Lesson 12: Choice of Unit

Classwork

Exercise 1

A certain brand of MP3 player will display how long it will take to play through its entire music library. If the maximum number of songs the MP3 player can hold is $1{,}000$ (and the average song length is 4 minutes), would you want the time displayed in terms of seconds-, days-, or years-worth of music? Explain.

Exercise 2

You have been asked to make frosted cupcakes to sell at a school fundraiser. Each frosted cupcake contains about 20 grams of sugar. Bake sale coordinators expect 500 people will attend the event. Assume everyone who attends will buy a cupcake; does it make sense to buy sugar in grams, pounds, or tons? Explain.

Exercise 3

The seafloor spreads at a rate of approximately 10 cm per year. If you were to collect data on the spread of the seafloor each week, which unit should you use to record your data? Explain.

The gigaelectronvolt, $\frac{\text{GeV}}{c^2}$, is what particle physicists use as the unit of mass.

1 gigaelectronvolt = 1.783×10^{-27} kg

Mass of 1 proton = $1.672\,622 \times 10^{-27}$ kg

Exercise 4

Show that the mass of a proton is $0.938\frac{\text{GeV}}{c^2}$.

In popular science writing, a commonly used unit is the light-year, or the distance light travels in one year (note: one year is defined as 365.25 days).

$$1 \text{ light-year} = 9{,}460{,}730{,}472{,}580.800 \text{ km} \approx 9.46073 \times 10^{12} \text{ km}$$

Exercise 5

The distance of the nearest star (Proxima Centauri) to the sun is approximately $4.013\,336\,473 \times 10^{13}$ km. Show that Proxima Centauri is 4.2421 light-years from the sun.

Exploratory Challenge 2

Suppose you are researching atomic diameters and find that credible sources provided the diameters of five different atoms as shown in the table below. All measurements are in centimeters.

1×10^{-8}	1×10^{-12}	5×10^{-8}	5×10^{-10}	5.29×10^{-11}

Exercise 6

What new unit might you introduce in order to discuss the differences in diameter measurements?

Exercise 7

Name your unit, and explain why you chose it.

Exercise 8

Using the unit you have defined, rewrite the five diameter measurements.

Problem Set

1. Verify the claim that, in terms of gigaelectronvolts, the mass of an electron is 0.000511.

2. The maximum distance between Earth and the sun is 1.52098232×10^8 km, and the minimum distance is 1.47098290×10^8 km.[1] What is the average distance between Earth and the sun in scientific notation?

3. Suppose you measure the following masses in terms of kilograms:

2.6×10^{21}	9.04×10^{23}
8.82×10^{23}	2.3×10^{18}
1.8×10^{12}	2.103×10^{22}
8.1×10^{20}	6.23×10^{18}
6.723×10^{19}	1.15×10^{20}
7.07×10^{21}	7.210×10^{29}
5.11×10^{25}	7.35×10^{24}
7.8×10^{19}	5.82×10^{26}

What new unit might you introduce in order to aid discussion of the masses in this problem? Name your unit, and express it using some power of 10. Rewrite each number using your newly defined unit.

[1]Note: Earth's orbit is elliptical, not circular.