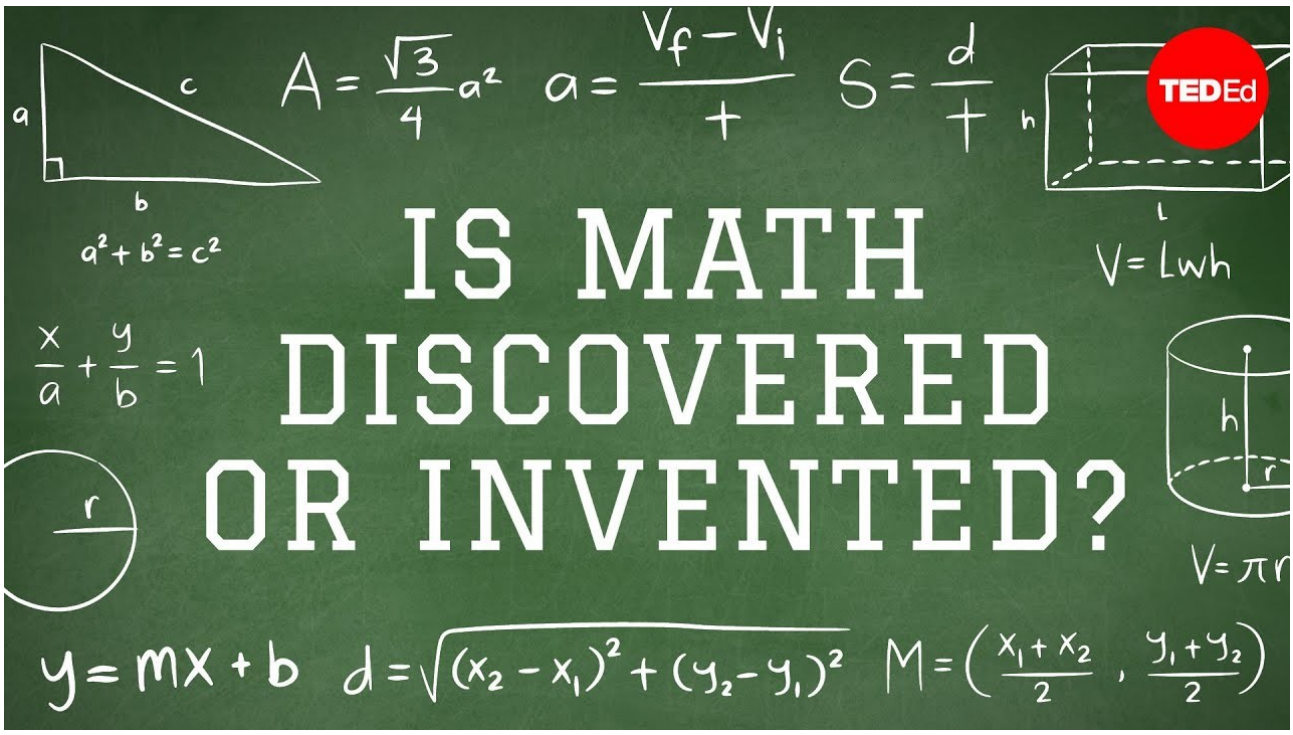
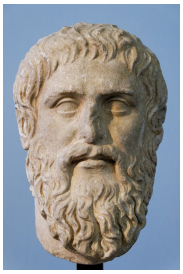


1. What would you say – is mathematics discovered or invented?

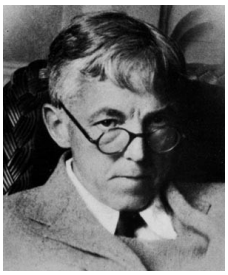
2. Pay attention to the following figures.

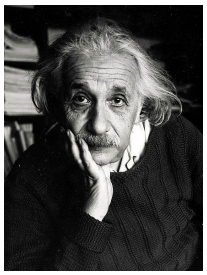
a. Match the name and the picture.







Pythagoras, Plato, Euclid, Leopold Kronecker, David Hilbert, Henri Poincaré, Eugene Wigner, Gottfried Hardy, Fibonacci, Bernhard Riemann, Albert Einstein

b. Put them in the right chronological order.

Pythagoras (5th c BCE), Plato (4th c BCE), Euclid (3rd c BCE), Fibonacci (1170-1250), Leopold Kronecker (1823-1891), Bernhard Riemann (1826-1866), Henri

Poincaré (1854-1912), David Hilbert (1862-1943), Gottfried Hardy (1877-1947), Albert Einstein (1879-1955), Eugene Wigner (1902-1995)

c. Discuss with your partner: which side do you think their maths would be on? Why? Which argument would they use? Do you think about other points to make?

Maths discovered	Maths invented
The Pythagoreans of 5th century Greece believed numbers were both living entities and universal principles. They called the number 1 "the monad," the generator of all other numbers and source of all creation. Numbers were active agents in nature. **Plato** (4th century BCE) argued mathematical concepts were concrete and as real as the universe itself, regardless of our knowledge of them. **Euclid** (3rd century BC), the father of geometry, believed nature itself was the physical manifestation of mathematical laws. In 1960, Nobel Physics laureate **Eugene Wigner** coined the phrase, "the unreasonable effectiveness of mathematics," pushing strongly for the idea that mathematics is real and discovered by people. Wigner pointed out that many purely mathematical theories developed in a vacuum, often with no view towards describing any physical phenomena, have proven decades or even centuries later, to be the framework necessary to explain how the universe has been working all along. For instance, the number theory of British mathematician Gottfried Hardy, who had boasted that none of his work would ever be found useful in describing any phenomena in the real world, helped establish **cryptography**. Another piece of his purely theoretical work became known as the Hardy-Weinberg **law in genetics**, and won a Nobel prize. **Fibonacci** (1248) stumbled upon his famous sequence while looking at the growth of an idealized rabbit population. Mankind later found the sequence everywhere in nature, from sunflower seeds and flower petal arrangements, to the structure of a pineapple, even the branching of bronchi in the lungs. The non-Euclidean work of Bernhard Riemann in the 1850s was used by **Einstein** in the model for general relativity a century later. Mathematical **knot theory**, first developed around 1771 to describe the geometry of position, was used in the late 20th century to explain how DNA unravels itself during the replication process. It may even provide key explanations for string theory.	**Leopold Kronecker** 1855 a professor of mathematics in 19th c Germany: "God created the natural numbers, all else is the work of man." During mathematician **David Hilbert**'s lifetime, there was a push to establish mathematics as a logical construct. Hilbert attempted to axiomatize all of mathematics, as Euclid had done with geometry. He and others who attempted this saw mathematics as a deeply philosophical game but a game nonetheless. **Henri Poincaré**, one of the fathers of non-Euclidean geometry, believed that the existence of non-Euclidean geometry, dealing with the non-flat surfaces of hyperbolic and elliptical curvatures, proved that Euclidean geometry, the long standing geometry of flat surfaces, was not a universal truth, but rather one outcome of using one particular set of game rules. **Gottfried Hardy** had boasted that none of his work would ever be found useful in describing any phenomena in the real world.

3. Check whether you were right by watching the video available on Célène.

Script:

Would mathematics exist if people didn't?
Since ancient times, mankind has hotly debated whether mathematics was discovered or invented. Did we create mathematical concepts to help us understand the universe around us, or is math the native language of the universe itself, existing whether we find its truths or not?
Are numbers, polygons and equations truly real, or merely ethereal representations of some theoretical ideal?

The independent reality of math has some ancient advocates.
The Pythagoreans of 5th century Greece believed numbers were both living entities and universal principles. They called the number 1 "the monad," the generator of all other numbers and source of all creation. Numbers were active agents in nature.
Plato (4th century BCE) argued mathematical concepts were concrete and as real as the universe itself, regardless of our knowledge of them.
Euclid (3rd century BC), the father of geometry, believed nature itself was the physical manifestation of mathematical laws.

Others argue that while numbers may or may not exist physically, mathematical statements definitely don't. Their truth values are based on rules humans created. Mathematics is thus an invented logic exercise, with no existence outside mankind's conscious thought, a language of abstract relationships based on patterns discerned by brains, built to use those patterns to invent useful but artificial order from chaos.
One proponent of this sort of idea was Leopold Kronecker 1855 a professor of mathematics in 19th c Germany. His belief is summed up in his famous statement: "God created the natural numbers, all else is the work of man."
During mathematician David Hilbert's lifetime, there was a push to establish mathematics as a logical construct. Hilbert attempted to axiomatize all of mathematics, as Euclid had done with geometry. He and others who attempted this saw mathematics as a deeply philosophical game but a game nonetheless.
Henri Poincaré, one of the fathers of non-Euclidean geometry, believed that the existence of non-Euclidean geometry, dealing with the non-flat surfaces of hyperbolic and elliptical curvatures, proved that Euclidean geometry, the long standing geometry of flat surfaces, was not a universal truth, but rather one outcome of using one particular set of game rules.

But in 1960, Nobel Physics laureate Eugene Wigner coined the phrase, "the unreasonable effectiveness of mathematics," pushing strongly for the idea that mathematics is real and discovered by people.
Wigner pointed out that many purely mathematical theories developed in a vacuum, often with no view towards describing any physical phenomena, have proven decades or even centuries later, to be the framework necessary to explain how the universe has been working all along.

For instance, the number theory of British mathematician Gottfried Hardy, who had boasted that none of his work would ever be found useful in describing any phenomena in the real world, helped establish cryptography. Another piece of his purely theoretical work became known as the Hardy-Weinberg law in genetics, and won a Nobel prize.

And Fibonacci (1248) stumbled upon his famous sequence while looking at the growth of an idealized rabbit population. Mankind later found the sequence everywhere in nature, from sunflower seeds and flower petal arrangements, to the structure of a pineapple, even the branching of bronchi in the lungs.

Or there's the non-Euclidean work of Bernhard Riemann in the 1850s, which Einstein used in the model for general relativity a century later.

Here's an even bigger jump: mathematical knot theory, first developed around 1771 to describe the geometry of position, was used in the late 20th century to explain how DNA unravels itself during the replication process. It may even provide key explanations for string theory. Some of the most influential mathematicians and scientists of all of human history have chimed in on the issue as well, often in surprising ways. So, is mathematics an invention or a discovery? Artificial construct or universal truth? Human product or natural, possibly divine, creation? These questions are so deep the debate often becomes spiritual in nature. The answer might depend on the specific concept being looked at, but it can all feel like a distorted zen koan. If there's a number of trees in a forest, but no one's there to count them, does that number exist?