VISIT MATH

Co-funded by the European Union

Functions

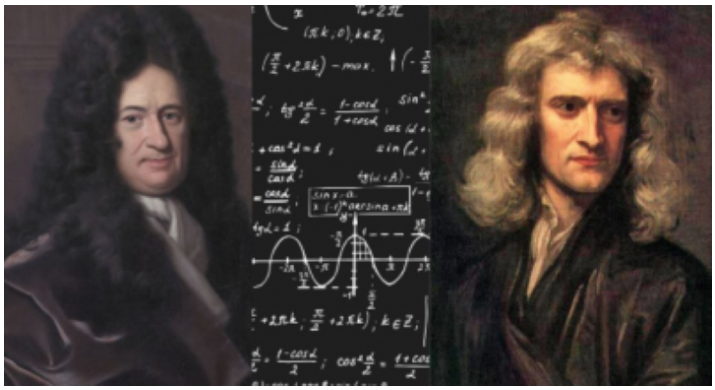
Topic	Calculus
Learning objectives	Algebra
Age group	10-16 years (to be adapted in each country)
Estimated duration	1 hour
Activities	Calculating functions in real life
Related visits	Warsaw Royal Route, Pisa, Athens

Previous knowledge required

Understating basic mathematical concepts

Step by step: the sequence in the classroom

Step 1: Introducing the topic



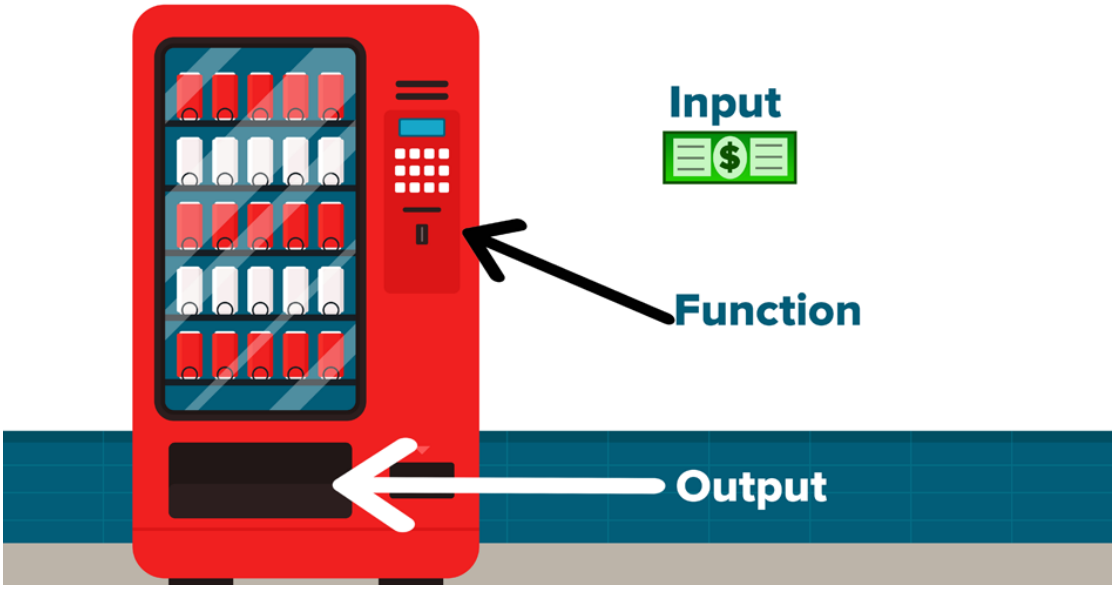
Source: https://www.stemfellowship.org/who-got-there-first-newton-leibniz-and-their-work-on-calculus/

What does Gottfried Wilhelm Leibniz, the German philosopher and mathematician, has in common with Sir Isaac Newton, the physicist and mathematician, and how does it affect the way you make your online orders and payments?

They both worked on Calculus, which is a branch of mathematics that deals with rates of change and is used in a multitude of fields. Among them are physics, engineering, economics, statistics, and medicine. Rates of change are used to describe the change that occurs in one variable as another variable changes.

Calculus is also used in such disparate areas as space travel, as well as determining how medications interact with the body, and even how to build safer structures in houses, railroads, ships, etc.

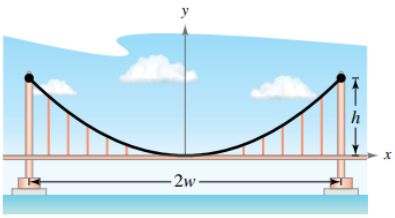
Let's discuss functions, a specific area of calculus, in order to appreciate the significance of the mathematical field. Consider a stamp machine, or a machine for snacks and soft drinks. When a user inserts money and presses a particular button, a particular object falls into the output slot. (The product price is the function rule. The money and the chosen button together make up the input. If the user enters more money than required by the function rule, the output is the product, which may occasionally be supplied with coins in change.)



Source: https://www.byjusfutureschool.com/blog/what-are-some-practical-applications-of-functions-in-real-life/

When designing bridges, civil engineers need to consider three structural elements: beams, tension, and compression members. Using calculus, we can determine the amount of force acting on the beam, including the weight of pedestrians, the weight of vehicles, and the amount of traffic anticipated on that bridge. Based on these factors, the materials, size, and capacity can be computed.

$$C = 2\int_0^w \sqrt{1 + \left(\frac{4h^2}{w^2}\right)x^2}\,dx$$



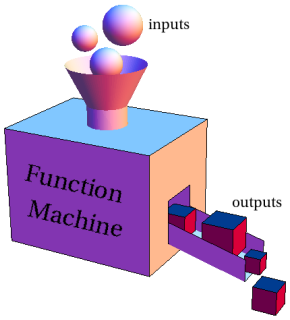
Source: https://opening.download/spring-2021.html

The pump used for filling an overhead tank, gardening tools, cars, motorcycles, robots, and many household appliances are designed using the principles of calculus.

Many more examples can be given about calculus and functions in real life.

Links between these elements and math topics

Functions are defined as a relationship between a group of inputs that each have one output. A function is a relationship between inputs in which each input is associated with exactly one output. In general, a function is denoted as f(x), where x represents the input. A function is generally represented as y = f(x).



Source: https://mathinsight.org/function_machine

Types of Functions in Math

An example of a simple function is $f(x) = x^2$. In this function, the function f(x) takes the value of "x" and then squares it.

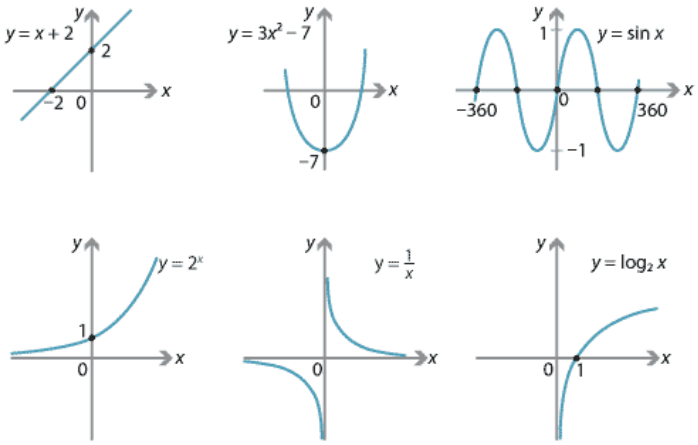
For instance, if x = 3, then f(3) = 9.

A few more examples of functions are: f(x) = sin(x), $f(x) = x^2 + 3$, f(x) = 1/x, f(x) = 2x + 3, etc.

There are also functions with more variables, e.g. $f(x, y) = x^2 + y^2$ concerning more complex problems.

Functions are used to create all the graphs we see in mathematics and in other sciences. These graphs illustrate graphically various concepts, and thus are easier to understand the presented topics.

These were a few examples of functions. It should be noted that there are various other functions.



Source: https://amsi.org.au/ESA_Senior_Years/imageSenior/2b_3.png

So, why should one study Functions?

Have you heard your students wonder "Why do we study functions? What shall we do with it?"

The answer is simple. Using functions, you can model the world around you.

Source: https://www.byjusfutureschool.com/blog/what-are-some-practical-applications-of-functions-in-real-life/

Examples

Temperature: When taking body temperature, the temperature of the body will act as the input while the measurement that comes out as either in degree Celsius and Fahrenheit scales is the function output.

Weight: When you weight yourself, usually by standing on a scale, your body weight will serve as the input while the measurement usually in kilogram is your output.

Fuel Efficiency: A car's efficiency in terms of kilometer per litre of fuel consumes is a function. If a car typically gets 10L per 100km and you input 50L of fuel, it will be able to travel roughly 500km.

Let's think about this further. **Instagram, Twitter,** and **Tik Tok** are applications made up of features, and thus likes, previous interactions, friends et al. are taken into account in order to produce the output, i.e. the post appearing to a user.

Step 2: Class activities

Activity 1

We have a machine that produces the following results 3, 5, 7, 17, 21, 23, when you give it the input numbers: 1, 2, 3, 8, 10, 11.

a. Which function has been utilized?

b. What is the value of f(5)?

Source: https://www.freepik.com/free-vector/game-machine-with-counting-number-isolated-background_18973456.htm

Activity 2

Evaluating functions given their formula. Watch a short video: https://www.youtube.com/watch?v=Id6UovYjd-M

Activity 3

As an archaeologist, you come upon a skeleton that may belong to a young warrior from the fifth century B.C.

How would you determine the young warrior's height if you knew how long his femur bone was?

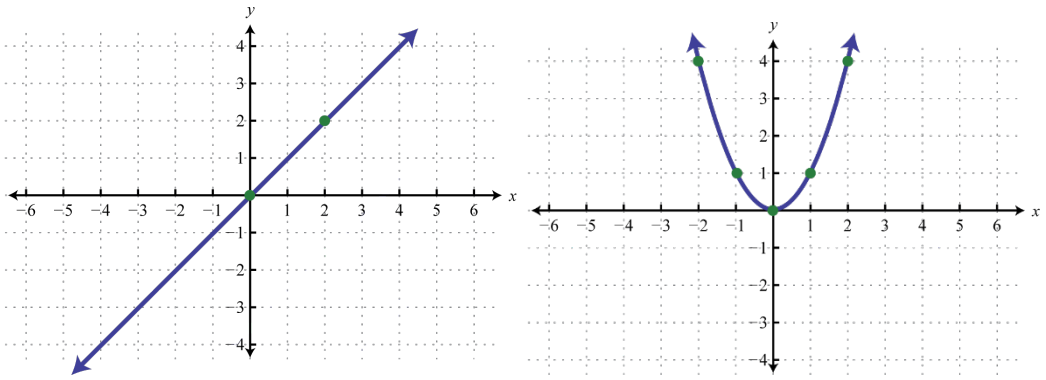
Study https://eforensics.info/learning_module/stature/ to come up with an estimation.

Source: https://www.freepik.com/premium-vector/paleontology-occupation-making-children-vector-paleontology-scientist-kids-working-excavation-exploring-researching-founded-artifacts-characters-archeology-job-flat-cartoon-illustration_20927175.htm

Step 3: Homework and development ideas

Activity 1

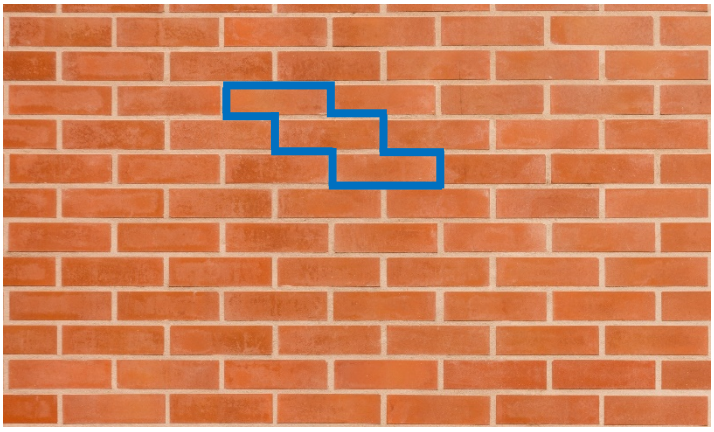
Step 1: Study the diagram below.



Step 2: Provide the function that has been used in each diagram.

Activity 2

Look at the brick wall.



1. What is the perimeter of a series of bricks arranged in a stair-step pattern if each brick is 2 inches by 8 inches?
2. What function rule describes the relationship?

References

https://www.britannica.com/science/function-mathematics/Inverse-functions

https://www.byjusfutureschool.com/blog/what-are-some-practical-applications-of-functions-in-real-life/

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