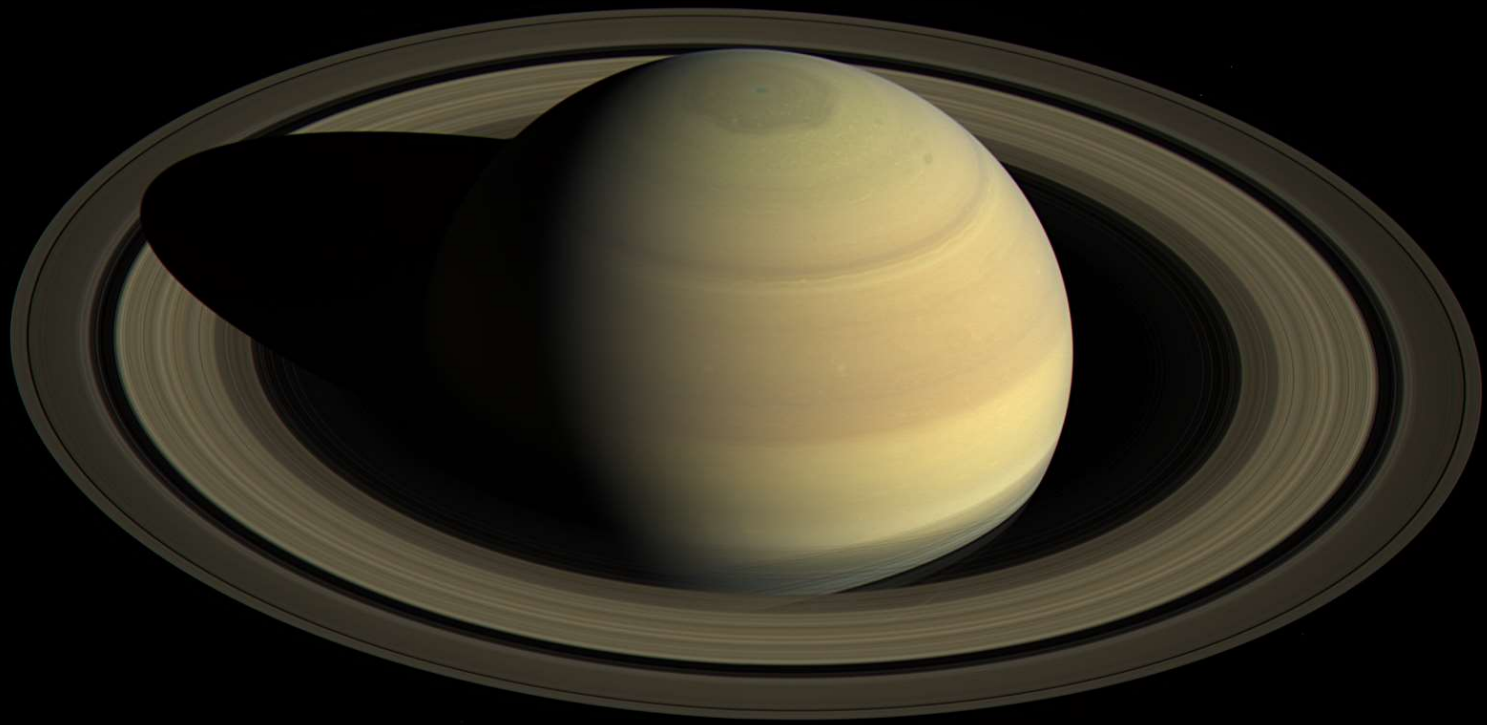
AST 2002
Introduction to Astronomy



iClicker2

Available at the bookstore.

At the beginning of every class will sync with iClicker base

(code will be BC).

Must register on Webcourses using knights email address within first week of class

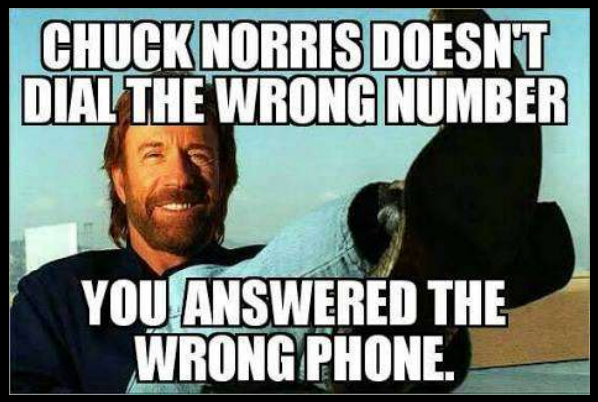
Participation counts for 5%

Correct answers for 5%

We will use the 1st week to practice taking polls

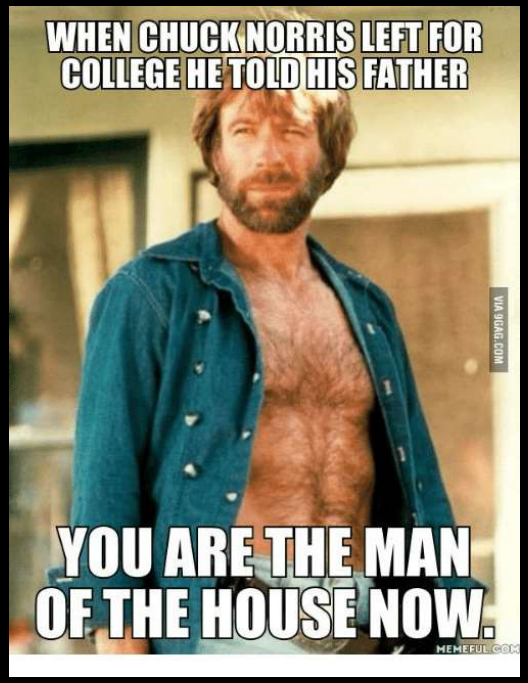
Material may be based on reading material to be covered that lecture

A.

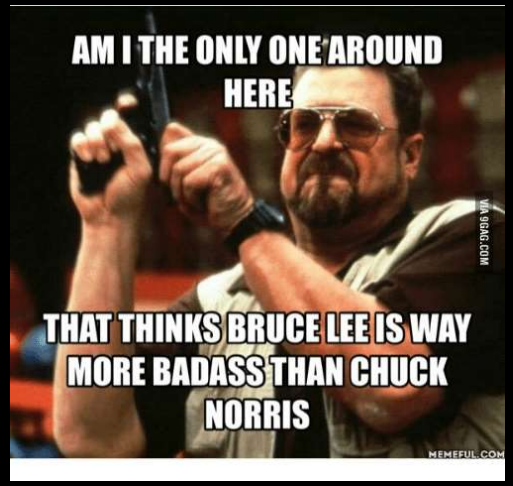


B.

C.



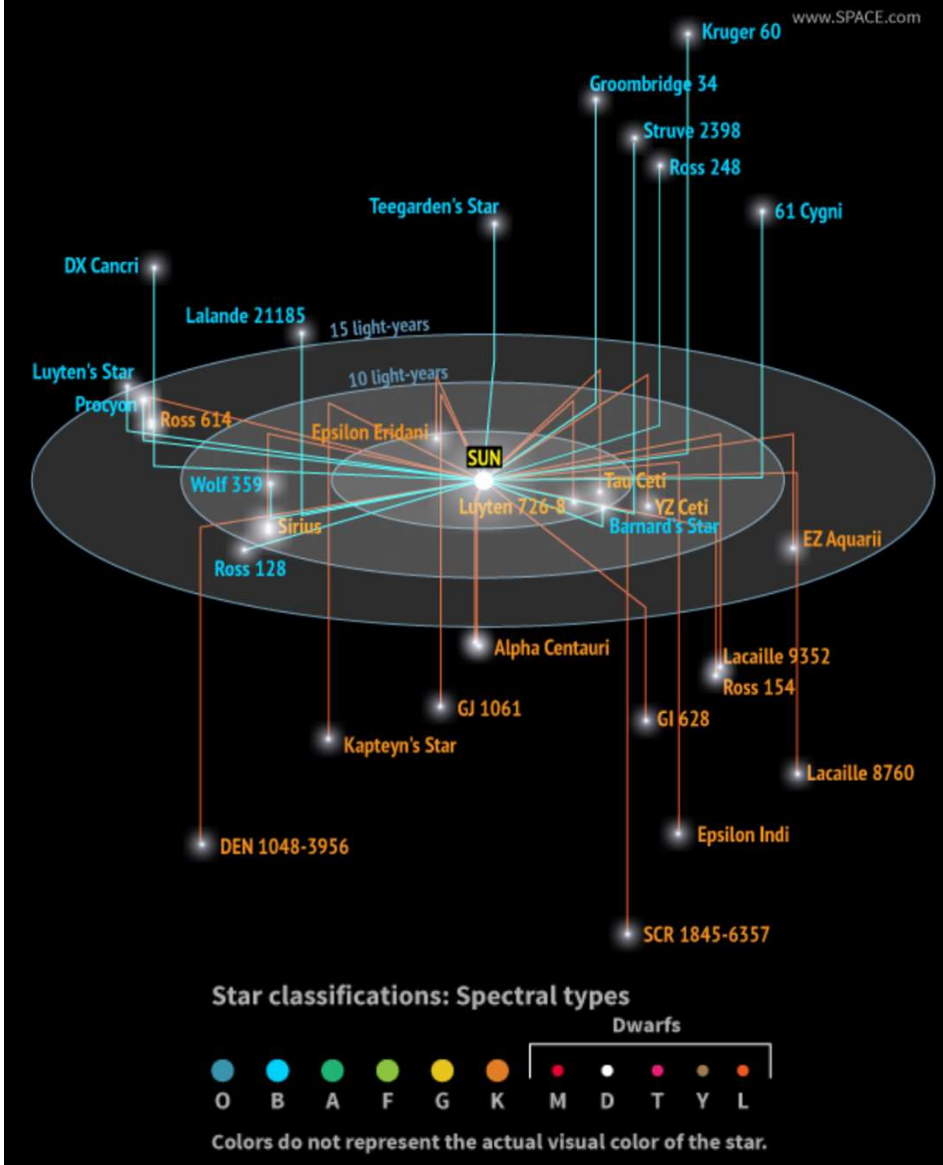
D.



Which is the best Chuck Norris theme?

- A: A
- B: B
- C: C
- D: D

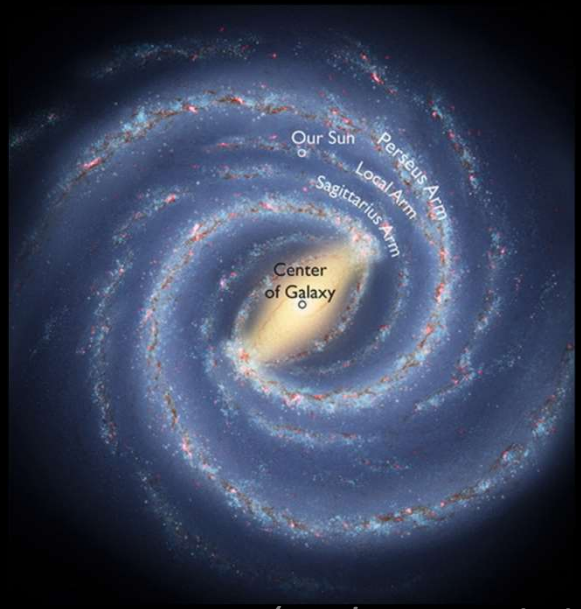
Other Nearby Stars



	Star system	Distance in light-years	Stellar type (s)	Observed planets
1	Alpha Centauri	4.24-4.37	M, G, K	1
2	Barnard's Star	5.96	M	
3	Wolf 359	7.78	M	
4	Lalande 21185	8.29	M	
5	Sirius	8.58	A, D	
6	Luyten 726-8	8.73	M, M	
7	Ross 154	9.68	M	
8	Ross 248	10.32	M	
9	Epsilon Eridani	10.52	K	2
10	Lacaille 9352	10.74	M	
11	Ross 128	10.92	M	
12	EZ Aquarii	11.27	M, M, M	
13	Procyon	11.40	F, D	
14	61 Cygni	11.40	K, K	
15	Struve 2398	11.53	M, M	
16	Groombridge 34	11.62	M, M	
17	Epsilon Indi	11.82	K, T, T	
18	DX Cancri	11.83	M	
19	Tau Ceti	11.89	G	5
20	GJ 1061	11.99	M	
21	YZ Ceti	12.13	M	
22	Luyten's Star	12.37	M	
23	Teegarden's Star	12.51	M	
24	SCR 1845-6357	12.57	M, T	
25	Kapteyn's Star	12.78	M	
26	Lacaille 8760	12.87	M	
27	Kruger 60	13.15	M, M	
28	DEN 1048-3956	13.17	M	
29	UGPS 0722-05	13.26	T	
30	Ross 614	13.35	M, M	

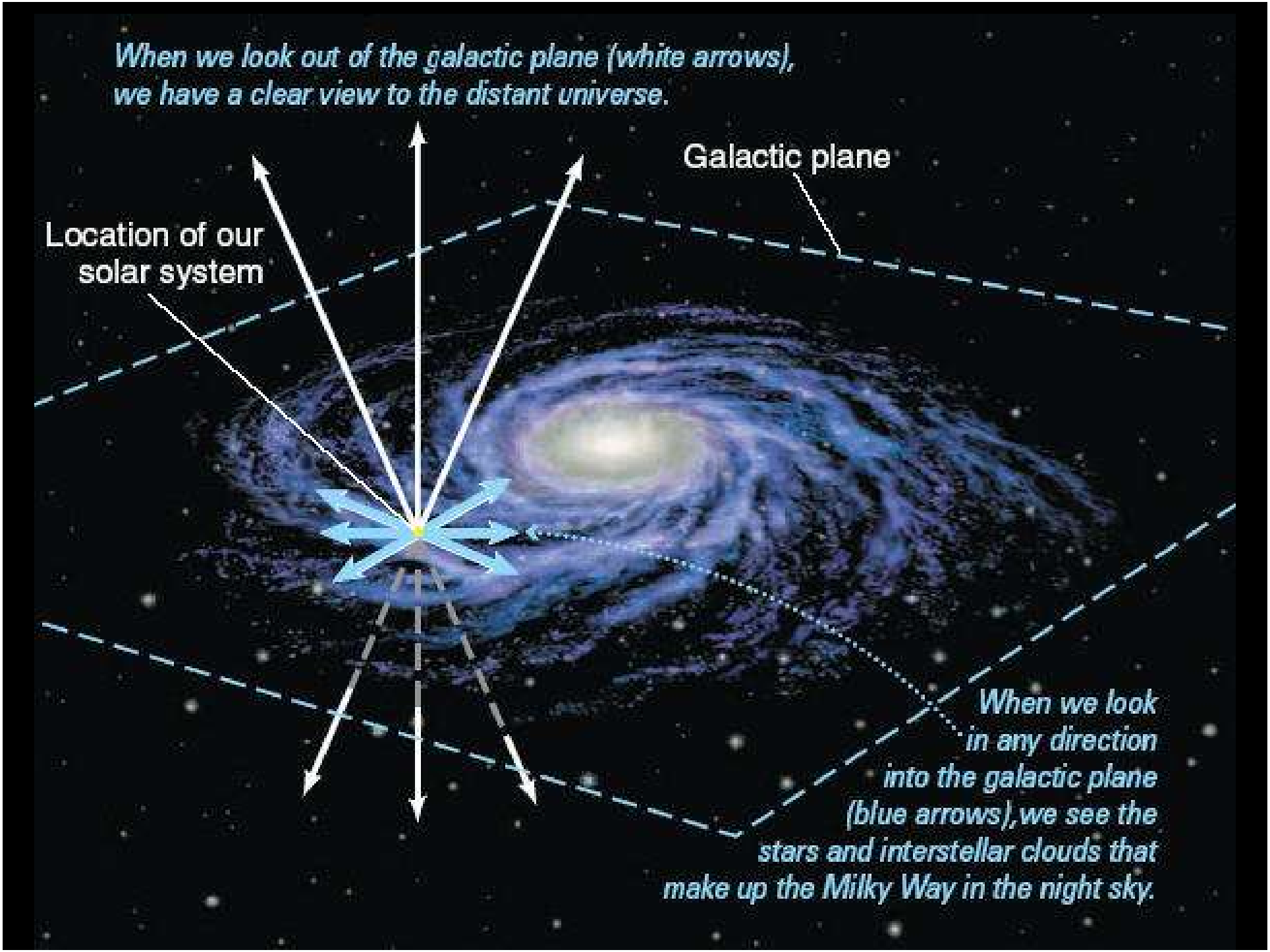
https://www.space.com/18964-the-nearest-stars-to-earth-infographic.html

How Many Stars Are There?

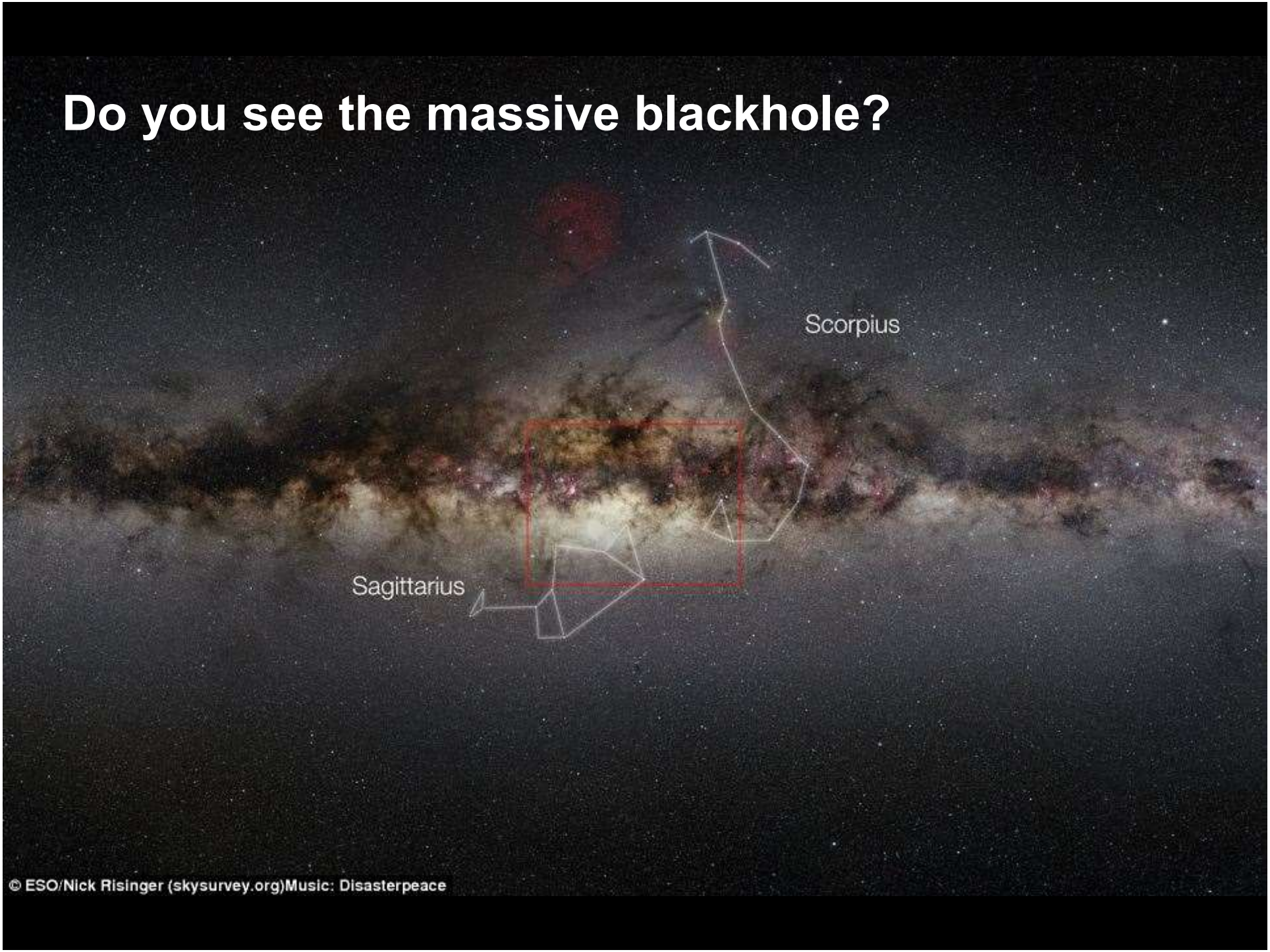


(Both are artistic impressions)

~ 100,000 light-years across
100 – 400 billion stars (maybe as many as 1 trillion)

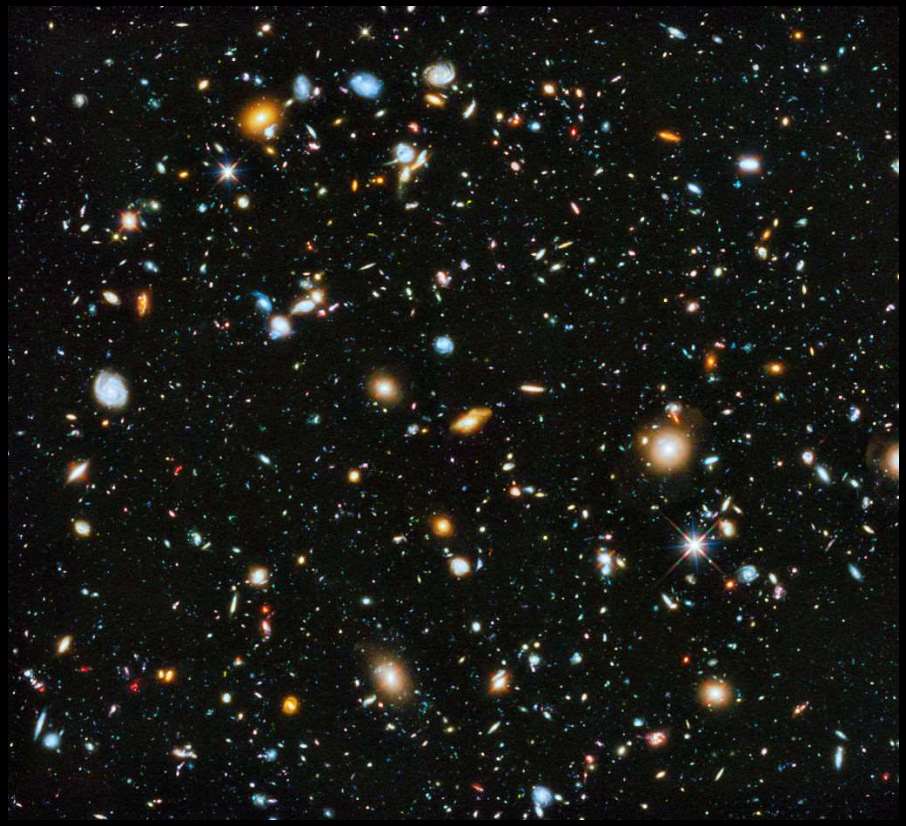

When we look out of the galactic plane (white arrows), we have a clear view to the distant universe.
Galactic plane
Location of our solar system
When we look in any direction into the galactic plane (blue arrows), we see the stars and interstellar clouds that make up the Milky Way in the night sky.

Do you see the massive blackhole?



Hubble Ultra-Deep Field (2012)

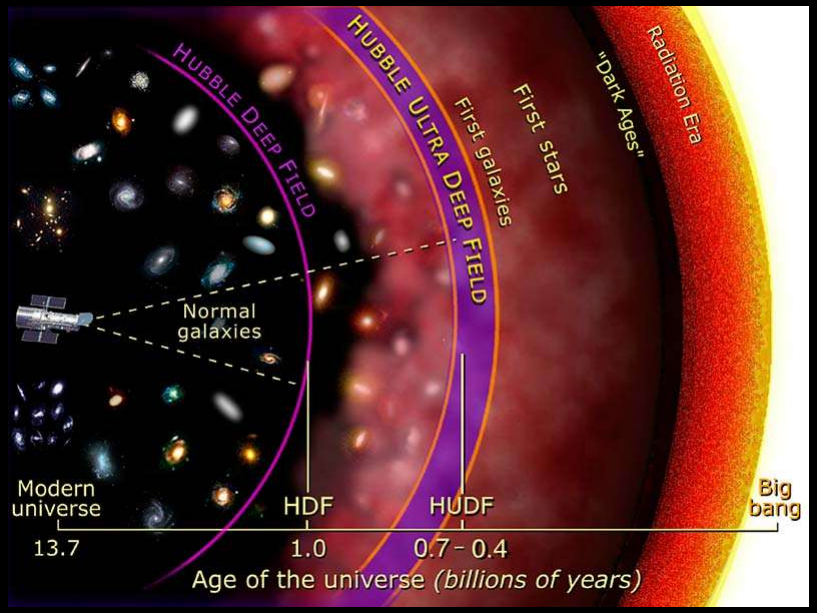
Original Deep Field taken in 1995 ~ 10 day exposure each wavelength used



This image contains over 10,000 galaxies

***"This is approximately one tenth of the angular diameter of a full moon viewed from Earth - smaller than a 1 mm by 1 mm square of paper held at 1 meter away, and equal to roughly one thirteen-millionth of the total area of the sky"* - Wikipedia (*cf., sand in the book*)**

Estimated 200 billion – 1 trillion galaxies in the Universe, each containing >100 billion stars…



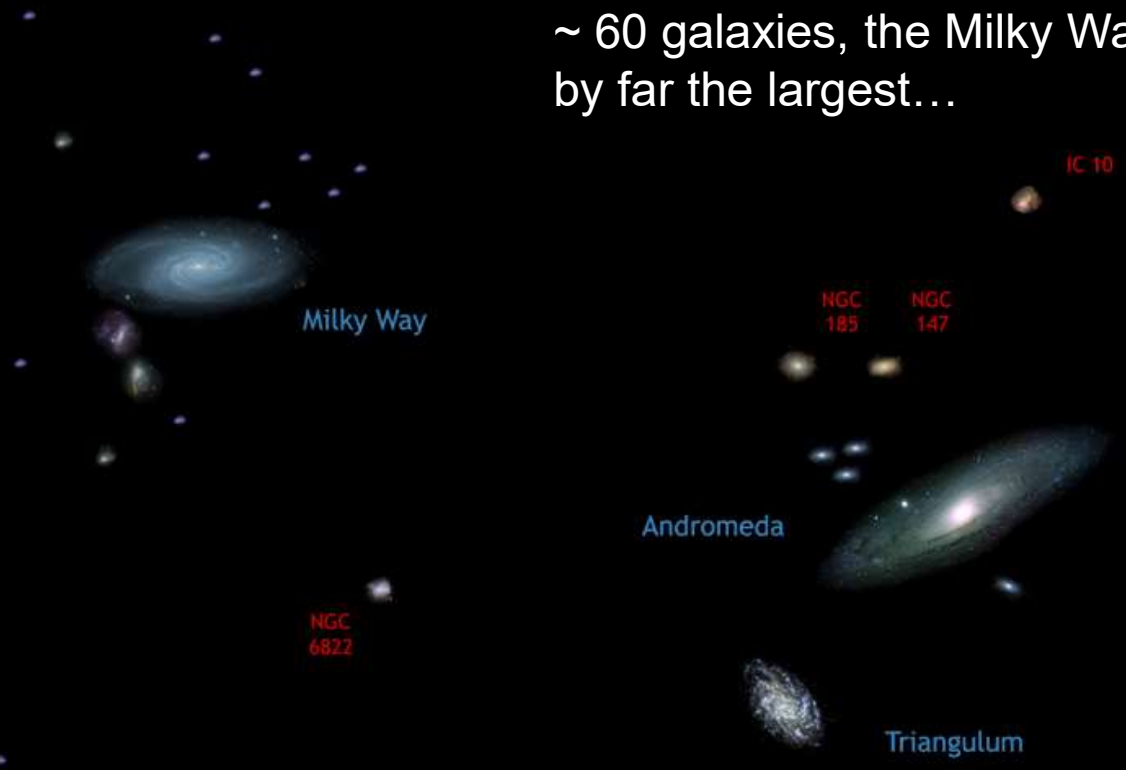
If there are 1 x 10^{11} galaxies, each with 10^{11} stars, there are ~10^{22} stars

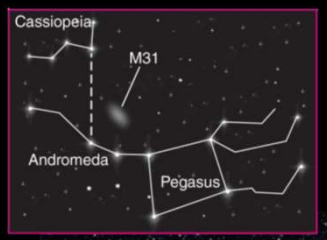
~ 10,000,000,000,000,000,000,000

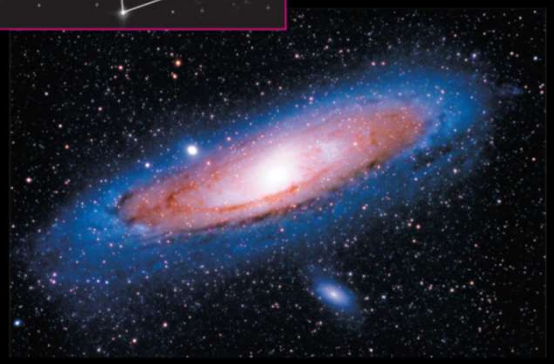
Comparable to number of grains of (dry) sand on every beach on Earth…

Our Local Galaxy Cluster

~ 60 galaxies, the Milky Way and Andromeda are by far the largest…





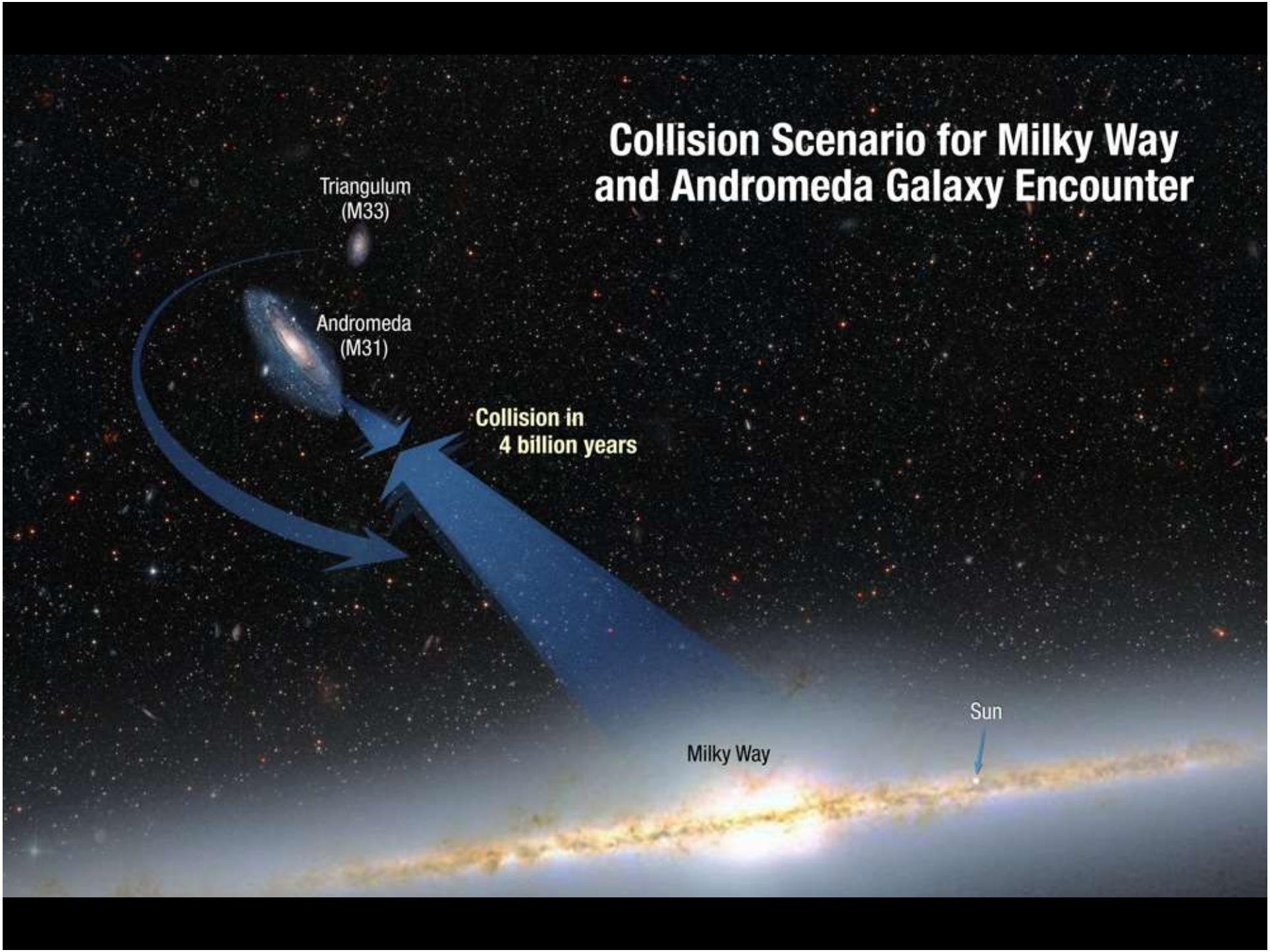


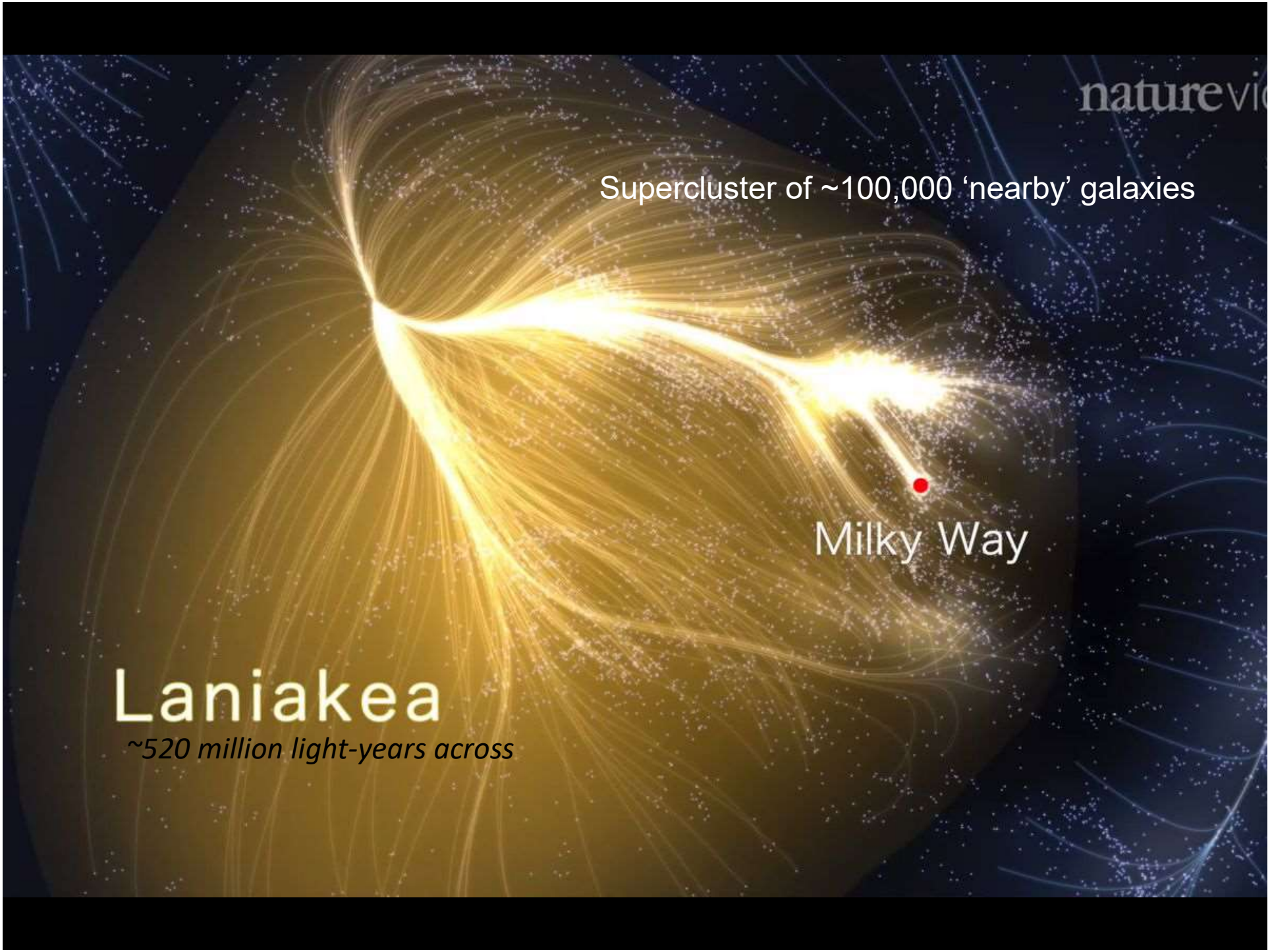
Andromeda (M31) can be seen with the naked eye

Andromeda is ~ 2.5 million light-years away

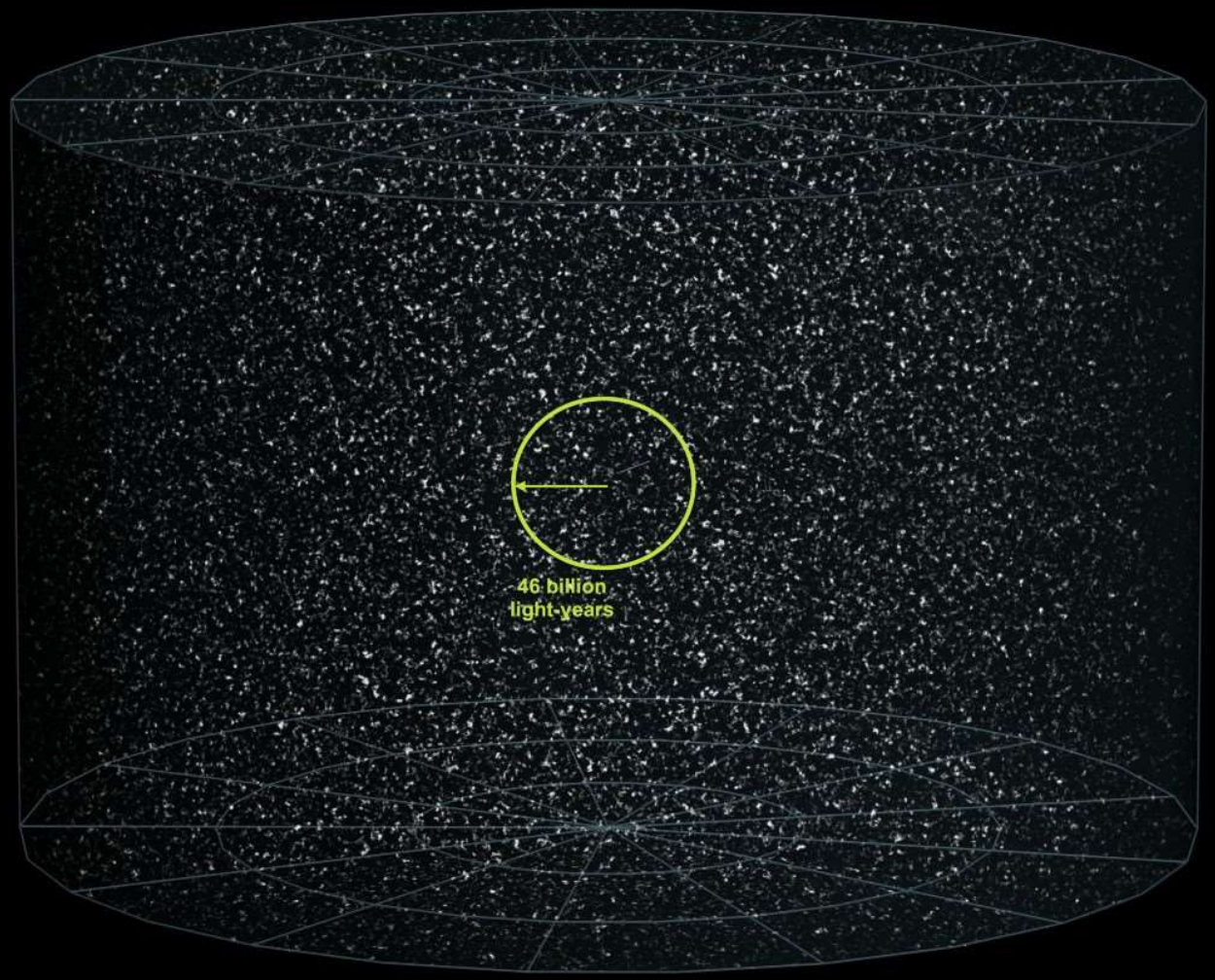
The Universe is expanding. Therefore, all galaxies are moving away from us.

- A: True
- B: False


Collision Scenario for Milky Way and Andromeda Galaxy Encounter
Triangulum (M33)
Andromeda (M31)
Collision in 4 billion years
Sun
Milky Way


nature
Supercluster of ~100,000 'nearby' galaxies
Milky Way
Laniakea
~520 million light-years across

How Big is the Known Universe?



Looking back in time

Light, although fast, travels at a finite speed and the Universe is *very* large

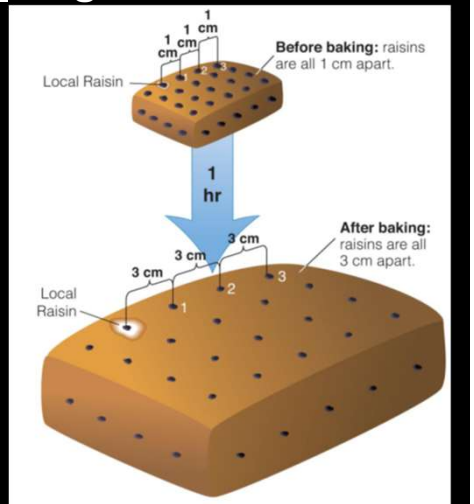
It takes: 8 minutes to reach us from the Sun
8 years to reach us from the star Sirius (8 light-years away)
1,500 years to reach us from the Orion Nebula

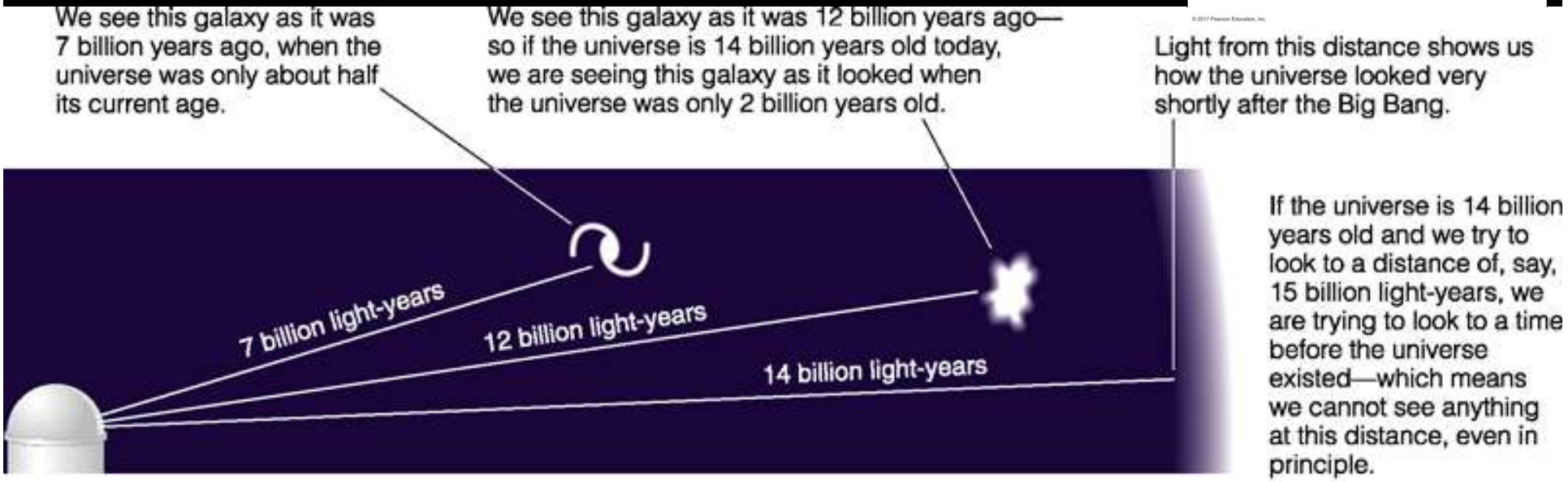
The farther out we look into the Universe, the farther back in time we see!

However, we see them at them "as they were" this far back in time.

A galaxy 12 billion light-years away may have traveled 12 billion light years

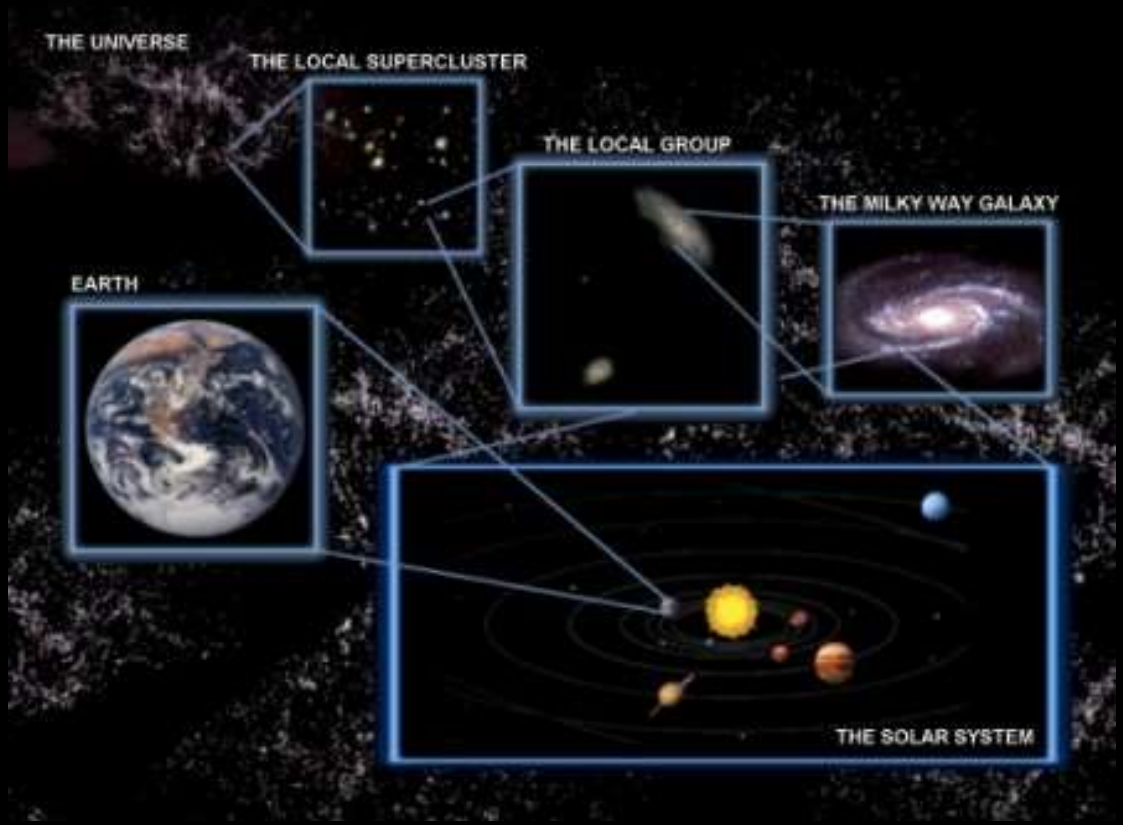
The Universe is also expanding (which we will get to later)!





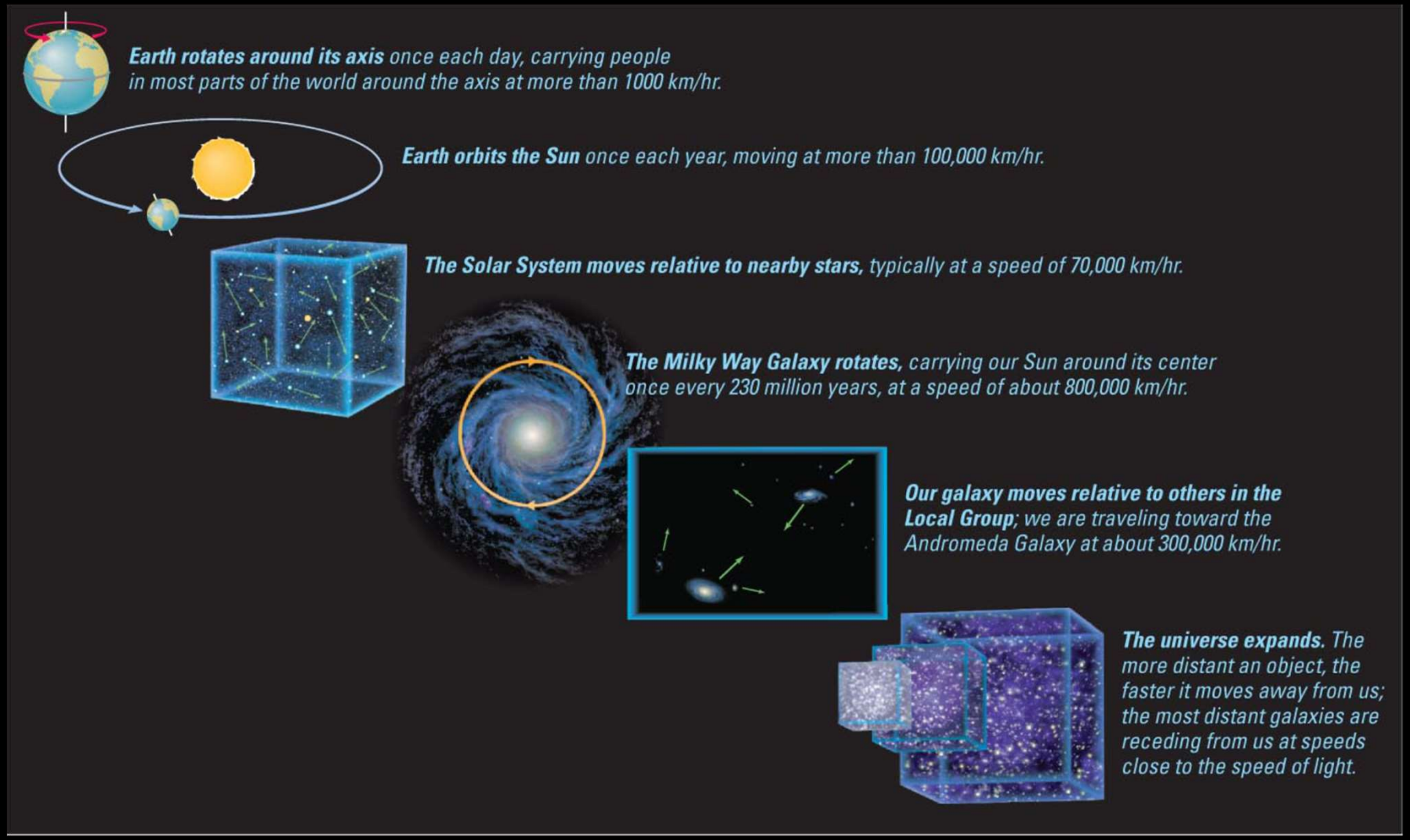
Our Cosmic Address

Our sun is one of 400 billion stars in the Milky Way galaxy, which is one of more than 100 billion galaxies in the visible universe.



Spaceship Earth

https://www.youtube.com/watch?v=ucLYUYDhgos for a visualization...



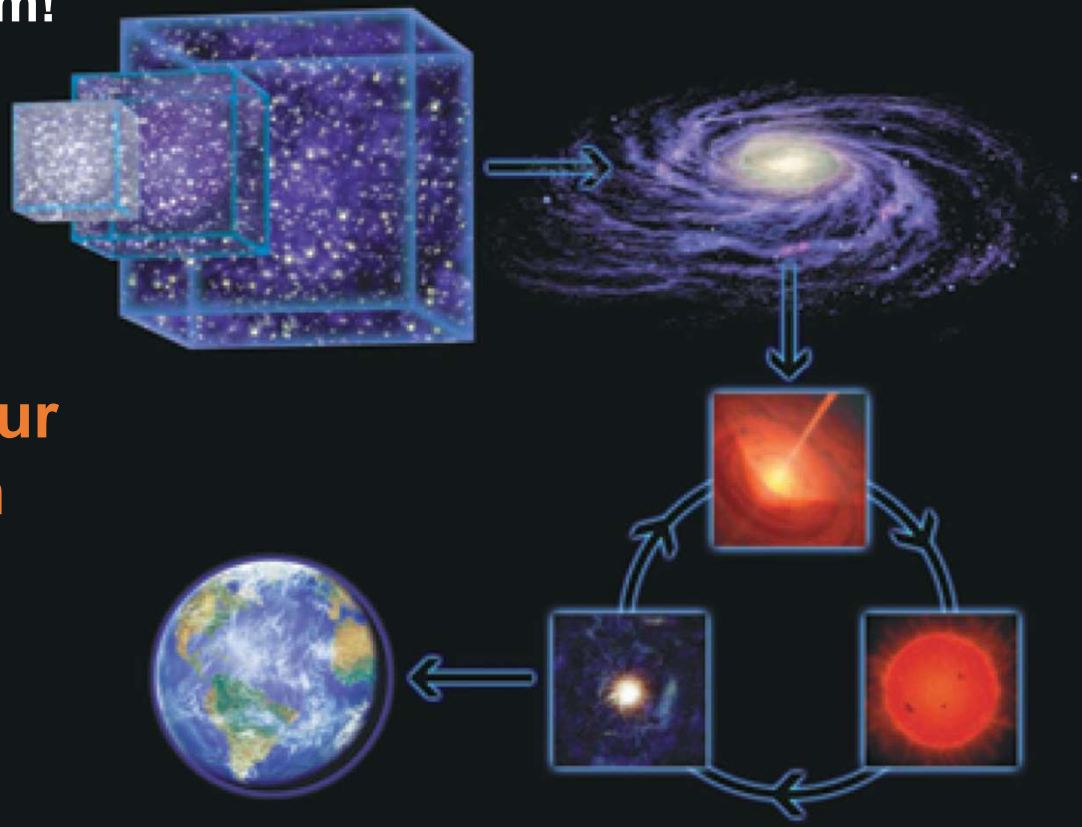
We Are Made of Star-Stuff!

Only the simplest atoms were created during the Big Bang (mostly Hydrogen and Helium)

More complex atoms were created in stars.

When the star dies, they are expelled into space….

new stars and planets form!



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

The Cosmic Calendar

The 13.8 billion year history of the universe scaled down to a single year, where the Big Bang is January 1st at midnight, and right now is midnight 1 year later

January	February	March	April	May	June	July	August	September	October	November	December

Known from telescopes looking back in time, physical models

Known from geologic record, fossils, genetic drift

The Month of December...

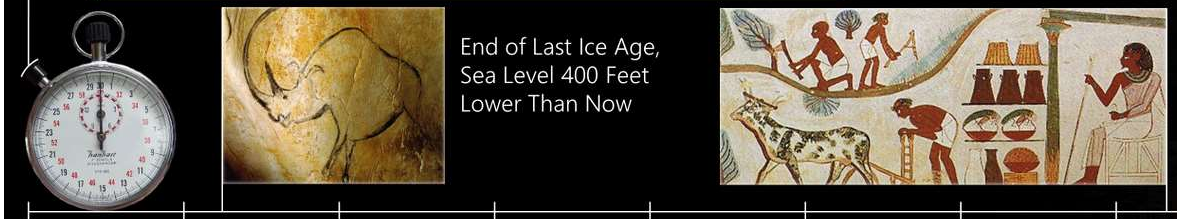
1	2	3	4	5	6	7	8	9	10	11	12	13	14
15 Trace Fossils Only		16		17 Bones and Shells		18 Vertebrates		19 Land Plants		20 Fish with Jaws		21 Insects	

The Final Minute...

A human life only lasts for the blink of an eye on the Cosmic Calendar: 100 years * 365 * 24 * 60 * 60 / 13,800,000,000 = 0.23 Cosmic Seconds

Known from artifacts, radiocarbon dating, DNA extraction from remains

Written records



Some Good Videos on the Scale of the Universe

- The Scale of the Universe 2, 3:23

https://www.youtube.com/watch?v=uaGEjrADGPA

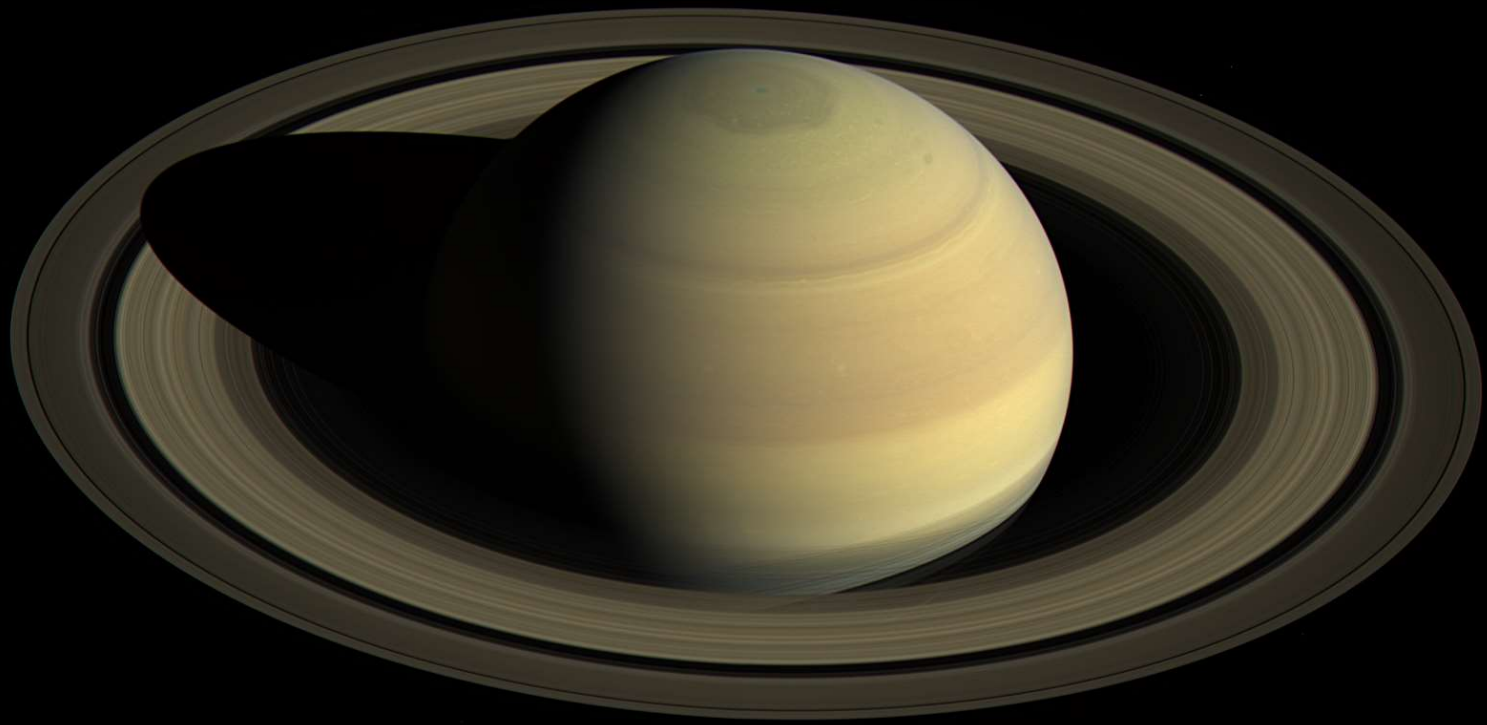
- Size comparison of the Universe 2017, 13:36

https://www.youtube.com/watch?v=kIiJZINJFiw

- Universe Size Comparison 3D, 5:07

https://www.youtube.com/watch?v=i93Z7zIjQ7I

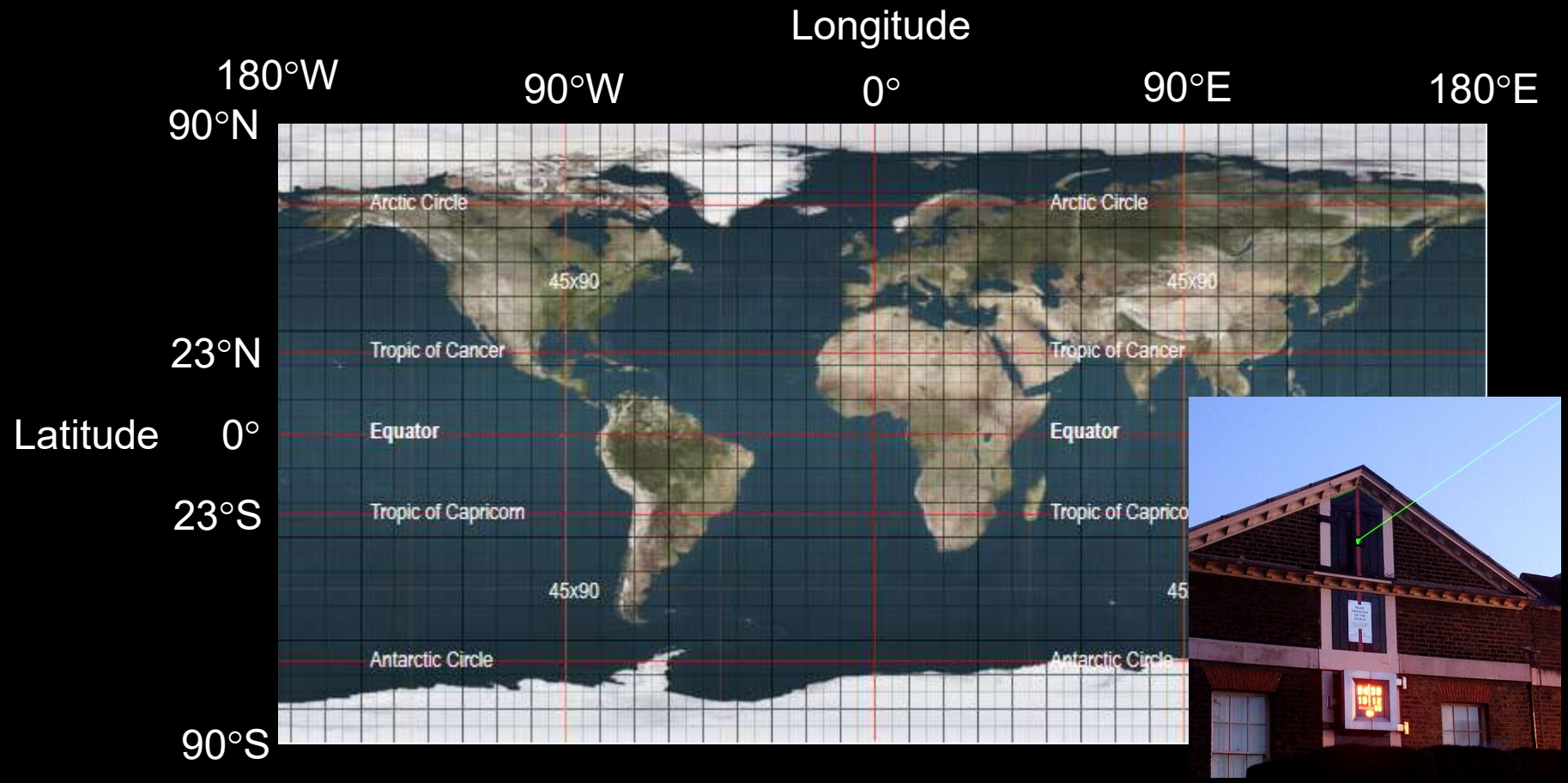
AST 2002
Introduction to Astronomy



Next Chapter

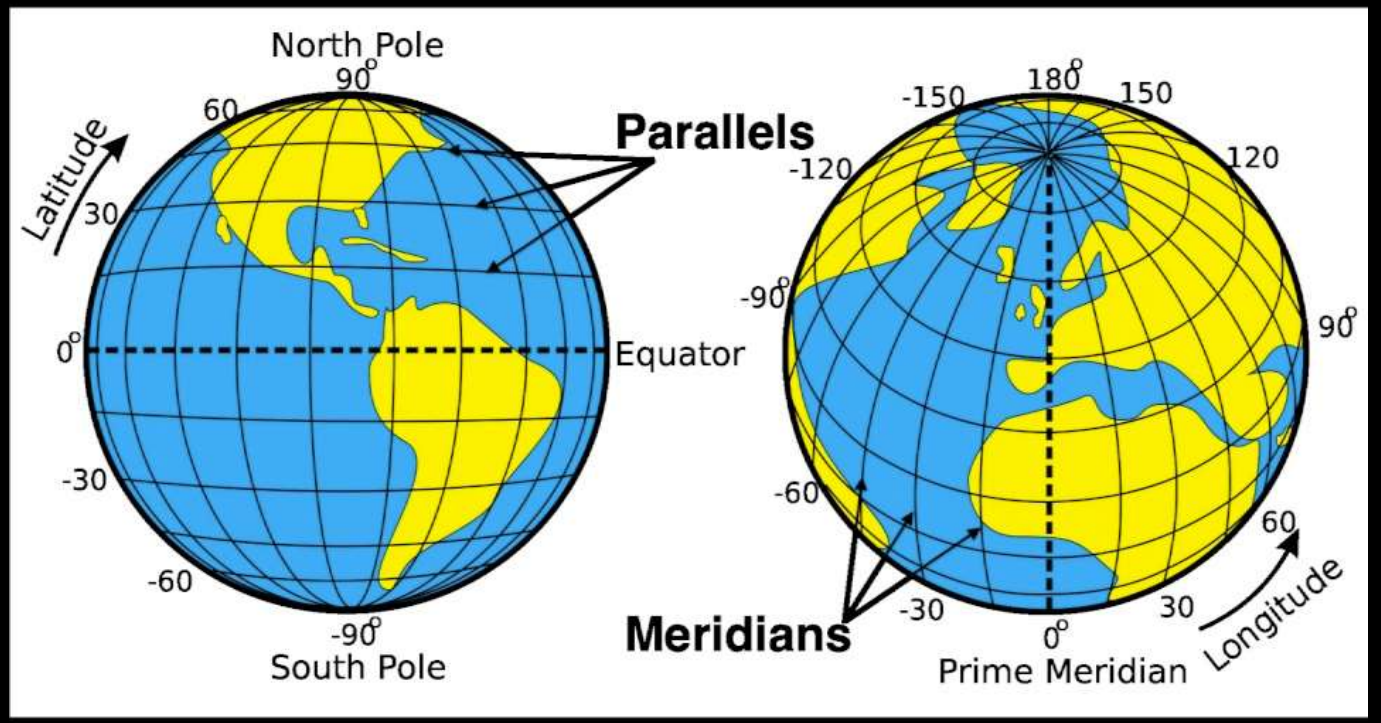
Longitude and Latitude on a Map

How is this projected onto a sphere?



0° longitude is defined as the prime meridian (Greenwich meridian – royal observatory, UK)

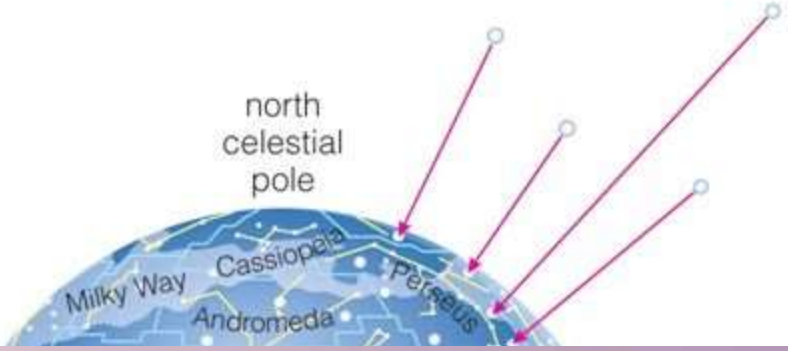
Longitude and Latitude on a Sphere



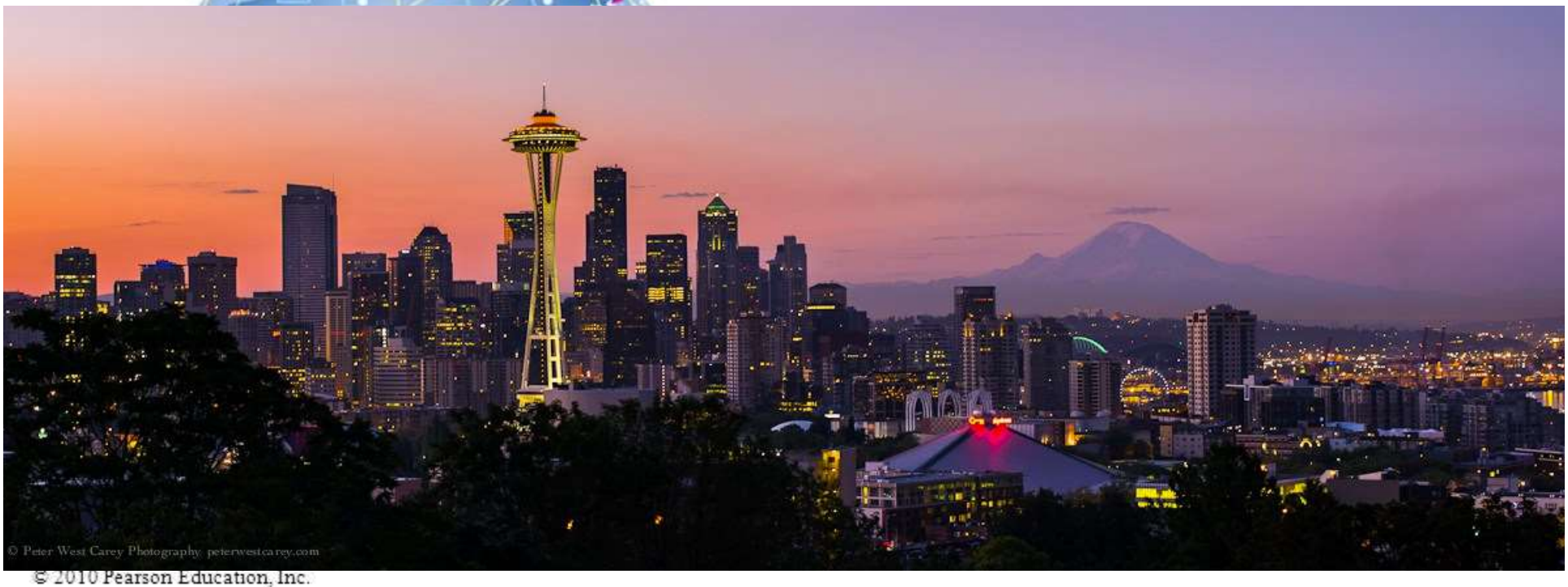
What happens at the same longitude?

What happens at the same latitude?

The Celestial Sphere

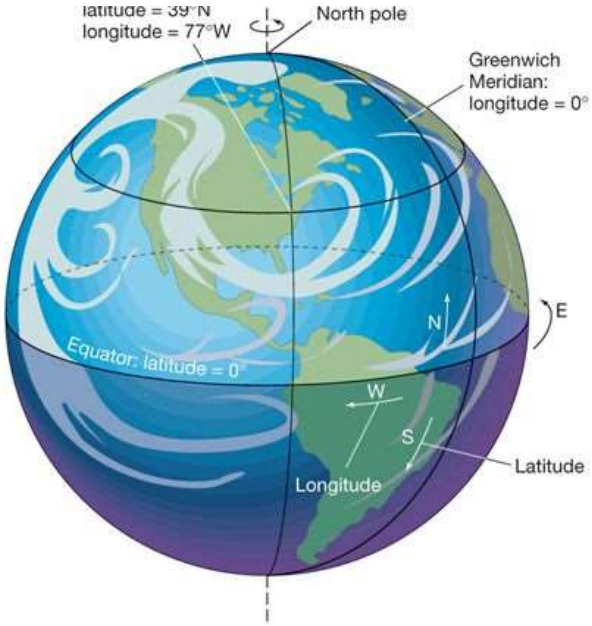


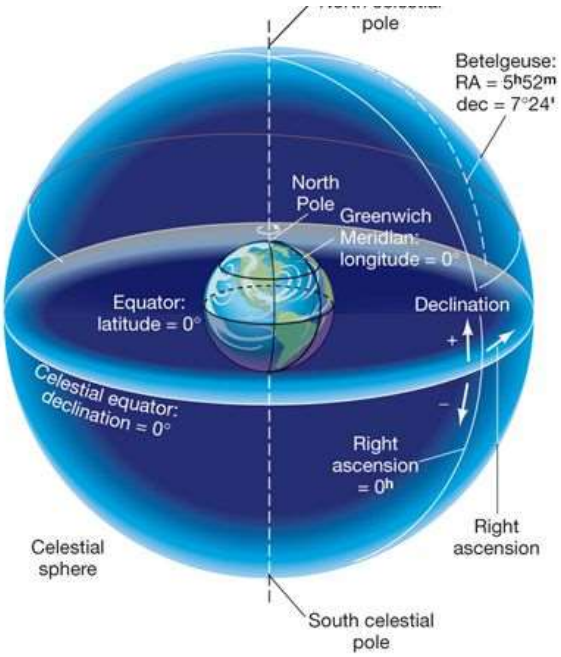
Stars at different distances all appear to lie on the celestial



Describing Positions on the Celestial Sphere

Declination: Degrees north or south of celestial equator (*cf.* Latitude)
Right Ascension: Measured eastward position from the 0° (given in degrees, or hours and minutes). 0° is defined as the position of the Sun at *Vernal equinox* (*cf.* longitude)





Earth Rotates East (Anti-clockwise)

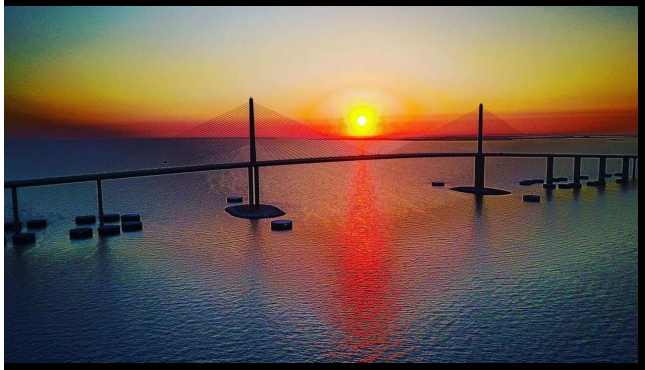
https://www.youtube.com/watch?v=GI3rBwqwDbw

The Sun always rises in the East

Kennedy Space Center

Earth is Rotating
Towards the EAST

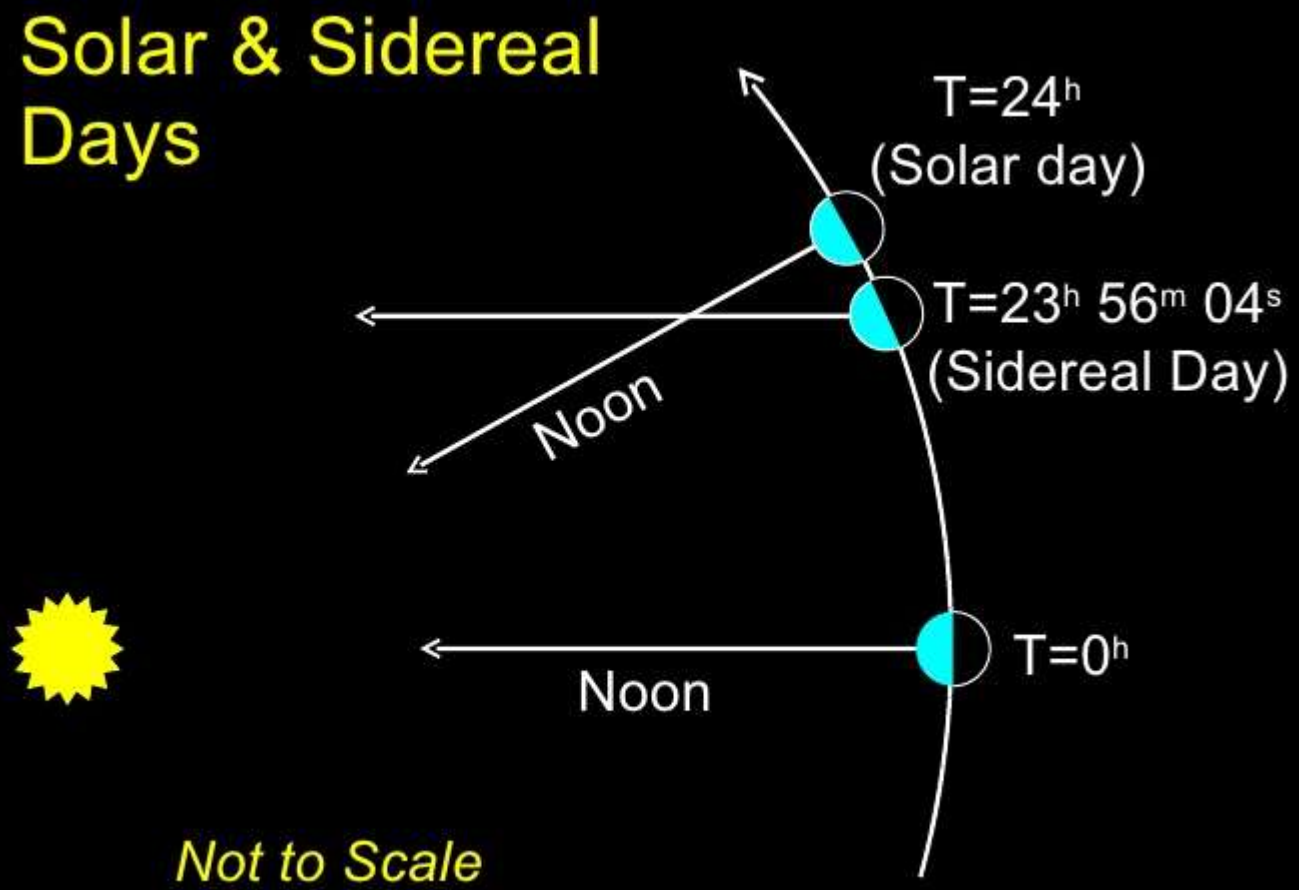
Sunshine Skyline Bridge, Tampa



The Sun always sets in the West

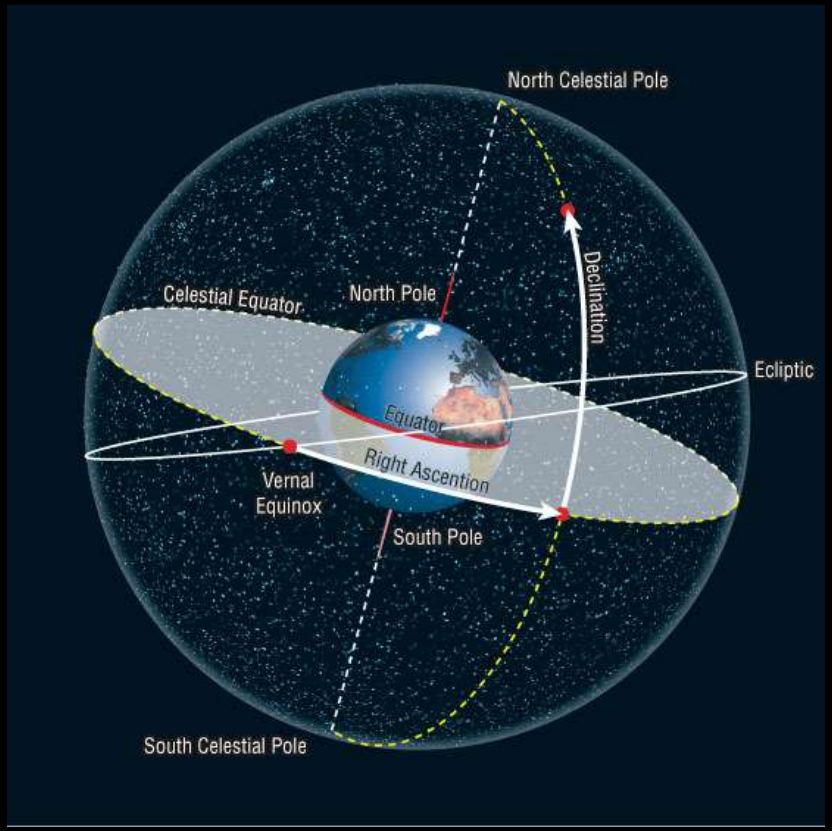
At the equator, at equinox
sunrise at ~6am, sun is directly overhead at ~12pm, sunset at ~6pm

Solar Day versus Sidereal Day



What Are the Constellations?

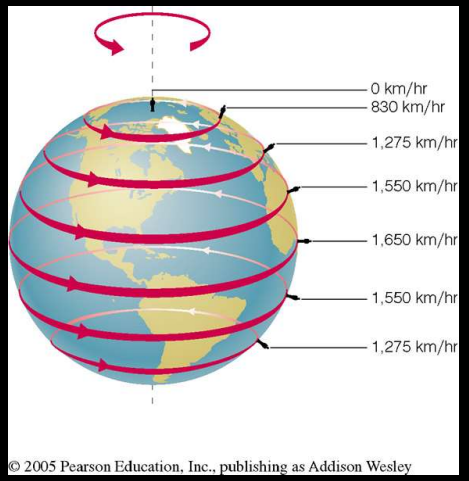
The Earth is Tilted 23.5°



The Earth rotates around the equator

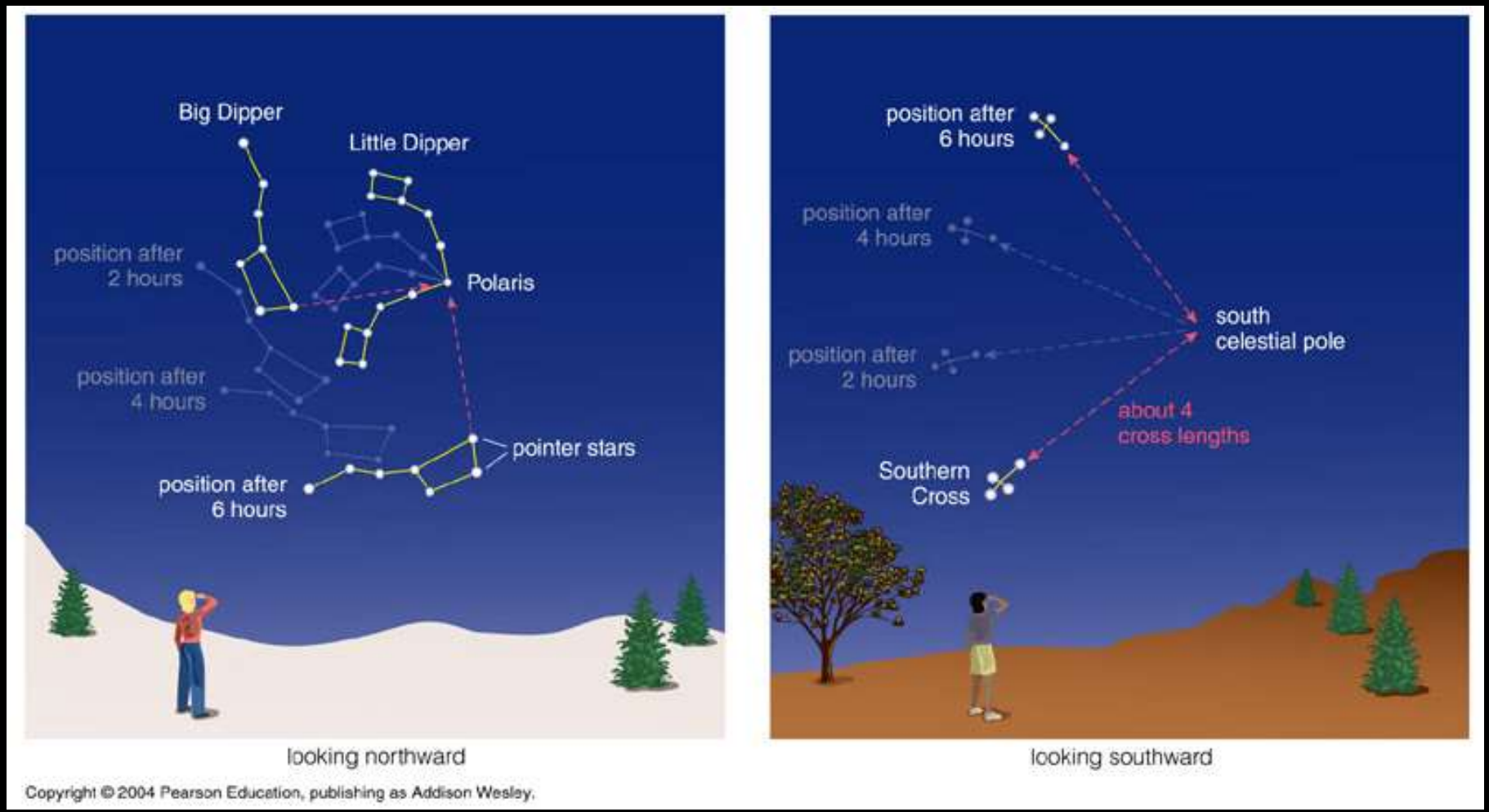
The Earth rotates around the Sun in the Ecliptic plane

Some places on Earth are moving more that others…



North & South Celestial poles are ~Fixed *(precession slowly changes this)*

North and South rotate in opposite directions




Star trails – 15 degrees ~ 1 hour.
created with Advanced Stacker PLUS
StarCircleAcademy.com
Steven Christenson
StarCircleAcademy.com

How long was this exposure for?

Circumpolar stars are stars near the celestial poles

iClicker2's that Need to be Registered with Webcourses

- #91E2A2D1
- #9919D454
- #9D8F3A28
- #9D8F697B
- #A14D678B
- #A42C9810
- #A52CDA53
- #A6B56A79
- #A6C1D9BE
- #A7128035
- #A7B51C0E
- #A9F76739
- #AA9B7849
- #AAAA9797
- #AC174FF4