Fermi problems

General information			
Respective blueprint	Fermi problems		
Description	A **Fermi problem** involves making estimates and using mathematics to answer a question; in more colloquial language, they might be termed 'back of envelope' calculations. An essential element of problem-solving is to be able **to break down the problem into parts** and decide on an order for working on those parts. An example on which we will demonstrate the solution of the Fermi problem: Find information about the height of the Zagreb Cathedral after the earthquake in Zagreb (Croatia), 2020. Calculate the number and value of coins needed to make the stacked coins reach the height of the Cathedral.		
Learning objectives	• discover who Enrico Fermi was and what his inventions are • learn what Fermi problems are • solving mathematical problems we will never know the exact answers to • measure with a sliding scale • The teacher explains how meters are converted to millimetres • converting meters to millimeters • performing arithmetic operations		
Related curricular subjects	art, mathematics		
Duration	30 min		
Level of difficulty	Basic	Medium	Advanced
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Inclusivity guidelines			
How to integrate students with SLD	work in pairs, with the help of the teacher or other students		

	Use clear visual elements without overloading them to illustrate concepts and support the text. Ensure that the images used match the text. Use a multisensory approach: wherever possible, provide different ways for learners to interact with the content (touch, manipulate, play, etc.). Focus on logic rather than memory.
How to integrate students who work faster	The students themselves find a building for which they calculate how many coins they need. They perform measurements and calculations with a different coin.

Step-by-step description of the lesson	
Step 1: Introduction	Estimated time: 10 min
Question for students: how can we calculate how many students fit in a classroom? Students suggest some ideas. Question for students: How long would it take to count to a million? Enrico Fermi sought solutions to such questions, and that is why such problems are called Fermi's. Enrico Fermi is the father of "solving maths problems we will never know the exact answer to". He was born in Rome on 29th September 1901- died in Chicago on 28th November 1954. He was an Italian and later naturalised American physicist. Fermi was awarded the 1938 Nobel Prize in Physics. Students independently search for a solution to the given Fermi problem: Calculate the number and value of coins needed to make the stacked coins reach the height of the Cathedral in Zagreb. The teacher uses a presentation.	
Step 2: Solving Fermi problems	Estimated time: 15 min
• Students independently research the information they need. • Then convert meters into millimetres.	

- Take a coin and measure its thickness.
- Stack more coins and measure the height.
- Divide the height of the Cathedral by the thickness of the coin. This is how many coins need to be stacked in order to reach the height of the Cathedral.
- Multiplying the number of coins by their value gives the value of all the coins that reach the height of the Cathedral.

Step 3: Presentation and conclusion	Estimated time: 5 min
Students show and compare their works. Students conclude how they came to the solution. The teacher asks the students about the difficulty of the task whether they had problems with Fermi problem.	

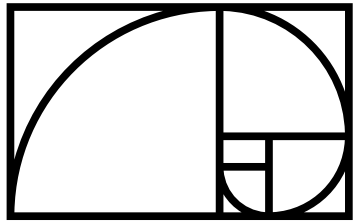
Assessment activities
Activity 1: Evaluation sheet
Students fill out the evaluation sheet.

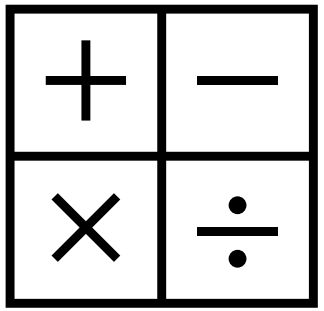
Attachments
• Evaluation sheet • Presentation

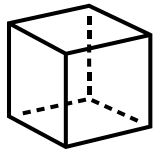
References

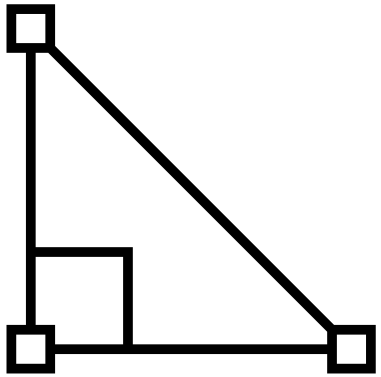
- https://www.nobelprize.org/prizes/physics/1938/fermi/biographical/
- https://en.wikipedia.org/wiki/Enrico_Fermi
- https://innovativeteachingideas.com/blog/an-excellent-collection-of-fermi-problems-for-your-class

STEAM IN TIMES









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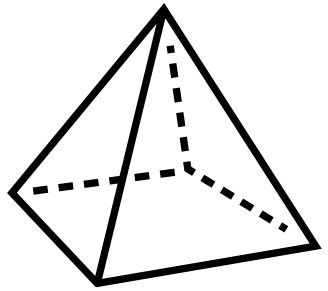

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Enrico Fermi was born in Rome on 29th September, 1901- died in Chicago on 28th November, 1954.

He was an Italian and later naturalized American physicist.

Fermi was awarded the 1938 Nobel Prize in Physics.

Fermi problems

- math problems which we will never know the exact answers TO

- examples of Fermi Problems:

How many studenTS can enter the classroom?

How many glasses of water do you need To fill the bathtub or THE olympic swimming pool?

How long DOES it take to count to a million?

example:

- FIND THE INFORMATION ABOUT THE HEIGHT OF THE ZAGREB CATHEDRAL, CROATIA, AFTER THE EARTHQUAKE IN ZAGREB, 2020.
- CALCULATE THE NUMBER AND VALUE OF COINS NEEDED TO MAKE THE STACKED COINS REACH THE HEIGHT OF THE CATHEDRAL.

Materials needed:

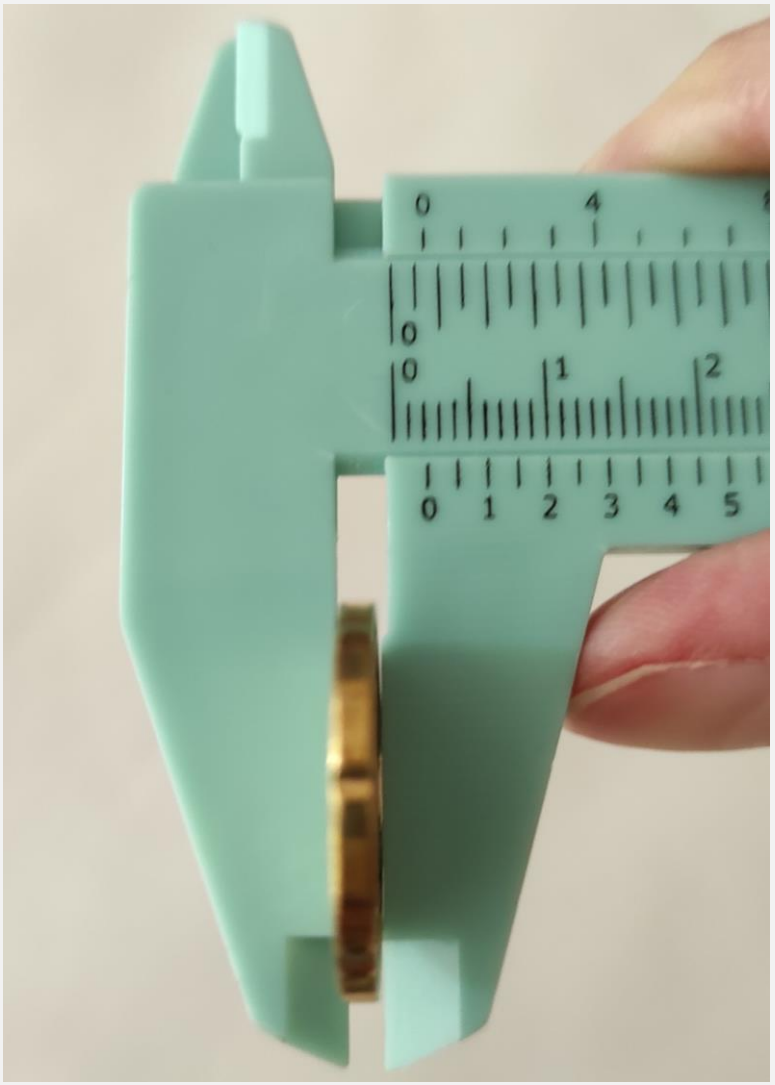
- coins of various sizes
- A paper template
- a pen for each student
- a ruler
- A Calculator
- a sliding scale

step 1:

- The height of the Zagreb Cathedral :
  105 meters =105 000mm

step 2:

Take a coin and measure its thickness.

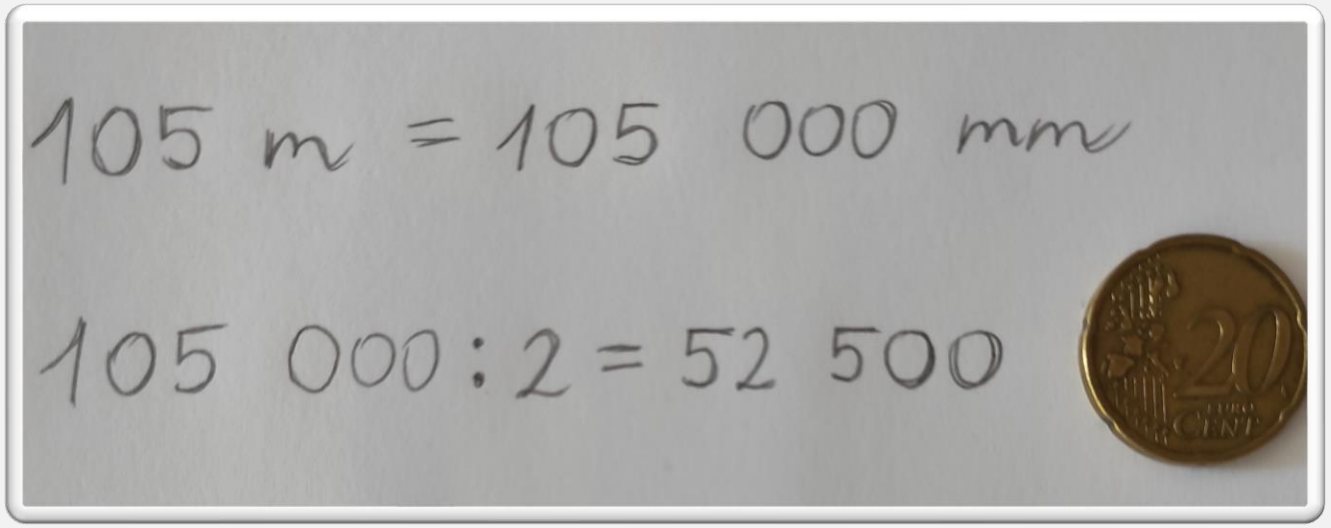


step 3:

Stack more coins and measure the height.

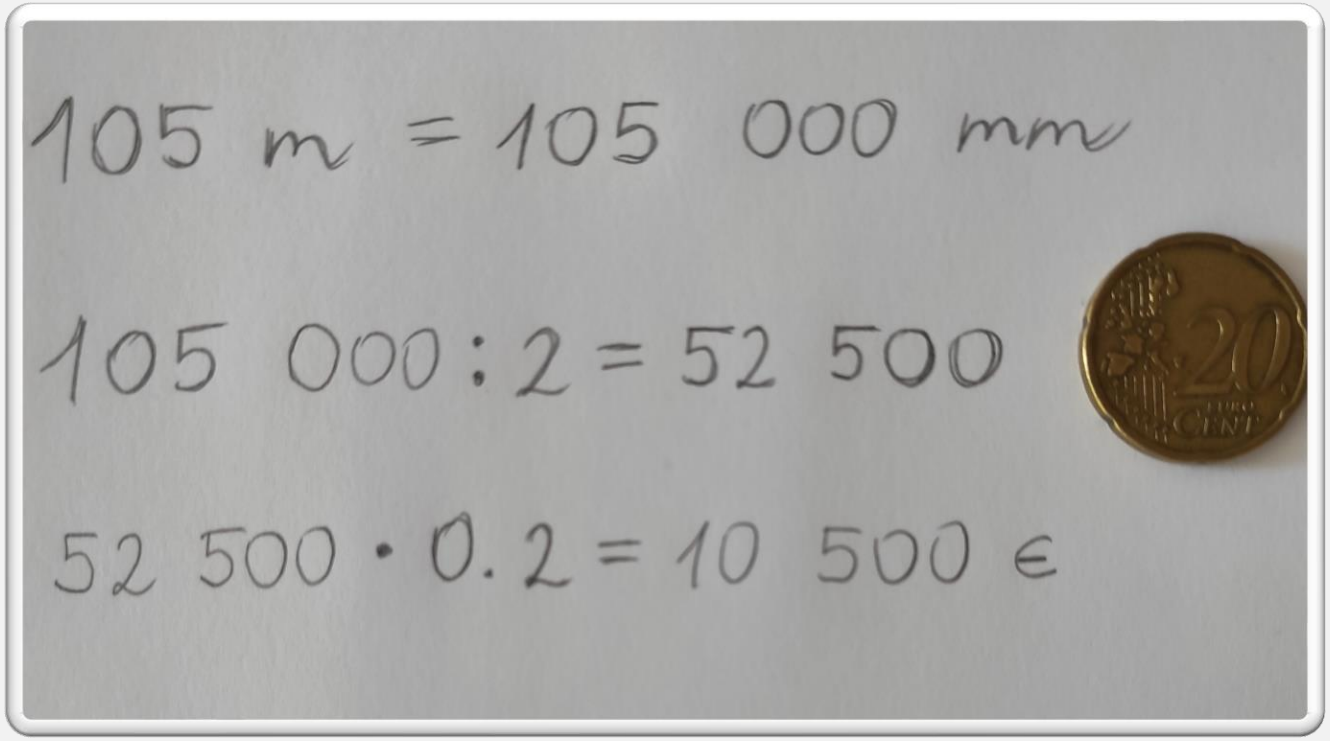
step 4:

- divide the height of the cathedral (mm) by the thickness of the coin.
- we will get the necessary number of the coins to reach the height of the cathedral



step 5:

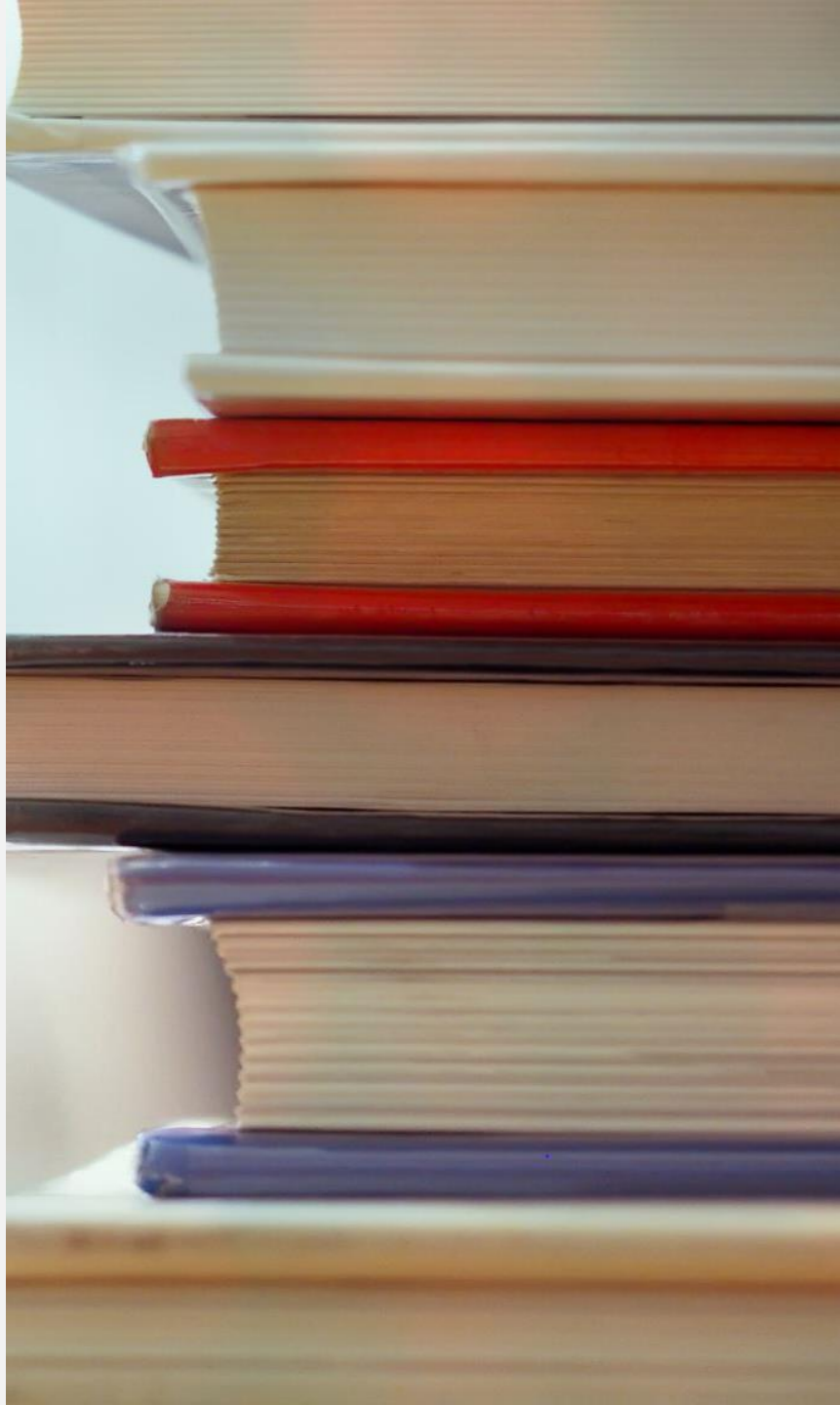
- finally, multiply the number of coins obtained by the value of one coin.
- We got the value of the coins as tall as a cathedral



- LITERATURE:

- HTTPS://WWW.NOBELPRIZE.ORG/PRIZES/PHYSICS/1938/FERMI/BIOGRAPHICAL/

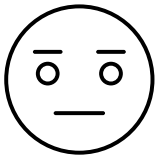
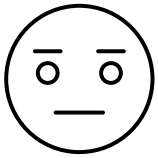
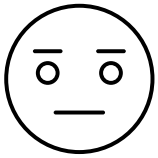
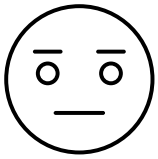
- HTTPS://EN.WIKIPEDIA.ORG/WIKI/ENRICO_FERMI



SELF – ASSESSMENT

NAME:

DATE:

I followed directions			
I did my best and had a positive attitude			
I completed my work			
I liked the activities			

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