

Midterm 2 Wednesday (Feb 29)

- Review session
 - 6:30PM Monday
 - **DIFFERENT ROOM!!!** Biochemistry 101
 - (next building to East of BPS)
- Exam format same as for Midterm 1
 - 34 multiple choice questions
 - Sit in assigned rows
 - Bring photo ID
 - No calculators
- Will cover material *since* midterm 1
 - See course schedule (in syllabus on web site) for corresponding textbook chapters.
 - But assumes you know the earlier material well enough to use it.
 - Will **NOT** include Pluto [9.3].

On the day of the midterm:

SIT IN YOUR ASSIGNED ROW!

TAKE ONLY THE TEST WITH *YOUR* NAME PRINTED ON THE FRONT COVER!

Seating Chart for Wednesday

Section 3, 10:20-11:10

FRONT

B			B
C	Aardvark - Bishop		C
D	Blalock - Calleson		D
E	Calzada - Davis		E
F	Degraw - Gadsby		F
G	Gallant - Holland		G
H	Holiday - Kogelmann		H
I	Krist - Li		I
J	Liles - Moyet		J
K	Mumphery - Poskey		K
L	Powers - Sciarini		L
M	Shaver - Theis		M
N	Thomas - Wiesemann		N
O	Williams - Zzzzzz		O

BACK

**SIT IN YOUR
ASSIGNED ROW!**
(this seating chart is in the
Study Guide on Angel)

**WHEN THE TESTS ARE
HANDED OUT,
TAKE ONLY THE
TEST WITH YOUR
NAME PRINTED ON
IT!**

*If your name falls in
alphabetical order
between the two
names listed for a row,
sit in that row.*

Can't figure it out?
On exam day, a name-by-
name list will be posted
just inside the door.

PHOTO ID REQUIRED!

Midterm 2 – Wed. Feb.29

What to Know

- You should know about *all* of the things I have discussed in class since Midterm 1.
 - This study guide just gives some of the high points.
- Study your lecture notes first, then use your textbook to help you understand your notes.
 - Add pgs 333-336 “Star Birth” to the reading suggestions given in the syllabus.
 - The test will only cover what I have discussed in class. This will NOT include Pluto (textbook section [9.3]).
- There will be a number of questions about facts about the various planets, etc. What are their surfaces and atmospheres like? How did they get that way?
- There are also a few more general ideas that you should understand, including the following examples:
 - What is the general layout of the solar system?
 - Why does it have those properties? What does “angular momentum” (spin) have to do with it?
 - What led to the great difference between the terrestrial and the Jovian (Giant) planets?
 - How do the processes of *differentiation*, *tidal locking*, and *orbital resonances* work?
 - Age dating methods (radioactive decay, crater counting).
 - Why is Venus so hot? Mars so cold?
- Some specific numbers to know (there are very few of these):
 - Age of solar system. And how is it measured?
 - Fraction of solar system’s mass that is in the Sun. Fraction of remaining mass that is in Jupiter.
 - Plus you should have an idea of *relative* sizes, distances, etc.

Overview of Solar System

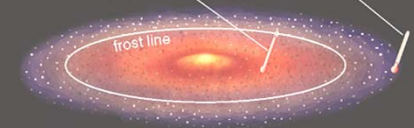
- The solar system is a disk
 - Rotation of sun, orbits of planets all in same direction.
 - Most planets rotate in this same sense. (Venus, Uranus are exceptions).
 - Angular momentum of pre-solar gas cloud.
- Terrestrial vs. Jovian (Giant) planets



- High vs. low density
 - Rocks vs. mostly gas
- Composition
 - heavy elements vs. primarily H/He
- Difference due to distance from Sun.

Object	% Total Mass
Sun	99.8
Jupiter	0.1
Comets	0.05
All other planets	0.04
Satellites & rings	0.00005
Asteroids	0.000002
Cosmic dust	0.0000001

Within frost line, rocks and metals condense, hydrogen compounds stay gaseous. Beyond frost line, hydrogen compounds, rocks, and metals condense.



Within the solar nebula, 98% of the material is hydrogen and helium gas that doesn't condense anywhere.

During planet formation in Solar Nebula:

Presence of ice

- ➔ more material for core
- ➔ could gravitationally attract large masses of hydrogen & helium gas.

Terrestrial Planets

- Earth

- Differentiated:
 - Iron/nickel core
 - Mantle of lighter rock
 - Thin crust on top
- Evolution of atmosphere
 - Thick CO₂ → life → N₂, O₂
 - Current global warming
 - Greenhouse effect
 - Man-made CO₂

- (Moon)

- Impact craters as clocks
- Old highlands (4.1-4.4 billion yrs)
 - Heavily cratered
- Maria (3.3- 3.8 billion yrs)
 - Fewer craters
- Rocks from each brought back by Apollo astronauts.
 - Age dating
 - Chemical composition
- Tidally locked to Earth
- Formation of Moon
 - Giant Impact is current favorite theory... collision between Earth & Mars-sized object.

- Mercury

- Closest to Sun, eccentric orbit.
- Airless, heavily cratered.
- Same density as Earth: iron-nickel core.
- Geologically dead (probably)
 - But cliffs → shrinkage at early time.
- Rotates in 2/3 of its orbital period
 - Tidal locking with a twist.

Terrestrial Planets (continued)

- Venus

- Same size, density as Earth.
- Differentiated like Earth
- Surface mostly studied by radar
 - Large volcanoes
 - “Continents” pushed up by tectonic flows in mantle.
 - Recent lava flows, constant resurfacing.
 - Crater density → very young surface
 - only 750 million yrs old.
- Thick CO₂ atmosphere
 - Result of runaway greenhouse effect.
 - Keeps surface very hot (900F).
 - Lead is molten.
- Retrograde (backward) rotation
 - Probably due to giant impact.

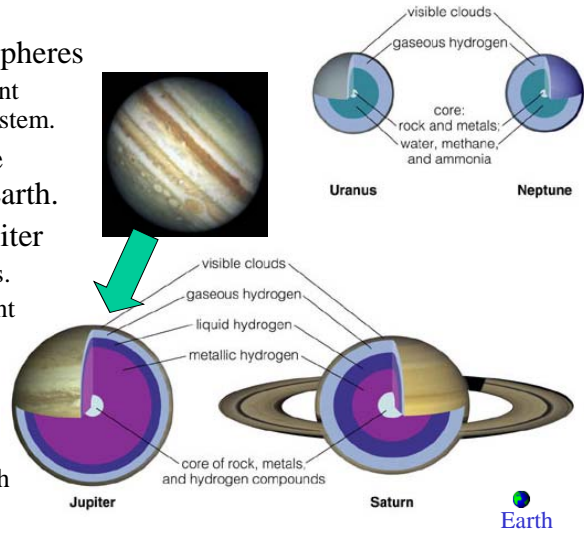
- Mars

- 50% smaller diameter than Earth
- 1.5 times further from Sun.
- Gigantic volcanoes.
- 50% highland “continents”
 - Tharsis bulge.
 - Cracked open to form Valles Marineris.
- 50% low-lying lava plains.
- Atmosphere
 - CO₂, like Venus, but very thin.
 - Liquid water currently impossible. *Why?*
- Climate change
 - Loss of atmosphere
 - Low escape velocity
 - Solar wind
 - Could not retain heat
 - Water froze out
 - even less heat retained
 - 2 Rovers found evidence of past water.
- Life?
 - Viking landers found no sign.
 - Questionable data in meteorite.

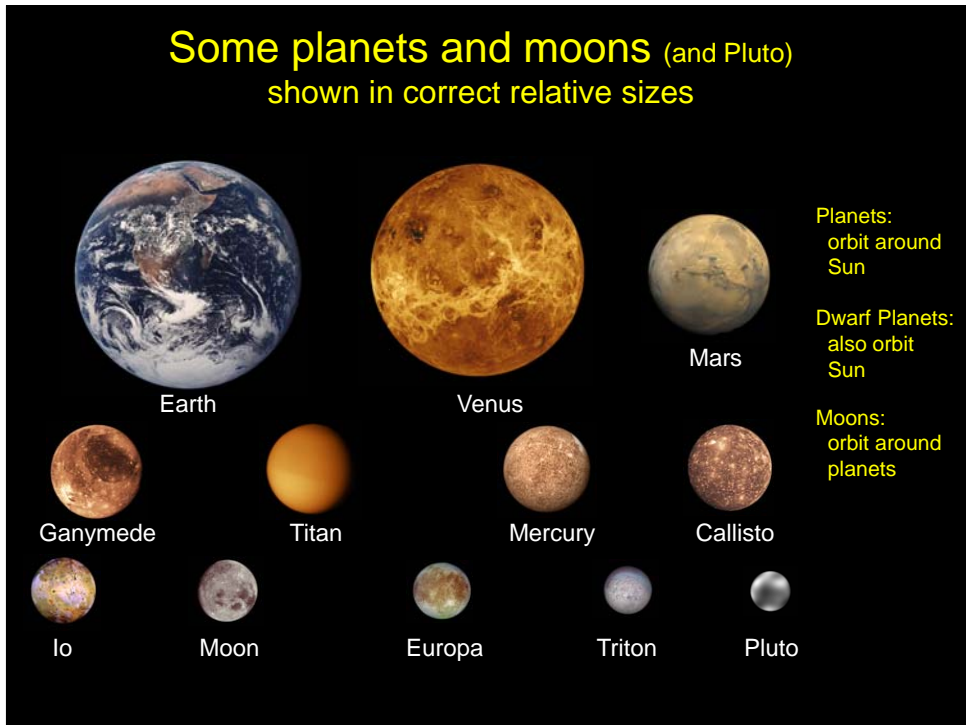
The Giant Planets

Jupiter – Saturn – Uranus - Neptune

- 14-300 x more massive than Earth.
- Massive H + He atmospheres
 - By far the most abundant elements in the solar system.
- On top of rock/ice core with 10-15 x mass of Earth.
- Lots of weather on Jupiter
 - Ammonia (NH₃) clouds.
 - Strong winds at different latitudes. (differential rotation)
 - Cyclonic storms
 - Great Red Spot
 - 2 x size of Earth
 - 400 yrs so far

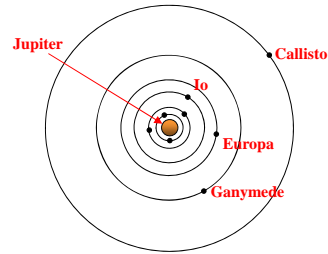


Some planets and moons (and Pluto) shown in correct relative sizes



Moons

- Jupiter's Galilean moons, as we get closer to Jupiter:
 - Callisto – ice, geologically dead.
 - Ganymede – ice, but geologically active.
 - Europa – rock, but covered by ice pack over liquid water.
 - Io – rock, extreme volcanic activity.
- Gradient of properties due to increased tidal effects & heating from Jupiter.
 - Inner 3 galilean moons have elliptical orbits due to orbital resonances.
- Jupiter's 59 other moons are much smaller.
- Saturn: over 30 known moons
 - largest is Titan
 - N₂ atmosphere.
 - Carbohydrate smog.
 - Similar to Earth's, but very cold (methane lakes).
 - Cassini/Huygens visit.
 - See movie of Titan landing, on course web site.
 - Enceladas
 - much smaller than Titan.
 - Has hot water down inside.
 - Ejects ice and rocky material to form Saturn's E ring.



Rings

- All 4 giant planets have rings.
- Jupiter, Uranus, Neptune have very thin rings. Saturn has much larger rings.
- Gravitational resonances important for shaping details of rings
 - Mimas created Cassini Division.
 - Shepherd satellites
 - moons sweep out divisions, contain rings through gravitational resonances.
- Rings made of ice and small bits of dust.
- Large moons cannot form inside of Roche limit
 - ripped apart because side of moon closer to planet moves faster than side that is farther from planet.
 - Roche limit is at about 2.5x planet's radius.

Asteroids

- Small rocky bodies in orbit about sun.
 - Left over from formation of Solar System.
- Most, but not all, in asteroid belt.
 - Some cross Earth's orbit

Meteorites

- Asteroids that hit Earth and don't burn up in atmosphere.
- Analyzing them →
 - Age of solar system (4.5 billion yrs) *How do we measure that?*
 - Initial chemical composition of solar system.

Comets

- Mostly ice
- Some on highly eccentric orbits
 - Spectacular tails when close to Sun.
 - Melted ice is driven off by solar radiation, solar wind.
- Most come from Oort Comet Cloud at edge of solar system.
 - Some from Kuiper Belt, just beyond Pluto.