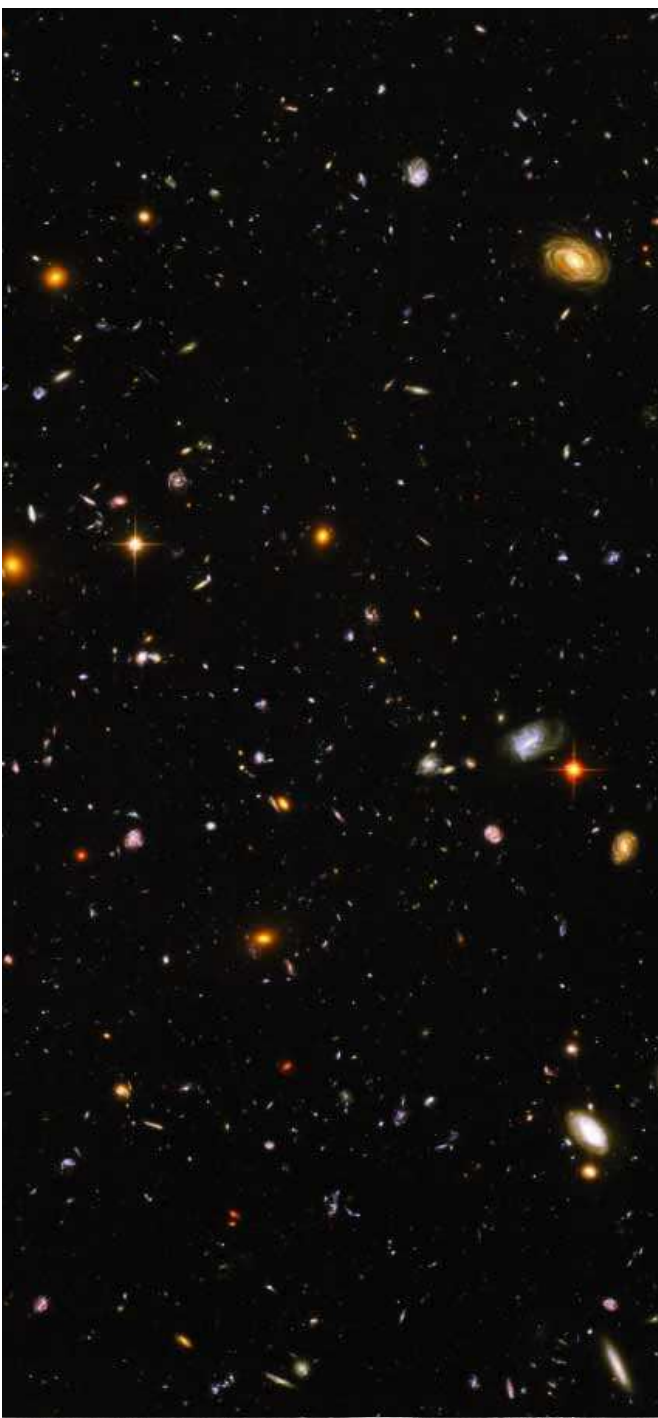
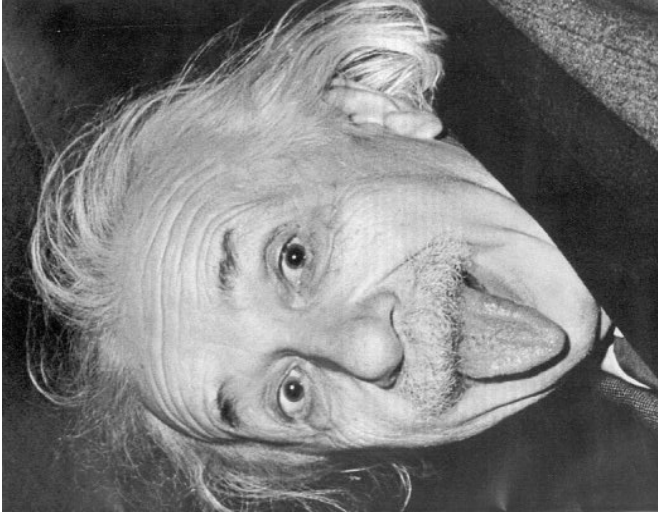




“Once you can accept the universe as
being something expanding into an
infinite nothing which is something,
wearing stripes with plaid is easy.”

Albert Einstein

ASTR 1010: Astronomy of the Solar System

Fall 2007

Mon/Wed/Fri 11:00 a.m. – 11:50 a.m.

Aderhold Learning Center 5

Deepak Raghavan

Why Astronomy?

“The diversity of the phenomena of nature is so great, and the treasures hidden in the heavens so rich, precisely in order that the human mind shall never be lacking in fresh nourishment.”

Johannes Kepler
1597 - 1630

Topics Covered in this Course

- The big picture understanding of the cosmos
- Common observations
 - Universe as viewed from the Earth
 - Seasons, Lunar Phases, Eclipses
- Development of astronomy through the ages
- Physical laws of the universe
- Light and its interaction with matter
- Telescopes & Techniques
- Solar System Formation
- The Sun, Planets, Moons, and other SS bodies
- Extrasolar planets
- Life on Earth and in the Universe



Assessing Your Performance

- 4 Homework Assignments 15%
- In-class Activities/Quizzes 10%
- Laboratory work 25%
- In-class Exams (Best 2 of 3) 30%
- Final Exam on December 12th 20%
- Grading Scale
 - A 94 – 100% A- 90 – 93% B- 80 – 83%
 - B+ 87 – 89% B 84 – 86% C- 70 – 73%
 - C+ 77 – 79% C 74 – 76%
 - D 60 – 69% F 0 – 59%

Keys to Your Success

- “Eighty percent of success is showing up” – Woody Allen
- Participate actively in the classroom
- Stop me for questions, clarifications, comments
- Don’t forget the labs!
- Office Hours
 - I want all of you to succeed
 - If you need extra help, please come see me!
- Work Hard
 - I’ll try to challenge you, but also support you and make it fun
- Utilize the class website:
<http://www.chara.gsu.edu/~raghavan/teaching.html>

Things to Purchase

- New textbook
 - "The Cosmic Perspective 4th edition"
 - Bennett, Donahue, Schneider, Voit
 - Comes with
 - Astronomy Media Workbook
 - Mastering Astronomy website access
 - Used book \$85, does not include web access (\$22)
 - Lab workbook
 - Activities in Astronomy, 2007-2008 edition
 - John Wilson
 - Used copy will not work!
 - Lab materials card
 - At the GSU bookstore
 - Submit to lab instructor
 - All this will work for ASTR 1020 as well
- \$113
- \$ 41.95
- \$ 20

A Few Things That I Ask of You

- Turn off cell phones, pagers etc.
- Don't work on other stuff while in class
- Don't disturb class with side discussions
- If you must leave during class, please do so quietly
- Participate, Interact, Enjoy...

So, let the journey begin!

What We Will Learn Today

- Where did we come from?
 - Your personal connection to astronomy
- What is a “science”?
- What is our place in the universe?
- How can we learn about how the universe was in the past?

Where Did You Come From?

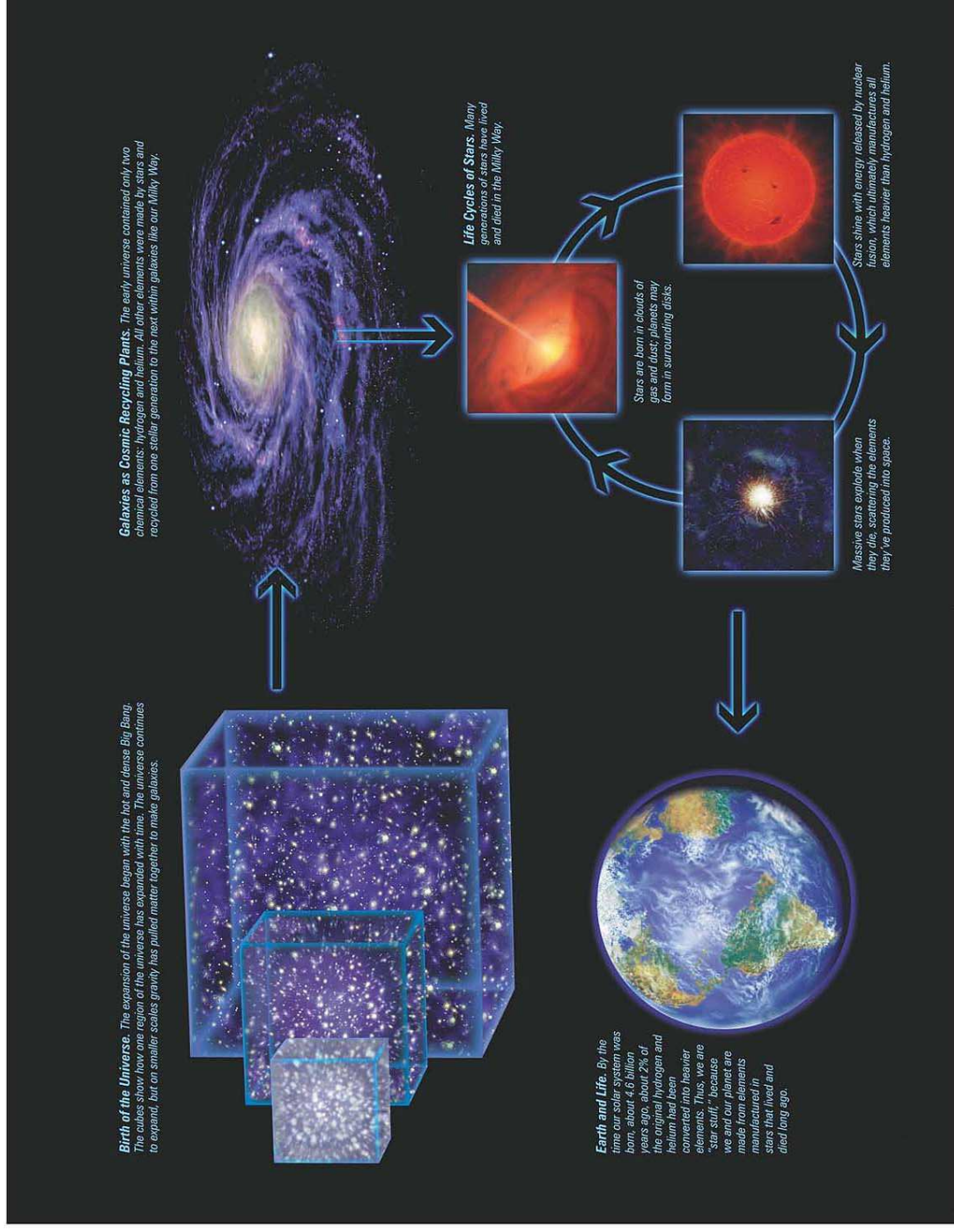


Fig 1.2

“We’re all star-stuff” Carl Sagan

A Quick Recap of Universal History

- Starts with a “Big Bang” about 14 billion years ago
 - Seeded the universe with Hydrogen & Helium
- Sets into a perpetual expansion
- Local pockets of matter condense to form galaxies, and within them, stars
- Stars burn hydrogen to helium, and successively, to higher elements in their core
- The more massive stars die in a spectacular explosion (supernova) blasting the elements into space
- Next generation stars & planets (including terrestrial) form with the help of these higher elements
- At least one planet fosters life!
- A few of these living beings register for this astronomy course!

Astronomy is a Science

- Science is the *process* of acquiring knowledge gained via a rigorous technique called the **scientific method**



- Science is *not* a body of facts

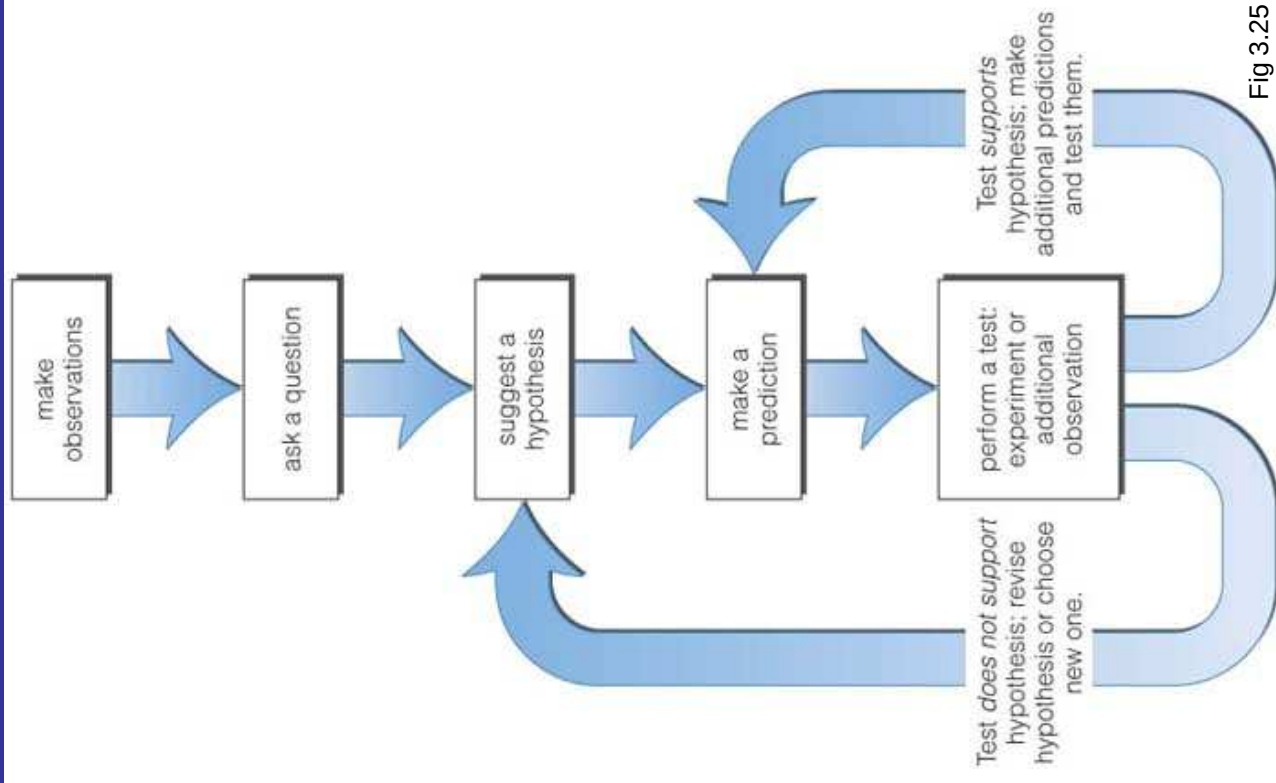


Fig 3.25

The Hallmarks of Science

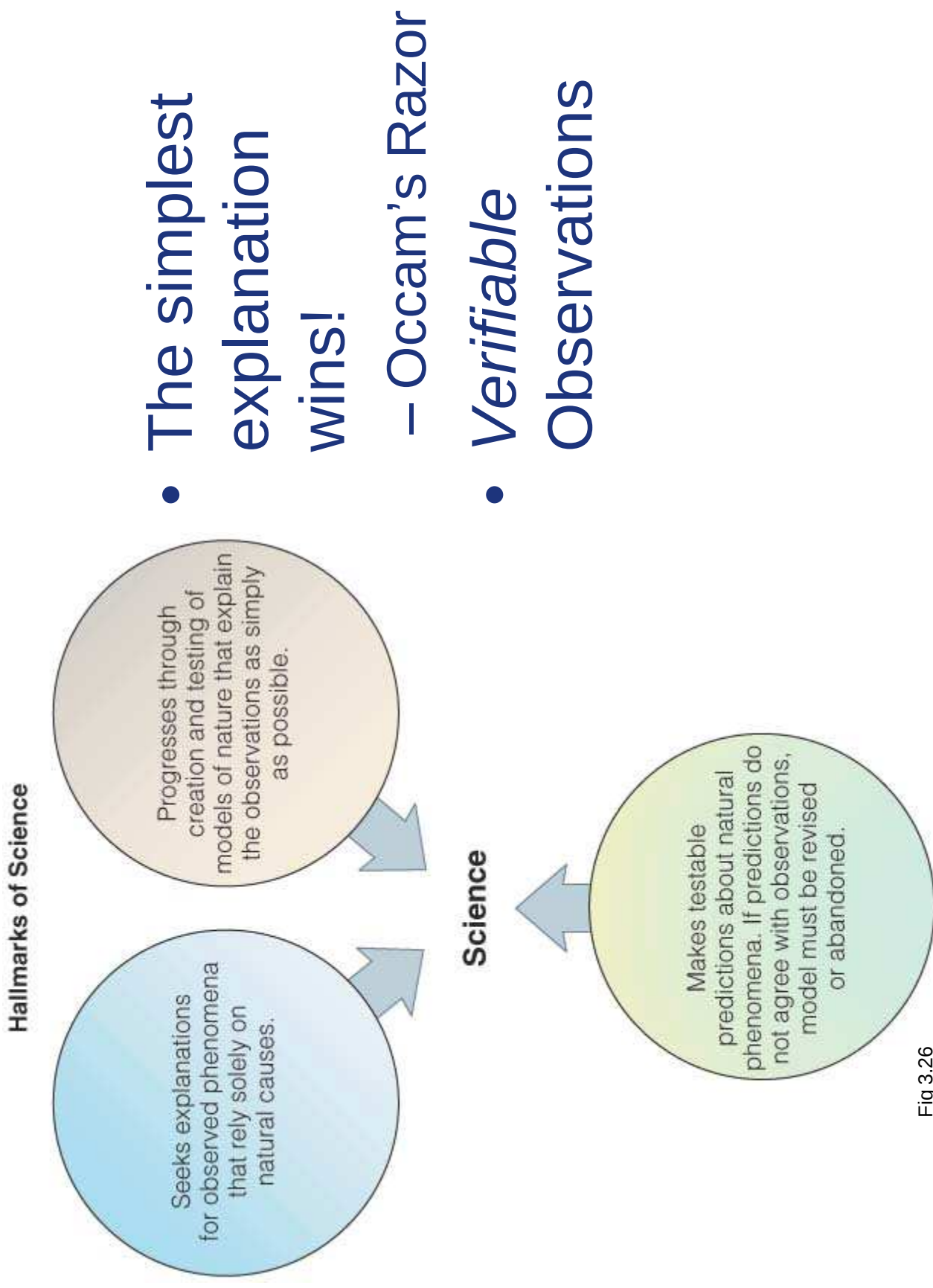
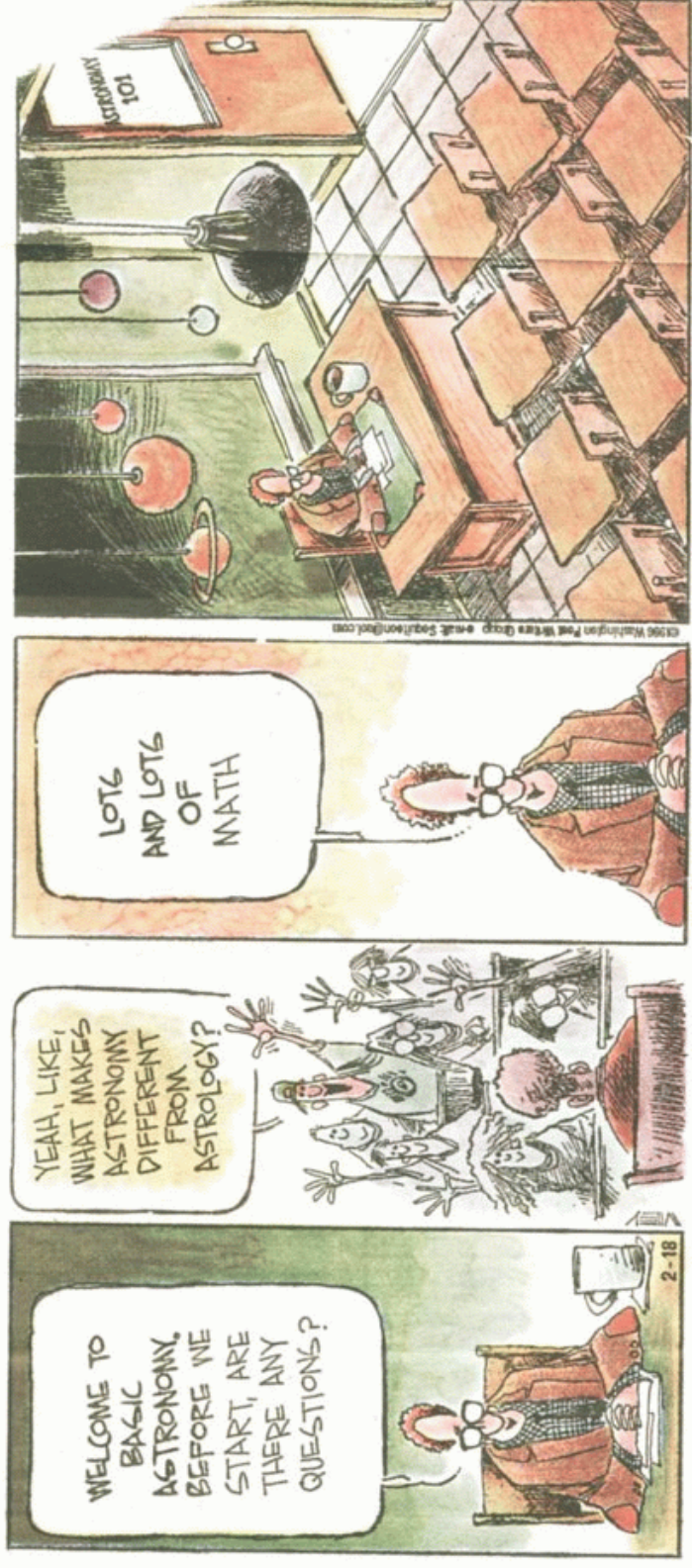


Fig 3.26

Scientific Theory

- The meaning of *theory* is different in science than in everyday life
- In science, a theory is not the same as a hypothesis, rather:
- A scientific theory *must*:
 - Explain a wide variety of observations with a few simple principles
 - Must be supported by a large, compelling body of evidence
 - Must NOT have failed any crucial test of its validity

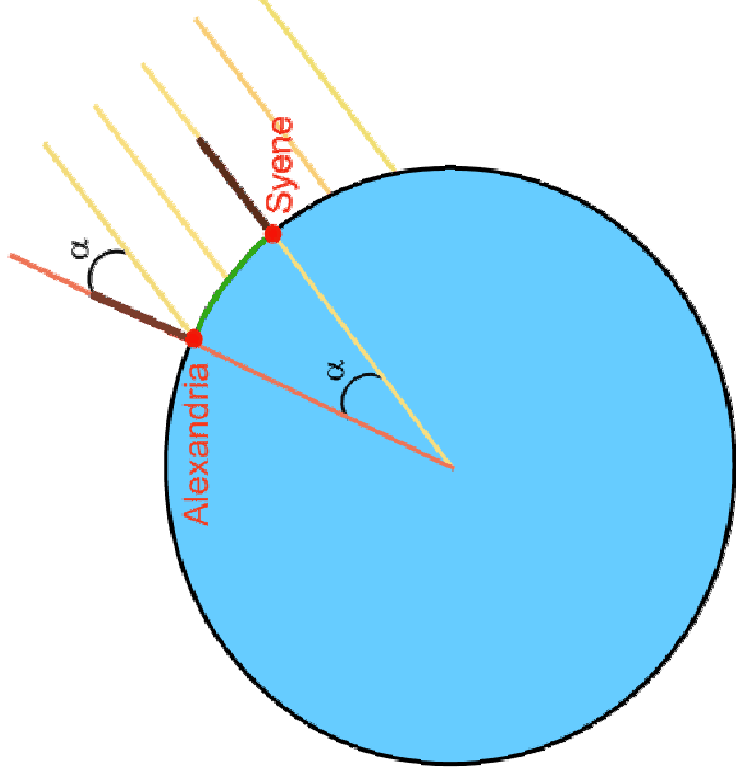
Mathematics in Astronomy



- Remember it is a tool to help you
- We will only need calculations and simple algebra
 - You will be using a scientific calculator
- Come see me if you need help

Ancient Ponderings

- How do we know what we know?
 - Flat Earth or Round Earth?
 - Sun around Earth or Earth around Sun?



Your Cosmic Address

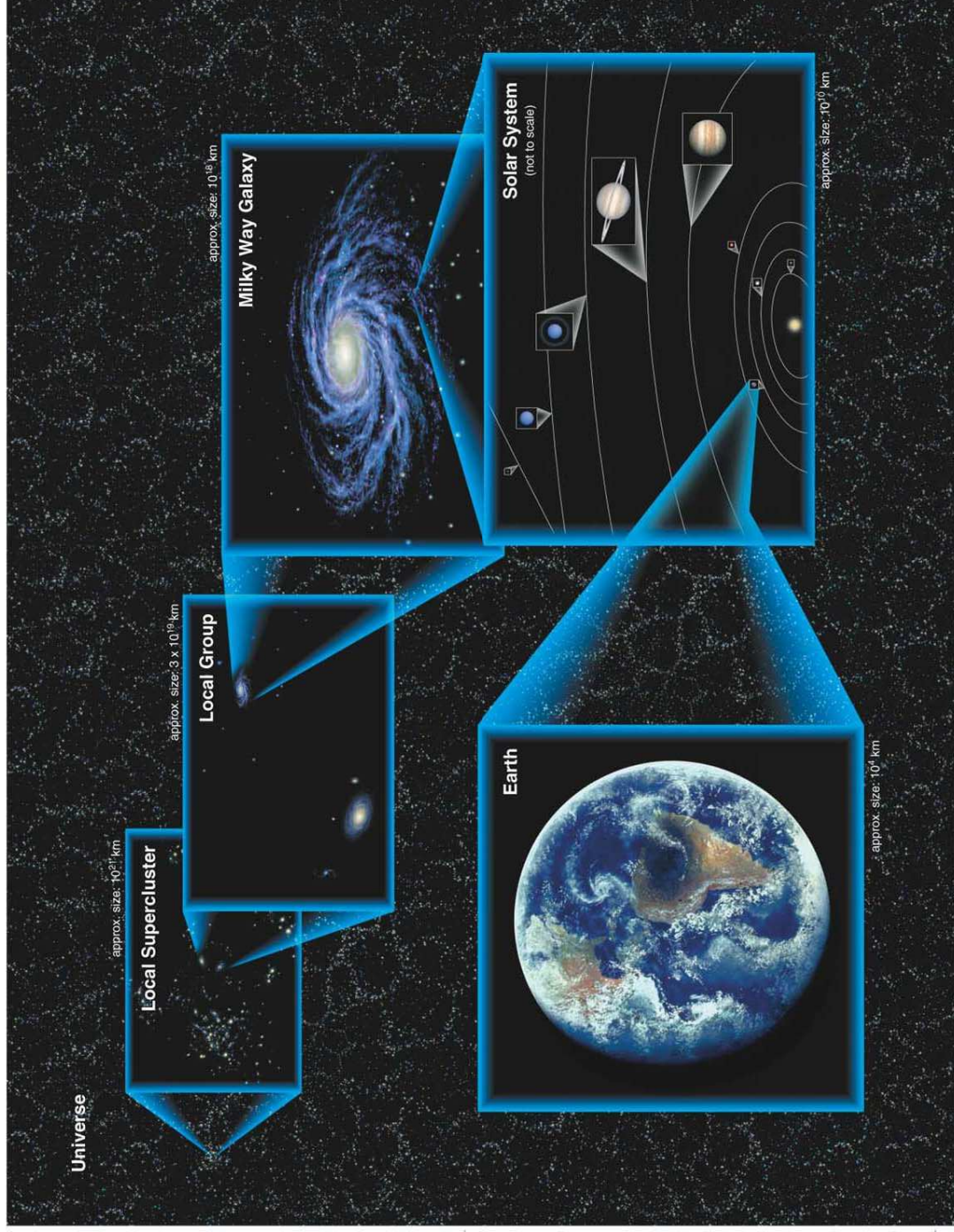


Fig 1.1

Let's watch the Powers of Ten Movie...

Main Points Seen in the Movie

- The Universe is extremely large (10^{26} m)
- There is a lot going on even in the microscopic realm
 - We've seen structure down to 10^{-18} m
- The Universe is mostly empty
 - On large scales (solar system, galaxy etc.)
 - On small scales (atoms, molecules etc.)
- Local pockets of density make the Universe interesting

The Cosmic Journey

- In this course, we'll discuss all 40 orders of magnitude covered in the movie!
- We deal with the extremely small...
 - Size of an atom ~ 0.0000000001 m
- To the very large...
 - Distance to *nearest* star $\sim 40,000,000,000,000$ m
- We use two tools to help us
 - Scientific Notation
 - $10^3 = 1,000$
 - $10^{-3} = 0.001$
 - Invent new units
 - Angstrom $= 10^{-10}$ m (approx. the size of an atom)
 - Light-Year $\sim 10^{13}$ km (order of the distance to the nearest star)

The Speed of Light

- $300,000 \text{ km/s} = 186,000 \text{ miles/s} = 670 \text{ million mph}$
- Extremely fast, but still a finite speed
- Around the Earth ~ 8 times in one second!
- To the Moon ~ 1 second
- To the Sun ~ 8 minutes
- To the *nearest* star ~ 4 years
- To the *nearest* galaxy ~ 2.5 *million* years

1 Light Year = **Distance** travelled by light in one year
Approximately 6 trillion miles

Light Year

- 1 Light Year = Distance travelled by light in one year.
 - Distance = Speed x Time
 $1 \text{ ly} = \text{speed of light} \times 1 \text{ year of time}$
 $= 300,000 \text{ km/s} \times (365 \times 24 \times 60 \times 60 \text{ s})$
 $= 9,460,000,000,000 \text{ km}$
- 1 light year is
- Approximately 10 trillion km
 - 6 trillion miles
- Note: The nearest star is about 4 ly away

Look-back Time

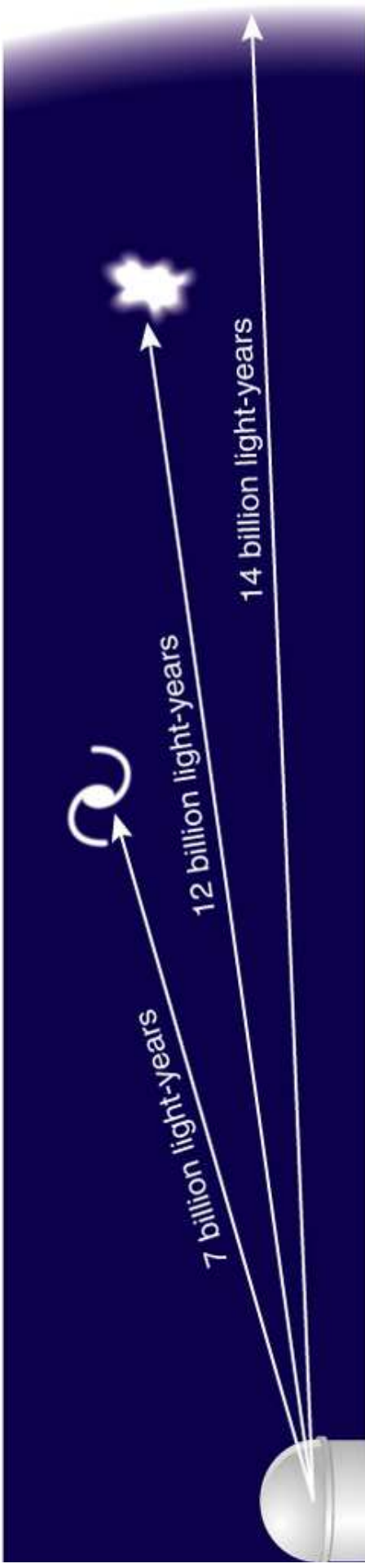


Fig 1.5

- The farther we look out, the further into the *past* we see!
 - Direct consequence of the finite speed of light
- The Sun we see is as it was 8 minutes ago!
- Andromeda Galaxy is a 2.5 million years old image!

