# **RBYTE**

# Pennies to the Moon - Fermi Estimation

### Context:

*Sometimes spotting bullshit takes a bit of work. We can make this work easier with “Fermi estimation” - some rounding/”back of the envelope calculations.”*

#### Who Was Fermi?

Enrico Fermi was an Italian physicist who immigrated to America. After the war, Fermi served under J. Robert Oppenheimer on the General Advisory Committee, which advised the Atomic Energy Commission on nuclear matters. After the detonation of the first Soviet fission bomb in August 1949, he strongly opposed the development of a hydrogen bomb on both moral and technical grounds. He was among the scientists who testified on Oppenheimer's behalf at the 1954 hearing that resulted in the denial of Oppenheimer's security clearance.

The Fermi method was used to estimate the bomb's impact when it was tested in New Mexico which had a devastating impact on Native tribes and the environment.

### Class Walkthrough + Example:

*When spotting misinformation or "bullshit" requires clarification, Fermi estimation can simplify the process. Here's an example using a* [*Food Stamp Fraud Case Study*](https://callingbullshit.org/case_studies/case_study_foodstamp_fraud.html)*:*

Given: $70 million dollars of loss

Assumptions:

300 million Americans

10% use food assistance (choose a power of 10, the actual is closer to 10% than 1% or 100%)

30 million people get benefits

Benefits are $1000/year

Calculations:

Total benefits = 30 million x $1000 = $30 billion

Loss rate = $70 million / $30 billion = 7/3000

Percentage loss ≈ <1%

## You Try!

### Guidelines:

* Use Fermi estimation techniques.
* Your answers will not be perfect but should be reasonable and approximate.
* Record your answers to each question on another page to keep the main activity page clean and organized.
* Ensure that you write your team name, list the members of your team, and write out the Fermi question you are investigating at the top of your answer page.

### Here’s some possible bullshit:

* A Bill Gates fortune in pennies would be enough pennies to go from the earth to the moon and back when lined up next to each other in a path.
* Is this bullshit? More specifically, is it false?

### Make a Guess! Is it bullshit?



### Let’s Figure it out Using Fermi Estimation:

* Work in groups of 2-4 and document your proccess/findings
* Use these guidelines…
  + Estimate relevant quantities or parameters involved in the claim
  + Make reasonable assumptions to simplify calculations
  + Perform calculations using rounded numbers and approximate values
  + Compare the estimated results to determine the plausibility of the claim