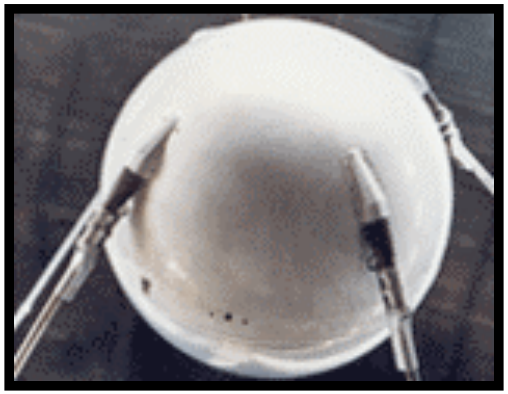
Scales in the Solar System:

Space and Space Travel

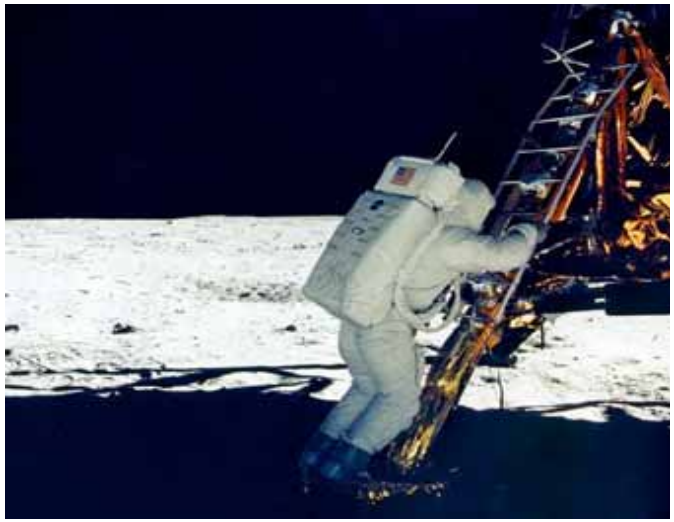
Milestones in Space Exploration (1900-1970):

1) 12/17/1903: First Human Flight.

2) 10/04/1957: Sputnik 1 Orbits Earth.



3) 7/16/1969: Apollo 11 Lands on Moon.



Space and Space Travel

Milestones in Space Exploration (1970-2004):

9) 12/15/1970: Vernera 7 Lands on Venus
10) 04/19/1971: Salyut 1 is the First Space Station
11) 11/14/1971: Mariner 9 Orbits Mars
12) 07/20/1976: Viking 1-first long duration lander
13) 04/12/1981: First Flight of Shuttle Columbia.
14) 08/29/1989: Voyager 2 Reaches Neptune.
15) 07/4/1997: Pathfinder Lands on Mars
16) 12/17/2003: Attempt to recreate Kitty Hawk Flight Fails…
17) 01/2004: Spirit and Opportunity Land on Mars
18) 01/14/2005: Huygens Probe Lands on Titan.

Scales in the Solar System

The Solar System is characterized by extremes:

1) The *very hot* to the *very cold*
2) The *very big* to the *very small*
3) The *very dense* to the *very tenuous*
4) The *very close* to the *very distant*
5) The *very numerous* to the *very unique*
4) The *very fast* to the *very slow*

Scientific Notation:

Scientific Notation is a shorthand way of writing and multiplying large (and small) numbers.

0.000000001	10^{-9}	Nano (n)	(billionth)
0.000001	10^{-6}	Micro (μ)	(millionth)
0.001	10^{-3}	Milli (m)	(thousandth)
1	10^{0}	Unity	
1000	10^{3}	Kilo (k)	(thousands)
1,000,000	10^{6}	Mega (M)	(millions)
1,000,000,000	10^{9}	Giga (G)	(billions)
1,000,000,000,000	10^{12}	Terra (T)	(trillions)

To do numbers that are not divisible by ten, we ***multiply*** by an exponential number.

$4{,}275{,}000{,}000 = 4.275 \times 10^{9}$ ***or*** $0.000374 = 3.74 \times 10^{-4}$

Using Scientific Notation:

To ***multiply*** numbers using scientific notation we ***add*** the exponents.

$10^{3} \times 10^{-9} = 10^{(3)+(-9)} = 10^{-6}$

$10^{2} \times 10^{5} = 10^{(2)+(5)} = 10^{7}$

To ***divide*** numbers using scientific notation we ***subtract*** the exponents.

$10^{3} \div 10^{-9} = 10^{(3)-(-9)} = 10^{12}$

$10^{2} \div 10^{5} = 10^{(2)+(5)} = 10^{7}$

To ***add or subtract*** numbers using scientific notation we work ***in front of*** the exponents.

$3.0 \times 10^{2} + 2.6 \times 10^{5} = (3 \times 2.6) \times 10^{(2+5)} = 8.1 \times 10^{7}$

$1.0 \times 10^{5} - 7.0 \times 10^{2} = (1 \div 7) \times 10^{(5-2)} = 1.42 \times 10^{-3}$

Scientific Notation Example

How long does light take to travel from the visible surface of the Sun to the Earth?

Distance from Sun to Earth $D = 150{,}000{,}000\ km$

In Scientific Notation $D = 1.5 \times 10^{8}\ km$

The Speed of Light $C = 3 \times 10^{5}\ km/s$

Time = distance/speed = *D/C*

$$D/C = (1.5 \times 10^{8}) \div (3 \times 10^{5})$$

$$= (15 \times 10^{7}) \div (3 \times 10^{5}) = (15 \div 3) \times 10^{(7)-(5)}$$

$$Time = 5 \times 10^{2} = 500 \text{ seconds} = \mathbf{8.33\ minutes}$$

Distance Scales in and near the Solar System:

Distance	Example	Time @ Mach1
100 km	Seattle to Olympia	*0.1 hr*
1000 km	Olympia to Sacramento	*1 hr*
12000 km	Earth's Diameter	*12 hr*
4.0×10^5 km	Distance to Moon	*19 days*
1.4×10^6 km	Sun's Diameter	*2 months*
1.5×10^8 km	1 AU	*17-yr*

1 Astronomical Unit (AU) = Distance from Sun to Earth

6.0×10^9 km	40 AU (Pluto's Orbit)	*685-yr*
7.5×10^{12} km	1×10^4 AU (Oort Cloud)	*1.7×10^5-yr*
2.5×10^{13} km	Nearest Star	*2.8×10^6-yr!!!*

The Sun and the Solar System

Any study of the solar system must start with the Sun…..

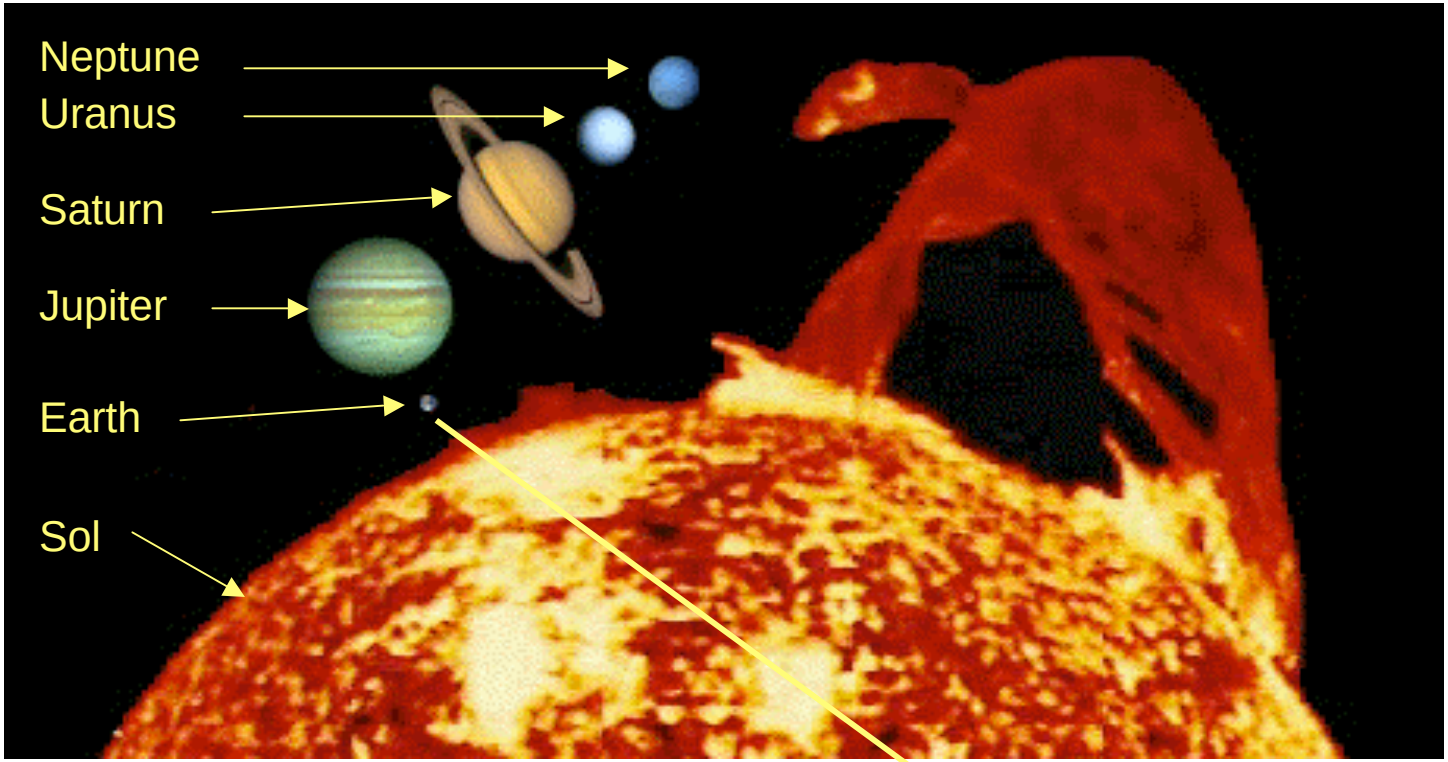
1) The sun contains 99.9% of all the mass in the solar system (Jupiter has most of the remaining 0.1%)

2) The sun dominates energy (and light) production at all frequencies (except in radio waves where *human activity* is stronger!)

3) Solar energy largely determines the *effective* (or blackbody) temperatures of every object in the solar system.

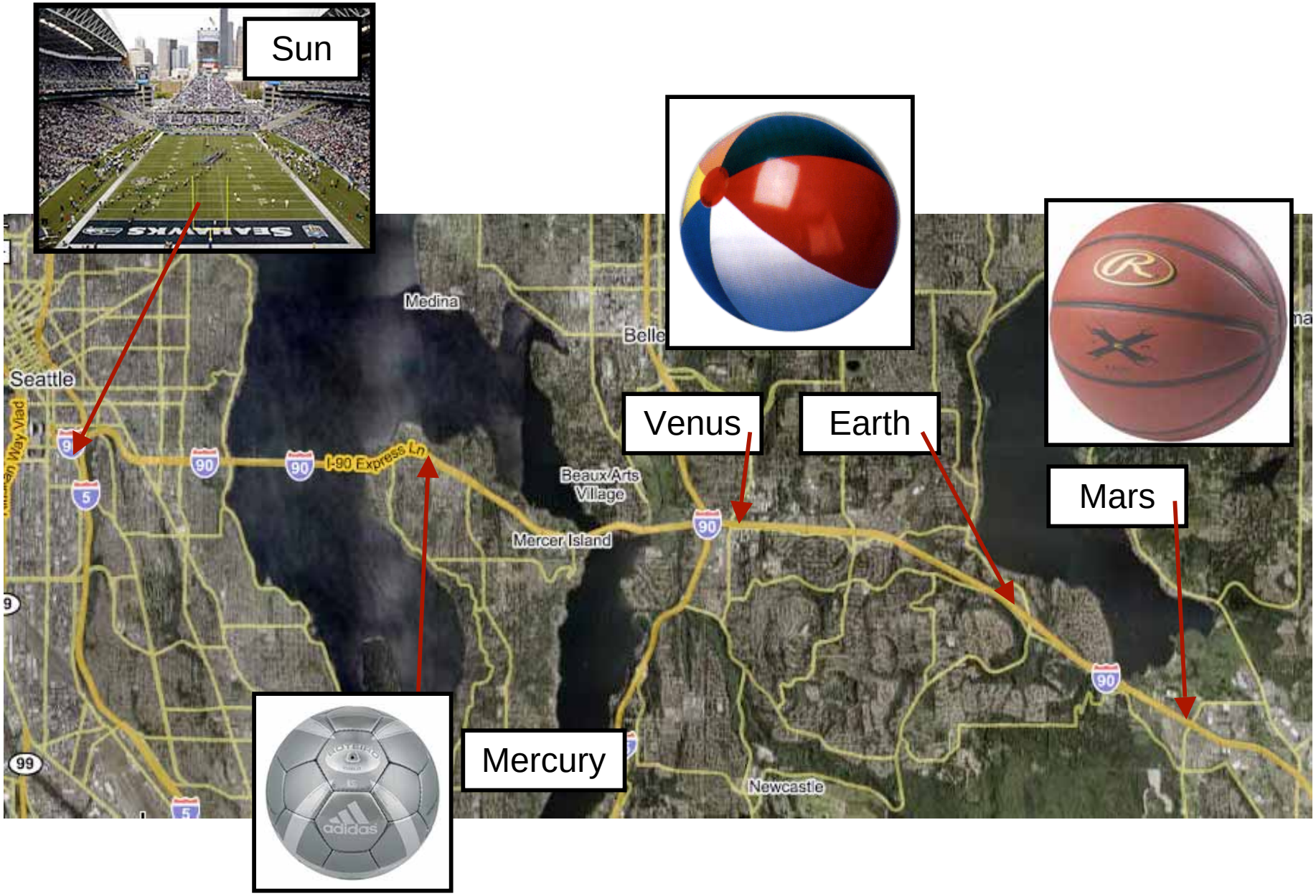
4) Material from the Solar Atmosphere is the dominant component of interplanetary space.

Compared to the Sun, the planets are nearly inconsequential…..



The Sun Dominates the Solar System.

The places *we* are most interested in don't add up to very much……

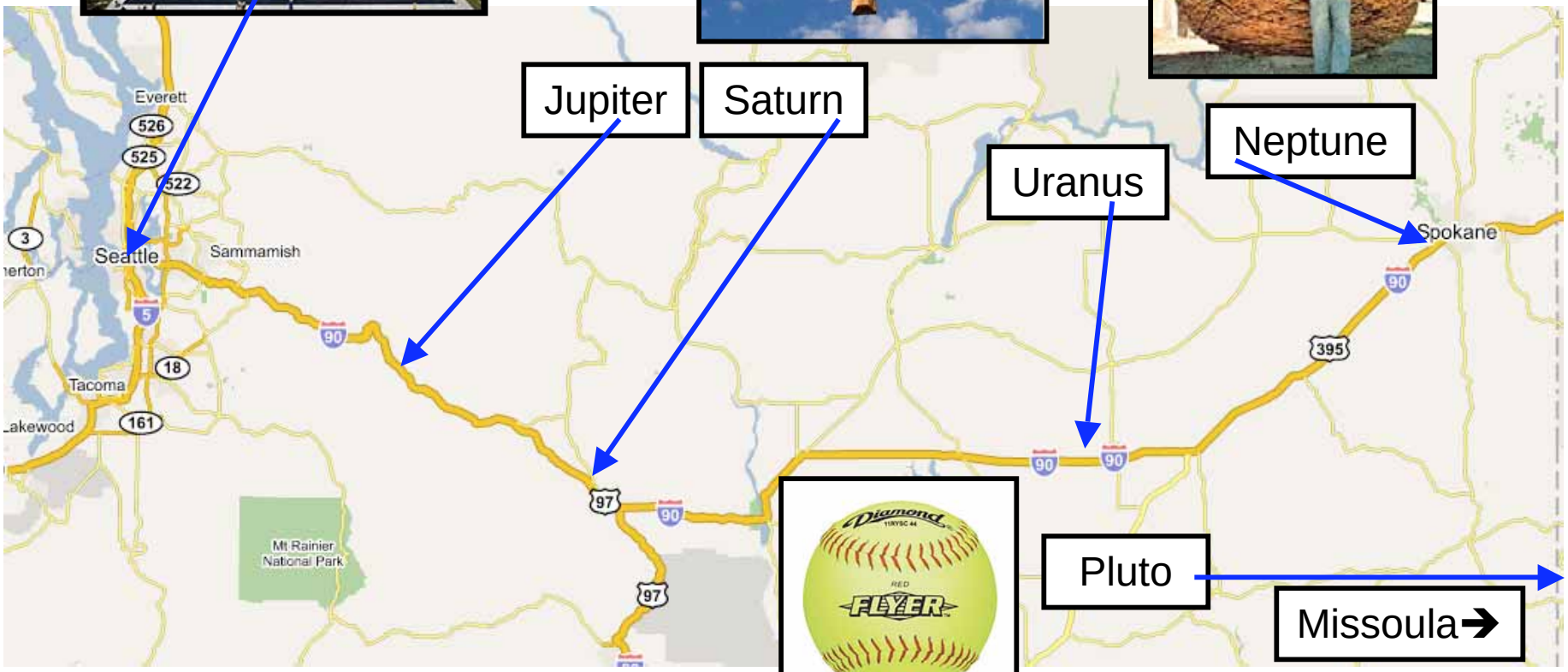

Sun
Venus
Earth
Mars
Mercury
Seattle
Medina
Belle
Beaux Arts Village
Mercer Island
Newcastle
I-90 Express Ln
90
5
99
9

Jupiter

Saturn

Neptune

Uranus



Pluto

Missoula➔