SUDOMATHS

1 Vocabulary

Sudoku, board, puzzle, table, row, column, cell, rule, to solve, digit, to notice, skill, to improve, Latin, square.

2 Watch the video and fill in the blanks

Today we'll be discussing how to solve Sudoku . In this clip, we'll talk about the basic of Sudoku, examine some of the patterns of Sudoku , and find a good puzzle to play. Here's an example of a Sudoku puzzle. Notice that there are some placed on the board. The object of the game is to the rest of the board with the numbers 1 through 9. There will be only one way to do this correctly, provided that you follow the one rule of Sudoku : 1 through 9 must appear exactly once in each , in each and in each block.

Using basic and techniques, you can fill in all the numbers on the board one by one. Each new number you placed on the board becomes yet another that can help you determine the numbers. Looking at the solution to this puzzle, notice the of the ones. Each one sits in its own block, each one sits in its own column, and in its own row. None of the ones attack each other horizontally or , and no two ones are ever in the same block. The same is for the set of twos in the solution, the set of threes in the solution, and so on.

In general, each cell on the has its own territory, determined by its row, block and column. Now let's take away the solution so we can work on finding it ourselves. The puzzle that we'll be working with today has clues given to start with, so there are numbers that we need to fill in. This is an to moderate puzzle with difficulty Level 2 of 5 while I'm considering Level 1 to be extremely easy and Level 5 to be more than what you would find in most books or .

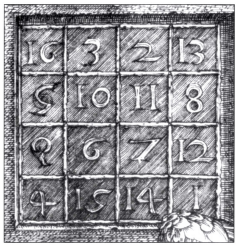
Score: **0** out of 20

Do you like playing Sudoku? Why? How can you explain its popularity?

What skills do Sudoku puzzles improve?

3 History of Sudoku

Sudoku is a logic-based number-placement puzzle. The objective is to fill a 9 × 9 grid made up of 3 × 3 subgrids with digits from 1 to 9, starting with various digits given in some cells (known as *givens* or *clues*). Each row, column, and subgrid must contain the same digit only once.



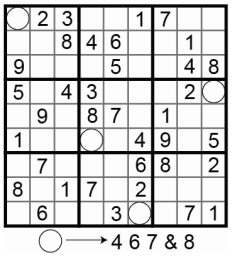
It's hard, perhaps impossible, to pinpoint the exact time and place in which the original concept of Sudoku began, but it seems to be related to the appearance of the first *magic squares* where no numeral was repeated and the sums of each row and each column and the two diagonals were the same. The idea of magic squares was transmitted to the Arabs from the Chinese, probably through India, in the eighth century, and may have been introduced to Europe through Spain c. 1100.

Then came the concept of *Latin squares* which has been known since at least medieval times and are the true ancestors of Sudoku. A Latin square is a square containing cells in which each row and each column have the same set of symbols in distinction from a magic square in which there is no repetition. You can find examples of Latin squares in Arabic literature over 700 years old.

They were rediscovered by the Swiss mathematician Leonhard Euler a few centuries later, who saw them as a new type of magic squares. In the 1780s he started building some puzzles after the model of the Latin squares and he proposed the following puzzle known as the *36 officers problem*: is it possible to arrange 36 officers of 6 different ranks and 6 different regiments in the cells of a 6 x 6 square so that each column and each row contains exactly one officer of each rank and exactly one of each regiment? Euler predicted there was no solution to this problem but the problem wasn't solved until the beginning of the 20th century. Latin squares have a wide variety of applications such as timetable designs, organising tournaments, biological experiments etc. After Euler studied these kinds of puzzles, they started to become popular.


UN PROBLÈME PAR JOUR

Number puzzles appeared in newspapers in the late 19th century. For example, *Le Siècle*, a Paris-based daily, published a partially completed 9×9 magic square with 3×3 sub-squares on November 19, 1892. It was not a Sudoku because it contained double-digit numbers and required arithmetic rather than logic to solve, but it shared key characteristics: each row, column and sub-square added up to the same number. These weekly puzzles were a feature of French newspapers for about a decade but disappeared about the time of World War I.



The modern Sudoku was most likely designed by Howard Garns, a 74-year-old American retired architect and freelance puzzle constructor, and first published in 1979 by Dell Magazines as *Number Place*.

In April 1984, Japan's puzzle group *Nikoli* discovered the *Number Place* puzzle and presented it for a Japanese audience in the pages of puzzle paper *Monthly Nikolist*. Originally named Sūji wa dokushin ni kagiru (数字は独身に限る), which can be translated as "the digits must be single", the puzzle became very popular. At a later date, the name was abbreviated to Sudoku (數獨) (*Su* number, *Doku* single) and the president of Nikoli trademarked the name. By 2005 it became an international hit and is now the most popular logic puzzle in the world.

Questions

1/ Explain the differences between Sudoku puzzles and magic squares.

2/ The 1st picture is a 4 x 4 magic square that appears in *Melencolia I*, an engraving portraying a troubled-looking angel surrounded by scientific objects produced by the German artist Albrecht Dürer. Fill in Dürer's square below.

16	3	2	13
5			8
9			12
4			1

The 2 numbers in the middle of the bottom row indicate the date of the engraving:
What is the sum of the numbers in any of the 4 columns?
What is the sum of the numbers in any of the 4 rows?
What is the sum of the numbers in any of the two diagonals?
What is the sum of any of the four quadrants?

This number is called the magic constant or magic number for this magic square.
Find at least two other sums of four symmetrically-placed numbers in Dürer's square equal to this constant.

3/ What is a Latin square? Fill in the 4 x 4 Latin square below. Is it possible to construct a 6 x 6 Latin square? How is Euler related to Sudoku puzzles?

1	2	3	4

4/ What does the name *Sudoku* mean? What is the original name of this game?

5/ Work out the total number of squares on a 9 x 9 Sudoku grid.

4 Sudomaths

In the following page, listen to the mathematical clues by clicking on each cell in the table, write down the clues in the next column, and fill in the answers to each clue. Use the box below to write calculations if needed.

Notes/Calculations

Once all your answers are in, click the "check" button. The answers in red are incorrect. Work out these answers again and finish the Sudoku puzzle below.

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									
8									
9									

Check Score: **0** out of 81

CELL	CLUE	ANS	CELL	CLUE	ANS
A3			A6		
A4			A8		
B1			B7		
B5			B9		
C1			C4		
C2			C8		
D2			D5		
D4			D8		
E2			E5		
E3			E9		
F1			F7		
F6			F8		
G1			G6		
G5			G7		
H2			H4		
H3			H9		
I3			I7		
I6			I9		

Check Score: **0** out of 36

5 Create your own sudomaths and play

Choose a team (blue or pink).
Invent 11 mathematical clues with answers matching the digit given for each cell in the following page.
Delete the answers in the table on the next page and save the clues page in a file.
Swap your file with someone from the other team.
Solve their clues and write your answers on the Sudoku grid below.
The first team to finish the whole Sudoku is the Sudoku champion!

Choose your team: **Blue** **Pink**

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4									
5									
6									
7									
8									
9									

Check Score: **0** out of 81

CELL	BLUE CLUES	ANS
A2		
A1		
B1		
C1		
D1		
D2		
D3		
C4		
B5		
B6		
B7		

CELL	PINK CLUES	ANS
H3		
H4		
H5		
G6		
F7		
F8		
F9		
G9		
H9		
I9		
I8		

Delete

Use the box below to write down notes or calculations if needed.

Notes/Calculations

6 Homework

Choose one task from the following for your homework.

- Write a one-page essay about the popularity of Sudoku puzzles.
- Work out the total number of squares on a *n* x *n* Sudoku grid.
- Write an algorithm that displays a 4 x 4 magic square with a user-given magic constant.
- Create 9 mathematical clues for a sudomaths grid using advanced maths.

Teacher's mark and comments: