciously, we do it unconsciously. Next time you have a walk around, look for the Golden Ratio. Look for the Fibonacci sequence. You'll see it in many places that you don't expect. It's a lot of fun.

Okay. Thank you for watching. That was quite interesting. I hope you understood that. Don't forget, as always, if you click in the link below here you can find the transcript for this talk. You can find questions, multiple choice, and essay type. You can find answers for them, you can find sample essays down there. Please have a look. Click on the link, try the questions, try the essay questions. You can write, you can improve your English. If you want to practice speaking, you can answer the essay questions out loud. You can use them as speaking topics. If you practice, your English will improve. If you liked this talk, click “like”. If you want to share it, please share it. If you want to subscribe, please subscribe. That button’s over here somewhere, it looks like my head. All right. Thank you for watching. I'll see you again next week. Goodbye.

**The Fibonnaci Sequence – Questions**

1.Where was the Fibonacci sequence discovered?

A: Italy

B: Arabia

C: Iraq

D: India

2. How many pairs of rabbits are there in the fifth month?

A: 2

B: 3

C: 5

D: 8

3. What is 1.61 known as?

A: Pi

B: The Golden Ratio

C: The wonderful number

D: Sine

4. Why is it also called “phi”?

A: Because it is the 21st letter of the Greek alphabet.

B: Because it was discovered by a Greek mathematician.

C: Because it is a fine number.

D: Because it is taken from Phidias, a Greek sculptor.

5. What is a good example of the Golden Ratio in the human body?

A: The length of your fingers.

B: The size of your nose.

C: The size of your feet.

D: The distance round your waist.

6. Why does the Fibonacci sequence occur in nature?

A: Because it has been genetically bred.

B: Because it is the most economical position.

C: Because it is beautiful.

D: Because it is consciously created.

7. Fibonnaci came up with his sequence as part of a thought experiment. As computer systems become more advanced, will there be a need for people to do math?

8. Do you think we consciously or unconsciously use the Golden Ratio in our art?

9. Do we take the discoveries of the past for granted?

10. Companies try to manipulate us by using the Golden Ratio in logos and advertising. Can you explain another way in which we are manipulated by big companies?

**The Fibonnaci Sequence – Answers**

1. D 2. C 3. B 4. D 5. A 6. B

7. Fibonnaci came up with his sequence as part of a thought experiment. As computer systems become more advanced, will there be a need for people to do math?

 As computer systems progress, there will be a need for math, but it will evolve from a practical need to a theoretical need. In the near future, more people with the ability to do math and create algorithms will be required to program the new race of computers. However, within a few decades, these computers will have become too advanced for humans to be able to program them and they will have to be programmed by other computers. Once this happens, math will become something that people will do for fun, in a philosophical manner. It will be an end unto itself. People will still pose thought experiments and try to prove problems, but they will do so merely for the sake of doing it, knowing that a machine could solve those same problems in nanoseconds. Then, once we have reached that level, the study of math could become an art form.

8. Do you think we consciously or unconsciously use the Golden Ratio in our art?

 I think some people use it consciously and some people use it unconsciously. There are two kinds of artists: those who have studied the theory of art and those who just create. For the former, the use of the Golden Ratio would be taught in classes. It might not be termed “Golden Ratio”, but the students of art will be taught about composition and how to structure a canvas. Photographers learn that a photo should be broken up into sections that follow the Golden Ratio. Sculptors learn that their proportions should follow the Golden Ratio. These kinds of artists use it knowingly. And then, the second kind of artists, probably use it unknowingly. The seek to recreate nature. They seek to create art that is pleasing to the eye. They seek to create art that makes us feel comfortable, and that is what the Golden Ratio does. So, in order to make their art pleasing, they use the Golden Ratio.

9. Do we take the discoveries of the past for granted?

 I believe that we do, and I believe that it is natural that we do because not only must any new invention or discovery stand on a tower of all the discoveries that went before it, our civilization is built on many millions of discoveries.

The discovery of flight, for example, would be nothing with the discoveries of cogs, gears, wire, wood bending techniques, canvas, aerodynamics, the properties of different types of wood, gravity and so many others. Each one of these discoveries was necessary for the discovery of flight. Without any of them, man would not have flown. When the Wright Brothers sat atop their plane, did they give thanks for all of these other discoveries? No, they didn’t. And that is perfectly natural because any civilization that is inventing or innovating must look forwards. Any inventor knows this. They are working to understand or utilize the world around them and, just as they use the discoveries of the past, they know that their discoveries will, in turn, be used in the future.

 As our civilization enters the 21st century, we have been discovering and inventing for close to 100,000 years. The first major discoveries would have been the wheel and fire, hunting tools and farming implements, language and then writing. The number of discoveries and inventions that have come before us are too great to be counted. When we do anything, were we expected to be grateful, we would be unable to list the things we are grateful for. There are simply too many of them.

 However, that being said, it is good to be grateful for where we are in life and to be grateful for all of the millions of people who have worked and toiled for us to be where we are.

10. Companies try to manipulate us by using the Golden Ratio in logos and advertising. Can you explain another way in which we are manipulated by big companies?

 There are so many methods that companies use to manipulate us that one could write a thesis about it. Let’s confine ourselves to talking about the use of color in marketing. It is well known that different colors have different effects on us. The color red is an activating color and it is used very often when advertisers want us to do something. It fills us with a sense or action and urgency, pushing us to make a choice that might not be rational.

 Advertisers also use a mix of many different colors to reduce the risk that we might think logically about what they are trying to get us to buy. Simple color schemes of just a few colors allow us to calmly think about a purchase. However, a mix of bright colors stop us being able to think. Sites that have a mix of vivid colors have a higher rate of sales than less colorful sites.

 There are many other ways that companies manipulate us with color. We have to be careful.