Got Math?

Southern Nevada Regional Professional Development Program

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A Newsletter from the Secondary Mathematics Team

PI DAY 3.14

What is pi? Who first used pi? How do you find the value? What is it good for? How many digits are in pi?

By definition, pi is the ratio of the circumference of a circle to its diameter. Pi is always the same number, no matter which circle you use to compute it. For the sake of usefulness, people often need to approximate pi. For many purposes you can use 3.14159, which is really pretty good, but if you want a better approximation you can use a computer to get it. Here's pi to many more digits: 3.14159265358979323846.

The area of a circle is pi times the square of the length of the radius, or "pi r squared": $A = \pi r^2$

A very brief history of pi

Pi is a very old number. We know that the Egyptians and the Babylonians knew about the existence of the constant ratio pi, although they didn't know its value nearly as well as we do today. They had figured out that it was a little bigger than 3; the Babylonians had an approximation of 3.125, and the Egyptians had a somewhat worse approximation of about 3.160484, which is slightly less accurate and much harder to work with. For more, see *A History of Pi* by Petr Beckman (Dorset Press).

The modern symbol for pi (π) was first used in our modern sense in 1706 by William Jones. Pi, rather than some other Greek letter like Alpha or Omega, was chosen as the letter to represent the number 3.141592... because the letter π in Greek, pronounced like our letter 'p', stands for 'perimeter'.

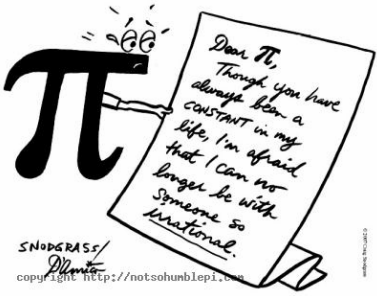
About Pi

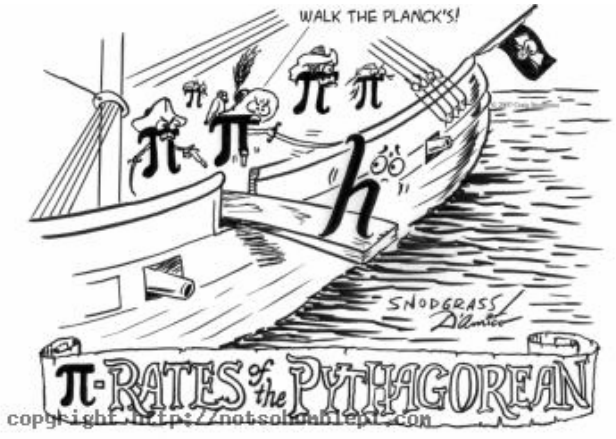
Pi is an infinite decimal. Unlike numbers such as 3, 9.876, and 4.5, which have a finite number of digits, pi has infinitely many numbers to the right of the decimal point. If you write pi down in decimal form, the numbers to the right of the decimal point never repeat in a pattern. Some infinite decimals do have patterns. For instance, the infinite decimal .3333... has all 3's to the right of the decimal point, and in the number .123456789123456789... the sequence 123456789 is repeated. However, although many mathematicians have tried to find it, no repeating pattern for pi has been discovered. In fact, in 1768 Johann Lambert proved that there *cannot* be any such repeating pattern.

As a number that cannot be written as a repeating decimal or a finite decimal, pi is *irrational.* You can never get to the end of it, and it cannot be written as a fraction or ratio of two integers.

Pi is one of the five most important constants in mathematics. The other four are 0, 1, *e*, and *i*. 0 is the additive identity, 1 is the multiplicative identity, *e* is the base of the natural logarithm, and *i* is the square root of -1. Leonard Euler (1707--1783) discovered a remarkable equation involving the five most important constants and no others: $\boldsymbol{e^{ni} + 1 = 0.}$ Euler's equation can be proved using Calculus II.

Computers have calculated pi to many decimal places. It's easy to find lists of them by searching for 'digits of pi'.





Math Resources

www.rpdp.net

In this issue:

π π π PI DAY ACTIVITIES π π π

Measure Pi

Have students bring in various circular (or cylindrical) objects. Using a string (kite string works well), measure the circumference and diameters of the objects. Collect the data from the class. TI-Navigator or a Smart Board works well for this, or you can have students write their numbers on the board. Have the class calculate the ratio of circumference and diameter of each object. Give a prize to the student whose measurements give a ratio that is closest to pi.

Memorize Pi

Hold a contest for memorizing pi. Give a prize to the student who can memorize the most digits. Students can also find mnemonics for memorizing pi or come up with their own. For example: How I wish I could enumerate pi easily, since all these horrible mnemonics prevent recalling any of pi's sequence more simply. (The number of letters in each word represent each digit of pi.)

Pi Project

Have students research the history of pi, the uses of pi, etc. Suggestions for the project include research papers, posters, presentations, etc.

Einstein Pi

Celebrate Einstein's birthday by researching his contributions to mathematics. Have students give mini-presentations about his life or create birthday cards with facts about Einstein.

Sing about Pi

There are many songs about pi. Students can sing together in class or go to a neighboring math class to "carol" pi songs. (See page 3 of this newletter.)

Read about Pi

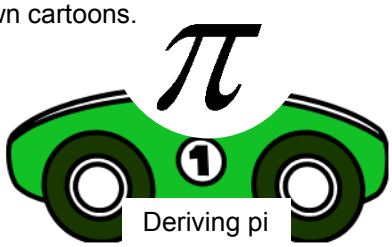
There are many books about pi that you can read to your class or assign them to read. One suggestion is the book "Sir Circumference and the Dragon of Pi".

Pi Online

There are many websites devoted to pi. You can find some on your own or have students find and share them with the class. One fun example is http://www.stevetoner.com/ph/TonerS/mathpi.html

Pi Cartoons

Share pi cartoons with the class. Have students create their own cartoons.



Deriving pi

Pi Limericks

The number pi's a ratio pal.
Whose fame is international.
C to diameter,
endless parameter,
to me it's all irrational!

- Paul Doherty

If inside a circle a line
Hits the center and goes spine to spine
And the line's length is "d"
the circumference will be
d times 3.14159

- http://www.markcarter.me.uk/math.html

'Tis a favorite project of mine
A new value of pi to assign.
I would fix it at 3
For it's simpler, you see,
Than 3 point 1 4 1 5 9

- http://www.markcarter.me.uk/math.html

Three point one four one five nine two
It's been around forever - it's not new
It appears everywhere
In here and in there
It's irrational I know but it's true !

- http://www.geocities.com/SiliconValley/Pines/5945/facts.html

Now there is an ancient Greek letter,
And I think no other is better.
It isn't too tall,
It might look very small,
But its digits, they go on forever.

- http://www.kathimitchell.com/piceleb.html

Wearing *Pi,* or *where do hat sizes come from?*

(from Mary Laycock)

Materials:

Measuring tapes, calculators, hats with sizes indicated inside them

To Do and Notice:

Most hat sizes range between 6 and 8. Brainstorm ideas for how such sizes could be generated. Then use a measuring tape to measure peoples' heads. As you do this, think of where a hat sits on a head. Now compare your results with the sizes written inside the hats. Do your numbers look like they could be hat sizes? (Hint: Try using different units of measurement.) **What's Going On?** Hat sizes must be related to the circumference of the head. The circumference of an adult's head usually ranges between 21 and 25 inches. The head's circumference divided by *pi* gives us the hat size. Use calculators to do the math.

PI DAY SONGS

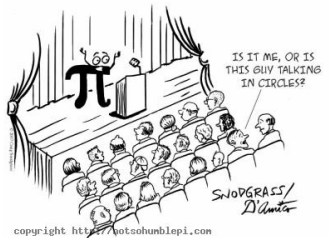
To the tune: "Happy Birthday"

Happy Pi day to you,
Happy Pi day to you,
Happy Pi day everybody,
Happy Pi day to you.

To the tune: "Oh Christmas Tree"

Oh, number Pi
Oh, number Pi
Your digits are unending.
Oh, number Pi
Oh, number Pi
No pattern are you sending.
You're three point one four one five nine,
And even more if we had time.
Oh, number Pi
Oh, number Pi
For circle lengths unbending.

Oh, number Pi
Oh, number Pi
You are a number very sweet.
Oh, number Pi
Oh, number Pi
Your uses are so very neat.
There's 2 Pi r and Pi r squared,
A half a circle and you're there.
Oh, number Pi
Oh, number Pi
We know that Pi's a tasty treat.



To the tune: "Jingle Bells"

Pi day songs
All day long.
Oh, what fun it is,
To sing a jolly Pi day song
In a fun math class like this
Verse:
Circles in the snow,
Around and round we go.
How far did we have to run?
Diameter times Pi!
(Repeat)

To the tune: "Bye, Bye Miss American Pie"

A long, long time ago,
Some Greek guy discovered Pi.
I don't know why (maybe he was hungry).
And to find circumference,
The circle's outside distance,
Don't think it has any relation with discriminants.
You must know the value of Pi,
If you want to find any radii.
The circumference can be found on a zucchini.
If not just ask me.
Can't remember if I cried,
When the math team and the teachers tied.
We all forgot how to divide,
The day the math team tied. So-,

Chorus:
Pi, Pi, 3.1415,
There's a pie that you can eat and a Pi you divide.
When you're in doubt just remember this line.
If you don't know what to do,
Think of Pi.
Don't know what to do,
Think of Pi.

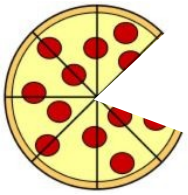
PIZZA PI

Compare the total area of a pizza with its diameter. Since $A = \pi r^2$, if you double the size of the pizza, you get 4 times the area (and 4 times the food), but it's rarely 4 times the price. Bigger pizzas are usually a better value.

If you can get a square pizza, you'll get more food too! A round pizza takes up only about 78.54% of the box. Using the formula for the area of a square and the area of a circle, see if you can figure out why.

A good approximation of π is $^{22}/_{7}$. This equals 3.14286 and π equals 3.14159. Less than .1% difference! So, if a pizza is 22 pepperoni's around it's very close to 7 pepperoni's across!

If a circle has a radius of 1, then it has a circumference of 2π. This is the basis of "radian" angular measurement. There are 2π radians in 360°. Since 2π is about 6.28, 1 radian is about $^{1}/_{6}{}^{th}$ of a pizza.



How does π relate to a "baker's dozen"? It has to do with the way circular objects stack. Note that on a standard size baking sheet, the most efficient way to place the cookies is to intermingle the rows by offsetting them by $^{1}/_{2}$ of a cookie. How many fit on the cookie sheet? A baker's dozen, or 13 cookies.