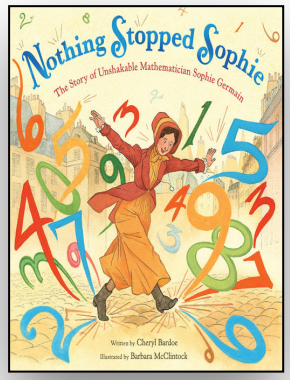
Cruchley's Collection

Diana Cruchley is an award-winning educator and author, who has taught at elementary and secondary levels. Her workshop are practical, include detailed handouts, and are always enthusiastically received.

Nothing Stopped Sophie
(or The Story of Unshakable Mathematician Sophie Germain)



Cheryl Bardoe, Little Brown and Company, ©2018, ISBN 978-0-316-27820-1

Sophie Germain was an 18th century math prodigy who simply refused to accept the assigned roles for a female. Her parents, the schools, the science establishment - nothing stopped her insatiable need to understand and use mathematics. She eventually found the formula that would predict patterns of vibration. We use it today to build bridges, skyscrapers, skytrains, earthquake scenarios…anything that has a structure and can vibrate. In 1816 she became the first woman to win a grand prize from the Royal Academy of Sciences.

Teaching Ideas

Sophie Germain Overcomes Obstacles to Women Achieving

Sophie can't go to university, is regarded as a bit of a freak prodigy by society, has a famous mathematician who writes to her but stops when he realizes she is a woman, and has trouble winning the prize on vibrations because they keep rejecting her solution - partly because she is a woman.

Students may be interested that until the 20th century women could not: vote, hold property in their own name with the same rights to sell it as a man, open a bank account or get a credit card, apply for a patent for an invention in their own name, attend a university especially in technical, accounting, law, or engineering, and could not serve on a jury. An activity might be to give students a list of things that are normal for women to do now, and ask them to find out when these rights were finally acknowledged.

Extreme Writing

Always present three possible topics for Extreme Writing so that students will have a choice. My book, ***The Power of Extreme Writing*** is available at ASCD for a complete explanation of this unique approach to journaling. There are 4 topics here - choose the best 3 or students will spend too much time deciding.

1. Sophie sneaks out of bed to study mathematicians. Have you ever snuck out of bed, or brought a flashlight to read under the covers, or….?
2. It was so cold in the bedroom that the ink froze in the bottle. Write experiences you have had with cold weather.
3. Persistence is one of Sophie's characteristics. Tell about something you persisted in doing?
4. Sophie sends her homework in the mail. Write about good and bad experiences with homework.

The French Revolution and Sophie

A great way of remembering lists of things or connections of things is through mnemonics – memory devices. Most students easily remember "In fourteen hundred and 92, Christopher Columbus sailed the ocean blue "(because it rhymes). We can remember HOMES as the names of the Great Lakes – Huron, Ontario, Michigan, Erie, Superior. Think of them as being in your HOME country,

Well, to remember when the French Revolution was, you need to think of the song, ***The Marseilles***, and then sing,

Louis the Sixteenth was the king of France, in 1789,
He was worth than Louis the fifteenth
He was worse than Louis the fourteenth
He was worse than Lou-o-ie the Thirteenth
He was the worst...da, da, da, da
Since Louie the First.

Why does this matter to this book? It doesn't, except that Sophie lived in France, during the French Revolution, and it affected how she saw math - as something solid, unchanging, and true in a world that was chaotic.

Writing to a Pattern

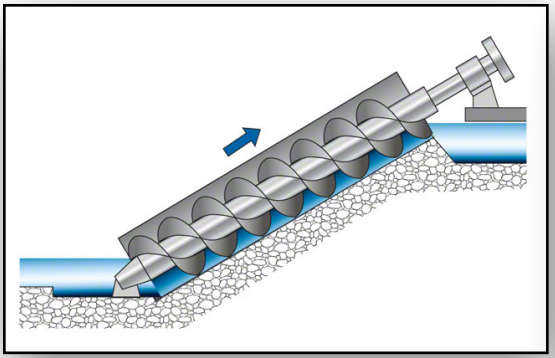
One of the things that holds this story together is the repeated line, "But nothing stopped Sophie." Ask students to write of something they wanted to do and worked hard to do - it can be as simple as mastering a computer program or a game, riding a bicycle, learning to type, playing an instrument, reading a map….it doesn't have to be amazing, it just has to be a challenge.

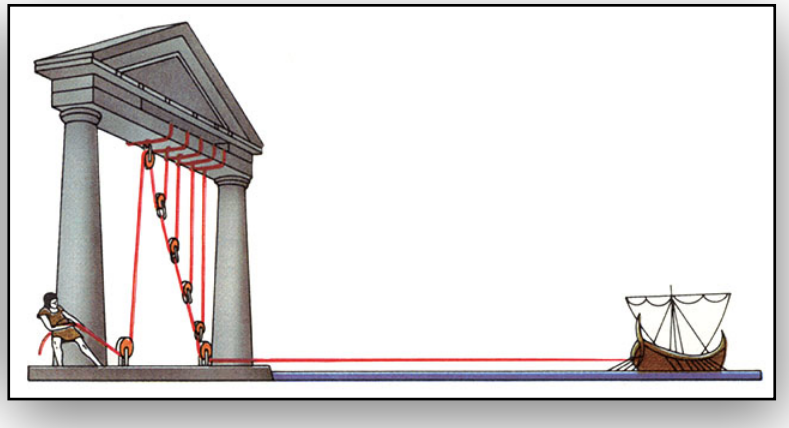
Ask them to set up the scenario of failing at first, then having 3 tries before the final success. At each stage it would be "But nothing stopped (name of student)".

Sophie Loved Ancient Mathematicians

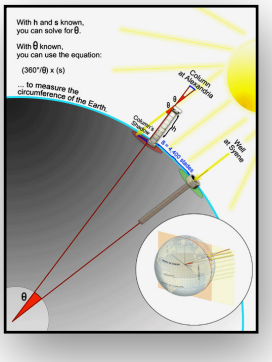
There are four ancient Greek science inventions and discoveries based on math that Sophie studies in this book. Why not ask students how they work?

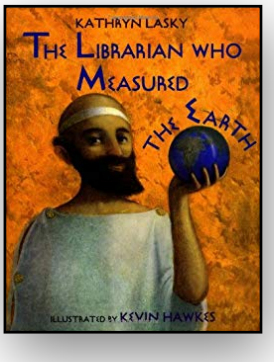
The Archimedes Screw that can make water flow uphill. The Archimedes Pulley which allowed him to calculate exactly what length of rope etc. would allow one person to drag an entire ship.



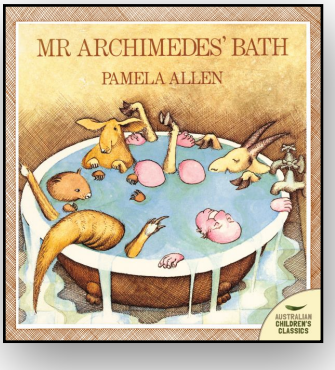


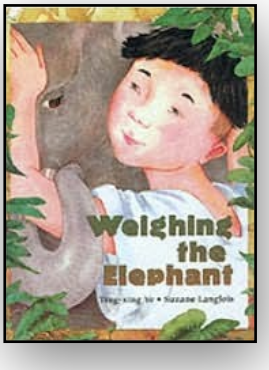
And my personal favourite, Erastothenes, who measured the circumference of the earth accurately to within 400 miles, at a time when people didn't even know the earth was round. Astonishing. At diana cruchley.com I have teaching ideas to accompany ***The Librarian Who Measured the Earth*** the picture book about his life and discovery.





Archimedes was the man who discovered that you could weigh objects by displacement of water - famously while displacing water himself in his bathtub and then running through the streets naked shouting "Eureka". The picture book Mr. Archimedes' Bath tells this story, as does the ancient Chinese tale about a boy genius in ***Weighing the Elephant*** (for which I have a set of teaching ideas in dianacruchley.com).





Vibrations That Make Patterns

The book describes a demonstration by Chladni of how sand (now table salt) sprinkled on a glass plate, against which you rub a violin bow, will make quite beautiful patterns, that change as the tone/ vibration changes. There are demonstrations on the Internet if your efforts fail to get the result you want. It's much better though, if students can see it "in person." The inspiration for Germain's breakthrough in the math of vibrations starts with Chladni's demonstration.

Winning a Prize for Achievement

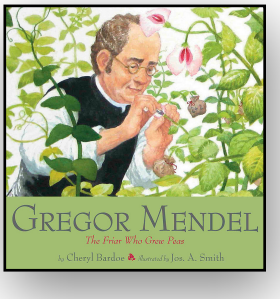
Sophie grand achievement was to calculate the mathematical formula that predicts patterns of vibrations. Real math seems interesting but essentially useless at first - and then turns out to be critical to understanding the earth. This math results in skyscrapers that stay up, buildings that resist earthquakes, bridges that carry rumbling vehicles, skytrains…any structure that might vibrate needs Sophie's math. She tried three times for the prize: - the first time the Academy said it wasn't accurate, the second time that it was accurate but where was the proof, and the 3rd time they awarded her the prize.

This can lead to talking about prizes. What are the prizes that can be won for various things from art, to movies, to science, to math, etc? There are thousands of them. The most prestigious in the world are the Nobel Prizes. - each worth about $1 million. However, there is also the Genius Grant - another $1 million grant this time given just as a gift to

people who have demonstrated persistence and creativity in their field. About 30 of those can be given out each year. The most prestigious math award is the Field Medal - although worth only about $15,000, it is the Nobel Prize of Math.

Talk about prizes. 1. What prizes would you like to win and for what? 2. It took Sophie 6 years of her life to win the prize. How long would you persist to win a prize? 3. There is research that giving rewards for doing something in school causes the student to value only the reward and not actually the thing they are learning. That would mean, no candy for reading the book, unless you want to create kids who love the candy but don't like books. Have you ever been rewarded for doing something? Did it make you love to do it more? 4. Would you rather have a Field Medal, A Genius Grant, a Nobel Prize, or an Academy Award? Why? 5. How do you feel when you get a ribbon for participating?

Author: Cheryl Bardoe



There are no teaching ideas on her website, but if students enjoy this book, they may also enjoy another book of hers, ***Gregor Mendel, the Friar who Grew Peas*** (world's first geneticist).

Arithmetic - Poem by Carl Sandburg

Just for fun..introduce students to a famous poet, Carl Sandburg, waxing lyrical about arithmetic…as long as we are reading about a famous mathematician.

Arithmetic is where numbers fly like pigeons in and out of your head.
Arithmetic tell you how many you lose or win if you know how many you had before you lost or won.
Arithmetic is seven eleven all good children go to heaven -- or five six bundle of sticks.
Arithmetic is numbers you squeeze from your head to your hand to your pencil to your paper till you get the answer.
Arithmetic is where the answer is right and everything is nice and you can look out of the window and see the blue sky -- or the answer is wrong and you have to start all over and try again and see how it comes out this time.
If you take a number and double it and double it again and then double it a few more times, the number gets bigger and bigger and goes higher and higher and only arithmetic can tell you what the number is when you decide to quit doubling.
Arithmetic is where you have to multiply -- and you carry the multiplication table in your head and hope you won't lose it.
If you have two animal crackers, one good and one bad, and you eat one and a striped zebra with streaks all over him eats the other, how many animal crackers will you have if somebody offers you five six seven and you say No no no and you say
Nay nay nay and you say Nix nix nix?
If you ask your mother for one fried egg for breakfast and she gives you two fried eggs and you eat both of them, who is better in arithmetic, you or your mother?

Fermat's Last Theorem

A math theorem is basically a math statement that is true in all instances and can be proven to be true. In science it would be called a law of science; in math it is a theorem. Fermat said that the formula $a^n + b^n = c^n$ "doesn't work" for any positive integer value for a, b, or c that is greater than 2. That's it…pretty complicated…too complicated for your class. But….

The proposition was first conjectured by Pierre de Fermat in 1637 in the margin of a copy of ***Arithmetica***; Fermat added in his handwriting that he had a proof that was too large to fit in the margin, but he died and his proof was never found.

Sophie spent a lot of time herself trying to prove it. The attempt to solve it (by many many mathematicians over 300 years) stimulated the development of algebra in the 19th century, and it was considered one of the hardest math problems in the world. It wasn't until 1995 that British mathematician Andrew Wiles published a successful proof.

The Art of Numbers

The artist Barbara McClintock has included fanciful numbers on several pages to show the passion Sophie has for math. There are several sites on line that show how to turn a number into a picture which might be an interesting activity for students. First have them think of what they could turn a 1 or a 2 into. After following the directions for them on the Youtube they could be encouraged to create one of their own for any number from 1-9. One of those sites is https://www.youtube.com/watch?v=O9o2lBJvUnY . The drawings are cute, but there are commercials between each of them… turn off the sound and black out the screen during the commercials.

Here's the conversion of the number 1 into a liner. When students have completed their drawings other students can guess what the original number was.