Math

2024

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Overcoming Math Anxiety with Confidence

Introduction

How do you feel when you encounter a math problem? Have you ever felt your heart race or your palms get sweaty? Does your mind go blank when a teacher asks you to answer a math question? Sometimes, do you wish you could escape from the world of numbers and equations?

Well, you're not alone! Many people experience this. It's called math anxiety. But fear not! In this article, we're going to explore what math anxiety is, why it happens, and most importantly, how you can overcome it.

What is math anxiety?

Math anxiety is a term to describe the fear, stress and worry that people experience in situations involving math. People of all ages can feel anxious about math, but it often begins in school. Some situations when you might experience math anxiety include:

- Having to complete a math worksheet
- Thinking about a math test or taking a math test
- Watching the teacher work out a math problem
- Working on math homework with lots of difficult questions
- Listening to the teacher talk for a long time about math
- Listening to another student explain a math problem
- Starting a new topic in math

Boy confused about a math problem (Source: Rubberball/Mike Kemp via Getty Images).

People may experience math anxiety in different ways. Think about the situations above. Have you ever noticed that you felt extra stressed, scared or overwhelmed when faced with math? Common symptoms math anxiety include:

- Racing heart
- Sweating
- Feeling like you have knots in your stomach
- Difficulty focusing
- Feeling like you want to escape the situation

These symptoms are your body's response to the stress and anxiety caused by math. When you experience math anxiety, your brain thinks you are in danger. So, it sends signals to your body that it is time to run. This is called the fight or flight response.

What is happening in your brain when you experience math anxiety?

You may have heard people say "my brain hurts!" while doing math. This might be true - sort of. Let's look at what is happening in the brain when people experience math anxiety.

Amygdala

The amygdala is a key part of the brain that processes negative emotions. These include fear, stress and anxiety. The amygdala sends fear signals to the rest of the brain. When the amygdala is activated, it causes a response in the body. This can include sweating, a racing heart or difficulty focusing.

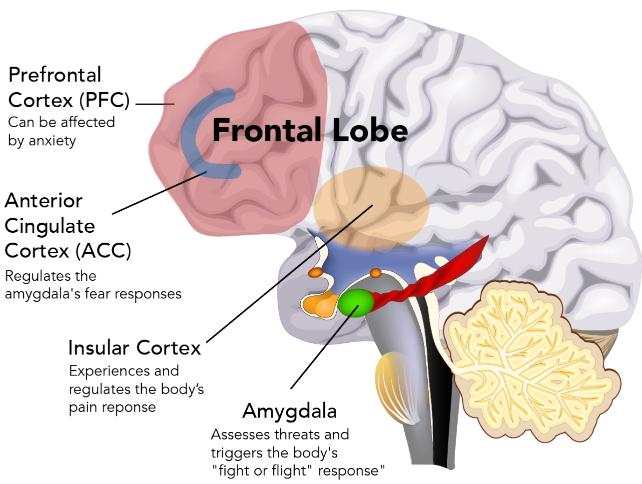
The Frontal Lobe

The frontal lobe is like the "control panel" in your brain. It is responsible for balancing your emotions. It also deals with your logic, reasoning and your working memory. Anxiety can overload that control panel. When you feel anxious about math, your frontal lobe gets busy dealing with that anxiety. So, it has less capacity to help you remember things and think clearly to solve problems.

Did you know?
The frontal lobe is made up of many parts including the Prefrontal cortex (PFC), the Anterior cingulate cortex (ACC), and the dorsal anterior cingulate cortex (dACC).

Pain Centres

The pain centres in your brain tell your body to feel pain. They also signal when there is a physical threat. When people are anxious about math, these parts of their brains become more active. One of these areas is called the Insular Cortex. It's not that math is physically painful. But just the thought of doing math can be painful!



Parts of the brain involved in fear and pain response (Let's Talk Science using an image by ttsz via Getty Images).

Did you know?
Dyscalculia is a learning disability that affects a person's ability to understand and work with numbers and math ideas. People with dyscalculia may have difficulty with tasks like counting, calculating and recognizing math symbols. It's similar to dyslexia, but with numbers!

Math in Real Life

You might be thinking, if I struggle with math anxiety, I just have to get through school. Then I won't have to worry anymore. Unfortunately, math anxiety doesn't stop after school. In fact, research suggests that students who are anxious about math will grow up to become adults who are anxious about math. This is a problem. Math anxiety can lead to difficulties making financial decisions, managing debt, and investing effectively.

So what can you do?

Overcoming Math Anxiety

Luckily, there are a bunch of strategies you can use to help overcome your math anxiety. Let's look at a few.

1. Strengthen your basics

Practicing your math basics is a great way to build confidence and reduce anxiety. Start by focusing on key math concepts, like addition, subtraction, multiplication, and division. Begin with easy problems and gradually work your way up to more challenging ones. Take small steps and celebrate your successes along the way. Practice can be fun too. Use math games, flashcards, or everyday situations like shopping to apply math skills. By mastering the basics, you'll develop a strong foundation and you'ill become more comfortable in math situations.

Student girl writing on whiteboard in classroom (Source: Ridofranz via Getty Images).

2. Write down your fears

Before a big test, grab a piece of paper and write down your thoughts and feelings about it. This is a process called **cognitive offloading**. By writing the feelings down, you're freeing up space in your brain. This makes it easier to use logic, reasoning, and working memory. Scientists have discovered that this process can help people feel less nervous, and even score better on the test.

Person writing in a notebook (Source: fizkes via Getty Images).

3. Breathe and Refocus

When you start to feel worried or stressed, take a moment to pause. Close your eyes, take a deep breath in through your nose, then slowly exhale through your mouth. Repeat this a few times. This simple exercise can help calm your mind and reduce anxiety, making it easier to focus on the math tasks ahead.

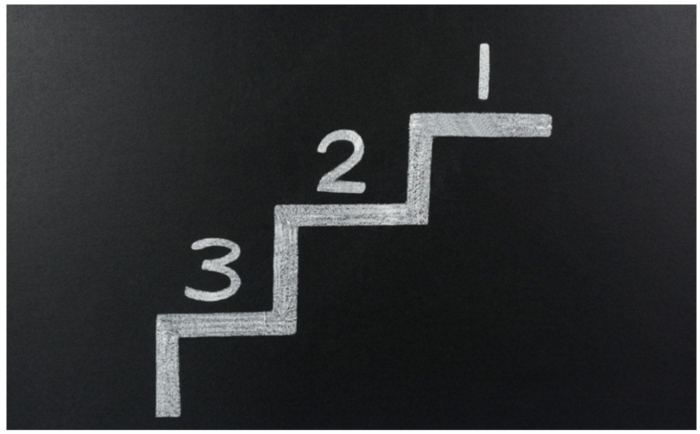
Person with hand on chest and abdomen (Source: mi-viri via Getty Images).

4. Practice a growth mindset

Instead of thinking, “I'm not good at math,” try to remind yourself that you CAN do hard things. A growth mindset means believing that your math skills can grow over time. Approach math problems with a positive attitude. Remember that every problem you solve and every mistake you make is a step toward becoming better at math. By seeing challenges as opportunities to learn and grow, you will become more confident and skilled over time.

5. Break down the question

If you look at a complicated math question and feel overwhelmed, start by identifying what the question is asking. Break the problem into simpler parts, tackling one step at a time. This way you will understand what each part of the problem means and how it relates to the overall solution. Breaking down math problems makes them less intimidating, and it will also boost your confidence as you make progress, step by step.



Three steps (Source: jayk7 via Getty Images).

Conclusion

The more comfortable you are with math, the better prepared you will be to use it in the future. There are also many careers that require math! Even some you may not have thought of.

Let’s Talk Science appreciates the contributions of Andie Storozuk in the development of this part of the handbook. Andie is a doctoral candidate in Experimental Psychology at the University of Ottawa. As part of the Emotion and Cognition Lab, she specializes in studying the connection between math anxiety and financial literacy.

Cooking Up Math

Do you like to cook or bake? Have you ever wanted to make something and realized you didn't have the right measuring cup? Did you use a smaller measuring cup instead? If you did, you were using math! Math functions like conversions, fractions and time calculations are all important for cooking. Everybody who cooks, from home cooks to world famous chefs, use math in the kitchen!

The Scoop on Measurement and Conversion

Measuring

Measuring is an important part of cooking and baking! Have you ever come across a vintage recipe asking for a 'tumbler' of milk or a 'gill' of sugar? Did you wonder what they were talking about? Fear not! Today, we have precise measurements at our fingertips, making cooking much more straightforward and enjoyable!

Did you know that wet and dry ingredients require different kinds of measuring cups?

For liquids, like milk or oil, you'll want to use a wet measuring cup. These are designed to allow the ingredient to self-level, so you can fill it to just below the measurement marked on the outside. For dry ingredients like flour or sugar and even mayonnaise, try to use dry measuring cups. These are meant to be filled right to the top. Then you can use a knife to level it off precisely.

Wet and dry measuring cups (Source: JulNichols via Getty Images).

In kitchens in North America, many people use the Imperial System of measurement when cooking. These measurements are not used in the Metric System.

Measurement	Unit	Abbreviation
Weight	Pound Ounce	lb. oz.
Volume	Gallon Quart Pint Cup Fluid ounce Tablespoon Teaspoon	gal. qt. pt. c. fl. oz. or oz. tbsp. tsp.

Conversion

To use some recipes, you may need to convert from one type of measurement to another. Like from tablespoons to teaspoons or from ounces to cups.

To convert from teaspoons to tablespoons you need to divide by three.
1 tbsp. = 3 tsp.
1 tsp. = ⅓ tbsp.

To convert from cups to tablespoons you need to divide by 16.
1 cup = 16 tbsp.
1 tbsp. = 1/16 cup

To convert from cups to fluid ounces , you need to divide by eight.
1 cup = 8 fl. oz.
1 fl. oz. = ⅛ cup

Question 1: How many teaspoons are in one cup?

The Scoop on Accuracy and Precision

If you do a lot in the kitchen, do you prefer cooking or baking more? There could be many reasons for this, but one of them might be math! Cooking requires people to be precise, but baking requires people to be accurate. You may think those two words mean the same thing, but they do not!

Accuracy is all about how close your measurement is to the true value. Some measuring tools are better for this than others. For instance, consider measuring flour with a cup versus a digital scale. The scale gives a more accurate measurement.

Precision is about how close your measurements are to each other. Imagine you and a friend both wanted to cook chili. The more precise you both are with your measuring, the more similar your chili will taste.

Accuracy = Close to Correct
Precision = Repeatable

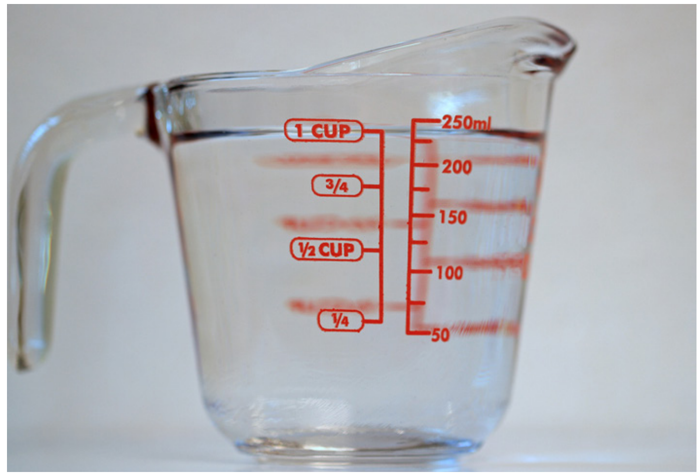
Ultimately, baking is like conducting an experiment! The **chemical reactions** that happen between ingredients—like baking soda and vinegar—require exact proportions. If you don't follow a baking recipe accurately, you can get unexpected results and treats that don't taste great! For example, too much baking soda can cause a cake to rise too quickly, then collapse.

In cooking, accuracy is not always as critical. There's more room for flexibility. A cook can adjust ingredients according to their taste, adding a bit more or less without significantly altering the final result. But if they want to repeat the dish, they will need to record what they did!

The Scoop on Fractions and Ratios

Fractions

A cup can be divided into smaller parts, known as fractions. Imagine a cup as a whole, and then think about splitting it into equal parts. For example, if we divide a cup into two equal parts, each part is called a half-cup. This means that two half-cups together make one whole cup.

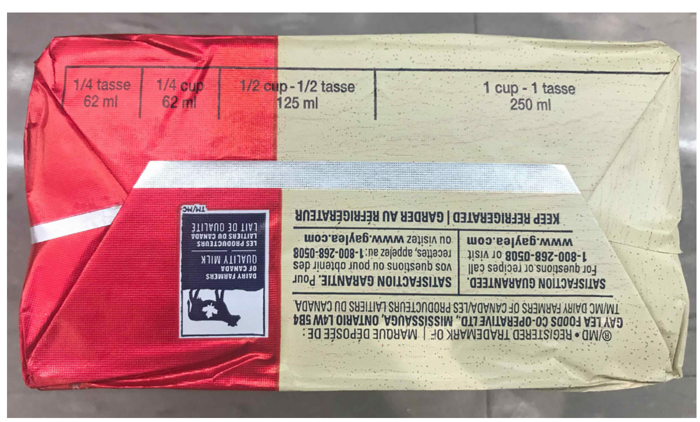


Glass measuring cup (Source: Zen Rial via Getty Images).

If we divide each half-cup into even smaller parts, we get more precise measurements called quarter-cups. We can also divide a whole cup into thirds, which means each part is one-third of a cup. This is particularly useful for recipes that call for specific, accurate amounts of ingredients.This level of precision is very handy, especially in baking where it can make a big difference.

Sometimes we measure without cups. How do we do it? Think of something that is yellow, comes in a rectangular package and tastes delicious on popcorn. What is it? Butter! Some butter packages have measurement guides. This is great for baking.

Individually wrapped sticks of butter are another convenient form of measurement. Each stick contains ½ cup or eight tablespoons of butter. Cutting a stick in half gives you ¼ cup or four tablespoons. When you combine four sticks to form a block, you have a total of two cups of butter.



Measurements on a package of butter (©2023 Kim Taylor. Used with permission).

Try this!
Say you have a cake that you want to cut into eight equal slices but you can only cut the cake three times. How do you cut it?

Read to the end of the chapter for the answer!

Ratios

Ratios come into play when adjusting recipe quantities. For example, when you double a recipe, you need to keep the same ratio of ingredients to each other. This ensures the dish has the same taste and consistency, even though it's bigger!

Imagine you have a recipe that serves four people. But you want to serve eight people. You would need to double the number of ingredients. Say the original recipe calls for one cup of flour and two cups of water. We could show this as a ratio. One cup of flour: two cups of water, or 1:2.

If we double this, then we need to multiply both sides of the ratio by two.

2(1): 2(2)

This would give us the ratio of 2:4. So you would need two cups of flour and four cups of water. This maintains the balance of ingredients, while scaling up the amounts. So the dish turns out as you'd expect! In this case, the ratio does not change. The doubled recipe still has a ratio of one part flour to two parts water, or 1:2.

Ratios are also a great shortcut for experienced cooks. They are a simple way to remember some basic recipes! Here are some common examples:

- Salad dressing is 3 parts oil to 1 part vinegar (3:1)
- Bread dough is 5 parts flour to 3 parts liquid (5:3)
- Pie crust is 3 parts flour to 2 parts fat, like butter or shortening to 1 part water (3:2:1)

So, you could make an enormous pie, or a tiny bit of salad dressing, as long as you use the right ratio of ingredients!

Bottle of oil and vinegar salad dressing (Source: stu99 via Getty Images).

Once you have mastered a basic recipe, you can build on it to suit your taste. For some people, that might be adding cheddar cheese to bread. Or adding spices to a salad dressing. But this can take some trial and error. Certain recipes are harder to modify than others.

Question 2: How much flour and water would you need to make a pie if you only had 1 cup of butter?

Temperature and Time

Temperature and time are really important when baking. They affect how recipes turn out. Different recipes need different temperatures for specific reasons. For example, both muffins and bread need to be baked at a high temperature. This makes them rise faster and develop the golden crust we love.

Various baked goods (Source: ALEAIMAGE via Getty Images).

Temperatures, like measurements, rely on different scales. The two scales people use when cooking and baking are Fahrenheit (°F) and Celsius (°C). In baking, Fahrenheit is most common. But there may be times when you need to convert between the two. To convert a temperature, follow these steps:

°C to °F
Divide by 5, then multiply by 9, then add 32

°F to °C
Deduct 32, then multiply by 5, then divide by 9

Imagine you're baking a cake, and the recipe recommends a temperature of 180°C, but your oven measures in Fahrenheit. Let's use the conversion to find out what to set the oven to.

°F = (°C/5 x 9) + 32

Plugging in 180 for °C:

°F = (180/5 x 9) + 32
°F = (36 x 9) + 32
°F = 324 + 32
°F = 356

So, 180 degrees Celsius is approximately 356 degrees Fahrenheit.

Question 3: What is 662° Fahrenheit in Celsius?

The relationship between cooking time and temperature is very important. If you use a higher temperature, your food will be cooked faster. But this could change its texture and moisture. Lower temperatures and longer times result in gradual, even cooking. This impacts the flavour and tenderness of the food.

The temperature of ingredients before cooking can also affect a recipe. For example, many cake recipes call for room temperature butter or eggs, rather than cold from the refrigerator. And people often cook steaks from room temperature to give them more flavour.

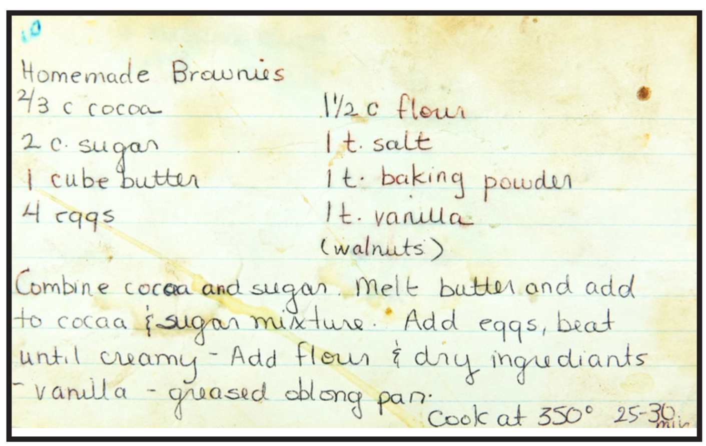
Temperature is also important in food! People who cook meat can use meat thermometers to measure its precise internal temperature. This ensures it has been cooked to the correct temperature and is safe to eat. Undercooked meat can contain **bacteria** that may cause food poisoning.

Meat thermometer in a piece of chicken (Source: BCK-Christine via Getty Images).

Data Anyone?

Did you know that collecting and analyzing data is an important part of cooking? Records of recipes you've cooked and adjustments you've made are forms of data. This data can be stored on recipe cards and shared with others!

Also, by taking note of the flavours, textures and cooking methods, you can pinpoint areas for improvement in recipes.



Handwritten recipe card (Source: raclro via Getty Images).

Commercialized food operations, like cereal companies, collect data on a larger scale. They do this through different rounds of product testing. Real people try the food and the company gathers data about what they think. By applying statistical techniques to the data, companies are able to determine if their product will be successful or not.

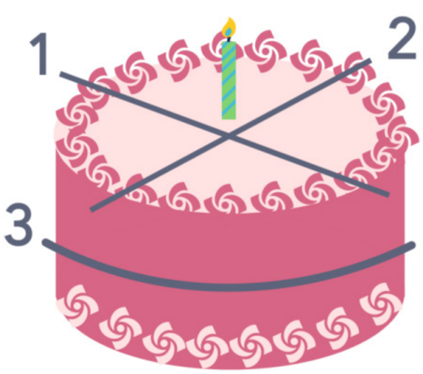
Did you know?
People who taste test food for a living are not called “taste testers”. Their official job title is Sensory Evaluator! They do more than just taste, they analyze the texture, flavour and smell of food. It’s about the whole experience of consuming a product.

The kitchen is a great place to grow and develop mathematical understanding. Measuring ingredients, temperature and time are key skills that allow a cook to feel confident. Fractions and ratios are powerful tools for home and professional cooks! Understanding accuracy and precision helps a cook create dishes that taste just right.

As we explore data and statistics, we realize how these ideas reach far beyond the kitchen, impacting even the biggest food companies. By carefully gathering and analyzing data, they refine products to suit the varied preferences of their customers.

So, when you're in the kitchen, remember, math can help you be a better cook!

Try This Answer:
You make two cuts across the top and one cut through the middle of the cake!



How to cut the cake (©2023 Let’s Talk Science).

Running Up The Score: The Math In Sports

Sports are a fun and exciting way to be entertained and to keep fit.

People have been playing sports for a very long time. Paintings of people wrestling in the Beni Hasan Tomb, from the Egyptian Ministry of Tourism and Antiquities in Egypt are over four thousand years old!

While sports may seem like a lot of fun and games, there’s serious math involved! Let’s dive in and learn more.

Painting of tomb wrestlers in the Beni Hassan tomb (Source: Crop from a public domain image via Wikimedia Commons).

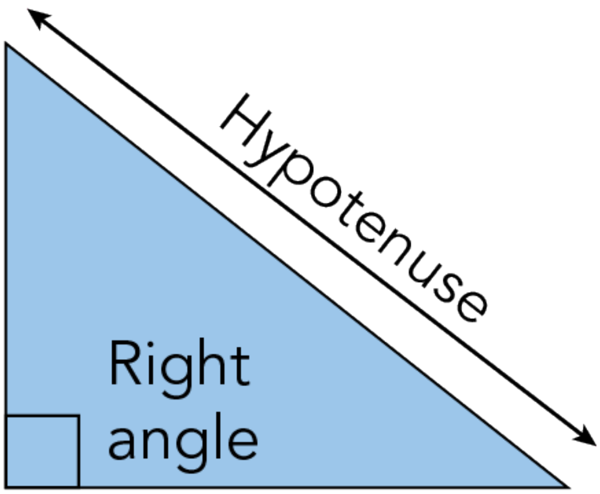
Geometry and Basketball

Basketball is a popular team sport. It was invented by Canadian physical education professor Jim Naismith at Springfield College in 1891. One of the reasons why it is so popular is that it is easy to learn. The goal of the game is to throw a ball into a **basket** above your head. Sounds simple - right? But behind this simple game, there are many connections to math.

One of the best examples of this is the **shot**. This is when a player throws the ball toward the hoop. When the ball goes into the basket, the player’s team scores points. The key is being able to throw the ball the right **distance** and at the correct **angle** to make this happen.

Knowing how far the ball has to travel in the air is an example of how we can use the **Pythagorean Theorem** in everyday life.

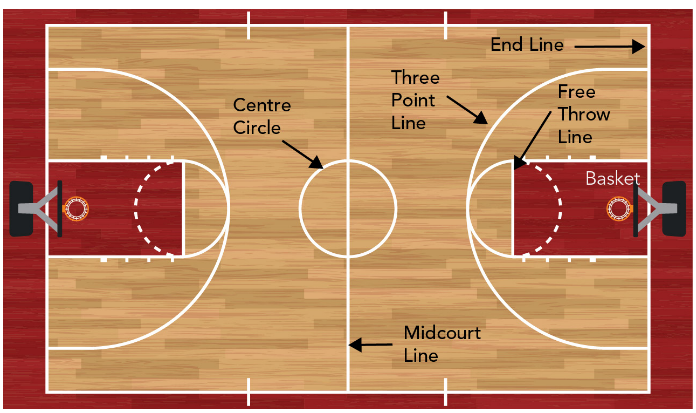
We use the Pythagorean Theorem to help determine the lengths of the sides of **right-angled triangles**. These are triangles that have a 90 degree angle. Another word for a 90 degree angle is a right angle. We call the side of the triangle opposite the right angle the **hypotenuse**.



A right angle triangle (©2023 Let's Talk Science).

Let's see how we could use the Pythagorean Theorem in basketball.

One distance we would need to find out is the horizontal distance from the player to the basket. It is helpful to know that some places on a regulation size basketball court have standard distances from the basket. For example, the **free throw line** is 4.57 metres (15 feet) from the basket and the **three point line** is 6.71 metres (22 feet) from the basket.



Lines on a basketball court (Let's Talk Science using an image by elinedesignservices via Getty Images).

The other distance we would need to find out is the vertical distance from the height where the ball leaves the player's hand, to the basket. Most players throw the ball above their heads. Some even jump to get more height! The distance a player releases the ball differs from player to player, but the average NBA player has a reach that is about 1.34 times their height. So, someone who is 1.82 metres (six feet) tall could reach up and release the ball at a height of 2.43 metres (eight feet). In addition to the reach, we also need to know the height of the basket. Basketball baskets are almost always around 3.05 m (10 feet) from the ground. This means the distance from the player's hand is the difference between their reach and the height of the basket.

Did you know?
In his game, James Naismith hung peach baskets on a railing that was 3 metres (10 feet) off the ground.
So early basketball used actual baskets!

Once we have horizontal distance and the vertical distance, we can figure out the distance from the player's hand to the basket. This distance is the hypotenuse of the triangle.

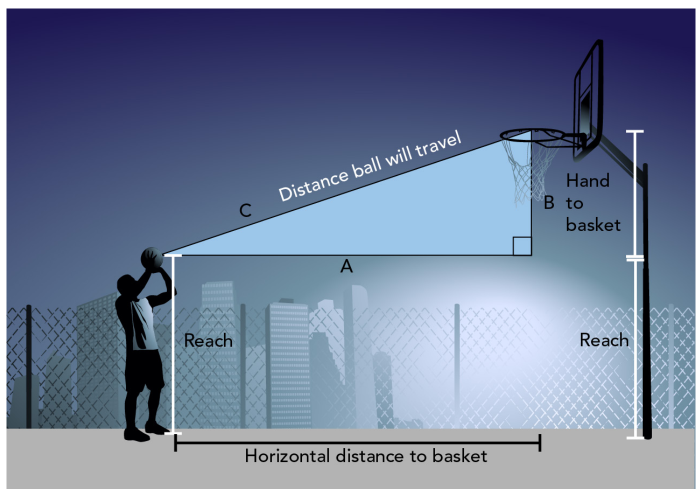


Diagram showing the distances involved when throwing a basketball (Source: Let's Talk Science using an image by nico_blue via Getty Images).

The Pythagorean Theorem states that, for a right angle triangle:

$A^2 + B^2 = C^2$

If A is the horizontal distance from the player to the basket and B is the vertical distance from the height of the player's hand to the basket, then we can figure out how far the ball has to fly through the air to reach the basket (C). Let's say that you're 1.82 metres (six feet) tall and you're shooting from the free throw line, which is 4.57 metres (15 feet) away from the basket. The basket is at a height of 3.05 m (10 feet).

$A^2 + B^2 = C^2$
$A = 4.57$ m
$B = 3.05$ m - (1.82 m x 1.34) = 3.05 - 2.44 = 0.61
$4.572 + 0.612 = C^2$
$20.88 + 0.37 = C^2$
$21.25 = C^2$
$\sqrt{21.25} = C$
$C = 4.61$ m
This means the ball has to travel 4.61 m (~15 feet) to get to the basket.

Question 4: If you're standing on the three-point line and you're 1.98m (6.5 feet) tall, how far will the ball have to travel through the air to reach the basket?

Statistics and Baseball

Baseball is an even older sport than basketball. Many different people and places claim they were the first to invent it. Like basketball, Canadians have long been associated with the sport. In fact, some of the first organized baseball leagues sprang up in southern Ontario.

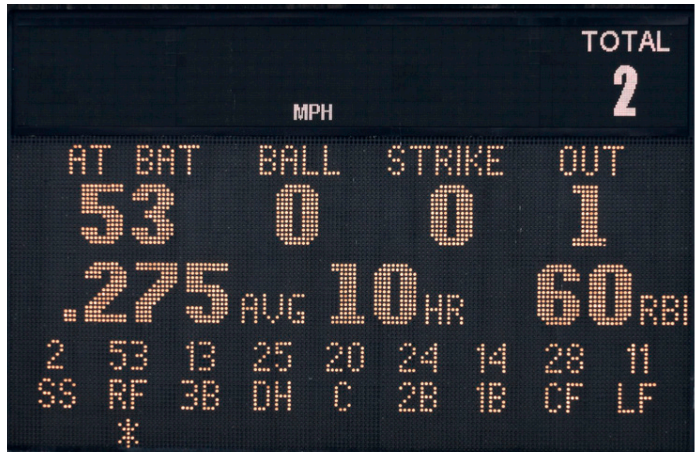
Did you know?
The world's oldest baseball ground that's still in use is Labatt Park in London, Ontario.

Professional baseball has been played in North America since 1876. In that time, lots of **data** has been collected about baseball games. With this data, baseball analysts do a lot of **statistics**. Statistics is a branch of math that involves collecting, analyzing, and making decisions based on data.

Batting Average

One common statistic that you often see or hear in baseball is a player's **batting average**. Sometimes this number is listed beside a batter's name when they come up to the plate. It's the number with the decimal in front.

A batting average is a measure of how often a batter can hit the ball and get on base.



Data on a baseball scoreboard (Source: iShootPhotosLLC via Getty Images).

You need two numbers to calculate a batting average. The first is the number of **hits** the batter has. The second is the number of **at-bats** or AB. A player gets a "hit" when they hit the ball and reach at least first base without being called out. A player gets an "AB" when they either hit the ball or strike out. If the pitcher **walks** a batter, they get neither a hit nor an AB.

Once we have the number of hits and the number of ABs, calculating a player's batting average is easy. The formula looks like this:

Batting Average = Hits divided by ABs

So, for example, if you got 37 hits in 150 at-bats, the calculation would be:

37 / 150 = 0.247

The result is always a number between 0 and 1. A batting average on its own doesn't mean much. It's mainly used to rank and compare players against each other. The example above, 0.247, is about average for hitters in Major League Baseball.

Screen capture of statistics for Vladimir Guerrero Jr., first baseman of the Toronto Blue Jays in the 2023 season (Source: ESPN).

Question 5: Davis Schneider played for the Toronto Blue Jays as a rookie in 2023. He got 32 hits in 116 AB. What was his batting average?

Baseball analysts look at statistics, like batting averages, to make **predictions** as to how well batters will do in different situations.

For example, they may use batting averages to find out how a batters does against right-handed pitchers vs. left-handed pitchers. They can also use it to determine if a batter hits better in their home field, or in other ballparks.

Earned Run Average

Pitchers have a similar statistic. It's called the **Earned Run Average**, or ERA. This statistic measures how many runs the opposing team scores, on average, against that pitcher in each game. It's called "Earned Run" because it doesn't include runs that are scored because of errors made by the pitcher's teammates.

The formula looks like this:

9 times Earned Runs divided by innings pitched

The 9 is because there are 9 innings in a game of baseball. So, if a pitcher gave up 36 earned runs in 131 innings, you could calculate the ERA like this:

9 x 36 / 131 = 2.47

The pitcher's ERA would be 2.47. Unlike the batting average, this statistic has a large range. The average for Major League pitchers in 2023 is 4.33. This is about four and a half runs per game.

2023 SEASON STATS

W-L	ERA	K	WHIP
12-9	3.16	237	1.18
Tied-23rd	7th	2nd	20th

Screen capture of statistics for pitcher Kevin Gausman of the Toronto Blue Jays for the 2023 regular season (Source: ESPN).

Question 6: José Berríos is a starting pitcher for the Toronto Blue Jays. In 2023 he gave up 65 earned runs in 180 innings. What was his ERA?

Both the batting average and ERA have been used for well over a hundred years to measure players against each other. These are only two of dozens of statistics that can be used to rank and compare players. Many of the statistics used in modern baseball are much more in-depth. Some of them can be quite complicated!

Measuring distances and comparing player averages are just two ways in which math plays a role in sports. So the next time you're watching a sports event, think about all the ways you could describe the action using math!

Basketball player in front of calculations on chalkboard (Peter M. Fisher, Getty Images).

Fibonacci and Golden Ratio

A Pattern in Nature

Have you ever wondered why flower petals grow the way they do? Why they often are **symmetrical** or follow a **radial** pattern. There are a lot of different patterns in nature. But one of the most well-known is the **golden ratio**.

Daisy flowers (Source: Klaus Böhm via Pixabay).

Did you know?
The golden ratio has many different names. The golden section, the golden mean, the golden proportion and the divine proportion are just a few. People have been looking for and seeing this pattern for thousands of years!

The Fibonacci Sequence

So where does this golden ratio come from? It is based on a sequence of numbers that mathematicians around the world have been studying since about 300 BCE.

That's around when Acharya Pingala, an ancient Indian poet and mathematician, wrote about a pattern of short and long syllables in the lines of Sanskrit poetry. This pattern translates to a sequence of numbers called the **mātrāmeru**.

The same sequence was named the F**ibonacci sequence** about 1500 years later. This is when, around 1202, Italian mathematician Leonardo Bonacci wrote about it in his book Liber Abaci.

Fibonacci and his writing were important to the development of mathematics in Europe. He helped introduce the Hindu-Arabic or Indo-Arabic number system to many people in the West. This system was much easier than the Roman numerals used in Italy at the time.

Did you know?
Hindu-Arabic or Indo-Arabic numerals are the same number system we use today!
The symbols for 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 developed in India and spread to the Middle East and North Africa. Mathematicians including al-Khwarizmi and al-Kindi first introduced the system to Europe. But it was later popularized by Fibonacci.

In Liber Abaci, Fibonacci wrote about something called The Rabbit Problem. It went like this:

A certain man put a pair of rabbits in a place surrounded by a wall. How many pairs of rabbits can be produced from that pair in a year, if it is supposed that every month each pair begets a new pair from which the second month on becomes productive?

(pp. 283-284, translated from original Latin)

By the end, that walled place would soon be hopping with rabbits! But how exactly would their numbers grow? Fibonacci wrote a series of numbers to solve the problem:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, …

There are zero rabbits in the first month. In the second month, one pair of rabbits move in, but they don't have any babies for the first two months. In the fourth month, a new pair of rabbits is born! And another in the fifth. By the sixth month, both the first and second pairs are having a pair of babies every month.

These numbers are growing quickly! But did you notice the pattern? After 0 and 1, each new number is the sum of the two numbers before it. This is the Fibonacci sequence. The individual numbers within this sequence are called Fibonacci numbers.

Question 7: What number comes after 4181 in the sequence above?

Did you know?
"Fibonacci" was Leonardo Bonacci's nickname. It means "son of Bonacci" in Italian. Guglielmo Bonacci was a merchant and Italian customs official. Leonardo travelled to Algeria with him, where he studied calculation. Later, Fibonacci worked and studied number systems in Egypt, Syria, Greece, Sicily, and Provence.

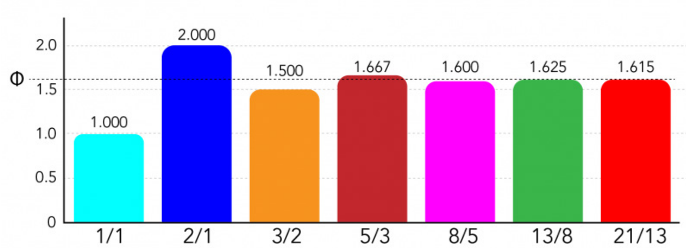
The Fibonacci sequence can also be expressed using this equation:

$$Fn = F(n-1) + F(n-2)$$

Where n is greater than 1 (n>1).

The sequence gets more interesting when we divide each number by the one that comes before it.
For example: 1÷1, 2÷1, 3÷2, 5÷3, 8÷5, 13÷8, and 21÷13.

The answers would be: 1.000, 2.000, 1.500, 1.667, 1.625, and 1.615. Look at those numbers in the bar graph below. The bars are different heights, But as each set of numbers gets larger, the answer gets closer and closer to the same dotted line.



Ratios for the first seven pairs of Fibonacci numbers (©2022 Let's Talk Science).

Question 8: What is the next pair of numbers you could add to the graph above? What would be the value of this ratio?

The dotted line is labelled with the symbol Φ. This is the 21st letter of the Greek alphabet, Phi. In math, Phi represents a number that starts with 1.618033988749895… And goes on forever without repeating! That's one reason Phi is an **irrational number**.

Did you know?
An irrational number is a real number that cannot be written as a simple fraction. For example, 1.5 can be written as 3÷2. But you can't do that with Phi. Pi (3.14159265358…) is also an irrational number.

The Golden Ratio

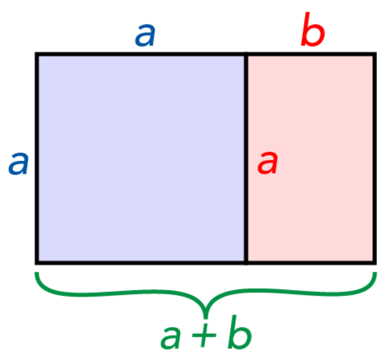
The Golden Ratio is not the same as Phi, but it's close! The Golden Ratio is a relationship between two numbers that are next to each other in the Fibonacci sequence. When you divide the larger one by the smaller one, the answer is something close to Phi. The further you go along the Fibonacci Sequence, the closer the answers get to Phi. But the answer will never equal Phi exactly. That's because Phi cannot be written as a fraction. It's irrational!

The Golden Ratio can also be seen using two quantities, like the lengths of two line segments. Have a look at the lines below. The blue and green lines have the Golden Ratio. This is because the length of the longer blue line, divided by the shorter green line, is the same as the length of the two lines added together (shown in black) and divided by the blue line. In other words, two quantities have the Golden Ratio if their ratio is the same as the ratio of their sum to the larger of the two quantities.
A Golden Rectangle works in a similar way. But the quantities are shapes rather than lines. Have a look at the diagram below. The rectangle has a long side of a + b and a short side of a. This is the entire coloured area of the diagram.

$$\frac{\text{Long Segment}}{\text{Short Segment}} = \frac{\text{Line Segment}}{\text{Long Segment}} = \frac{1+\sqrt{5}}{2} = 1.61803...$$

Ratios of line segments in the Golden Ratio (©2022 Let's Talk Science).

Imagine cutting off a square section of this using one line. The square is shown in blue. Each side of its sides is equal to the shortest side of the original rectangle, or a.

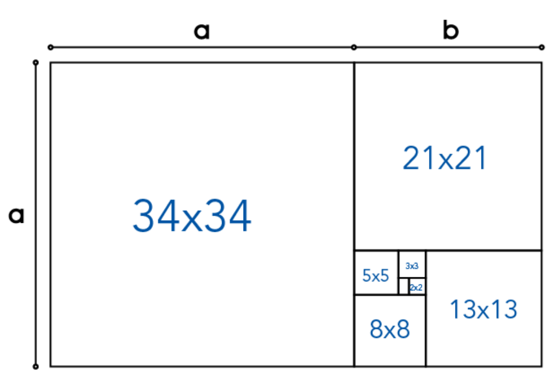


Golden rectangle (Source: Ahecht [public domain] via Wikimedia Commons).

But look at the smaller, leftover rectangle shown in pink. This has the same ratio of side lengths as the original rectangle! Even though it's smaller, it can be divided in the same way as the first.
The ratio between sides a and b is Φ or 1.61803…
You can see this written as an equation below:

$$\frac{a+b}{a} = \frac{a}{b} = \Phi$$

We can grow this pattern by adding a new, larger square to the long side (a + b) of the rectangle. This square, combined with the previous shapes, results in a new, larger rectangle. Do this again and again, and you can create a growing pattern, like the diagram below.

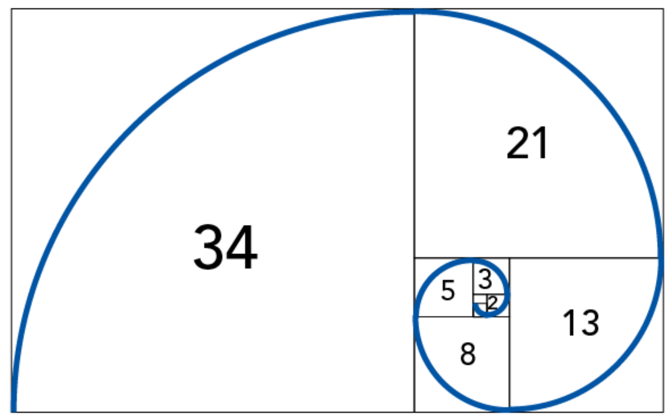


Multiple Golden rectangles (Let's Talk Science using an image by primo-piano via iStockphoto).

Question 9: How big would the next square be, to continue growing the pattern in the previous diagram?

We can take the Golden Rectangle one step further by adding a line that forms a quarter circle in each square.

Have a look at the diagram below. The curved lines connect to form a spiral. This is called a Fibonacci Spiral. Each square is also labelled with the length of its sides. These numbers are the same as in the Fibonacci Sequence!



The Golden ratio can also form a spiral (©2022 Let's Talk Science).

Fibonacci Spirals in Nature

Remember those flower petals? They help draw pollinators to the centre of the flower where the pollen is - like a bull's eye. This is why many flowers have evolved to grow petals in a Fibonacci spiral around their centres. Each new petals grows about 137.5 degrees away from the last. This is 1 ÷ Phi x 360 (total degrees in the circle). Or you can imagine dividing a circle into two curved lines. The arc of the longer line and the arc of the shorter line have the golden ratio. This is called the golden angle. In fact, if you count all the petals on a flower, you will often find a Fibonacci number!

Flowers that have a Fibonacci number of petals (©2023 Let's Talk Science).

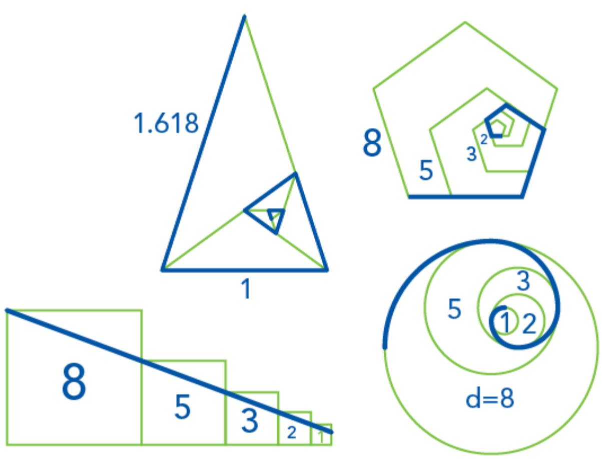
But it's not just petals that follow this pattern. Other plant parts follow the Fibonacci Sequence too. Seeds need enough space to grow properly.

Have a look at the sunflower below. The seeds are packed into the centre of the flower in a very familiar pattern! The same pattern can be seen in pinecones and pineapples. If you take the time to count the spirals in each direction, you often find Fibonacci numbers!

Fibonacci spiral on a sunflower (Let's Talk Science using an image by Damian Pawlos via iStockphoto).

> Misconception Alert!
> Fibonacci Spirals and Golden Spirals are not the same. A Fibonacci spiral is made of squares that increase in size. But a Golden Spiral is made by nesting smaller and smaller Golden Rectangles within a large Golden Rectangle.

The Golden Ratio can be used with other shapes as well. It is possible to find golden ratios in patterns involving circles, triangles, pentagons and other shapes. So, plants do math! Pretty smart eh?



Other shapes with their Golden ratios (Let's Talk Science using an image by primo-piano via iStockphoto).

Buying Power: The Math Behind Money

Having your own money and being able to make your own purchases is a big step towards becoming an adult. Instead of having to ask your parents for money, you can just think about what you want to buy, figure out if you have enough money, and then buy it. Being in charge of money makes a lot of people anxious - including adults! Buying things and handling money doesn't have to be complicated, though. You just need to keep math in mind.

Small Purchases

Buying things isn't that complicated, right? You just hand over your money and you get the thing you paid for. Well, not so fast. There are a couple of things you need to think about.

Let's say you want to buy a bicycle. You've saved up your allowance, or the money you've made from a part-time job like a paper route. You go into your local store and see the bike you want. The price tag under it says that it costs $299.99. You have saved up $350, so that's perfect! You can buy the bike and still have fifty dollars left over to spend how you like, right? Wrong. You still need to pay the **sales tax**.

Canadian currency with financial reports (Source: alfexe via Getty Images).

Taxes are payments that people make to a government. If you live in Canada, then some of your taxes go to the Government of Canada. Taxes are how the government gets the money they use to do things.

They use taxes to build and repair roads, pay for doctors and hospitals, and give people an education.

There are a lot of taxes you won't have to deal with just yet. These include income tax and property tax. But you do need to pay sales tax on almost everything you buy in a store. In Canada, they aren't usually shown on the price tag, either. You have to be able to do some quick math in your head if you want to figure out how much money you need before you get to the cash register.

How much sales tax you'll pay on your bicycle depends on where you live. In Canada, there are three different types of sales tax. The first is the **Goods and Services Tax**, or **GST**. The GST is a federal sales tax. This means that it is the same rate everywhere in Canada. The GST is 5% of the price on the tag. In the case of your bike, that's 5% of $299.99. We'll round it up to an even $300 to make it easier. That looks like this:

300 x 0.05 = 15
300 + 15 = 315

So with the GST added in, you're actually paying almost $315.

As well as the GST, many provinces have an additional **Provincial Sales Tax**, or **PST**. In Quebec this is known as the **Quebec Sales Tax**, or **QST**.

For example, in British Columbia and Manitoba the PST is 7% of the purchase price. For your bike, it would look like this:

300 x 0.07 = 21
300 + 21 = 321

So the total, with GST and PST added in, would be:

15 + 21 = 36
300 + 36 = 336

So after taxes, you would have $14 left over from your $350.00

In some provinces, like Ontario and Nova Scotia, the GST and PST are combined into one single sales tax, called the Harmonized Sales Tax, or HST. In Ontario the HST is 13%, and in the Atlantic provinces the HST is 15%.

Question 10: How much would your bike cost if you bought it in Ontario?

The sales tax is rarely added to the price on the tag in the store, so it's important to keep in mind how much extra you'll need to have to pay.

What if the item you want to buy isn't in Canada? Let's suppose that you can't find a single bicycle you like in Canada. Instead, there's a bicycle in an online shop based in the United States that is everything you want in a bike. Even better, it's listed for $269.99. That is thirty dollars cheaper than the bike you would have bought in Canada!

Well, maybe not. Just like sales taxes, the **exchange rate** is something you need to consider if you're buying things in or from other countries. The exchange rate determines how much the Canadian Dollar is worth when compared to the **currencies** of other countries.

Canadian and U.S. dollars with calculator (Source: alfexe via Getty Images).

At the time this handbook was written, the exchange rate between the Canadian Dollar (CAD) and the U.S. Dollar (USD) is 0.73. This means that each Canadian Dollar is worth 73 cents in the United States, and each U.S. Dollar is worth $1.36 in Canada.

Lower prices in U.S. stores can be deceiving because the Canadian Dollar is worth slightly less. This changes how much you're actually paying.

Let's take a look at what that would mean for your bike.

In the U.S, the bike you're looking at is $269.99. The exchange rate between the CAD and the USD is 0.73. This means that each USD is worth 1.36 CAD. To figure out how much $269.99 USD is in CAD, you have to multiply it by 1.36.

269.99 x 1.36 = 367.19 (rounded up)

So in your CAD, that $269.99 bike would actually cost you $367.19. That's more than you've saved up!

The exchange rate changes based on the **financial market**. This means that the value of the Canadian Dollar is based on how much people want to buy and sell it for. It can go up and down based on many different factors. The **daily exchange rate** between Canada and the United States has hovered around 0.74 for quite a while, but it has gone lower and higher at many points over the last fifty years. When Canadians buy from American stores, they need to keep the exchange rate in mind when thinking about prices.

Larger Purchases

Saving up for a relatively small purchase, like a bicycle, is pretty simple. For larger purchases, like a laptop or a car, it's a bit more complicated. There are two ways you can go about making a larger purchase. The first is to save up, like you did for the smaller purchase. The second is to use **credit**.

Saving is likely the way you'll make this kind of purchase right now. The most common way to save your money is to put it into a bank account. Banks offer many different kinds of accounts. They are usually divided into two types: **chequing accounts** and **savings accounts**. Until you have a steady full-time job, you probably won't need a chequing account. This kind of account is used to store money to use regularly, such as for paying bills.

A savings account allows you to store your money in a safe place until you need to use it. One reason for you to put your money in a savings account is that the bank will pay you interest on it. Interest is the money a bank pays you for putting your money into a savings account. How much money depends on the **interest rate**. The interest rate that a bank pays you differs from bank to bank, and account to account. A typical interest rate for a regular savings account is around 0.01% per day.

Let's say you saved up $500 from your part-time job and wanted to put it in a savings account. At the end of the first day, how much would you have saved up?

$500 x 0.0001 = $0.05

At the end of that first day you'd have $500.05. To figure out how much you'd make this way over a month, there's a handy formula:

Interest = Principal x Rate x Time

The Principal is the amount in your savings account. In this case, $500. The Rate is the interest rate, 0.01%. The Time is the period of time you're saving up for.

Question 11: If you have $500 in your savings account, and the interest rate is 0.01% per day, how much money have you gained in interest by the end of a 30-day month?

One thing to keep in mind with savings accounts, however, are the **bank fees**. Bank fees are what the bank charges you for their services. Chequing accounts often have a fee that you have to pay monthly in order to have it.

Children bringing savings into the bank (Source: Fly View Productions via Getty Images).

Savings accounts do not typically have this kind of monthly fee. There may be fees for withdrawing money from your account, though, or for transferring money from a savings account to a chequing account.

You get a bank card (often called a **debit card**) along with your bank account. And you usually have to pay fees for using it. So, when you purchase something using your debit card, you need to remember how much you will need to pay in fees for moving your money, and keep enough aside to cover them.

Until you're older and you get a full-time job, you probably won't be able to get **credit** from a financial institution like a bank or credit union. Credit is money that is given to you as a loan, that you eventually have to pay back with interest. Unlike your savings, the interest on your credit is calculated much more frequently - either monthly or daily.

To see how this works, let's pretend you owe $2 000 on a credit card. The annual interest rate is 16%. The interest rate is calculated daily, which works out to 0.044% per day. We'll calculate that for the first few days to show you how it works.

Day	Starting Balance	Interest Gained	Ending Balance
1	2 000	0.88	2 000.88
2	2 000.88	0.88	2 001.76
3	2 001.76	0.88	2 002.64
4	2 002.64	0.88	2 003.52
5	2 003.52	0.88	2 004.40

Question 12: If you owed $2000 on your credit card, and the interest rate was set at 0.044% daily, how much would you owe by the end of a 30-day month?

Credit lenders usually require a minimum monthly payment based on your balance at the end of the month. Let's suppose that minimum payment is 3% of your balance. This would look like this:

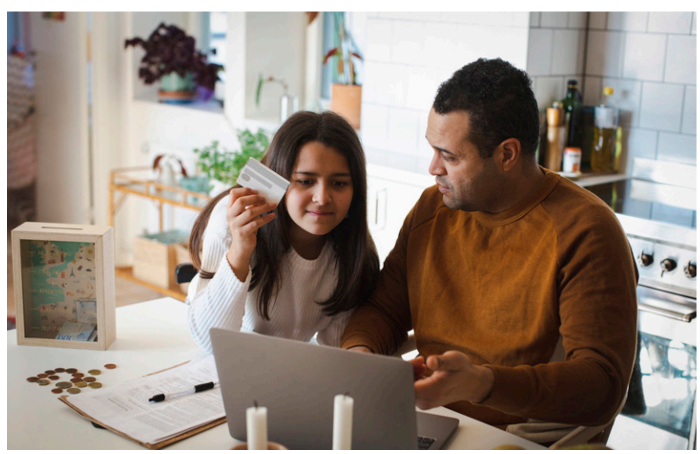
2026.40 x 0.03 = 60.79

The minimum payment on your balance would be $60.79. If you pay the minimum payment, your money goes to pay off the interest first. This means that you would pay $26.40 in interest, and $34.39 of the original $2000 balance. This would leave you with a balance of $1965.61.

But how long will it take you to pay back your $2000 balance? If you use a credit calculator, you'll find out that if you only pay the minimum each month, it will take you 12 years and seven months. Plus you'd pay an extra $1443.76 in interest on top of your original $2000. This would be a total of $3443.76. This is why it's a good idea to pay more than the minimum payment every month, so you can pay less interest over time.

Two teens count out their money at home (Source: kate_sept2004 via Getty Images).

Handling money is a valuable skill that you can develop at a young age. By understanding the basics of financial math, you can make informed financial decisions that will serve you well in the future. Whether it's managing taxes, dealing with exchange rates, or handling savings and credit, these skills will help you navigate the world of financial math.



Father and daughter doing online banking (Maskot, Getty Images)

Young Entrepreneurs – Math and Your Dream Business

Have you ever thought of starting your own business like Renee Tookenay? She is an entrepreneur who created her own natural cosmetics business. Starting a business requires passion, a great idea, and some math. Yes, math! Nelson (Edwin) and Let's Talk Science have teamed with some tips about starting your own business. Let's go!

Prepare: Let's get creative!

Do you have a great idea, a passion, or a hobby you'd love to turn into a thriving business? Do you want to run a business by yourself or collaborate with a partner? Let your creativity guide you to make your dream a reality.

PREPARE TASK

Create a vision board with all your ideas for your business. A vision board is a collection of images or objects arranged in a way to help you outline your goals or vision. The board can be physical or digital. Use words, images, colour and drawings as part of your vision board.
Here are some business ideas to get your creative juices flowing:

- Teaching computers to seniors
- Tutoring
- Fashion design
- Ready-to-eat meals
- Baked goods
- Dog walking

For example, let's see how to start a business selling cakes and other sweet treats.

Plan: Let's get down to business!

Now that you've decided on the focus of your business, there are many things for you to consider. These include budgeting, supplies, branding, advertising and more. Many of these involve math!

A great place to start during the planning phase is to create a survey. A market research survey is a way to gather information to help you understand people's wants and needs.

Surveys can include different types of questions, such as multiple choice, true or false, ranking choices and short answer questions.

Question mark cut from cookie dough (Source: eyegelb via Getty Images).

For example, part of a survey for a baked goods business might look like this:

Multiple Choice

What is the greatest amount of money you would be willing to pay for a dozen cupcakes?

- ☐ $25
- ☐ $30
- ☐ $35
- ☐ Over $35
- ☐ I wouldn't buy cupcakes

Ranking

Rank these sweet treats from your most favourite (1) to least favourite (4).

- ☐ Brownies
- ☐ Cakes
- ☐ Cookies
- ☐ Cupcakes

Short Answer
Where do you usually purchase baked goods?

PLAN TASK

Design a survey to learn more about your prospective customers and what they think about your business idea.

You may want to include questions about such things as:

- Your product or service
- Where and when to sell
- Pricing

Once people have completed your survey, you will need to determine what the data tells you about your proposed business. This can include:

- Organizing and representing the data using tables and graphs
- Analyzing the data
- Drawing conclusions from the data

People looking at data (Source: courtneyk via Getty Images).

Now that you have an idea about what your customers want, it is time to create a **budget**. A budget is a plan to manage income and expenses.

All businesses need to spend money on various things. These are called **expenses**. There are two types: fixed expenses and variable expenses.

- **Fixed expenses** are regular expenses that are easy to predict. These include expenses like rent, insurance and staff salaries.

Question 13: What fixed expenses would you expect your business to have?

- **Variable expenses** are items and services that cost different amounts and are paid at different times. These include expenses like material costs and gas.

Question 14: What variable expenses would you expect your business to have?

Business budgets also include the expected **revenue**. This is money that a business expects to bring in.

You often see budgets in a table like the one below. By creating a budget, you will be able to figure out how much money you expect to earn and spend. A **surplus** occurs when, in a given year, a business' revenue exceeds its expenses. This will cause a positive **balance** in the budget. On the other hand, when a business spends more than it receives in revenue, a **deficit** occurs. This will cause a negative balance in the budget. The balance is the total expenses subtracted from the total revenue.

Monthly Revenue	January	February	March
Birthday cake orders	$25	$100	$50
Cupcake orders	$12	$24	$36
Cookie order	$10	$30	$20
Totals	$47	$154	$106
Monthly Expenses	**January**	**February**	**March**
Cell phone fees	$12	$12	$12
Baking supplies	$25	$40	$30
Transportation	$18	$24	$18
Totals	$55	$76	$60
Balance	**?**	**?**	**?**

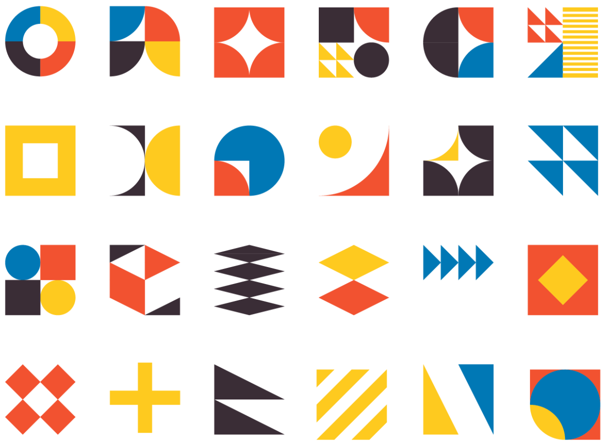
Question 15: What was the balance for each month? Which months had a budget surplus? Which months had a budget deficit?

Propel: Let's put the plan into action!

So far, you've had a vision for a business, you've done your research and crunched some numbers. There are still some other things to think about before your big grand opening. These include coming up with your brand and advertising.

Memorable brands often have great names and logos. A logo is a graphic that represents your brand. It may use words, pictures or both. Many logos use geometric shapes.

Graphic designers use shapes to represent ideas. For example, a triangle that points up can represent stability. A circle can represent wholeness and harmony. You can create even more interesting logos by combining shapes!



Examples of geometric logos (Source: naqiewei via Getty Images).

For a baked goods business, think about what shapes could represent baked goods (e.g., circles for cakes and cookies).

PROPEL TASK

Design a logo that uses at least one geometric shape. What does your shape or shapes represent? How does that relate to your business idea?

Question 16: What companies do these geometric logos belong to?

a. b. c.

Reflect: Let's think about it!

No matter what stage you are in – planning, building, or working in your business – it's always wise to pause and reflect on where you've been, where you are and where you're going.

REFLECT TASK

Ask yourself:
What's working well?
What isn't working well?
What do I love about my business?
Where do I want to go next?
What do I need to get there?

Not sure what else to do next? You can find more information about starting a business and getting start up funding from the Government of Ontario and read about the career journeys of entrepreneurs.

Starting a business can be hard work, but it also can be incredibly rewarding.

Meet Edwin

Nelson's digital education platform, Edwin, is a safe virtual sandbox giving students choice and autonomy in their learning. Many of the math resources featured in this part of the handbook are from an Edwin lesson collection called, "So You Want to Be an Entrepreneur."

Let's Talk Science appreciates the contributions from Nelson Edwin to the development of this part of the handbook.

Answers

Question 1:
How many teaspoons are in one cup?

There 3 tsp. in 1 tbsp. and 16 tbsp. in 1 cup. So there are 3 x 16 = 48 tsp. in 1 cup.

Question 2:
How much flour and water would you need to make a pie if you only had 1 cup of butter?

Pie crust is 3 parts flour to 2 parts butter or shortening to 1 part water. The ratio is 3:2:1
If you had two cups of butter, you wouldn't have to do much math! Just add three cups of flour and one cup of water. But if you only had one cup of butter, then you would have to divide every other part of the ratio in two as well.

3/2: 2/2: 1/2. This gives us 1.5:1:0.5.
So, you would need 1 ½ cups of flour and a ½ cup of water.

Question 3:
What is 662° Fahrenheit in Celsius?
To go from °F to °C you deduct 32, then multiply by 5, then divide by 9
= [(662-32) x 5]/9
= (630 x5)/9
= 3 150/9
= 350
662° Fahrenheit is 350° Celsius

Question 4:
If you're standing on the three-point line and you're 1.98 m (6.5 feet) tall, how far will the ball have to travel through the air to reach the basket?

$A^2 + B^2 = C^2$
A = 6.71 m
B = 3.05 m - (1.98 m x 1.34) = 3.05 - 2.65 = 0.4
$6.712 + 0.42 = C^2$
$45.02 + 0.16 = C^2$
$45.18 = C^2$
$\sqrt{45.18} = C$
C = 6.72 m
This means the ball has to travel 6.72 m (~22 feet) to get to the basket.

Question 5:
Davis Schneider played for the Toronto Blue Jays as a rookie in 2023. He got 32 hits in 116 AB. What was his batting average?

A: Batting Average = 32 / 116
Batting Average = 0.276

Question 6:
José Berríos is a starting pitcher for the Toronto Blue Jays. In 2023 he gave up 65 earned runs in 180 innings. What was his ERA?

9 x 65 / 180 = 3.25
Berrios' ERA was 3.25.

Question 7:
What number comes after 4181 in the sequence above?
6765

Question 8:
What is the next pair of numbers you could add to the graph above? What would be the value of this ratio?
34/21, 1.619

Question 9:
How big would the next square be, to continue growing the pattern in the diagram above?
55x55

Question 10:
How much would your bike cost if you bought it in Ontario?
299.99 x 0.13 = 38.99
299.99 + 38.99 = 338.98
So you would be paying $338.98 for your bicycle.

Question 11:
If you have $500 in your savings account, and the interest rate is 0.01% per day, how much money have you gained in interest by the end of a 30-day month?
A: Interest = Principal x Rate x Time
Interest = $500 x 0.0001 x 30
Interest = $1.50
You would have gained $1.50 in interest by the end of the month.

Question 12:
If you owed $2000 on your credit card, and the interest rate was set at 0.044% daily, how much would you owe by the end of a 30-day month?
We can use the same formula as above: Interest = Principal x Rate x Time, using your credit card balance as the principal.

Interest = 2000 x 0.00044 x 30
Interest = 26.40
At the end of the month you would have added $26.40 to what you owe from interest.This makes the total balance you owe $2026.40.

Question 13:
Answers will vary but could include the cost of a booth, such as at a farmer's market or regular ads in a newspaper.

Question 14:
Answers will vary but could include transportation, advertising, special event fees, etc.

Question 15:
The balances were: January $ -8, February $78, March $46.
January had a deficit balance, February and March had surplus balances.

Question 16:
Red Cross
Microsoft
Olympics

Designing with the Fibonacci Sequence

Consider using the Design & Build Process with this challenge.

This activity will help build skills related to the Research, Plan, and Reflect & Share phases of this process.

Materials:

- Paper and drawing tools
- Ruler
- Computer with internet access (optional)
- Device for taking photos (optional)
- Modelling materials, e.g., building blocks, clay, recycled materials

What to do!

Your challenge is to find ways to use the Fibonacci sequence (including the golden ratio, golden rectangle, Fibonacci spiral, or golden spiral) as many times as possible in the design for an art piece, sports field, or building, etc.

Tips and Hints

Looking at examples of what you want to design is a great place to start. For example, you may want to look at pieces of art or buildings. It can also be very inspiring to look at things that are totally unrelated. Many great designers and innovations are inspired by nature.

1. **Research** – Look for ways the Fibonacci sequence is incorporated, or could be incorporated in various artworks, structures, etc. You might want to check out:
   For art: National Gallery of Canada, Art Gallery of Ontario, Smithsonian Institute.
   For architecture: Canadian Architectural Archives, Canadian Architect projects, the buildings around you, or ones you've visited or seen in pictures.
2. **Plan** – When you're ready to design, use a format you're familiar with. You can draw, design on the computer, or build a model.

3. **Reflect & Share** – Show your design to someone else and see how many times they can spot the Fibonacci sequence in your design. Are there any you didn't realize that you used? Are there any places where you could add more?

What's happening?

Artists and architects have been inspired by the Fibonacci sequence for a long time. Some of them have used ideas such as the Golden ratio to arrange the parts of an image or a building.

The Dutch artist **Piet Mondrian** is well known for his abstract geometric artworks. The Golden Ratio appears in some of his paintings. The architect **Le Corbusier** was very interested in math and the proportions of rooms and buildings. His work still influences architects and city planners today.

Why does it matter?

Math is all around us, and not just in traditional STEM contexts! Learning about principles like the Fibonacci sequence can help us understand our world in new ways and stretch our creativity.

Investigate further!

- What other math principles can you spot in your design? Where could you use the Pythagorean theorem or measure ratios?
- Try measuring everyday things to see if they follow the Golden ratio.
- Count the number of petals on a flower, leaves on a stem, or investigate the branching pattern on a tree or the curve of a spiral shell. Do they fit the Fibonacci sequence?
- People often find rectangles drawn using the Golden ratio to be pleasing to look at. See if this is true by surveying your friends and family. Draw several rectangles, only one of which follows the golden ratio and find out which one they like best. Are the results what you expected?

Benjamin Klein

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Baskin Wealth Management

I grew up in Toronto, ON and I still live there. I have a Bachelor of Arts, Honours in Applied Economics from Queen's University. I am also a Chartered Financial Analyst, CFA Institute and a Certified Financial Planner, FP Canada.

What I do at work

To sum it up, I help people invest their money so they can save enough to retire and meet any other financial goals they have. But there is a lot more involved. I spend a lot of time speaking with clients, answering questions about their investments and money, and helping them think about their money in a productive way.

My understanding statistics and math helps me to understand politics and world events that may have effects on the financial markets. I use a special computer software with data on all kinds of different investments as well as Microsoft Excel.

At Baskin Wealth Management, we have an investment committee of 10 people. This committee meets formally every month to review our investments, current world events, as well as what the financial markets are doing. We also speak in person, by email and by phone daily. We use our understanding of what is going on in the world and financial markets, to make decisions on what investments to buy and sell. We suggest ideas and discuss the pros and cons of each before making a final decision. We use this information to help our clients decide which investments are best for them.

My career path

Once I had taken economics courses in school, I knew I wanted to study it in university. I didn't know what kind of work I would end up doing until after completing my undergraduate degree. I completed two graduate-level certifications in financial analysis (investing) and financial planning.

While at university, I volunteered as a Financial Analyst with a student-run club. In this role, I analyzed companies to determine the potential growth of their stocks. I summarized this information and prepared due diligence reports on prospective companies for presentation.

After graduation, I moved to into a Financial Services Representative with an investment company. Here I started doing work similar to what I do today. When I moved to Baskin Wealth Management, I began as a Research Analyst. I was doing similar work as I had before but was learning new things. I worked my way to the Portfolio Manager position over several years of hard work and continuous learning.

I am motivated by

Investing is interesting because ideas can come from anywhere. You can invest in new technologies, trends, demographics, smart management teams, and everything in between. I also enjoy teaching people and helping them understand complicated topics so helping people plan for the future is very rewarding.

How I affect peoples' Lives

Money is a source of stress for many people. I try to make people feel confident about their ability to take care of themselves well into the future and to allow them to continue to live the lives they choose without worrying about money.

My advice to others

Be interested in everything, no matter how "useful" it is. You never know when skills you've learned will help you learn other skills in the future.

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