

Some Fermi Problems

A “Fermi problem” is an estimation problem that is designed to teach approximation and that logic can lead to results that, at first look, might seem impossible to find. They are named after Italian scientist Enrico Fermi.

My favourite is: “How fast, miles per hour, is your hair growing?”

Well this is, at first, weird. Then you can see it as a change in units problems. Miles per hour means $\frac{\text{miles}}{\text{hours}}$

while we can think of hair growing at inches per month, or $\frac{\text{inches}}{\text{month}}$. Let us assume that it grows one and one-half inches per month, then:

$$\frac{1.5 \text{ inches}}{1 \text{ month}} \times \frac{1 \text{ month}}{30 \text{ days}} \times \frac{1 \text{ day}}{24 \text{ hours}} \times \frac{1 \text{ foot}}{12 \text{ inches}} \times \frac{1 \text{ mile}}{5280 \text{ feet}} = \frac{3.288 \times 10^{-8} \text{ miles}}{1 \text{ hours}}$$

By arranging the fractions to cancel the units, the numbers are arranged, multiplied and cancelled the same way. Thus, we have an answer: 3.288×10^{-8} miles per hour, or 0.00000003288 miles per hour. So, by using logic, one can come up with answer. These questions are good for group work and brain-storming sessions as well.

Here are some more Fermi examples:

How many piano tuners are there in Chicago?

How many planets are there that can support life in our universe?

How many tennis balls will fill this classroom?

How many drops of water are there in Lake Erie?

Take a deep breath. What is the probability that you breathed in a molecule that Julius Caesar breathed out with his dying breath when he was assassinated in 44 BC ?

Or this one that I use every week when buying my lotto ticket. “I’ll be back tomorrow to pick up my \$4 million dollars. I’ll have it all in loonies please, I’ll bring the wheel barrow”. A loonie is a Canadian one dollar coin. If it has a mass of 7 grams, then how many pounds are 4 million loonies?