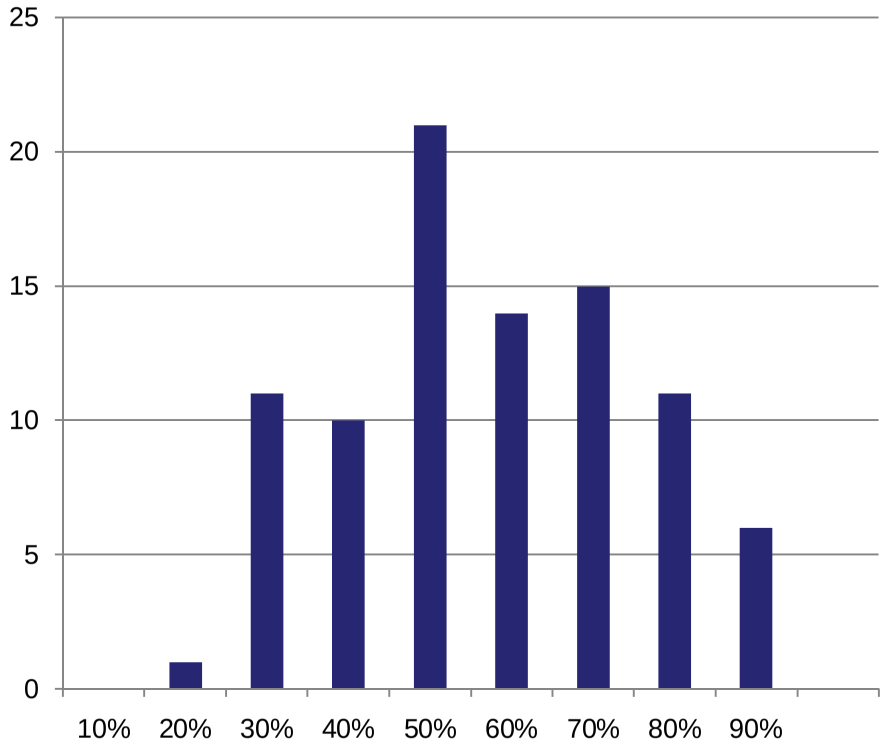
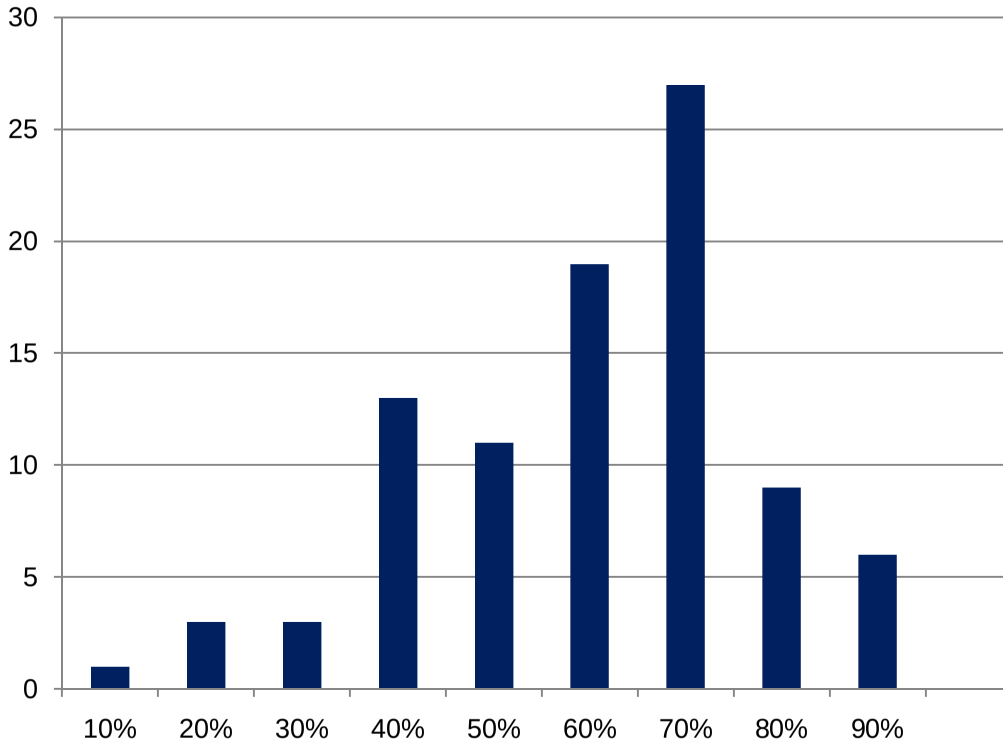
Exam 1 Performance



Max = 300

Range = 74 – 289 (15% - 96%)
Mean = 188 (63%)
Median = 180 (60%)

Cumulative



Max = 500

Range = 44 – 495 (9% - 99%)
Mean = 324 (65%)
Median = 336 (67%)

"I'm a great believer in luck, and I find the harder I work the more I have of it." - Thomas Jefferson

What We Will Learn Today

- What are the main components of the Solar System?
- What are the patterns in our solar system?
- Could these clues help us determine how the Solar System formed?
- What is the leading theory of Solar System formation?

A Quick Solar System Tour

- The Sun
- Terrestrial Planets
  - Rocky, small, close to Sun, and each other
- Asteroid Belt
  - Failed planet?
- Jovian Planets
  - Giants, Gaseous, have rings, many moons, farther from Sun and each other
- Kuiper Belt
  - Pluto is a member!
  - Some comets live here
- Oort Cloud
  - Comets live here as well

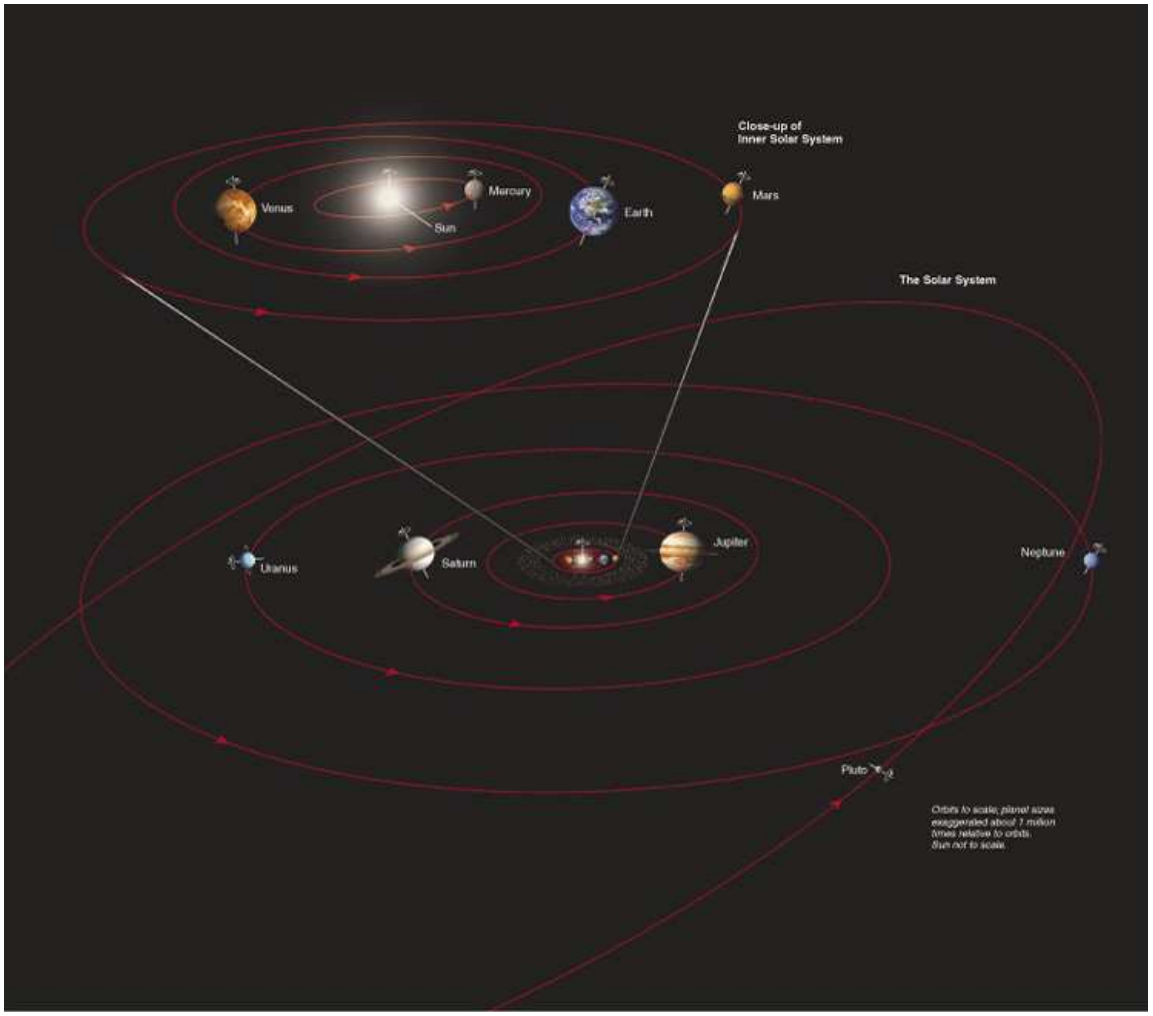
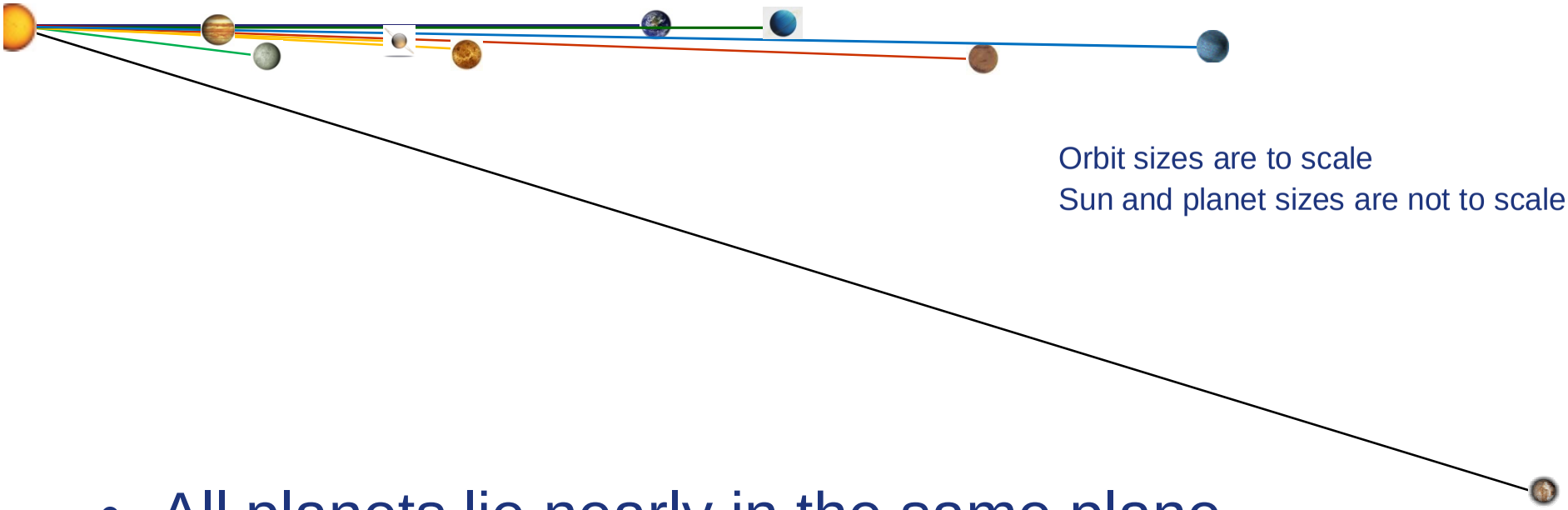


Fig 7.1

The Solar System

- Appropriately named after our Sun
  - Contains > 99.9% of the SS mass
    - 1,000 times more massive than all other objects combined!
  - Virtually 100% of light output of SS
  - All SS objects go around the Sun
- Remember the broader scale
  - The Sun is just a “grapefruit in a SS city”
  - Nearest star is hundreds of miles away on this scale

Solar System Viewed Edge-On



Orbit sizes are to scale
Sun and planet sizes are not to scale

- All planets lie nearly in the same plane
  - Preferential orientation
  - Pluto is a notable exception
- This plane is close to the Sun's equator

Solar System Viewed From Top

- Sun rotates counterclockwise, viewed from above Earth's north pole
- ***All*** planets orbit counterclockwise
- Most orbits are nearly circular
  - Low eccentricity
  - Pluto is a notable exception
- Most planets rotate counterclockwise
  - Venus, Uranus, Pluto are exceptions
- Most major moons orbit their planets counterclockwise
  - Near the planet's equatorial plane

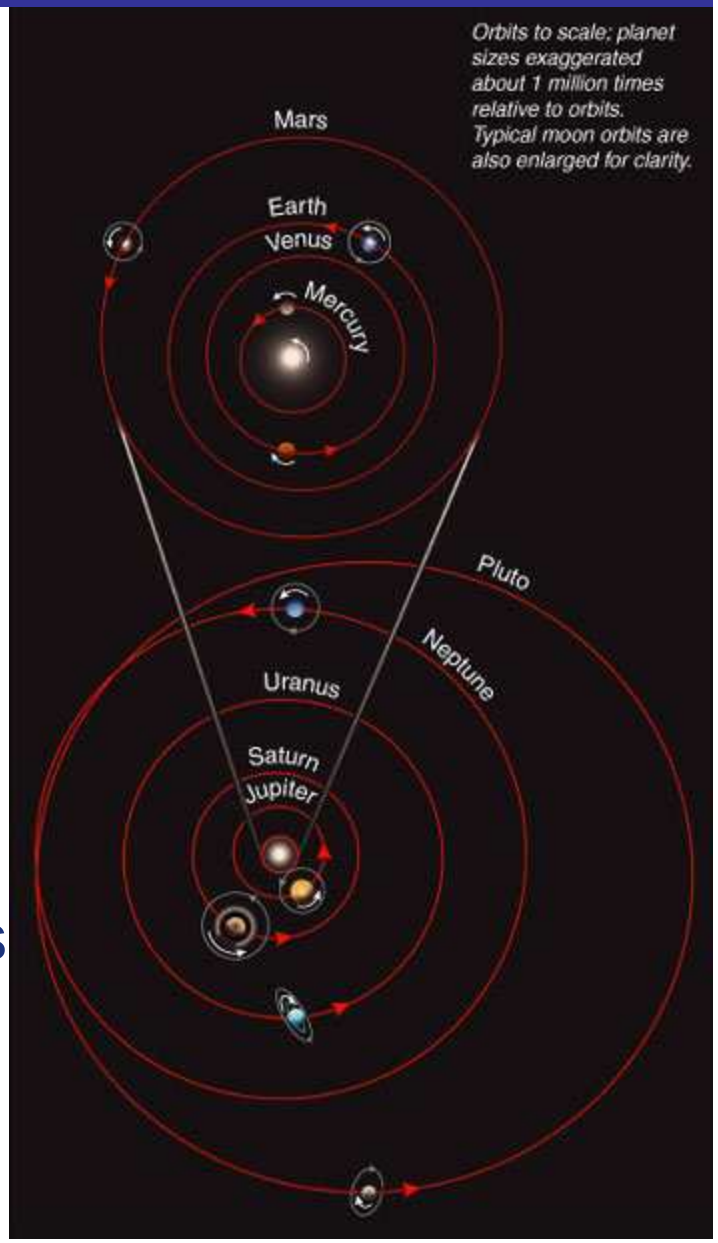


Fig 7.2

Solar System Seems Organized

- Four planets close to the Sun are small and terrestrial
  - Earth and Mars have moons
- Separated from gas giants by the asteroid belt
- Followed by distant and widely spaced Jovian planets
  - Also referred to as “gas giant” planets
  - All have many moons *and* rings
- Pluto is once again an exception
- Kuiper Belt Objects beyond Neptune
- Comets lie farther away in the Oort Cloud
- In general
  - Farther from Sun you go, inclination and eccentricity increases (Asteroid Belt, Kuiper Belt, Oort Cloud)

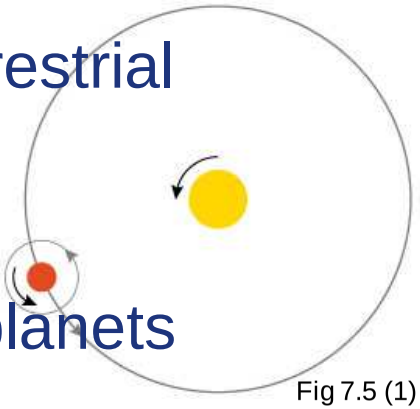


Fig 7.5 (1)

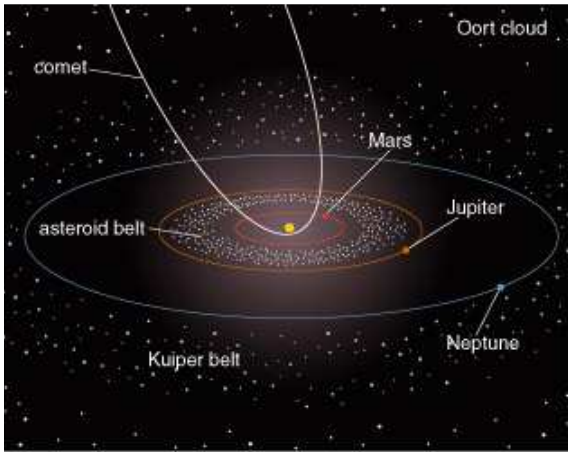


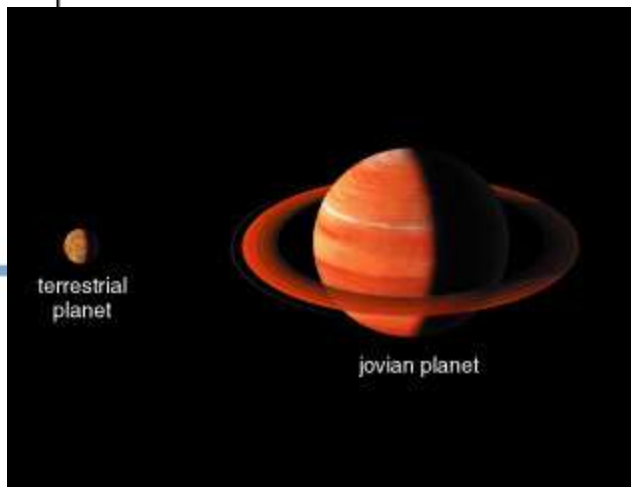
Fig 7.5 (3)

The Two Types of Planets

Table 7.2 Comparison of Terrestrial and Jovian Planets

Terrestrial Planets	*Jovian Planets*
Smaller size and mass	Larger size and mass
Higher density	Lower density
Made mostly of rock and metal	Made mostly of hydrogen, helium, and hydrogen compounds
Solid surface	No solid surface
Few (if any) moons and no rings	Rings and many moons
Closer to the Sun (and closer together), with warmer surfaces	Farther from the Sun (and farther apart), with cool temperatures at cloud tops

Fig 7.5 (2)



Is Pluto a Planet?

- Does not follow the pattern
  - Terrestrial, Jovian, ice ball?
- Highly eccentric and inclined orbit
- Does have a moon, almost half the size of Pluto
- Seven other moons of the Solar System are larger than Pluto!
- One of many!
- People started discovering objects larger than Pluto orbiting the Sun
  - Brought this issue to a head
- If it were discovered today, would not be designated a planet
- IAU defined a planet (Prague 2006)
  1. Must orbit the Sun
  2. Must be massive enough to become roughly spherical
  3. Must have cleared the orbit of other objects (must dominate its surrounding region)
- Pluto only satisfied 1 & 2 and is hence a dwarf planet.

Solar System Pneumonic

My Very Excellent Mother Just
Served Us Nine Pizzas

My Very Excited Mother Just
Screamed “Upstairs, Now!”

Solar System Pattern Exceptions

- Venus rotates backwards (“retrograde”)
  - Clockwise as viewed from above north pole
- Uranus is tipped over
  - Moons orbit along nearly concentric circles as viewed from Earth
- Earth is only terrestrial planet to have a large moon

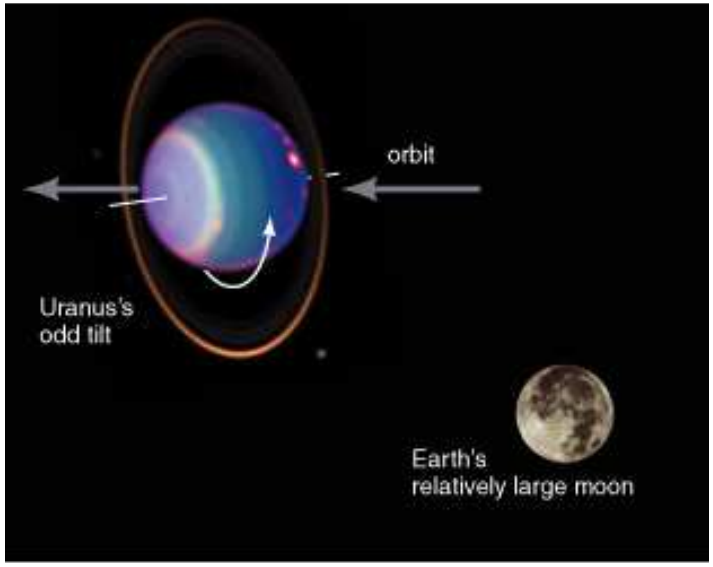


Fig 7.5 (4)

The Inquisitive Mind

- How did our solar system come to be?
- Remember, a successful theory must explain the observations discussed
- Better yet, it should make predictions that could be confirmed by future observations
  - Extrasolar planets
- Hypotheses:
  - **Chance** collection of objects?
  - Sun **captured** planets as it moved about?
  - Sun nearly **collided** with another star producing planetary remnants?
  - Sun and planets **condensed** from the same matter?

Process of Elimination

- Chance Collection of objects
  - Can’t explain the organized pattern of objects or orbits
- Sun captured the objects
  - Highly improbable sequence of events
  - Can’t explain the organization
- Sun nearly collided with another star
  - Highly improbable event, many other solar systems seen
  - Can’t explain the organization
- Sun and planets condensed out of the same material (nebular theory)
  - Seems to be the winner!