Tale of the Golden Pi

Written by D. and S. Birks
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Editing contributions by Daniel Birks
(Happy birthday, Gene!)

The Magic Chest

I bought an old house. It was like entering an old world. One rainy afternoon, I decided to do some exploring. Rummaging around in the attic, I came upon a suit of armor, some very old books, and a timeworn chest. Nothing remarkable. It wasn't of oak, heavily strapped with iron. It was simply a wooden box, painted dark green. It occurred to me it might contain something mysterious and wonderful. When I raised the lid, disappointed, my first thought was that it was empty. Then I realized it was half full of flats of papers. I took one out…magic! Not a hoard of pirate's gold, but a treasure trove of imagination! Beautiful drawings! Whoever drew them must have been an illustrator of fairy tales! They were so enchantingly whimsical: princes and princesses, ogres, trolls, and dragons, Little Red Riding Hoods, Big Bad Wolves, rocket men, dancing girls, scalawags and cowboys, Aladdins, genies, and mysterious characters with an air of delicacy and grace of the Orient. As I looked through the drawings, each seemed to come alive—lost in a fantasy world all their own! Like Sleeping Beauty, they had been lying there, waiting for a handsome prince to open the chest…to bring them to life—to once again spring from the page, tell their story, and live on. I picked up a drawing. Ooh, an authoritative schoolmaster and his young, whippersnapper pupil. What a tale they must have to tell! I wonder… perhaps a fairy tale of science!

The Golden Pie

Once upon a time,
in a small schoolhouse, a young boy tentatively raised his hand.

"Yes, Johnny. You have a question?"

"Well, sir, yesterday you read a story about Archimedes at the public bath, stepping into a tub and watching the water overflow."

"Oh, yes, that delightful anecdote of Archimedes, who—after realizing he could test the purity of the gold in the king's crown by measuring the volume of water it displaced—leapt from the tub and ran home naked, shouting, 'Eureka!' The first streaker! One of Vitruvius' best stories. But what's your question, lad?"

"I thought maybe Archimedes' volume idea could be used to resolve pi."

"Resolve pi with volume? Sounds interesting. What did you have in mind?"

"Well, Archimedes' story is about gold having an exact weight-to-volume ratio. So, rather than filling a tub with water, if a pie pan were filled with liquid gold—and the pie pan was a perfectly round cylinder with a depth of one inch..."

"You mean more like a cake pan. Hmm, the 'golden pie'—or should I say pi? Okay, let's say we've captured a wee leprechaun with a pie pan o' gold. Go on, Johnny."

"If I weighed the golden pie (minus the weight of the pie pan), I'd have an exact volume of gold. And as volume is calculated as length by width by depth..."

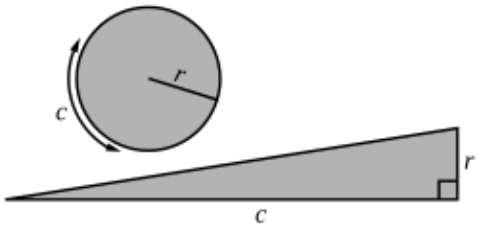
"I see. (rubbing his chin, thinking) By dividing the volume of the gold by the depth of one inch, that'd leave the length and width! So you'd have the exact surface area of the pie—the precise area of a circle—something that's never been done in science!

Well, well! We certainly won't be running through the streets in our birthday suits, but, in light of your compelling 'pie'-dea, I think we can safely exclaim... ***Eureka!****"*

"But, there's more, sir. (pulling out a slip of paper) I have it written down right here: (reading) ***Archimedes' Measurement of the Circle, Proposition 1:***

> ***The area of any circle is equal to a right-angled triangle, in which one of the sides about the right angle is equal to the radius, and the other to the circumference, of the circle."***

"I can see you've done your homework. But Archimedes' equation for the area of a circle as a right triangle brings up the age-old problem: How do you construct a straight line equal to the length of the circumference?"

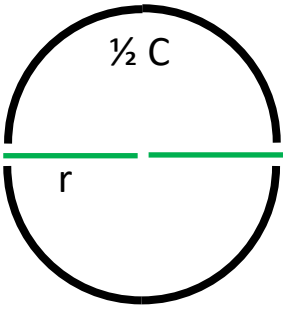


"That's just it, sir. By having the surface area of our golden pie, we don't have to."

"Hmm, you'll have to explain that, Johnny."

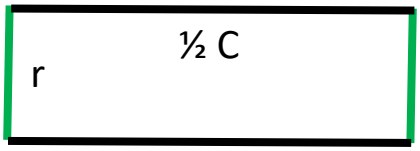
"Well, the equation for Archimedes' right triangle is half the circumference times the radius—in other words, half the circumference times half the diameter."

"Oh, I see. You're breaking the circle into four parts—four 'sides,' so to speak. That's how you convert the area of a circle into the area of a rectangle! This is exciting, Johnny. Lemme draw that on the board."



"Right, sir. The lines of the circle create the area. The four 'sides' of the circle—the two halves of the diameter and the two halves of the circumference—are equal to the sides of a rectangle!"

"So you don't have to straighten the curve. Since you already have the exact area of the circle (from the volume of your golden pie), if you divide that area by the length of the radius…you have the exact length of half the circumference! Again, something that's never been accomplished!"



"Exactamundo, sir! And by knowing the exact lengths of half the circumference and half the diameter (the radius), perhaps we can finally resolve pi!"

"Wait! As pi equals C/d, if the diameter, d, is one (e.g., 1 foot)…with pi equal to C/1—once you have the length of circumference, C, ***you already have resolved pi!*** *Well, I'll be! And that's how you resolve pi with your golden pie!"*

"But, sir, I was thinking. Couldn't we do this with any shape of flat-bottomed mold?"

"By golly, you're right! With Archimedes' weight-to-volume ratio, we could fill a mold with liquid gold, divide the volume by the depth of the mold, and have the exact surface area of whatever shape. I don't know how practical it is, but with your liquid gold/molding math, it'd be possible to convert the area of any shape into a rectangle of length and width. Once you have the volume…you have it all!
You know, Johnny, my boy, I think you're on to something!
We may have just stumbled upon a new type of liquid/gold calculus!"

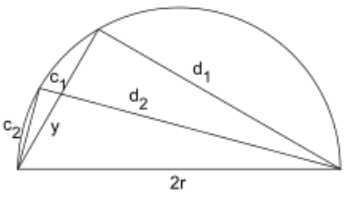
"Calculus, sir? Does this mean I get extra credit?"

(Smiling benevolently) "Well, we'll see, Johnny. We'll see."

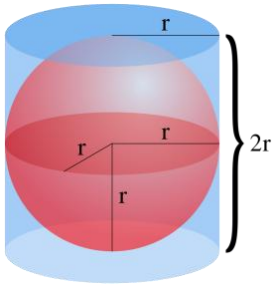
Epilogue

I know it's all science make believe. But, never having to do a calculus equation—ever again? Now there's a worthy fantasy! I don't want to rewrite history…

But what if Archie—instead of using his exhaustive method of filling a circle with inscribed polygons (infinitely)—had simply filled a cylinder with liquid gold? He could've filled in the area completely, proven his equation for the area of a circle, resolved C/d easily,..and saved us all a boatload of trouble to boot!



What's more, by melting down a golden globe, and pouring it into a cylinder of the same diameter and height, Archimedes could've had solid gold, liquid proof of his famous equation that the volume of a sphere equals 2/3 the volume of the cylinder it can be inscribed in.



Ah, alas! We can't change the history of math.
But what about the future? Lot of potential ways
to apply Archie's (or should I say, Johnny's) liquid math.
Hmm, maybe it's time for a new "gold standard" in math!

So ends our chronicle—our tale of pi. Or is this just a beginning?
What does the future of science hold for young Johnny?
Happily ever after? I'll leave that up to you.