

Thursday, September 23  
Astronomical Numbers



"Space is big. Really big."  
- Hitchhiker's Guide to the Galaxy

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Astronomical Numbers  
Key Concepts

- 1) Large (& small) numbers can be written using scientific notation.
- 2) Units of length include kilometers, astronomical units, and light-years.
- 3) Units of time include seconds and years.
- 4) Units of mass include kilograms.

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Scientists use scientific notation to write large (& small) numbers  
[Appendix C.2]

- $1000 = 10^3$   
 $1,000,000,000 = 10^9$   
 $0.001 = 10^{-3}$   
 $2,200,000 = 2.2 \times 10^6$

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Number of people  
living on Earth =

Number of stars in  
our galaxy =

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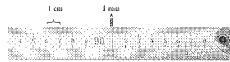
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Scientists often use the Metric System  
to express physical units.

Lengths in **Meters**



Time in **Seconds**



Masses in **Kilograms**



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Standard prefixes are used to help  
us express some large numbers.

$10^3$  = **kilo-** (kilogram, kilometer)

$10^6$  = **mega-** (megawatt, megayear)

$10^9$  = **giga-** (gigabyte, gigayear)

$10^{-3}$  = **milli-** (millisecond, millimeter)

$10^{-6}$  = **micro-** (microsecond, micron)

$10^{-9}$  = **nano-** (nanosecond, nanometer)

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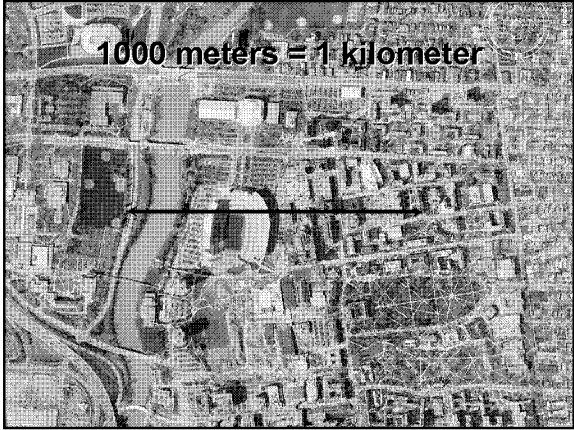
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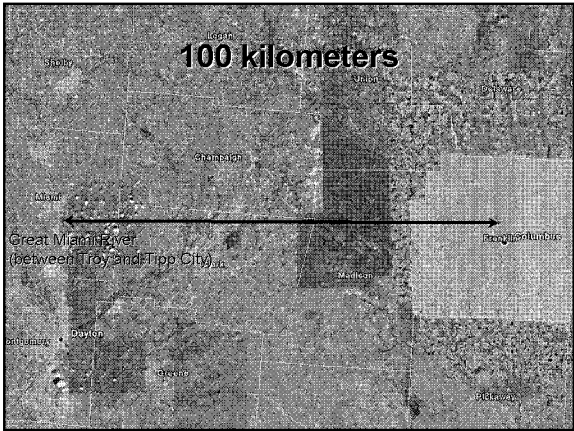
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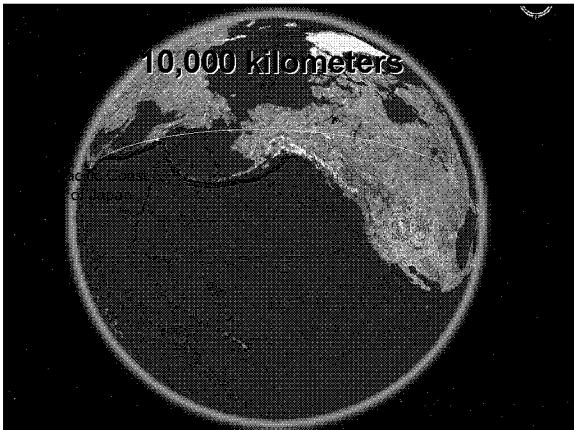
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Astronomers measure length in astronomical units and parsecs.

Distance from Earth to Sun =  
150 billion meters =  
150 million kilometers =  
1 astronomical unit (AU)

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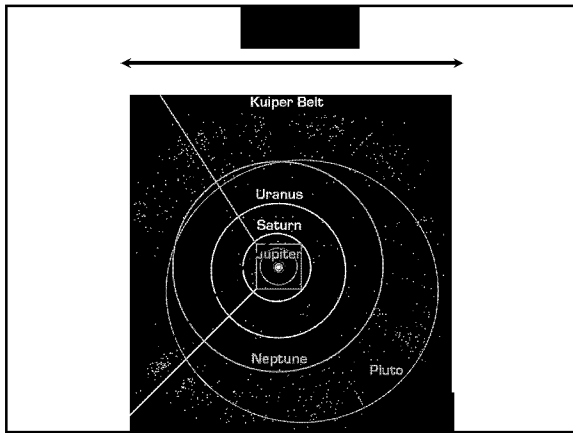
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1 light-year (ly) = distance traveled by light during one year.



1 light-year =  
63,000 astronomical units =  
9.46 x 10<sup>12</sup> kilometers

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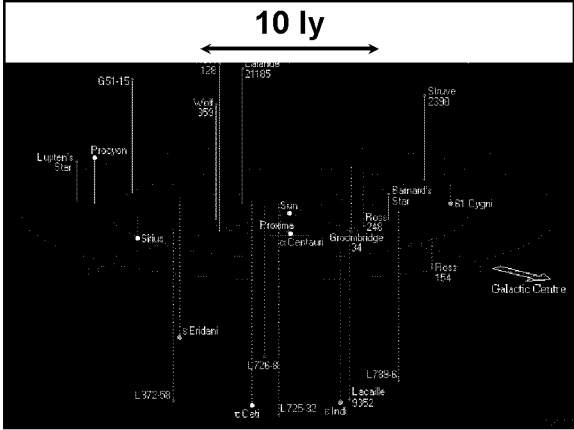
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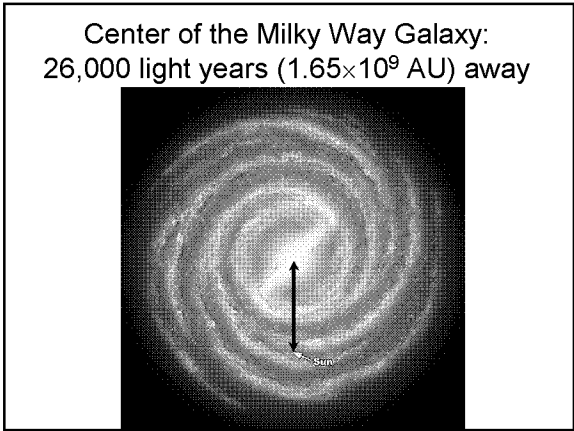
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Astronomers measure time in seconds and years.

Time for Earth to go around Sun =  
1 year =  
365  $\frac{1}{4}$  days =  
 $3.2 \times 10^7$  seconds

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Astronomers measure mass in kilograms.

**NOTE: mass and weight are NOT the same thing!**

MASS = amount of matter

WEIGHT = force with which gravity pulls on matter

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Example:

MASS = 1 kilogram = 1000 grams

WEIGHT = 35 ounces on Earth

WEIGHT = 6 ounces on Moon

WEIGHT = 13 ounces on Mars

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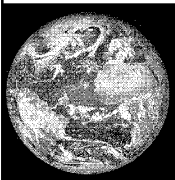
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Properties of the Earth (a planet)



Diameter = 13,000 kilometers  
(7900 miles)

Mass =  $6 \times 10^{24}$  kilograms

Age = 4.6 billion years

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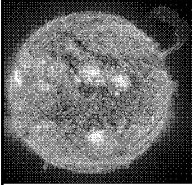
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Properties of the Sun (a star)

Diameter = 1.4 million kilometers =  
100 × Earth diameter



Mass =  $2 \times 10^{30}$  kilograms =  
330,000 × Earth mass

Age = 4.6 billion years

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Tomorrow's Lecture:

Imagining Other Worlds

This week's reading:

Chapter 1

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