

Lecture 2: August 25, 2010

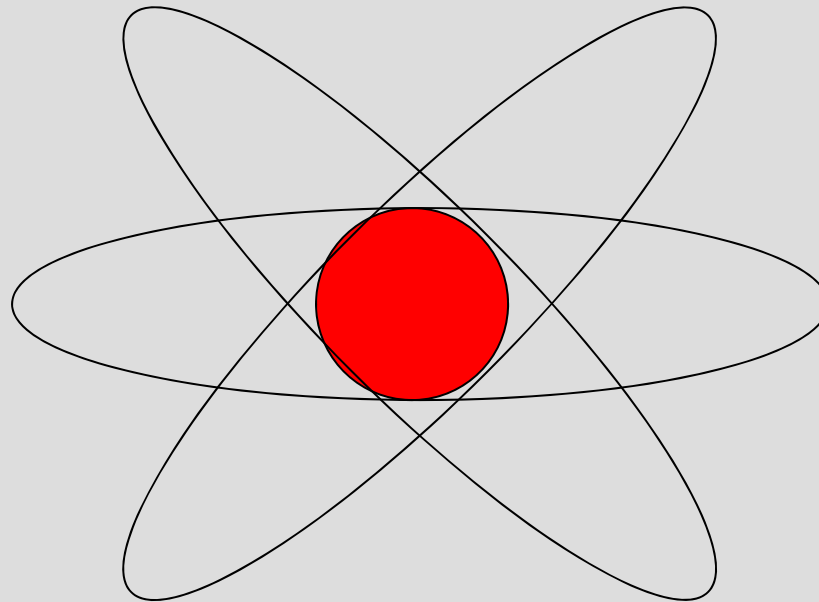
- Estimation
- How much money does the US spend per public K-12 student per year, on average?

Universe

The sum total of all matter and energy; that is, everything within and between all galaxies

Atom

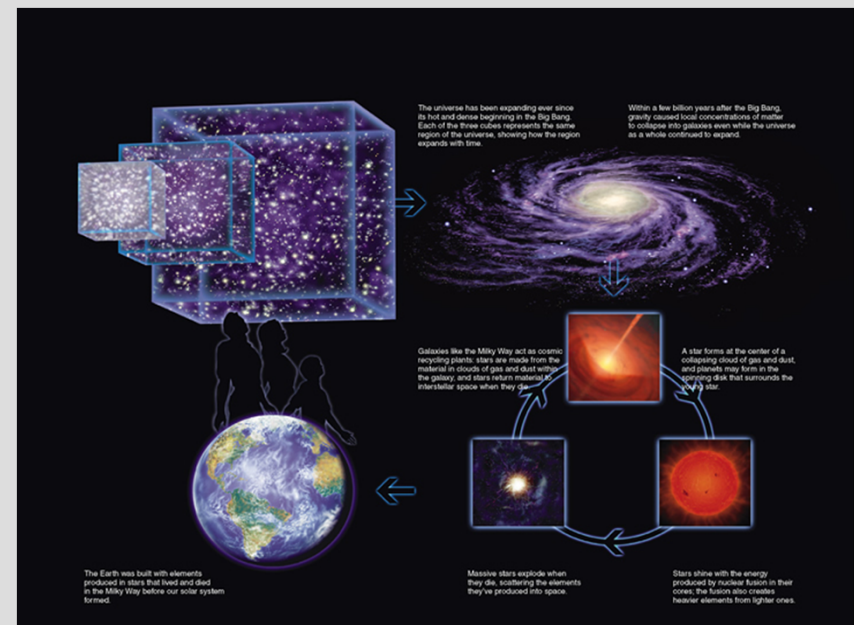
Microscopic “building blocks” of all chemical elements



Where do we come from?

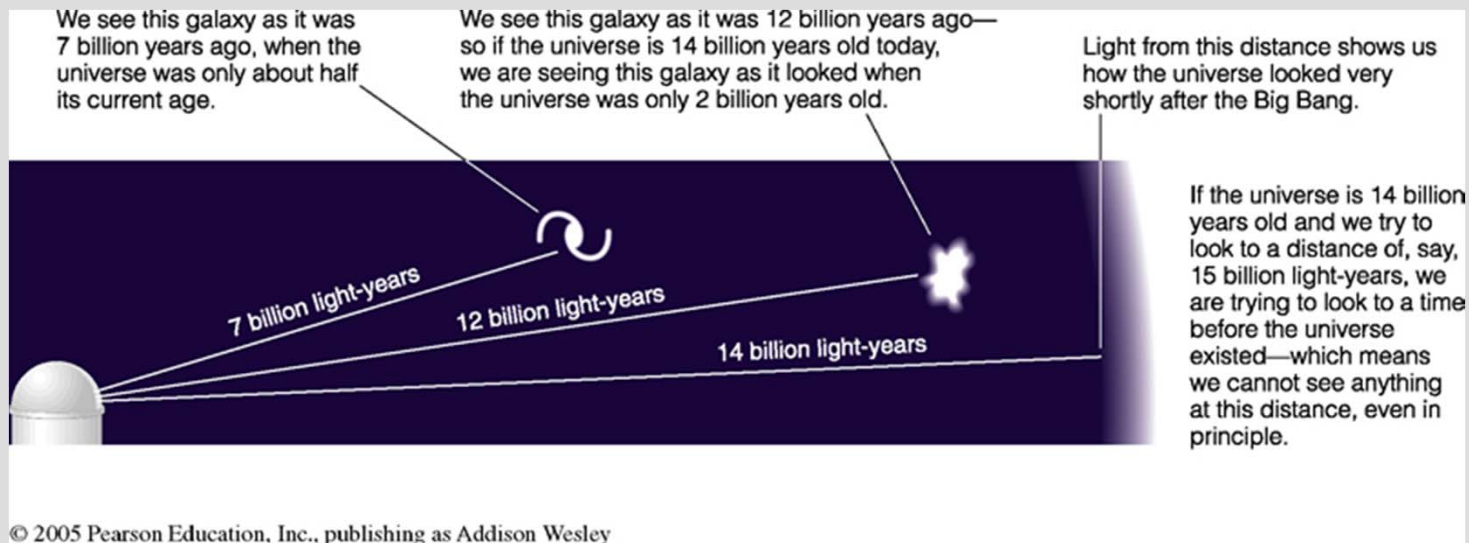
- The first (and simplest) atoms were created during the **Big Bang**.
- More complex atoms were created in stars.
- When the star dies, they are expelled into space.... to form new stars and planets!

Most of the atoms in our bodies were created in the core of a star!



Looking back in time

- Light, although fast, travels at a finite speed.
- It takes:
 - 8 minutes to reach us from the Sun
 - 8 years to reach us from Sirius (8 light-years away)
 - 1,500 years to reach us from the Orion Nebula
- The farther out we look into the Universe, the farther back in time we see!



A Light Year

- Light moves at 3×10^8 m/s
- A year is $\pi \times 10^7$ seconds
- A light year is about 10^{16} m
 - 10^{13} km = 10 trillion km = 6 trillion miles
- The closest star is 4 light years

A Parsec

- A parsec is the distance at which 1AU subtends one arcsecond of angle
 - 1 AU (Astronomical Unit) = $1.5 \times 10^{11} \text{m}$
 - 1 arcsec = $1/3600$ degrees
- $1 \text{pc} = 3 \times 10^{16} \text{m} = 3 \text{light years}$

Friday, August 27

- Problems with Enrollment
- Homework – not yet!
- Estimation Challenge

<http://casa.colorado.edu/~wcash/APS1030/aps1030.htm>

1.2 The Scale of the Universe

Our goals for learning:

- What does our solar system look like when viewed to scale?
- How far away are the stars?
- How do human time scales compare to the age of the Universe?

Picture a Distance in Your Mind

- A meter
- A kilometer
- 1000 kilometers
- A light year

Scale of Things

- Start at 1m and grow in factors of 10
- Start at 1m and shrink in factors of 10

- Do at the board

Scale Model

- Million to one?
- Do at board

How old is the Universe?

- The Cosmic Calendar
 - if the entire age of the Universe were one calendar year
 - one month would be approximately 1 billion real years



If the Universe was 1 year old

- The Milky Way formed in February
- Several generations of stars lived and died in the coming months
- Our solar system forms in early September
- Microscopic life flourishes in late September
- Recognizable animals do not exist until mid-December
- First dinosaurs appear the day after Christmas
- Early hominids (human ancestors) first appear at 9:00 PM on December 31.
- **THE ENTIRE HISTORY OF HUMAN CIVILIZATION LASTS FOR 30 SECONDS!**
- The pyramids were built 11 seconds ago.
- Most of you were born 0.05 seconds ago and will live for only 0.25 seconds.