NUMERACY LAB: 12 REAL-LIFE MATH EXPERIMENTS
賴爸爸的數學實驗：12 堂生活數感課

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Math can sometimes seem abstract with all its numbers and formulas, but math is everywhere and touches so many parts of our lives. Let's see math concepts in the real world with these 12 fun experiments from Lai I-Wei, the experienced advocate behind Numeracy Lab.

Did you know pineapples grow according to the pattern of the Fibonacci series? Did you know that if you fold a piece of A4 paper in half, the ratio of the smaller rectangle would be the same as the bigger one? We can find math anywhere in our lives, it's not just a series of abstract formulas or a headache-inducing subject at school.

With fun comics and hands-on experiments, the lessons in *Numeracy Lab: 12 Real-Life Math Experiments* help children build a concept of math that relates to their own life experiences. The questions at the end of each lesson also encourage children to think further about the concepts. In this book, author Lai I-Wei shares his own experiences in learning math, hoping to inspire the readers to think more and obtain the numeracy skills that could help them to make better judgments when faced with statistical information.

Lai I-Wei 賴以威

Lai I-Wei is an assistant professor of computer science at National Taiwan Normal University, and a co-founder of the mathematics literacy platform Numeracy Lab. Alongside promoting math education, he is also an author of several novels. He believes that writing a love story is like constructing a beautiful math problem:

human relationships are equations, probabilities lurk behind chance encounters, and conclusions are variables waiting to be solved.

Content

1 Can pineapples count?

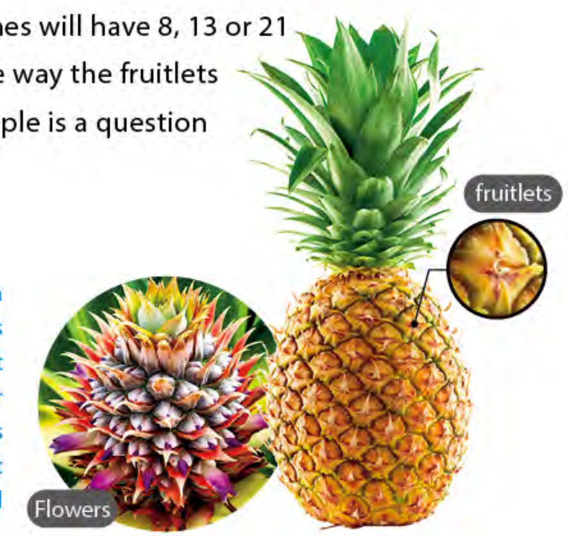
The wonderful, beautiful laws of nature are hard to put into words, but they can be written in sequences.

When maths teachers are asked "what use is maths?", they usually say:

"Maths can help us discover the patterns behind things."

You might think of a pattern as being decorative. For example, if your mother has a dress with a simple pattern on it, say of checks, or flowers or hearts. From a distance, the pattern looks quite complex, but close up, it's the same thing repeated many times.

The pattern on the dress is repeated in a certain way, and this is what we call a law. Nature is full of things that are made in a certain way: for example, a honeycomb is made of regular hexagonal cells, and a pineapple is covered with a scale-like skin. Each of those scales on the pineapple is a fruitlet, and the fruitlets are arranged in lines that spiral across the body of the pineapple. Each of those lines will have 8, 13 or 21 fruitlets. In other words, the way the fruitlets are arranged on the pineapple is a question of mathematics!



▶ We think of a pineapple as a single fruit. In fact, a pineapple is made of many smaller fruits that have grown together. First, a cluster of flowers bloom. Then, small fruits grow where the flowers were, but instead of growing as individual fruits, they merge together.

The fruitlets tell us about the growth pattern of the pineapple. We can see the same growth pattern in other plants and animals. What's really amazing is that the mathematician Leonardo Fibonacci found a mathematical formula to describe this pattern, which we now call "the Fibonacci sequence". A sequence is a series of numbers that follow a particular pattern, and make a law.

The rules of the Fibonacci sequence are simple:
the first two numbers are 1, and after that,
the next number is the sum of the previous two numbers.

With those two rules, you can write down the rest of the sequence: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233…

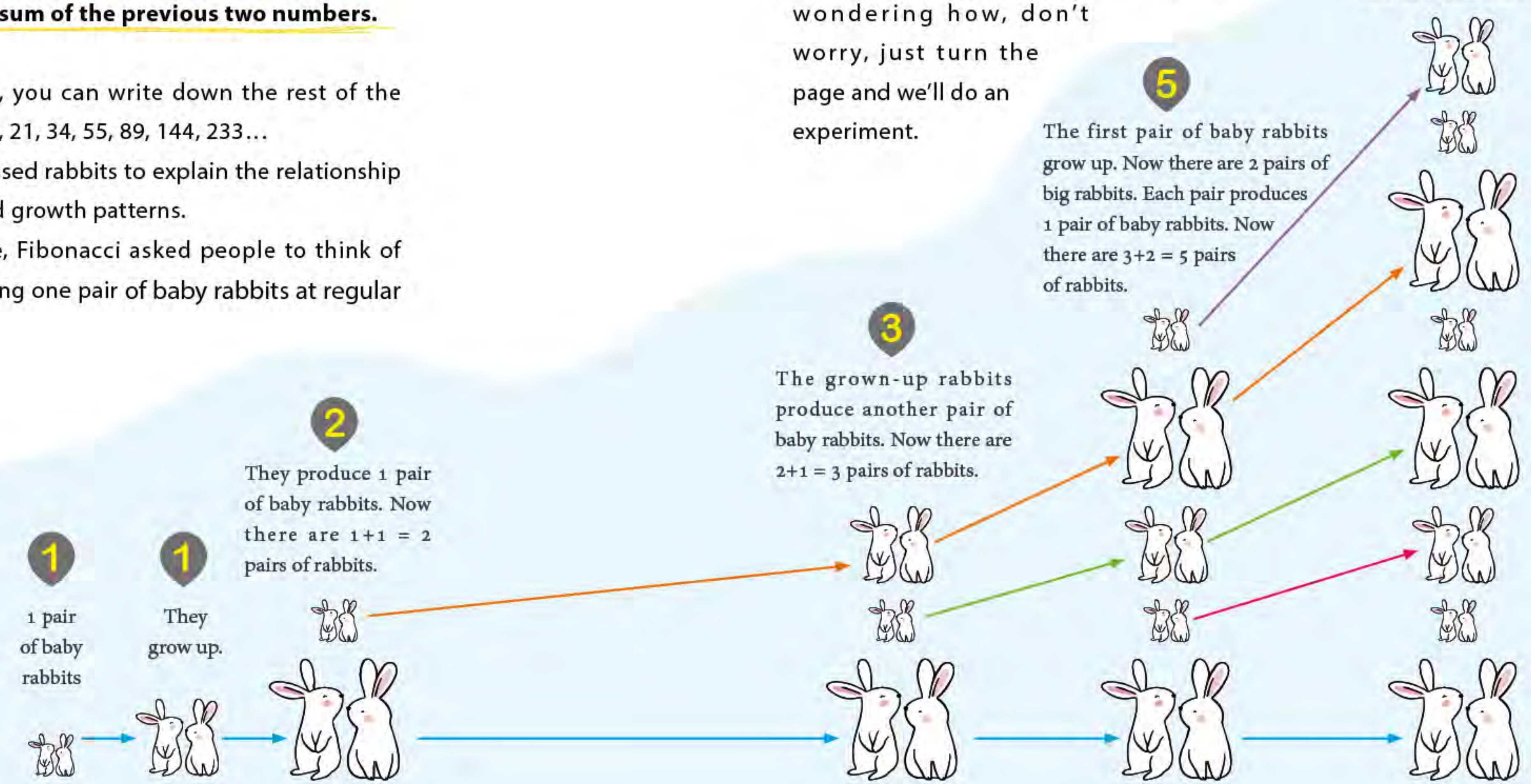
Back then, Fibonacci used rabbits to explain the relationship between this sequence and growth patterns.

In his rabbit example, Fibonacci asked people to think of one pair of rabbits producing one pair of baby rabbits at regular intervals. When the baby rabbits matured, they also started producing one pair of baby rabbits at the same regular intervals. That's a lot of pairs of rabbits! In the chart below, you can see how the number of rabbits would increase. (This isn't how rabbits actually breed, but it was Fibonacci's way of showing how the sequence works.)

The fruitlets on the pineapple have exactly the same growth pattern. If you're wondering how, don't worry, just turn the page and we'll do an experiment.

Fibonacci's Rabbits

If a pair of newborn baby rabbits grow up and have one pair of baby rabbits, and those baby rabbits grow up and have one pair of baby rabbits, and all the pairs of rabbits continue to produce one pair of baby rabbits at the same regular intervals, how will the number of rabbits increase?



Mathematical experiment

1. You will need a pineapple and two different color sticky tapes.

2. On the pineapple find a line of fruitlets that spirals from top left to bottom right of the pineapple, and mark the line with a piece of sticky tape.

3. Using the same color sticky tape, cover all the spirals going from top left to bottom right of the pineapple. When you have marked them all, count how many spirals you marked.

4. Then take the other color of sticky tape, and mark all the spirals going from top right to bottom left of the pineapple. When you have marked them all, count how many spirals you marked.

Not only rabbits and pineapples

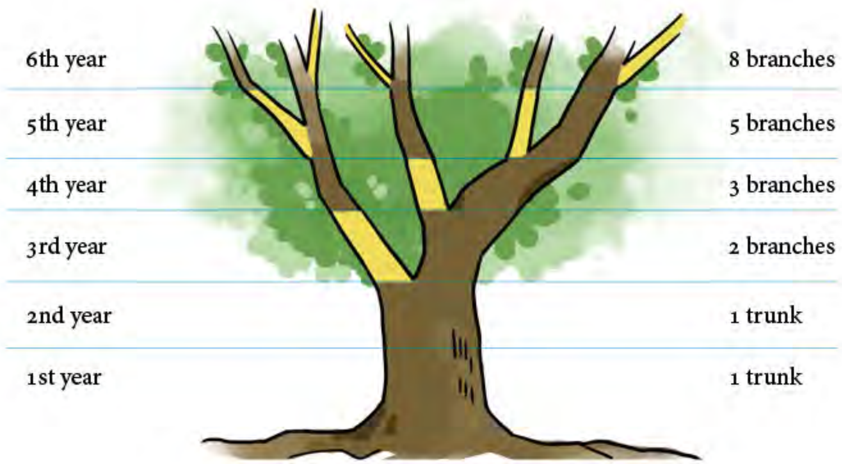
When you have marked and counted the spirals on the pineapple, you should find that there are 8 or 13 spirals. If the fruitlets are very close together, you might be able to count 21 spirals.

These three numbers are the 6th, 7th and 8th numbers in the Fibonacci sequence (1, 1, 2, 3, 5, 8, 13, 21, 34…). If you didn't know this, you might wonder why there are always 8, 13 or 21 spirals on a pineapple. Well, pineapples can't count, and it isn't a coincidence. It's because living things naturally grow according to a particular pattern: they need time to grow and then to produce the next generation.

Note! In this case, "next generation" does not only mean the parent-child relationship. It can also refer to the order in which petals grow on a flower or branches grow on a tree.

Mathematics is just a way of describing laws like this one. You can find the Fibonacci sequence everywhere in nature, not just in pineapples and rabbits.

Let me give you another example. When I was a child, and had to paint a tree in art class, I would start with the trunk, then paint two branches, which then branched into two smaller branches. My brushstrokes would get thinner and thinner as I went from 1 to 2, 4, 8, 16 and so on. But I was never happy with the trees I painted. At the time, I concluded that I had no artistic talent, but later I realized there was another reason. Back then, I hadn't looked closely enough — I hadn't seen that the growth pattern for trees follows the Fibonacci sequence.



Does this example help you to understand that "mathematics can help us discover the patterns behind things"? Some people don't like mathematics because they feel it is too abstract, and they can't see its relevance to their lives. But if you think about it the other way round, you will find that

It is precisely because mathematics is abstract, that it's in many different things, and can describe the patterns that exist behind all kinds of things.

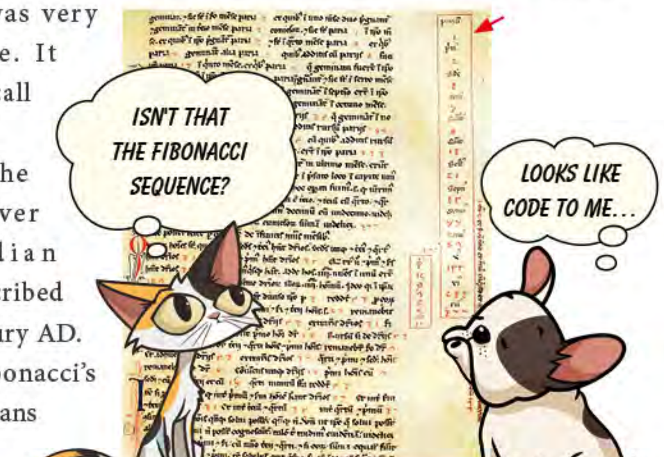
Mathematics is not "directly" relevant to life, but if you look closely, you will find mathematics everywhere in life.

Extension

Who was Fibonacci?

Fibonacci was born in Italy around 850 years ago. His interest in mathematics was inspired by his father, a merchant, who needed to make calculations. In those days, Europeans used numbers in a different way from today. Fibonacci often accompanied his father on business trips around the Mediterranean, where he came into contact with Eastern arithmetic. He found it very easy to use, and later introduced the Arabic numeral system in his book *Liber Abaci* (Book of Calculation), which was very influential in Europe. It included what we now call the Fibonacci sequence.

Fibonacci wasn't the first person to discover this sequence. Indian mathematicians had described it as early as the 6th century AD. But it was thanks to Fibonacci's introduction, that Europeans first became aware of it.



Pages from *Liber Abaci* (Book of Calculation)

Things to think about

1. There are many more interesting things about the Fibonacci sequence. For example, if you use a calculator and divide each number in the sequence by the previous number — e.g. 1÷1, 2÷1, 3÷2, 5÷3, 8÷5, 13÷8 and so on — you will find that the higher the numbers, the closer the result will be to 1.618, which is known as The Golden Ratio — the formula for beauty. Try it and see for yourself!
2. Can you see the Fibonacci sequence anywhere else?