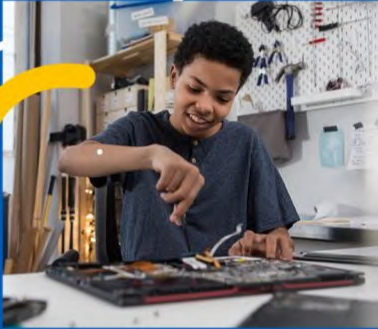


# NEXT ENGINEERS

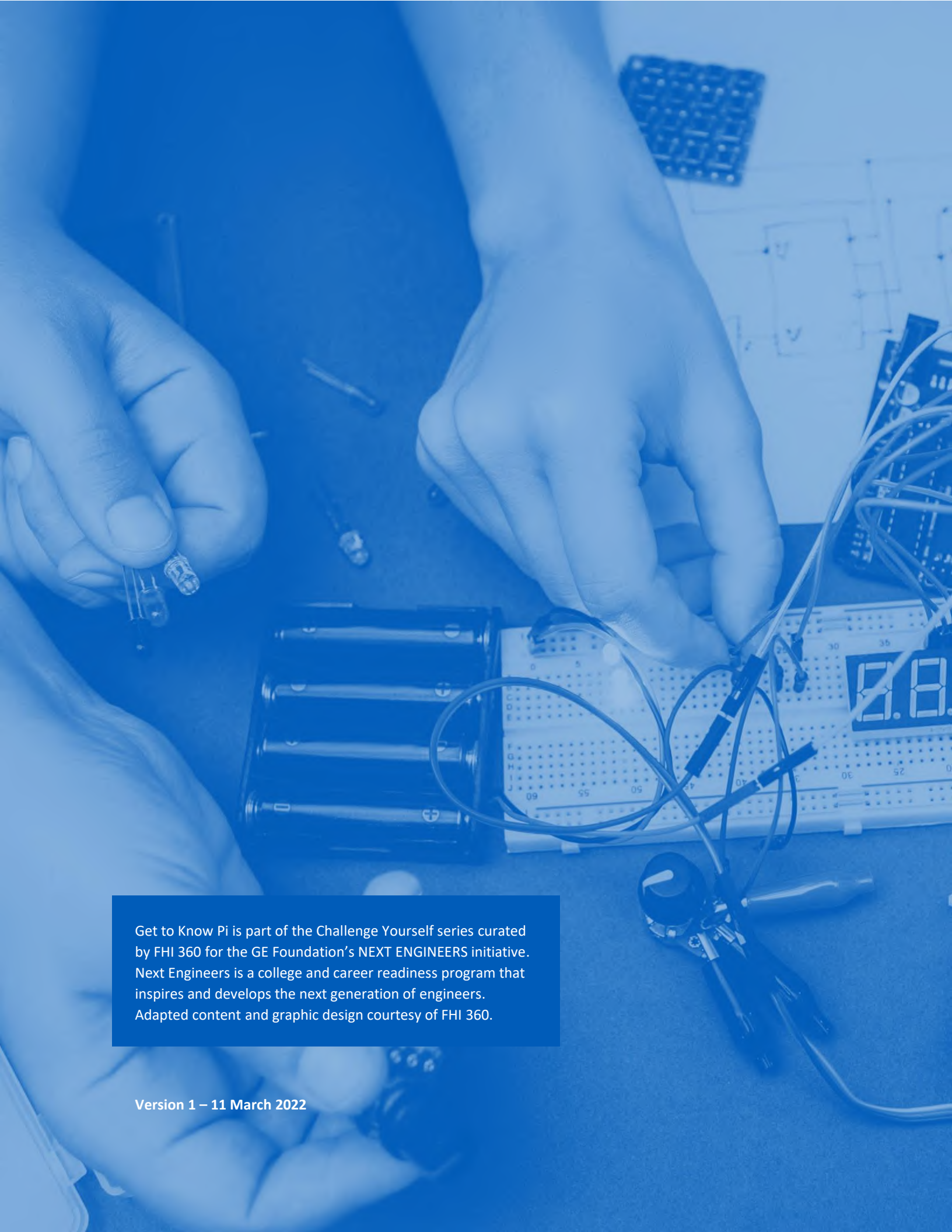


CHALLENGE YOURSELF

Pi Day: Get to Know Pi  
All Engineering



GE Foundation



Get to Know Pi is part of the Challenge Yourself series curated by FHI 360 for the GE Foundation's NEXT ENGINEERS initiative. Next Engineers is a college and career readiness program that inspires and develops the next generation of engineers. Adapted content and graphic design courtesy of FHI 360.

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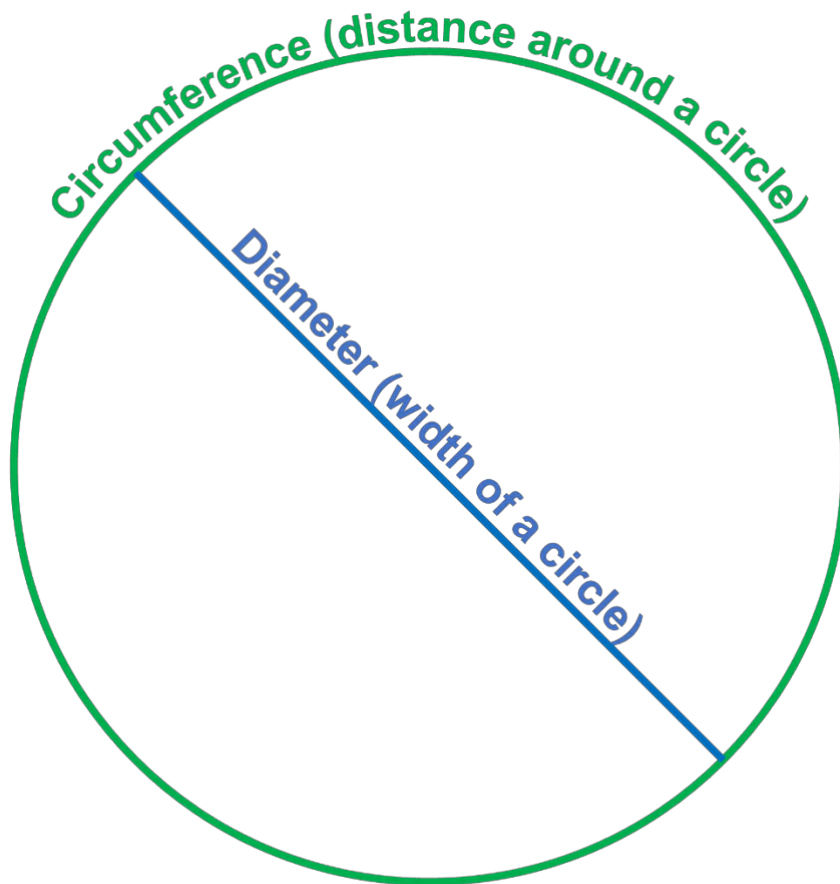
## Get to Know Pi

### NERD OUT

#### What is $\pi$ ?

The number  $\pi$  (denoted by the Greek letter 'pi') is a very special and important number. It is probably one of the best-known numbers in the world. William L. Schaaf, in his book *Nature and History of Pi* notes that "probably no symbol in mathematics has evoked as much mystery, romanticism, misconception, and human interest as the number pi."

$\pi$  is a mathematical constant with an approximate value of 3.14. It is the ratio of the length of the **circumference** of a circle to its **diameter**.



$$\pi = \frac{\text{Circumference}}{\text{Diameter}} \approx 3.14$$

*The definition of  $\pi$  (pi)*



#### GET ACTIVE

$\pi$  is the 16<sup>th</sup> letter in the Greek alphabet, called 'pi'. Pi represents the sound 'p'.

Use the Internet to find out which came first -  $\pi$  the Greek letter or  $\pi$  the mathematical constant?

It does not matter how big or small the circle is,  $\pi$  always has the same value. This is why we call  $\pi$  a **mathematical constant**.

We say that 3.14 is an approximation of  $\pi$  because nobody has ever nor will ever calculate the exact value of  $\pi$ . It is an **irrational number**. This means that the number has a never-ending and never-repeating string of digits after the decimal point.

The first known method for rigorously calculating better and better approximations of  $\pi$  was developed by the Greek mathematician Archimedes of Syracuse in the third century B.C.E. Records suggest that the ancient Egyptians, Babylonians, and Indians all had fairly accurate approximations of  $\pi$  before Archimedes' work.

To date, we have calculated the first 62.6 trillion<sup>1</sup> digits of  $\pi$ . This is far more than we use for any practical purposes. NASA, for example, uses the first 15 or 16 digits to launch rockets and the first 40 digits would be enough for atom-sized accuracy even if the size of the circle was the size of the known universe.

By the way, here are the first 40 digits of  $\pi$ .

3.141592653589793238462643383279502884197

Pi is central to a great deal of mathematics. It crops up in all sorts of interesting places, not just those involving circles and spheres. One example is if you add up all the fractions where the numerator is one and the denominator is a perfect square, the answer turns out to involve  $\pi$ .

$$1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \frac{1}{25} + \dots + \frac{1}{n^2} = \frac{\pi^2}{6}$$

More practically,  $\pi$  is used in quantum mechanics (the study of sub-atomic particles), the study of light and other kinds of electromagnetic waves, and many kinds of engineering.

Watch the video called *The infinite life of pi* (3:44) (<https://www.youtube.com/watch?v=9a5vHXsUvUw>) for an excellent summary of this extraordinary number.

## Discover $\pi$

If you are new to  $\pi$  why not try this quick activity to help you better understand what  $\pi$  is. All you will need is a collection of round objects like cups and pie dishes, a piece of string, a ruler, and a calculator.

1. Take any of the round objects available and measure the length of the object's circumference (that's its outside edge). A good way to do this is to lay a piece of string carefully along the edge and then to lay the string along a ruler. Write this number down.

<sup>1</sup> <https://www.popularmechanics.com/science/math/a37329769/supercomputer-calculated-pi-to-record-breaking-628-trillion-digits/>



### 22.4 TRILLION DIGITS OF PI

Visit *22.4 trillion digits of pi* (<https://pi2e.ch/blog/2017/03/10/pi-digits-download/>) to learn more about the world record computation of  $\pi$ . You can even download all 22.4 trillion currently known digits.

Just note that this is not the most digits of  $\pi$  that have been computed. That record is currently 62.8 trillion.



2. Now measure the diameter (the straight line that passes through the center of the object from one side to the other). Write this number down.
3. Use a calculator to divide the length of the circumference by the length of the diameter. What answer do you get? Is it about 3.1?
4. Now repeat the above steps with as many other round objects. What number do you get at the end each time?

## The digits of pi

Mathematicians and math enthusiasts have spent many hours looking through the digits of  $\pi$  and have discovered all sorts of interesting patterns. The video called *A mile of Pi* (6:27) (<https://www.youtube.com/watch?v=0r3cEKZiLmg>) is a wonderful exploration of some of the patterns that have been discovered within its first 1 million digits.

## Other interesting $\pi$ resources:

- *Why is Pi so special?* (5:52) – This video briefly explores some of the strange places  $\pi$  appears in the real world.  
<https://www.youtube.com/watch?v=Q2QZmcp-kL8>
- *A surprising Pi and 5* (16:39) – This video explores a fascinating link between the number 5 and  $\pi$ .  
[https://www.youtube.com/watch?v=IMY2\\_yzDm9I](https://www.youtube.com/watch?v=IMY2_yzDm9I)
- *Pi: The Most Important Number in the Universe?* – This webpage is an extract from a fascinating online introduction course on  $\pi$ . You or your students might want to enroll.  
<https://www.thegreatcoursesdaily.com/the-origins-of-pi/>
- *The Discovery That Transformed Pi* (18:39) – Attempts to calculate  $\pi$  ever more accurately has driven important advances in both mathematics and computer science. This video explores one of these advances.  
<https://www.youtube.com/watch?v=gMlf1ELvRzc>
- *Pi* – The Wikipedia entry on  $\pi$  is detailed and informative.  
<https://en.wikipedia.org/wiki/Pi#Antiquity>
- *Explanation of pi and its importance* (1:30) – A short explanation of why  $\pi$  is so important.  
<https://www.youtube.com/watch?v=RpWFli2Iz9E>

