Order-of-Magnitude Estimation
Solar Escape (Level 3)

The Question
How long does it take a photon generated in the core of the Sun to escape the surface?

Background
The Sun’s energy is generated via nuclear fusion (smashing Hydrogen atoms together to make Helium). The energy is released as light, which we can treat as packets called photons. However, these photons can’t stream directly out of the Sun’s core, because they are scattered by the protons and electrons that make up the Sun’s mass. If a photon is scattered in a random direction each time it runs into a proton, how long does it take to make it to the surface of the Sun where it can stream freely into space?

The Solution
Education Standards

This OoM Estimation problems meets the following standards in **bold**:

*Next Generation Science Standards (NGSS)*:

- Physical Sciences
  - **Matter & Its Interactions**
  - Motion and Stability: Forces and Interactions
  - **Energy**
  - Waves and Their Applications in Technologies for Information Transfer

- Life Sciences
  - From Molecules to Organisms: Structures and Processes
  - **Ecosystems: Interactions, Energy, and Dynamics**
  - Heredity: Inheritance and Variation of Traits
  - Biological Evolution: Unity and Diversity

- Earth and Space Sciences
  - **Earth’s Place in the Universe**
  - Earth’s Systems
  - Earth and Human Activity

- Engineering, Technology, and Applications of Science
  - Engineering Design

*Common Core Standards (CSS)*:

- Counting & Cardinality
- Operations & Algebraic Thinking
- Numbers & Operations in Base Ten
- Number & Operations — Fractions
- Measurement & Data
- Geometry
- Ratios & Proportional Relationships
- The Number System
- Expressions & Equations
- Functions
- Statistics & Probability