Order-of-Magnitude Estimation
How big is New Hampshire? (Level 2)

The Question

What fraction of the land area of the Earth makes up New Hampshire?

Background

The Earth is big, and states in the North East are fairly small. But how small are they?

Guiding Questions

Here are some things you may need to consider:

- How much surface area is there on Earth?

- How much of Earth's surface is land?

- How big is New Hampshire?

The Solution

The Earth is a sphere with a radius of about 6,400 km. This means that it has a surface area of:

$$A_{\text{tot}} = \pi R_{\text{Earth}}^2 = \pi \times 6,400^2 = 2 \times 10^8 \text{ km}^2 \tag{1}$$

Considering that the Earth's surface is roughly two-thirds water, the total land surface area is:

$$A_{\text{land}} = 0.33 \times 2 \times 10^8 = 5 \times 10^7 \text{ km}^2 \tag{2}$$

New Hampshire is roughly 110 km wide and 270 km long. This gives it a total area of about:

$$A_{\text{NH}} = 110 \times 270 = 3 \times 10^4 \text{ km}^2 \tag{3}$$

Therefore, the area of NH as a fraction of the Earth's land area is:

$$f = \frac{A_{\text{NH}}}{A_{\text{land}}} = \frac{3 \times 10^4}{5 \times 10^7} = 5 \times 10^{-4} \tag{4}$$

To convert this to a percentage, we multiply by 100 and find that NH is 0.05% of the total land surface of the Earth.

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