PART V: Literature & Mathematics

AGE RANGE: 13-15

TOOL 46: PRIME NUMBERS IN THE CURIOUS INCIDENT OF THE DOG IN THE NIGHT-TIME BY MARK HADDON

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Educator's Guide

Title: Prime Numbers in "The curious incident of the dog in the night-time" by Mark Haddon

Age Range: 13-15 years old

Duration: 2 hours

Mathematical Concepts: Prime numbers, Mersenne's Primes, Perfect numbers.

Artistic Concepts: The murder mystery novel, internal narrator, structure of the novel.

General Objectives: To discover the mathematical concepts presented in the book and learn how to build math reasoning in everyday life.

Instructions and Methodologies: The students will explore math through literature, by applying it to real-life situations and reading excerpts from the book. Your class will discover the different math concepts to learn about Prime and Perfect Numbers.

Resources: This tool provides online resources for you to use in your classroom. The topics addressed in these resources will help you find other materials to personalize and give nuance to your lesson.

Tips for the educator: Learning by doing is very efficient, especially for young learners with learning difficulties. Always explain the practical use of each math concept.

Desirable Outcomes and Competences: At the end of this tool, the student will be able to:

- o   Differentiate prime and composite numbers;
- o   Understand what Mersenne's Primes are;
- o   Find Perfect Numbers using these new math concepts.

Debriefing and Evaluation:

Write 3 aspects you liked about this activity:	1. 2. 3.
Write 2 aspects that you have learned	1. 2.
Write 1 aspect for improvement	1.

Introduction

Reading can help us understand the world around us in a way we didn't expect. Books are thus valuable resources for learners to explore new topics and concepts hidden within the story. Some of the authors use mathematics in their plots, which students often don't really focus on though they will be more likely to understand a topic they have already read about.

Seeing the characters reflect on mathematical problems and concepts makes the reader want to understand those concepts and solve those problems with them in the same way as readers often try to guess the end of a story. Here, they will learn new things just by following the narrator's thoughts and observing the book's structure.

Therefore, teaching students the mathematics that hide behind some well-known books can be a great added value to a math course, by giving learners a more immersive experience of the possible uses of mathematics.

"The curious incident of the dog in the night-time"
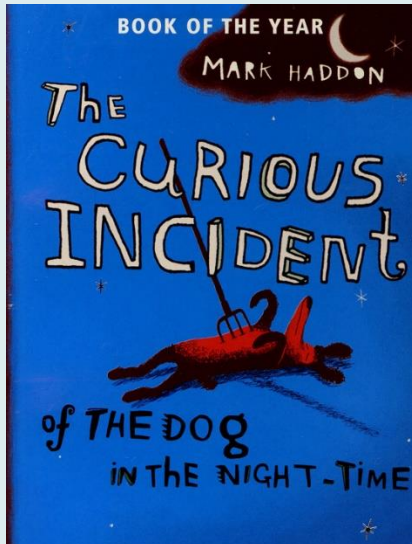
By mark haddon

1. Synopsis

Figure 1: Cover of the book "The curious incident of the dog in the night-time" by Mark Haddon

This novel written by Mark Haddon in 2003 tells the story of a fifteen-year-old boy, Christopher, who has Asperger's syndrome and sees the world with a mathematical perspective. The story starts when he discovers that his neighbour's poodle has been murdered. He explains that he likes dogs better than some humans, which is why he chose to write about a dog's murder. While investigating the murder, Christopher will have to face a world he doesn't know well, which is why his helper, Siobhan, advises him to write a book about his experience.

2. Christopher

The main character, Christopher, has autism, and more particularly, he has Asperger's syndrom. This syndrom makes him experience the world differently, through another perspective. He is passionate about mathematics and science and likes it when things are clear and explicit. He also shows that he has difficulties to identify other people's emotions, to understand jokes, and to cope with stressful behaviors, which are some of the characteristics of the autism spectrum. The book is written with him as the internal narrator of the story, which helps the reader understand his view of what surrounds him. He explains that the novel is a murder mystery novel because it is the only type of novel he likes, with puzzles to solve. His love for mathematics and science quickly appears in the book when you look at the chapters' numbers. He later explains that, as he loves prime numbers, he decided to only use those numbers to list the chapters of his novel. He then goes on to explain what prime numbers are.

📖 3. The excerpt:

"Chapters in books are usually given the cardinal numbers 1, 2, 3, 4, 5, 6 and so on. But I have decided to give my chapters prime numbers 2, 3, 5, 7, 11, 13 and so on because I like prime numbers.

This is how you work out what prime numbers are.

First, you write down all the positive whole numbers in the world.

Then you take away all the numbers that are multiples of 2. Then you take away all the numbers that are multiples of 3. Then you take away all the numbers that are multiples of 4 and 5 and 6 and 7 and so on. The numbers that are left are the prime numbers.

The rule for working out prime numbers is really simple, but no one has ever worked out a simple formula for telling you whether a very big number is a prime number or what the next one will be. If a number is really, really big, it can take a computer years to work out whether it is a prime number.

Prime numbers are useful for writing codes and in America they are classed as Military Material and if you find one over 100 digits long you have to tell the CIA and they buy it off you for $10,000. But it would not be a very good way of making a living.

Prime numbers are what is left when you have taken all the patterns away. I think prime numbers are like life. They are very logical, but you could never work out the rules, even if you spent all your time thinking about them."

Now that Christopher has explained what Prime Numbers are through literature, let's see it in a more mathematical way!

🎥   Here is the audio book if you want to listen to the story rather than read it (the excerpt starts at 15:43): https://www.youtube.com/watch?v=PgZx_lrgWKE.

Glossary

Asperger's syndrome: is a condition of the autism spectrum that comes with higher functioning, but that affect social and communication skills.

Internal narrator: a character who narrates the story of the book using the person "I".

Murder mystery novel: a novel that narrates the discovery and solving of a murder.

Cardinal numbers: are the numbers that express a quantity (opposed to ordinal numbers that express the order such as first, second, etc).

The CIA: the Central Intelligence Agency, is a service of the federal Government of the USA which operates within the United States.

The math behind the curious incident of the dog in the night-time

Mathematics are actually shaping the novel since the whole book is divided according to Prime Numbers and that the narrator and main character of the story talks about science and mathematics throughout the narrative.

Prime Numbers

Here is the mathematical definition of prime numbers:

> A **prime number** is a whole number higher than 1 that cannot be divided by any other number than itself or 1.
>
> Examples: 2, 3, 5, 7, 11, 13 and so on.

These numbers are to be distinguished from composite numbers, which are defined as follows:

> A **composite number** is a whole number higher than 1 that can be divided by other numbers than itself or 1.
>
> Examples: 4, 6, 8, 9, 10, 12 and so on.

Can you guess if these are prime or composite numbers?

55	
41	
37	
49	
17	

As Christopher says, it is very difficult to know if a very large number is prime or composite. There is no formula that would allow us to do this quickly for any existing number. Even computers can take years to find it out. However, some techniques might help you!

Now, we are going to focus on a particular kind of prime numbers to reach what is called "Perfect Numbers". You'll understand why Christopher likes mathematics so much!

Mersenne's Primes

Marin Mersenne was a French mathematician from the 17th century who found a pattern of primes that were made from the following formula:

For some prime n

$M_n = 2^n - 1$

His list of primes begins as such:

n	2	3	5	7	13	17	19	31
$2^n - 1$	3	7	31	127	8191	131071	524287	2147483647

Perfect Numbers

Do you know who Euclid was? He was a Greek mathematician from 300 BC. He is mostly known for his 13 books about Geometry, called "elements".

Euclid also worked on prime numbers and he found what he called the "Perfect Numbers". To find them, he also used $2^n - 1$.

Here is the formula he based his Perfect Numbers on:

An even perfect number is equal to the sum of its positive factors (other than itself).

If $(2^n - 1)$ is prime, $2^{n-1}(2^n - 1)$ is an even perfect number.

Here are some examples:

n	$2^n - 1$	$2^{n-1}(2^n - 1)$	Perfect?	n = prime?	$2^n - 1$ prime?
1	1	1	No	No	No
2	3	6	Yes	Yes	Yes
3	7	28	Yes	Yes	Yes
4	15	120	No	No	No

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TASKS

The novel's chapters:

Christopher needs your help writing another novel!

Can you help him name his chapters?

Here is what you know:

- He has written seven chapters
- He wants to use Perfect Numbers to name his chapters
- Sometimes, $2^n - 1$ is not a prime number!

You can use this online tool to check if large numbers are prime or not:

🔗 https://www.mathsisfun.com/prime_numbers.html

How will you do it?

n	$2^n - 1$	$2^{n-1}(2^n - 1)$	n = prime?	$2^n - 1$ prime?	Perfect?

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LEARN MORE...

Cover picture:

http://www.markhaddon.com/curious.htm

The whole audiobook:

https://www.youtube.com/watch?v=PgZx_lrgWKE

Article about the drama adaptation of the book:

https://www.walesonline.co.uk/whats-on/arts-culture-news/curious-incident-dog-night-time-maths-8994208?fbclid=IwAR2cyL2QAaJhZF8JtZObdb3q4rboqkZB_eqo9ZptBqOacKeWv9dUal4240A

Analysis of the main character of the book:

https://vinhanley.com/2017/10/03/an-analysis-of-the-character-of-christopher-boone/

Analysis of the book:

https://www.shmoop.com/curious-incident/

A fun riddle about prime numbers by Ted-ED:

https://www.youtube.com/watch?v=Uj3_KqkI9Zo

Video about Mersenne Primes and Perfect Numbers:

https://www.youtube.com/watch?v=T0xKHwQH-4I