Astronomy 120

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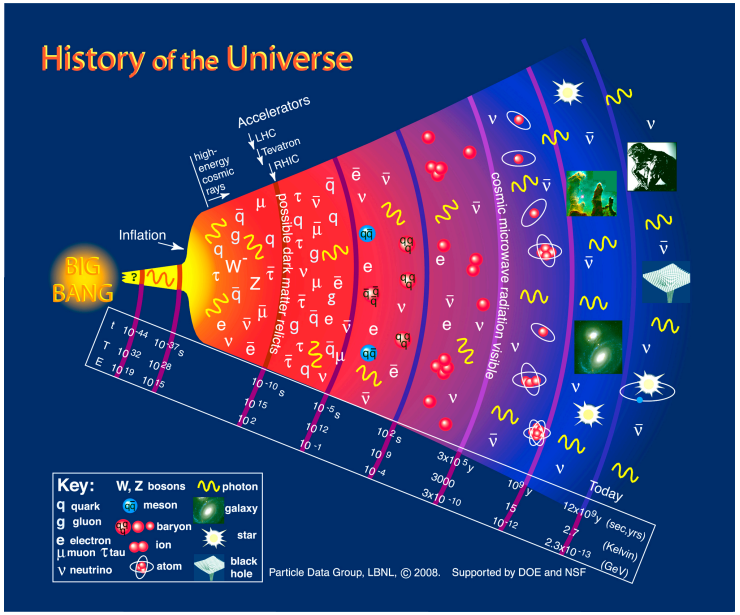

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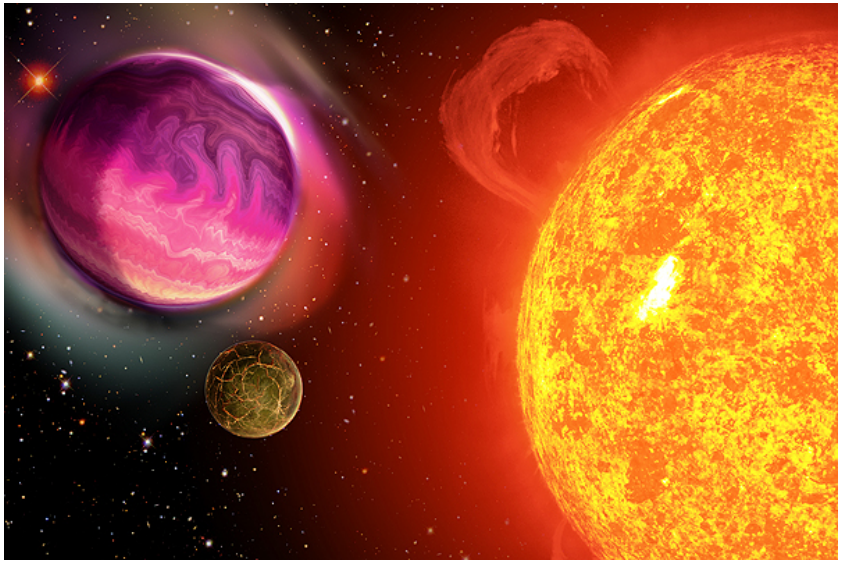


Astronomy 120

- Have you ever wondered:
  About black holes?
  The evolution of the universe?
  Extrasolar planets?
  Danger from asteroids?
- Then ASTR 120/121 might be for you!
- Course for astro or science majors
- I encourage questions at any time!
- Let's get some of the structure of the course out of the way before we explore the universe...

Astronomy 120—ASTR120

Professor	Dr. Cole Miller
Office	PSC 1114
Phone	301-405-1037
E-mail	miller@astro.umd.edu
Office Hours	Mon 10–11 am, Wed 2–3 pm, or by appointment
Lectures	TuTh 11 am–12:15 pm, ATL (Atlantic Building) 2400
Discussion	F 1–1:50 pm ATL 2400 (0101)
Textbooks	Cosmic Perspective 8e w/Modified MasteringAstronomy
Online Materials	https://myelms.umd.edu/courses/1227103
TA	Liz Tarantino (ejtino@astro.umd.edu, PSC 1238, office hours Tue 1-2 and Fri 2-3)
Grader	Drew Leisner (aleisner@terpmail.umd.edu, ATL 1224, office hour Mon 3-4)

Grading

- Total of 1000 points
- Homework is 300, discussion section is 150, in-class quizzes are 50, midterm 1 is 150, midterm 2 is 150, final is 200. Quizzes will be on that day's class; read in advance!
- I guarantee your letter grade will be no *worse* than:
  A- if you have 900-1000 points
  B- if you have 800-899 points
  C- if you have 700-799 points
  D- if you have 600-699 points
  Your letter grade *might* be higher than this, depending on the class average.
- The only extra credit will be on exams and homeworks. If you don't do work, you can't make it up!

Homework and Exams

- All homeworks are included in the syllabus; they are due at 11:00 AM on the due date. After the beginning of class they will be docked 20+%. All homeworks need to be put in PDF format on the class ELMS site; the PDF must be typed, not scanned in.
  Note: Word, LaTeX, etc. can output in pdf (including eqns!)
- Exams will be in-class, closed book, no notes. Bring calculators, but please don't program them.
- For valid emergencies (see syllabus), contact me by email or voice mail before the start of the class or exam. A valid written excuse must be submitted and documented.

Academic Integrity

- Taken very seriously by the University!
- See the syllabus and the Code of Academic Integrity (URL in syllabus). Examples include:
- Homework must be written in your own words. Working with a friend is fine, but copying from a book or website or from others' work *or allowing yours to be copied* is a violation.
- All sources must be credited. This includes books and Web sites, among others (including our textbook!).
- Copying on an exam, bringing cheat sheets, or forging excuses is a violation.
- If you have questions, ask!

Calculus Co-Requisite

- We are fortunate that this is the first year in which the mathematical requirement is a calculus co-requisite.
- Why fortunate? Because mathematics adds dramatically to our understanding of the universe!
  We will be able to probe topics with greater depth and understanding.
- For prospective astro majors, this means that you will get a boost of preparation for later classes
- I will thus assume knowledge of pre-calculus (algebra, geometry, trig, etc.) and will follow the progress of MATH 140 in assuming calculus knowledge

If You Need a Math/Other Refresher:

- See our grader, TA, or me
- Use the tutoring services: ATL 1220, schedule to be determined (but should be most of the time)
- If you prefer not to have human contact: Khan Academy ☺ (it really is pretty good)
- We'll try to challenge you in this course. If you have questions, many people will be happy to help you!

The First Five Minutes

- In the first five minutes of the class, I will be happy to discuss any astronomy topic you bring up!
  Doesn't have to be related to the day's class; could be something in the news, or just a point of curiosity
- In some classes, right after that I will give you an in-class quiz about that day's lecture
  Two multiple-choice questions worth 2 points each; 1 point for correct answer, 1 point for brief justification.
  You will also get 1 point for just signing your name!
- Also: if you find a <2 minute video related to the topic of the class and give it to me >=1 day in advance, I might show it. Could be movie clip or something whimsical!

Laptop/Tablet and Phone Policy

- Laptops/tablets can be used to take notes efficiently...

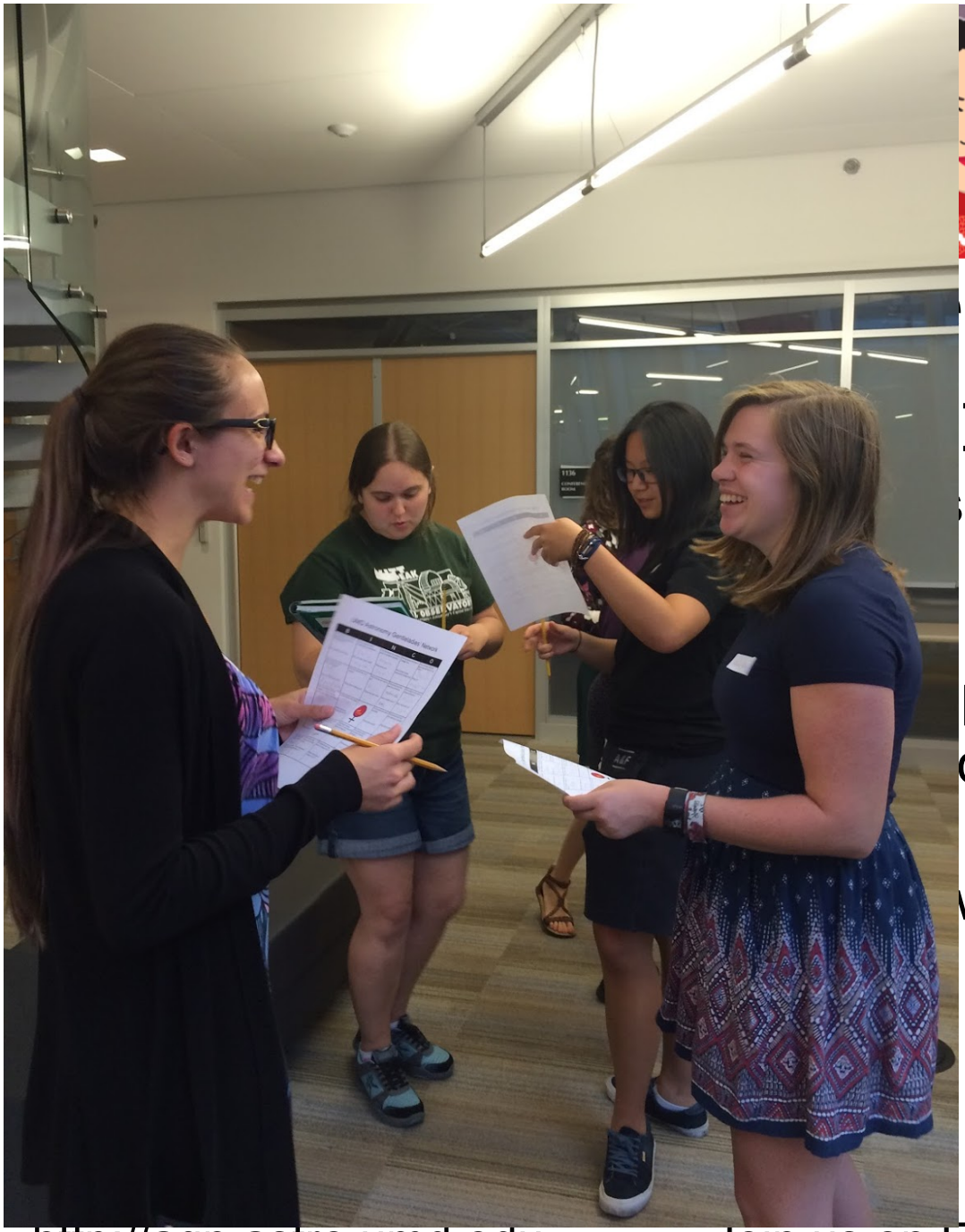
Laptop/Tablet and Phone Policy

- Laptops/tablets can be used to take notes efficiently...
  ...but often they are used for different purposes ☺
- I do hope that, should you use laptops/tablets, it is for class purposes, but to avoid distracting anyone behind you, if you use laptops or tablets then (1) no headphones, and (2) you must sit in the very back row.
- With phones, we might use them as calculators in class or to look things up, but unless we do that, please put them away
  And the sound should be off at all times
- Thanks! I hope this makes the experience better for all.

Astronomy Gentleladies' Network

- Mentoring group to support and discuss the presence of women in Astronomy
  - Tentatively, meet the 1st Tues of each Month
- Sponsors Discussions, Workshops, Panels, Talks, and Social Events (grads and undergrads only), refreshments provided
- Monthly coffee breaks open to the whole department, coffee & breakfast food provided

http://agn.astro.umd.edu Join us on Facebook! agn@astro.umd.edu



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ds only), refreshments

whole department, coffee &

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&

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Can't get enough astronomy? Join AstroTerps!

astroterps
University of Maryland Astronomy Club

First meeting: Wed Sep 6 @ 6 pm in ATL1220 (undergrad lounge)

- Telescope viewing.
- Light pollution activism.
- Maryland Day.
- Free pizza!
- Etc.

Presidents:

Chris Bambic,
Junellie Gonzalez Quiles

http://www.astro.umd.edu/~astroterp/

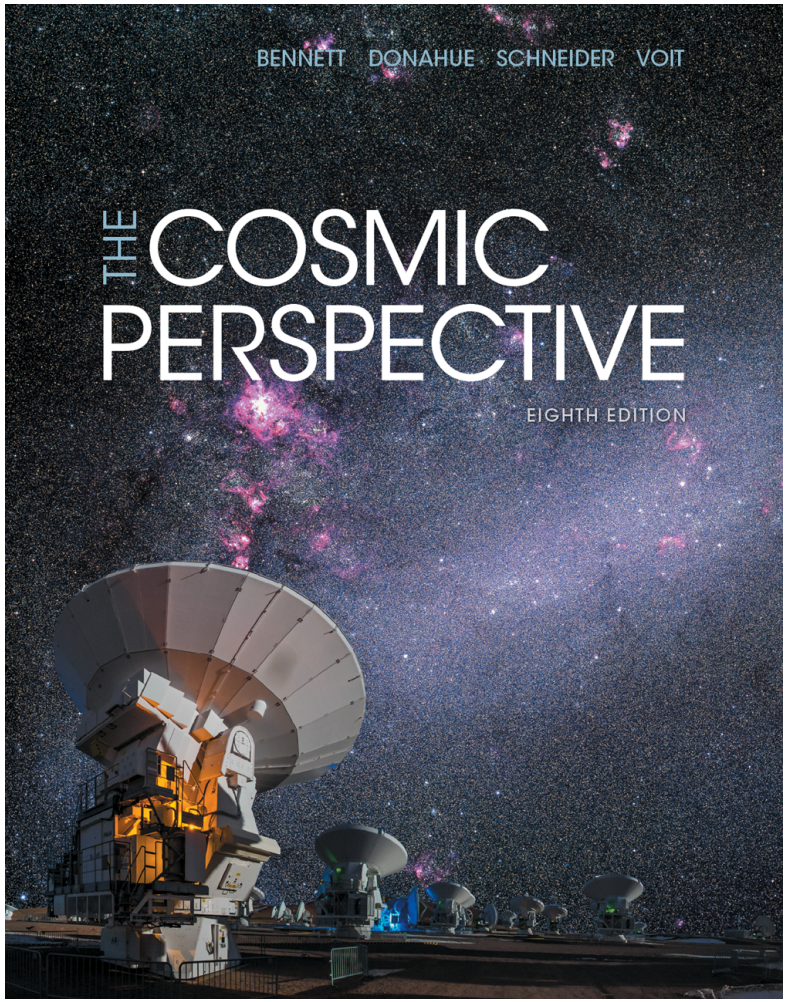
Career Paths Seminar: ASTR 288I

- Introduction to the Astronomy Major
  1-credit seminar about possible career paths someone with an astronomy degree can take, soft skills that we suggest that you develop to help your career, and strategies for how to get involved in research as an undergrad.
- Co-taught by Dr. Melissa Hayes-Gehrke (astro undergrad advisor) and Prof. Andy Harris (chair of Astronomy)

[01] The Modern Universe (8/29/17)

ASTR120 Upcoming Items

1. Do “Introduction to the Course” ASAP.
2. Read Chapter 1, skim Appendix C, and do the Chapter 1 Reading, Concept, and Visual quizzes in *MasteringAstronomy* by Thursday. Start soon!!
3. Homework #1 now available, and due at start of Tuesday’s class.



LEARNING GOALS

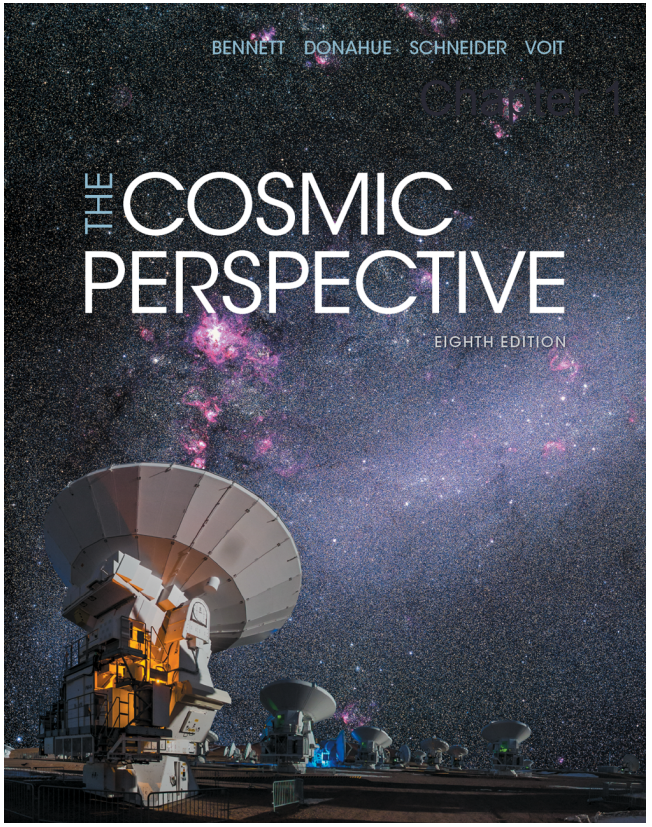
Chapter 1

For this class, you should be able to…

… understand the scale of the size and distance of astronomical objects such as planets, stars

… explain why the constancy of the speed of light means we see distant objects as they were in the past;

... explain why we can't just use images to learn about objects in the universe



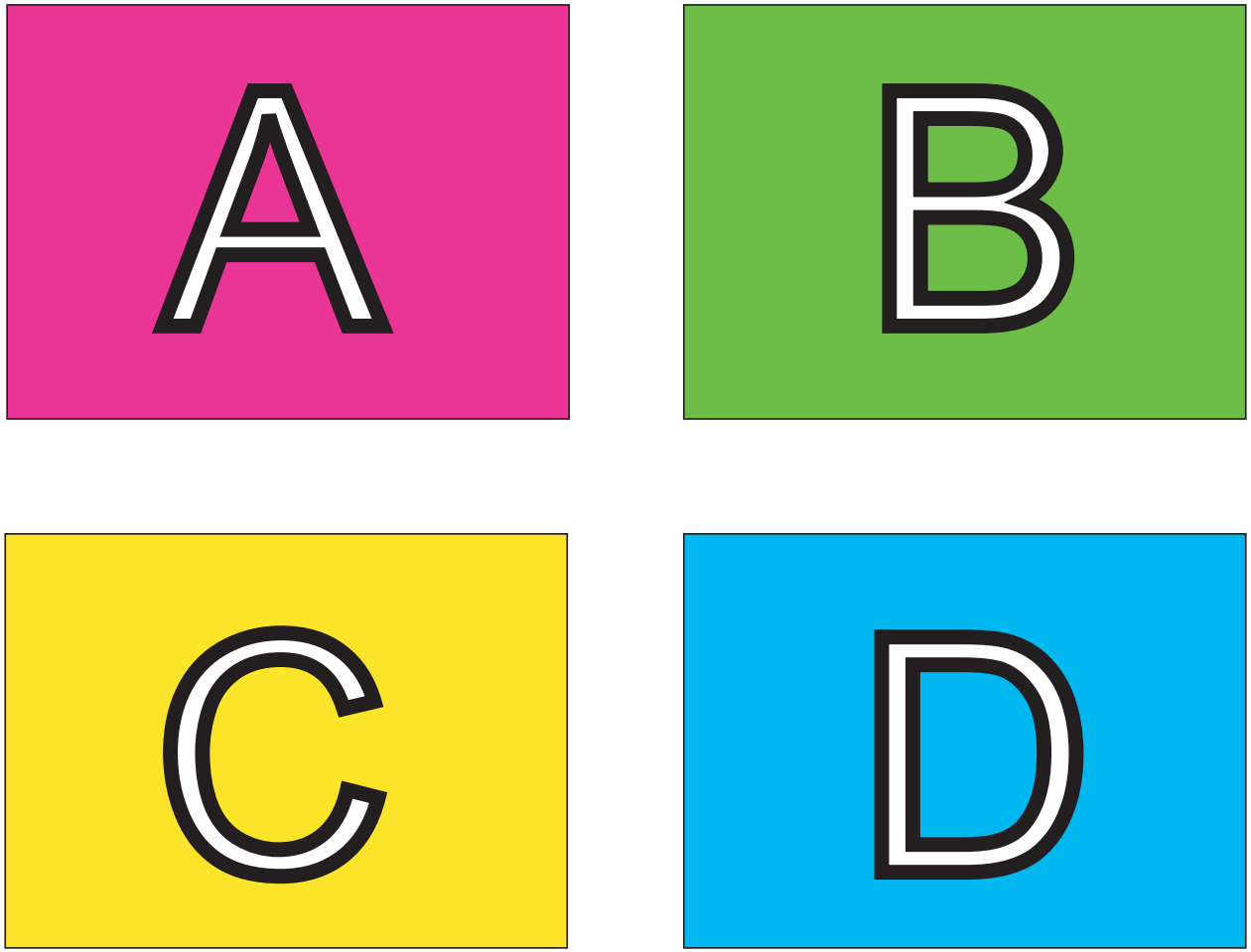
A Couple of Examples of Scale...

Group Exercise

1. Introduce yourselves within your groups.
   - What got you interested in astronomy?

2. A basketball has a radius of 12 cm. On a scale where the Sun (actual radius 7×10^{10} cm) is the size of a basketball:
   a. How far is the Earth (actual distance 1.5×10^{13} cm)?
   b. Pluto (actual distance 6×10^{14} cm)?
   c. Nearest star to the Sun (4×10^{18} cm)?
   d. Center of our Galaxy (4×10^{22} cm)?
   e. Nearest cluster of galaxies (5×10^{25} cm)?
   f. Light travel distance from farthest galaxies ($>10^{28}$ cm)?
3. What does all this imply about the scale of the universe?

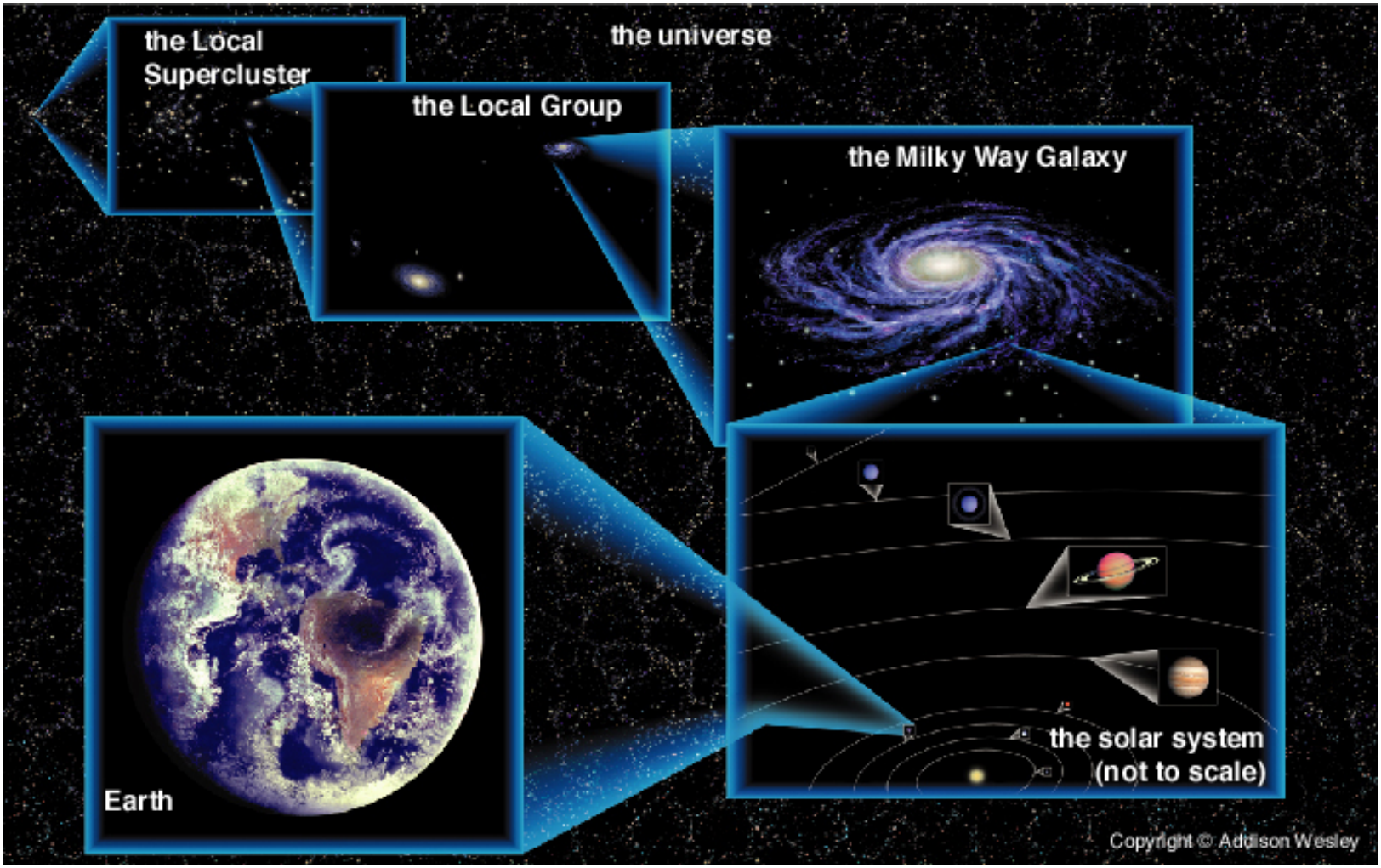
Voting Cards



The Modern Universe

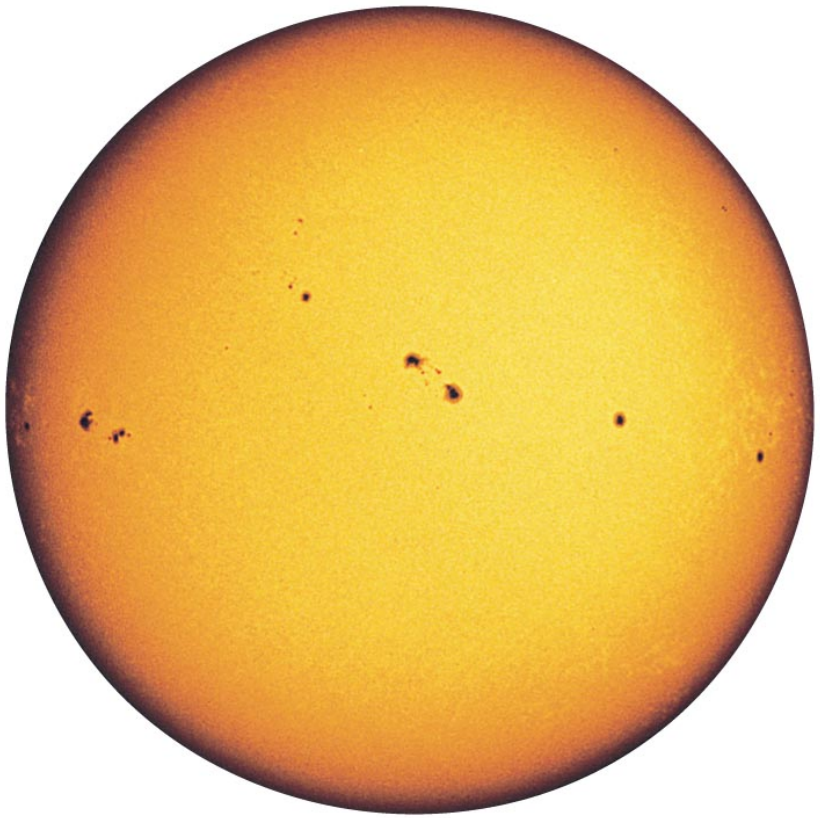
- We live on a small rocky planet orbiting a fairly average star about midway from the center of the Milky Way.
- The Milky Way is one of countless galaxies that are mostly moving away from each other in the universe.
- About 14 billion years ago, the universe was hot & dense, and has been cooling and getting less dense ever since.
  - Finite light speed: we see distant objects as they were in the *past*.

Our "Cosmic Address" http://htwins.net/scale2/

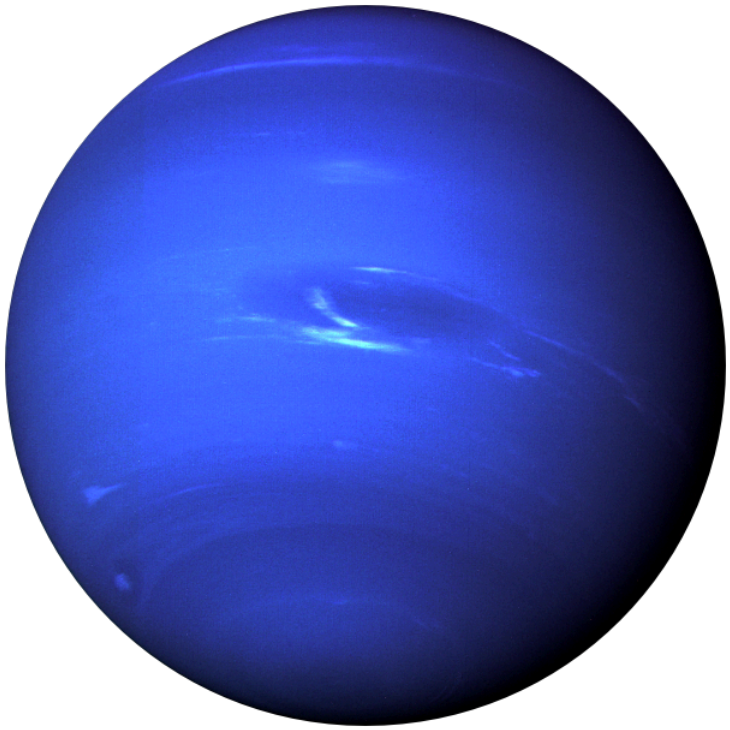


Star

- A large glowing ball of gas that generates heat and light through nuclear fusion.

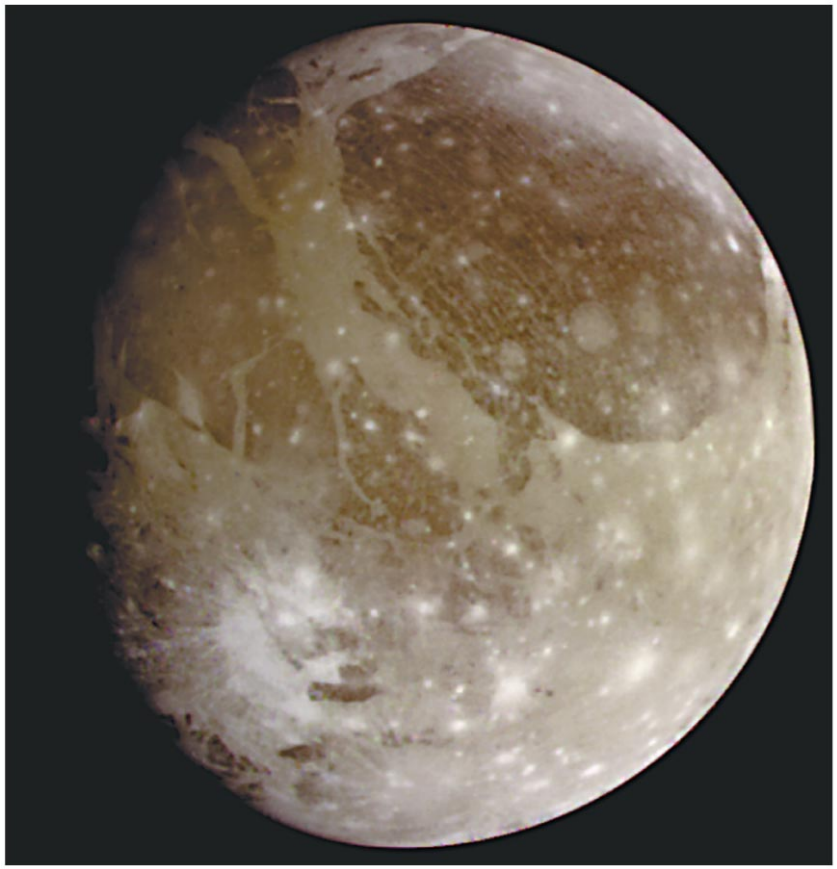


Planet



- A moderately large object that orbits a star; it shines by reflected light. Planets may be rocky, icy, or gaseous in composition.

Moon (or Satellite)

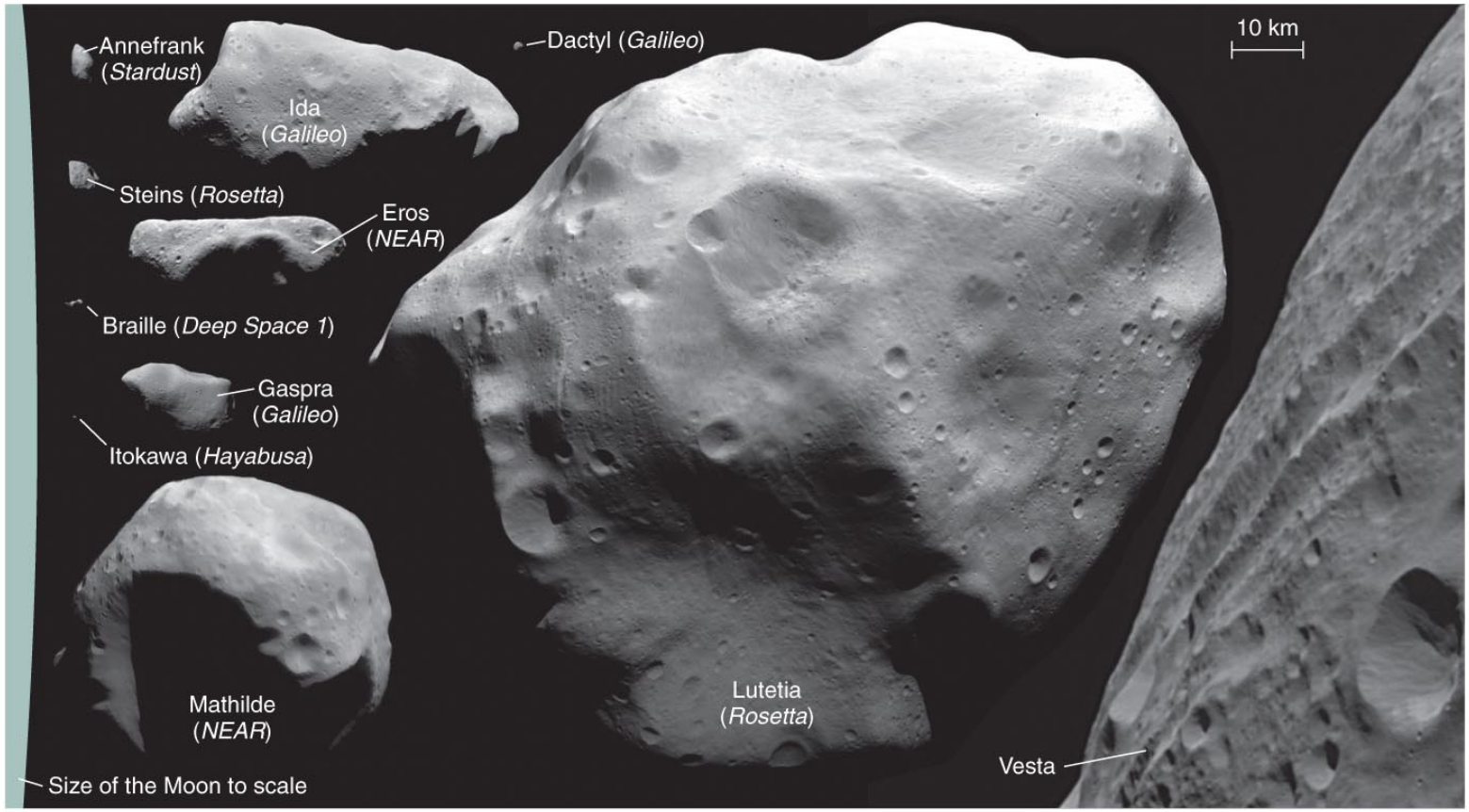


Ganymede (orbits Jupiter)

- An object that orbits a planet.

Asteroid

- A relatively small and rocky object that orbits a star.

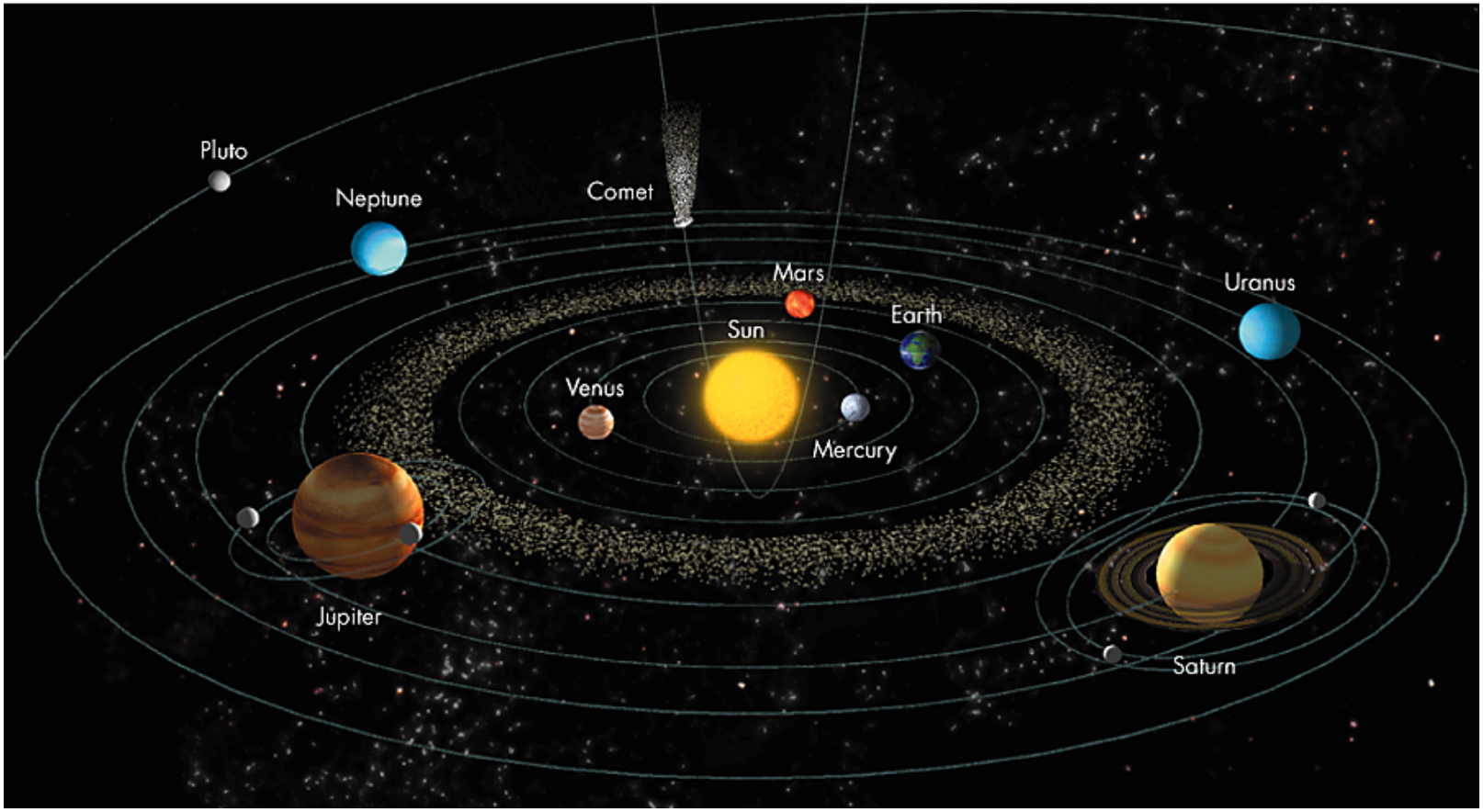


Comet

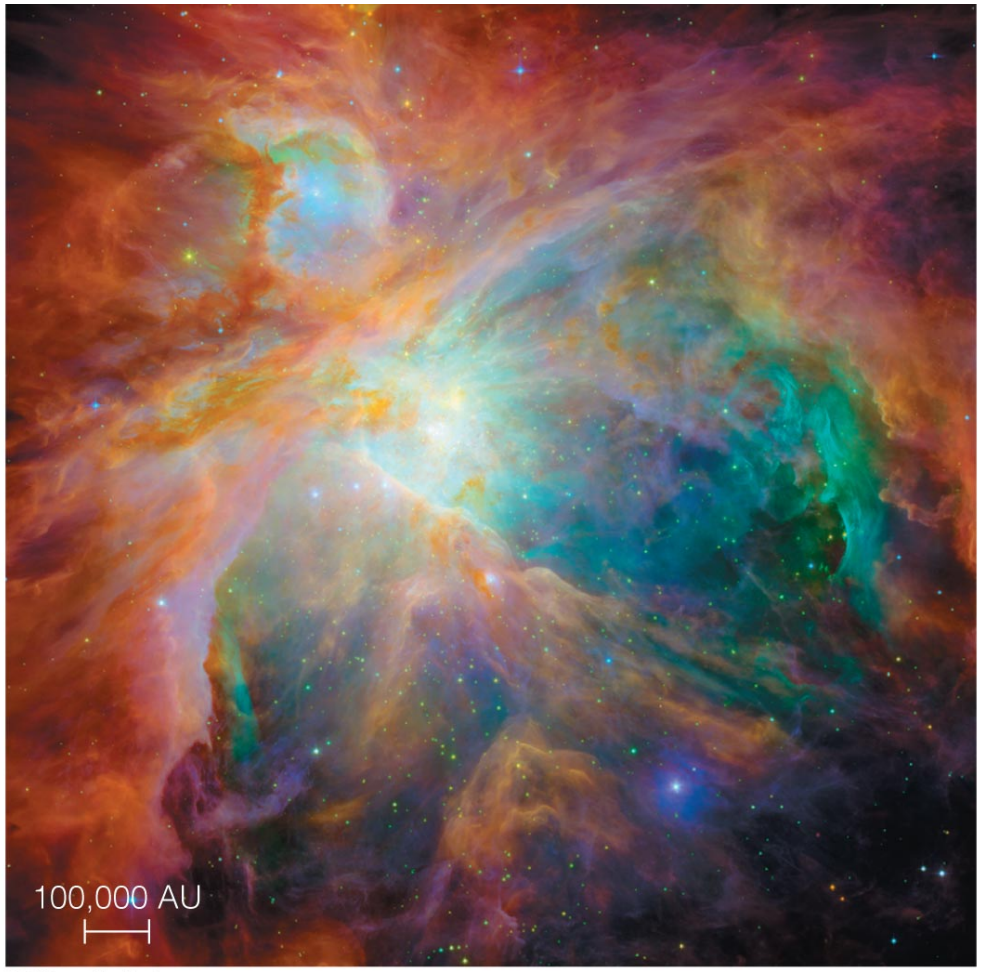
- A relatively small and icy object that orbits a star.

Solar (Stellar) System

- A star and all the material that orbits it, including its planets and moons.



Nebula



- An interstellar cloud of gas and/or dust.

Galaxy

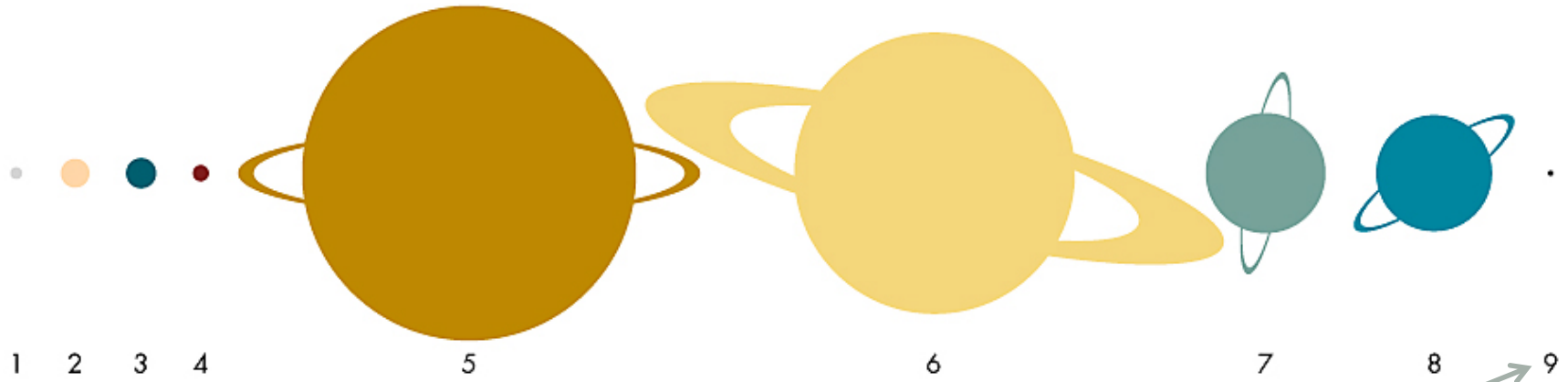
- A great island of stars in space, all held together by gravity and orbiting a common center.

M31, The Great Galaxy in Andromeda

Universe

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

Relative Sizes of the Planets



Oops, old slide!

Far away means back in time?

- Light travels at a finite speed ($c \approx 300{,}000$ km/s).

Destination	Light travel time
Moon	1 second
Sun	8 minutes
Sirius	8 years
Andromeda Galaxy	2.5 million years

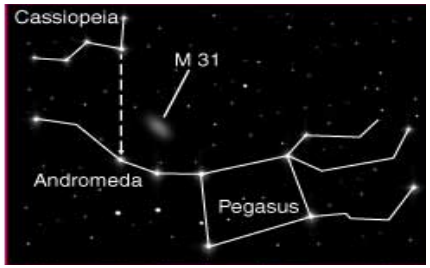
- Thus we see objects the way they were in the past:

The farther away we look in distance,

the further back we look in time.

Example

- This photo shows the Andromeda Galaxy as it looked about 2½ million years ago.
- Question: When will be able to see what it looks like now?



Definition: A *light-year* (1 ly)

- The **distance** light can travel in one year.
- About 10 trillion km (6 trillion miles).

$$1 \text{ light-year} = (\text{speed of light}) \times (1 \text{ year})$$

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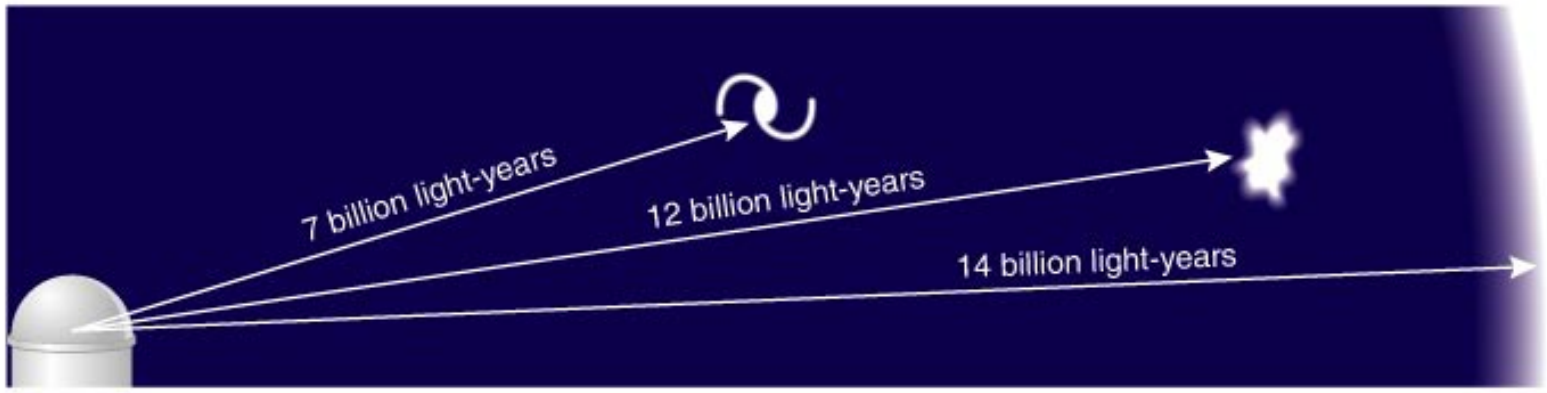
$$\sim \left(300{,}000 \frac{\text{km}}{\cancel{\text{s}}}\right) \times \left(\frac{365 \cancel{\text{days}}}{1 \cancel{\text{yr}}} \times \frac{24 \cancel{\text{hr}}}{1 \text{ day}} \times \frac{60 \cancel{\text{min}}}{1 \cancel{\text{hr}}} \times \frac{60 \cancel{\text{s}}}{1 \cancel{\text{min}}}\right)$$

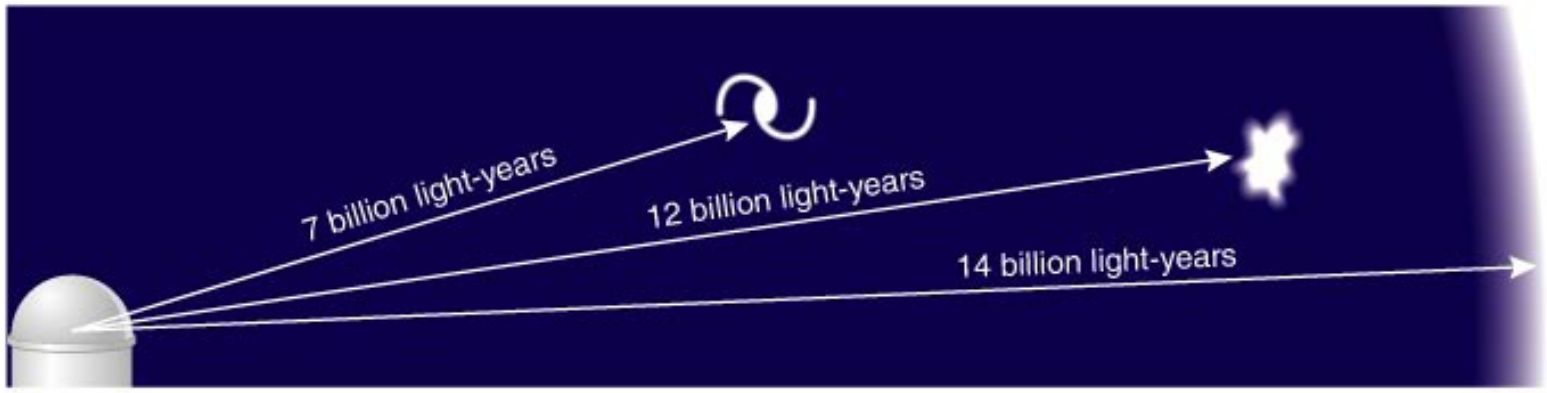
$$= 9{,}460{,}000{,}000{,}000 \text{ km}$$

$$= 9.5 \times 10^{12} \text{ km to 2 significant figures}$$

- At great distances, we see objects as they were when the universe was much younger.



- Can we see the entire universe?



Angular size: the small angle formula

- Suppose we have an object of diameter D that is a distance d from us
- How do we determine the angle θ that it subtends, where θ is measured in radians?

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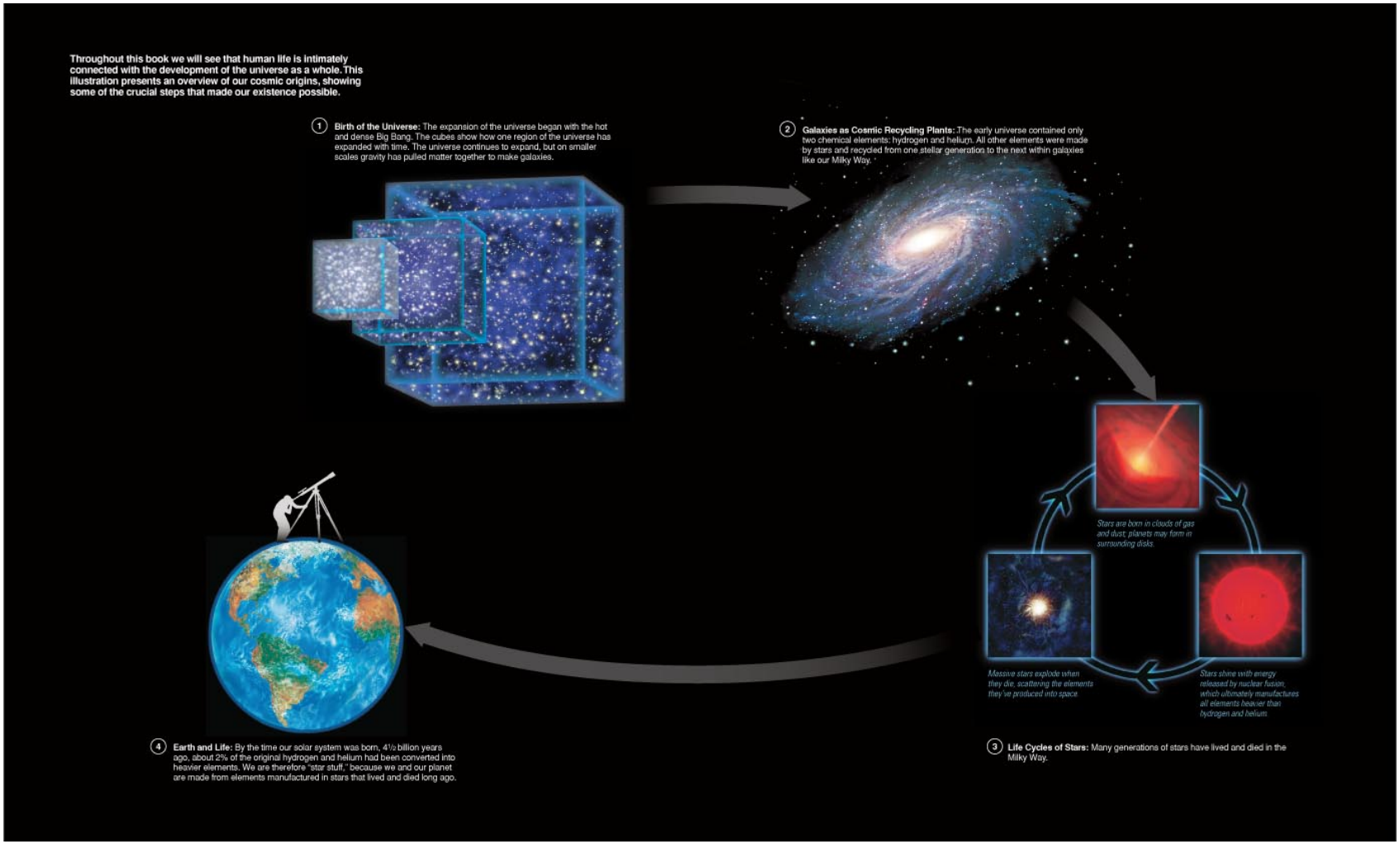
- Suppose we have an object of diameter D that is a distance d from us
- How do we determine the angle θ that it subtends, where θ is measured in radians?
  The angle is given by $\tan \theta = D/d$
- But tangents are a pain. Luckily, in astronomy it is usually the case that D<<d. Then we can use the *small angle formula* $\theta \sim D/d$ instead. **Extremely** useful!
  Let's motivate the formula using Google...

Group Q: Using the Small Angle Formula

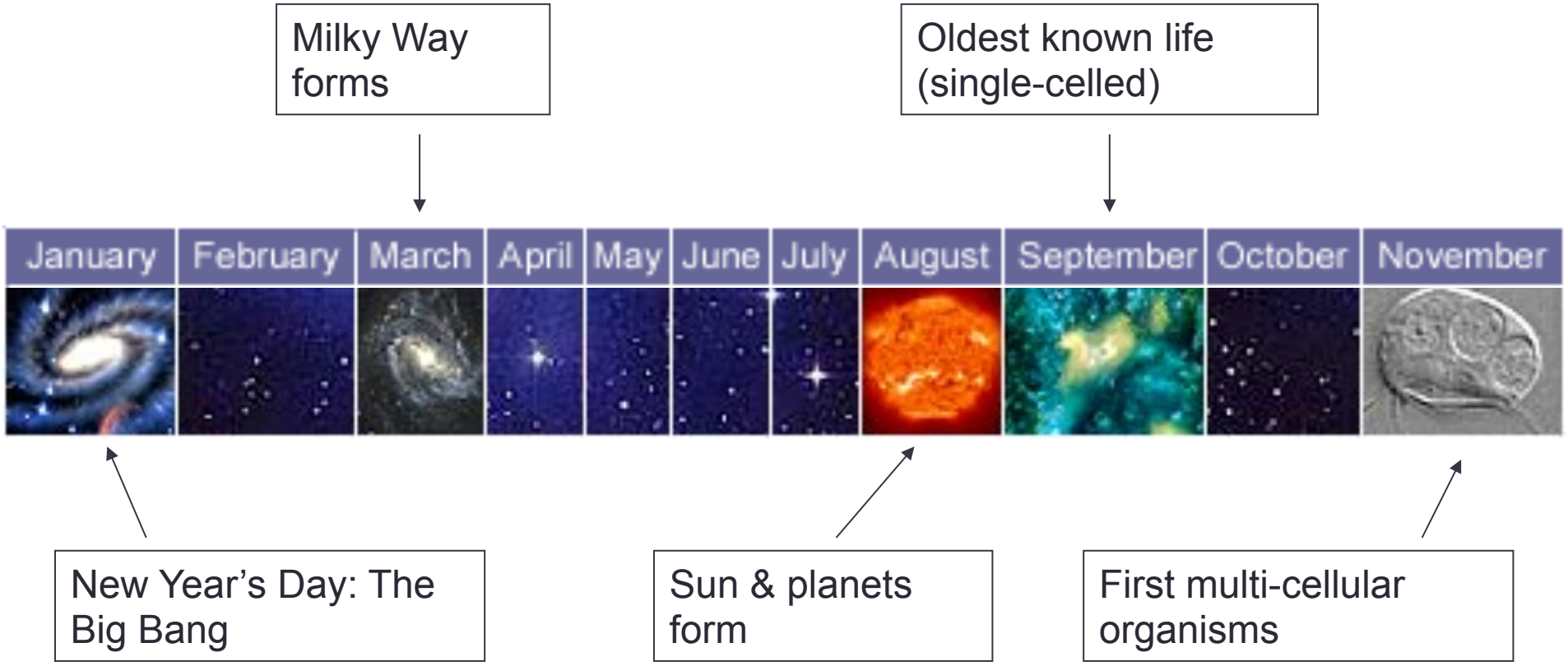
- Using θ=D/d, compute θ in radians for:
  a. The Orion Nebula (D~2×10^{19} cm, d~10^{21} cm)
  b. Sirius (D~1×10^{11} cm, d~8×10^{18} cm)
  c. The Andromeda galaxy (D~10^{23} cm, d~2×10^{24} cm)
  d. Typical quasar (D~10^{13} cm, d~10^{28} cm)
- For which of these could the Hubble Space Telescope resolve visual detail? θ_{min} for Hubble ~ 2×10^{-7}
- What does that imply about whether imaging of astronomical sources can always give us information about them? What other sources of information are there?

How did we come to be?



How do our lifetimes compare to the age of the universe?

- The Cosmic Calendar: a scale on which we compress the history of the universe into 1 year.



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