Astronomy 3
Earth Movements
Seasons
The Moon
Eclipses
Tides
Planets
Asteroids, Meteors, Comets
Earth’s Movements

- **Orbit**—the path in which an object travels around another object in space

- **Revolution**—the movement of an object around another object in space
  - It takes Earth 365.25 days (1 year) to make one revolution around the Sun
  - Other planets take more or less time and have longer or shorter years
• **Rotation** – the spinning motion of an object on its axis
  
  • Earth completes one rotation approximately every 24 hours
  
  • The half of the Earth that is facing the Sun experiences daytime and the half that is facing away from the Sun experiences nighttime
  
  • Other planets also have day/night cycles; however, each planet rotates at a different rate and therefore has different length days/ nights
Seasons

- Earth’s axis is tilted 23.5°. Seasons happen because of this tilt.

- When a hemisphere is tilted toward the Sun (summer), the weather is generally warmer because the Sun’s rays strike the Earth more directly.
  - When it is summer in one hemisphere it is winter in the other.
• Seasons have nothing to do with distance from the Sun!!!
• We actually have summer when the Earth is at its farthest point from the Sun.
Solstice

- Occurs when the Sun is the greatest distance north or south of the equator

  - **Summer Solstice** – longest day of the year
    - June 21\(^{st}\) or 22\(^{nd}\) in Northern Hem.

  - After the SS days decrease in length until the WS

  - **Winter Solstice** – shortest day of the year
    - Dec. 21\(^{st}\) or 22\(^{nd}\) in Northern Hem.

  - After the WS, days increase in length until the SS
Equinox

- Occurs when the Sun is directly above the equator
- Daylight and nighttime hours are roughly equal

- **Vernal Equinox** (Spring)
  - Mar. 20\textsuperscript{th} or 21\textsuperscript{st} in Northern Hem.

- **Autumnal Equinox** (Fall)
  - Sep. 22\textsuperscript{nd} or 23\textsuperscript{rd} in Northern Hem.
The Seasons on Earth

Autumnal Equinox
The first day of Autumn in the Northern Hemisphere

23.5° Axis of rotation

Winter Solstice
The first day of Winter in the Northern Hemisphere

Vernal Equinox
The first day of Spring in the Northern Hemisphere

Spring

Summer

Summer Solstice
The first day of Summer in the Northern Hemisphere

The Sun and the Earth are not to scale in this drawing.
Formation of the Moon

• The Impact Theory – the Moon formed billions of years ago from condensing gas and debris thrown off when Earth collided with a Mars-sized object.
The Moon

• The movement of the moon is responsible for many events on Earth:
  • Lunar Phases
  • Eclipses
  • Ocean Tides
Lunar Phases

- **Satellite** – an object in space that orbits a larger object such as a planet or star
  - The Moon is a natural satellite

- The Moon does not give off its own light. We see the Moon because light from the Sun reflects off its surface.

- We always see the same side of the Moon because it takes exactly 1 month for the Moon to rotate once.
During its lunar cycle, the Moon appears to have different shapes, called phases.

The phases change as the Moon’s orbit changes how much of the illuminated side of the Moon we can see.

The lunar cycle is the 29.5-day period during which the Moon passes through all its phases.
• When the entire surface of the Moon is illuminated we say it is a **full moon**.

• As the Moon passes from full to new (shrinks) we say it is **waning**.

• When the entire surface of the Moon is dark, we say it is a **new moon**.

• As the moon passes from new to full (grows) we say it is **waxing**.
The Sun-Moon angle is the angle defined by Sun->Earth->Moon with Earth (where you are) as the angle vertex. As the Sun-Moon angle increases we see more of the sunlit part of the Moon. Note that if this drawing were to scale, then the Moon would be half this size and its orbit would be about 22 times larger in diameter and the Sun would be about 389 times farther away than the Moon!
Eclipses

• Because Earth is orbiting the Sun, the Moon also orbits the Sun as it orbits Earth. The combination of these two movements is what is responsible for eclipses.
Solar Eclipse

- **Solar Eclipse** – happens when the Moon moves b/w Earth and the Sun, blocking sunlight from reaching Earth.
Diamond Eclipse
The next total solar eclipse visible from the United States will occur on August 21, 2017, across a 70 mile (113 km) wide path stretching from Salem, Oregon, to Charleston, South Carolina.
Lunar Eclipse

- **Lunar Eclipse** – happens when Earth moves b/w the Sun and the Moon, blocking the sunlight from reaching the Moon
• The next total lunar eclipse that will be visible from the United States will occur on December 21, 2010. It will be the second lunar eclipse to occur in 2010. The first lunar eclipse will only be a partial lunar eclipse.
Tides

• Cyclic changes in ocean level

• The pull of the Moon’s gravity on Earth causes slight bulges in the ocean on both sides of Earth. These bulges change position as Earth rotates.
The yellow dot is just before high tide.

The earth has done one full rotation, 24 hours.

The Moon has moved 1/28 of its orbit.

The yellow dot is exactly at high tide.
• The Sun also affects the tides.
  • Can strengthen or weaken the Moon’s effects

• **Spring Tides** – when the Sun, Moon, and Earth are all aligned, high tides are higher and low tides are lower (bigger tidal range)
  • Happens during a new moon and a full moon
Spring Tide

- Gravitational force from the sun
- Bulges of water formed by the moon
- Gravitational force from the moon
- Bulges of water formed by the sun
• **Neap Tides** – When the Sun and Moon are at right angles to each other, high tides are lower and low tides are higher (smaller tidal range)
  • Happens during the first-quarter and third-quarter moons
Neap Tide
The Solar System

- *the Sun and its family of orbiting planets, moons, asteroids, meteoroids, and comets*

- During the formation of the solar system, the matter that did not get pulled into the center to form the Sun, collided and stuck together (accreted) to form the planets and asteroids.
Inner Planets

• Mercury, Venus, Earth, Mars

• Also called **Terrestrial Planets** (means Earth-like)

• Small, rocky planets with iron cores

• Close to the Sun, the temperature was hot, and the easily vaporized elements could not condense into solids. This is why lighter elements are scarcer in the planets nearer the Sun.
Outer Planets

• Jupiter, Saturn, Uranus, Neptune

• Also called **Jovian Planets** (means Jupiter-like) and gas giants

• The outer planets are much larger and are made mostly of lighter substances such as hydrogen, helium, methane, and ammonia
Asteroids

- **Asteroids** - solid, rock-like masses.
- Are believed to be left over materials from the solar system’s formation
- May be extinct or inactive comets
- Most have irregular shapes
- Some are considered “minor planets”
- Make up the Asteroid Belt, between Mars and Jupiter
Comets

- **Comets** - objects made up of rock & ice
  - AKA “dirty snowballs”
  - Spend most of their time outside of Pluto’s orbit
  - When they travel closer to the sun they begin to form a tail.
  - Tail always points away from the sun. (this proves there is a solar wind)
3 parts of a comet

- **Nucleus** - solid rock and ice mass
- **Coma** - cloud or haze surrounding the nucleus
- **Tail** - consists of ice, dust, gas, and rock particles trailing off of the nucleus.
  - There are 2 tails: 1 made of dust and rock particles and 1 made of ionized gases.
• *as comets leave behind fragments of matter, the Earth may travel through them. If the Earth does we experience a meteor shower.
Meteoroid

- **Meteoroid** – is a rock or an icy fragment traveling in space
  - They may be large boulders or small grains of sand.
Meteor

• **Meteor** – is the light made by a meteoroid as it passes through the earth’s atmosphere.
  • The light is caused by friction.
  • The friction excites the atoms.
  • Fire balls - Brighter meteors.

• **Approximately 100 million meteoroids enter our atmosphere daily, however we can only see about 5 to 15 daily.**
Meteorites

- **Meteorites** – is the part of the meteoroid that survives its trip to earth.

- **Stones** - made mainly of rock with some iron mixed in, 93% of meteorites are stones,

- **Irons** – made mainly of iron with some nickel mixed in.

- **Stony-irons** – a mixture of stone and iron.

- Most of these have been found in Antarctica. Some have come as far as the Moon and Mars.
- Meteorite craters – the earth has been scarred repeatedly by impacts from space, however most are no longer visible. Because we have an atmosphere our weather (wind, rain) have either eroded them away or filled them in.
• **Meteor showers** – as a comet passes through space it leaves behind a trail of rocks and dust. As our earth passes through these trails the rocks and dust enter our atmosphere and the meteor activity is elevated. In some cases you can see more than 20 meteors in 1 minute.
• *Some of the most popular meteor showers are known to occur around these dates each year.*

• *Perseids – August 12*

• *Orionids – October 20*

• *Taurids - November 10*

• *Leonids – November 17/18*

• *Geminids – December 10*