Properties of the Solar System

Disk shape of the solar system:

Planets orbit the sun in nearly the same plane (Solar System forms a disk).

All planets orbit the sun in the same direction.

Most rotate in the same sense as they revolve about the sun.

Two types of planets:

Terrestrial (Earthlike) Planets

Giant (Jovian) Planets

Small Bodies:

Asteroids:

Small rocky bodies.

Most orbit the sun between the orbits of Mars and Jupiter in the *asteroid belt*.

Comets:

"Dirty Snowballs"

Most exist in the outer reaches of the solar system.

Oort Cloud—Spherical cloud of comets extending halfway to the nearest stars.

Kuiper Belt—objects beyond the orbit of Neptune.

When they approach the sun the ices boil off and are blown away from the sun forming the comet's tail.

Formation of the Solar System

Any theory of the formation of the Solar System must be able to explain its general properties.

Two Types of Theories:

Catastrophic theories:

A star collided with the sun throwing out material which eventually formed the planets.

Prediction:

Solar Nebula Theory:

Planets formed along with the sun from gas and dust which surrounded the sun as it formed.

It is thought that the Solar System formed from a cloud of dust and gas about 4.5 billion years ago.

Cloud collapses under its own gravity.

The central region collapses to form the sun.

As the cloud collapses its spin rate increases:

Due to the spin, the gas and dust bulge out forming a disk of material around the forming sun.

Condensation

As the disk starts to cool off, the gas starts to condense.

Metals (e.g. iron) condense at the highest temperatures.

Rocky materials condense at somewhat lower temperatures.

Volatile materials (such as water, carbon dioxide, nitrogen) only condense at low temperatures.

Temperatures in the disk near the forming sun are the highest and fall off away from the center:

Near the forming sun we would expect what materials to condense out?

Little further out we would expect what to condense out?

Even further out?

Accretion

Grains of material grow by condensation as gas molecules condense onto the grains

Eventually (sizes of a few centimeters), the growth by condensation becomes inefficient.

Large number of grains are formed by condensation.

These will continually collide with each other.

Some of them will stick together thus growing larger in a process called accretion.

This process of accretion continues until the grains grow to sizes of about 1 to 100 kilometers.

At this point they are known as planetesimals.

As the planetesimals grow, gravity starts to become important and helps to keep the planetesimals together.

Eventually, a few bodies become large enough to grab other particles by their own gravity.

At this point a runaway process occurs—these particles grow bigger—> more gravity—>grow even more quickly...

These bodies eventually become the planets in our Solar System.

Near the end of the formation of the planets, a period of heavy bombardment occurs as the planets sweep up any remaining debris in the Solar System.

It is during this period, about 4 to 4.5 billion years ago, that most of the craters seen on planetary surfaces were formed.

Gravitational Collapse

If a proto-planet grows large enough, its gravity will become strong enough to pull gas from the nebula (mostly hydrogen and helium) onto itself.

This process is called gravitational collapse.

This process occurred for the Jovian planets but not the terrestrial planets for two reasons:

Predictions of the Solar Nebula Theory:

The sun and planets are formed at the same time from a large cloud of dust gas.

Predicts what relation should hold between the ages of the planets and the sun?

What about the catastrophic theory?

If solar nebula theory is correct young stars should be surrounded by clouds of gas and dust.

Solar nebula theory predicts that planetary systems are commonplace.

Review for Test

Test will be similar to the quizzes (though unlike the quiz you will have some choice in questions to answer). It will consist of:

37-39 multiple choice questions of which you need to answer 35.

4 short answer questions of which you need to answer 3.

Remember that you can bring 1 4×6 index card, written on both sides, to the test.

Questions will be similar to the quizzes—in fact I will copy a few straight off old quizzes.

What to Study

In the multiple choice questions I will ask some factual/definitional type questions.

However, in the short answer questions I have tried to ask questions that require you to synthesize the material in the chapters.

On the test I'll likely ask a question which asks you to synthesize material across chapters.

In studying I wouldn't necessarily read the whole book again—rather read over the chapter summaries.

Look over your (my) notes—if I talked about it I think it's important.

Try, *without referring to your notes or the book,* to answer the questions at the end of the chapters and especially off the review sheets.

If you can, great, if not, review those areas where you are fuzzy.

After a couple hours or so then try to answer the questions again.

If you can, great, if not, review that material further.