

OUT OF RANGE

NAME \_\_\_\_\_ DATE \_\_\_\_\_

PERIOD \_\_\_\_\_ Estimating Out of Range Measurements

There are certain measurements that are out of our range, that we can't easily measure. But we CAN estimate the values by making several assumptions.

Example: How many leaves are on a tree? First, assume that the tree is a cube, perhaps 10 meters on a side. That means the tree has a volume of  $10\text{m} \times 10\text{m} \times 10\text{m} = 1000$  meters cubed.

Now suppose that there are leaves evenly distributed all over the tree and that ten leaves end to end are about 1 meter. That means that each cubic meter has 10 leaves  $\times$  10 leaves  $\times$

10 leaves = 1000 leaves per cubic meter.

So now the number of leaves on the tree is:

$$1000 \text{ leaves} \times 1000 \text{ m}^3 = 1 \times 10^6 \text{ leaves} \\ \text{m}^3$$

ESTIMATE answers for the following problems. You need to show and check all your assumptions.

1) Numbers of hairs on your head: (Hint: estimate the number of hairs per square centimeter and the area of your head)

$$\text{my head: } 100 \text{ hairs/cm}^2 * 12\text{cm} * 20 \text{ cm} = 24000 \text{ hairs/head}$$

2) Times your heart beats in a lifetime.

$$\text{Beat: } 80 \text{ beats/min} * 60 \text{ min/hr} * 24\text{hr/day} * 365 \text{ day/yr} * 85 \text{ yrs/life} = 3.5 \text{ billion beats} \\ (3.5 * 10^9 \text{ beats})$$

3) Time you spend in school total in life:

$$3600 \text{ sec/hr} * 7 \text{ hrs/day} * 183 \text{ days/yr} * 13 \text{ yrs} = 1.6 * 10^4 \text{ hrs} = 6 * 10^7 \text{ sec}$$

\*\*4) Weight of the whole earth's atmosphere: (Earth has 6371 km radius, 4 mile high air)

$$\text{AIR: density} = 1.29 \text{ kg/m}^3 * (4 * \pi * (6371,000 \text{ m})^2) * 4\text{miles} * 1,600\text{m/1mile} \\ = 4.2 * 10^{18} \text{ kg} \\ \text{or AIR} = 14.7 \text{ lb/in}^2 * (4 * \pi * (6,371,000 \text{ m} * 39.37 \text{ in/m})^2) = 1.16 * 10^{19} \text{ lbs}$$

\*\*5) Number of atoms in the earth (made mostly of carbon, 6371 km radius)

$$5.9 * 10^{24} \text{ kg/ earth} * 1000\text{grams/kg} * 1 \text{ mole C/ } 12 \text{ g} * 6.02 * 10^{23} \text{ atoms/mole} \\ = 3 * 10^{50} \text{ atoms/earth}$$

7) Grains of sand on a typical beach

$$50 \text{ grains/in} * 50 \text{ grains/in} * 12 \text{ in/ft} * 12 \text{ in/ft} * 50 \text{ ft/beach} * 1000 \text{ ft/beach} \\ = 1.5 * 10^9 \text{ grains/beach} = 1.5 \text{ billion grains}$$

8) Number of blades of grass on a soccer/field hockey field

$$20 \text{ blades/in} * 20 \text{ blades/in} * 12 \text{ in/ft} * 12 \text{ in/ft} * 100 \text{ ft/field} * 50 \text{ ft/field} \\ = 2.9 * 10^8 \text{ blades/field}$$

9) Volume of ice cream eaten by the total population of town in a year.

$$20\% \text{ people/people} * 14000 \text{ people/town} * .5 \text{ gal/week} * 52 \text{ week/yr} = 73,000 \text{ gal/yr}$$

10) Amount of liquid our school can hold:

$$10 \text{ m} * 20 \text{ m} * 4 \text{ m/classroom} * (8 \text{ classroom/hall} * 8 \text{ hall/school}) * 100 \\ \text{cm/m} * 100 \text{ cm/m} * 100 \text{ cm/m} * 1 \text{ ml/cm}^3 = 5.1 * 10^{10} \text{ ml} = 5.1 * 10^7 \text{ liters} = 1,300,000 \text{ gal}$$

11) Speed of a butterfly

$$30 \text{ cm/1 sec} * 1 \text{ ft/30 cm} * 1 \text{ mile/5280 ft} * 60 \text{ sec/1 min} * 60 \text{ min/1 hr} = .7 \text{ miles/hr}$$

12) Distance traveled per evening in a rocking chair.

$$2 \text{ ft/rock} * 1 \text{ rock/sec} * 60 \text{ sec/min} * 60 \text{ min/hr} * 3 \text{ hrs/evening} = 21,600 \text{ ft/evening} = \\ 4 \text{ miles/evening}$$

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TIME: Using convenient units such as minutes, hours, days, or years, estimate the lifetime

of each of the objects below. rank them in order from smallest to largest. Then find the approximate value in SECONDS for each one.

human    baseball game

dog    lightning flash

sea turtle    firefly flash

sun    a road's yellow line

flea a pencil