GEOG 101 Part II
People and their Physical Environment

10: Earth-Sun Relationship

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Textbook Chapters: 2, 3, 4, 5

Introduction to People and their Physical Environment

- ✓ I. Introduction to the Physical Environment
- ➢ II. Earth-Sun Relationship
- III. Earth Systems
  - A. The Hydrosphere: Oceans
  - B. The Atmosphere: Weather and Climate
  - C. The Lithosphere: Geologic Influences
- IV. Earth Habitat
  - A. Biosphere
  - B. Natural Controls and Cycles
  - C. Human Impact
  - D. Natural Hazards
  - E. Earth Resources

EXAM 2 covers all the topics listed

Earth-Sun Relationships

❖ The most important aspect of the earth-sun relationship is **temperature**.

The earth's temperature is influenced by three major variations:

1. **Proximity** (variation of distance to the sun)
2. **Earth movements and positions** (variations in the angle at which the sun's rays hit the earth)
3. **Conditions on the sun's surface** (variations in the emission of solar radiation from the sun)

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Earth-Sun Relationship

Proximity: The earth is the third planet from the sun.

Too hot — Too cold — Just right for life "as we know it."

In addition, the Earth has an elliptical orbit around the sun, not a circular orbit, which influences the amount of solar energy received during the year.

Earth Movements and Positions

Two MOVEMENTS

1. **Rotation** (on its axis)
2. **Revolution** (around the sun)

Two POSITIONS

1. **Inclination** (tilted at 23½°)
2. **Parallelism** (axis is always parallel to itself)

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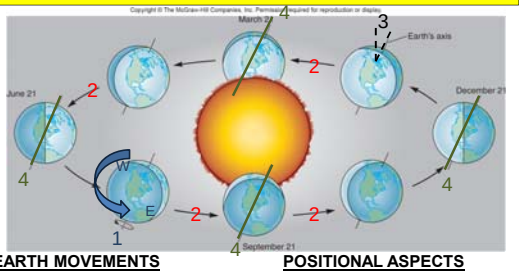
Earth Movements and Positions



EARTH MOVEMENTS
1. Rotates on its axis from W to E.
2. Revolves around the sun in a counterclockwise direction.

POSITIONAL ASPECTS
3. Axis is tilted 23½° off vertical.
4. Axis remains parallel to itself throughout its orbit.

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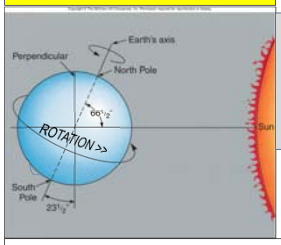
ROTATION



ROTATION gives us:

1. **Day** and **night**
2. **Equalizes temperatures**
3. **Influences daily ocean tides**
4. **Creates the Coriolis Effect**

- **Rotation on the axis is from WEST to EAST.**
- One rotation takes 23 hrs., 56 min., 4 sec.
- Speed of rotation at the equator is 1,000+ mph (25,000 mi/24 hrs.)

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TIDES

❖ The earth's ocean **TIDES** are influenced by **ROTATION.** Rotation creates a **centrifugal force** and is responsible in part for the location of the **"bulge of water"** (high tide) on earth's surface.

✓ In conjunction with the positions of the moon and sun, the location and height of the bulge varies every day.

➢ ***Tides are created because ocean water has greater mass and when "stretched" by a dynamic forces piles up more easily than smaller bodies of water and land which cannot be pulled and stretched as much.***

➢ **There are two high tides** and **two low tides daily.**

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TIDES

1. The spin of the earth creates **centrifugal force** which attempts to throw the water off the surface, thus creating the tidal bulge **(high tide).**

2. Gravitational forces of the moon along with that of the sun, pull or stretch the water towards them, creating larger bulges **(higher tides).**

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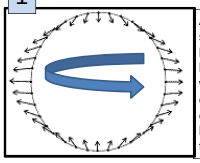

A water-covered, spinning Earth without landmasses would have a permanent water bulge at the equator (due to centrifugal force) with lower water levels at the poles.

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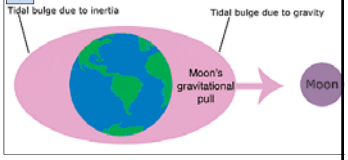

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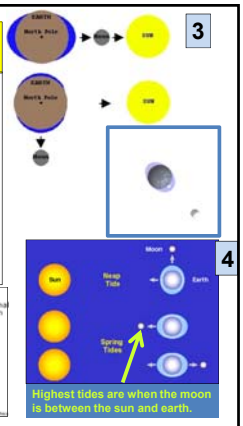
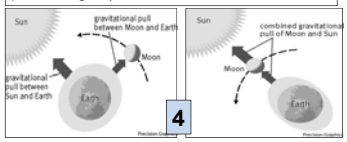
TIDES

3. Low tide is the period between the high tides. It is created during the time when water is drawn away from the area and pulled to where the centrifugal and gravitational forces are the strongest (high tide areas).

4. Different tide cycles occur because the earth's rotation varies its position in relation to the moon and sun (different pull strengths).





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EARTH-MOON RELATIONSHIP:
more than the creation of tides

1. Provides light at night by reflecting the sun's rays back to earth (except during the period of the New Moon).
2. Lunar gravity affects earth movements, including spin, tilt and wobble.
3. Lunar position affects the characteristics of ocean tides (timing and height).
4. Tidal cycles create unique shoreline biomes (tidal zones).
5. Tidal cycles help to mix ocean water (temperature and salinity) affecting climate.
6. Tidal cycles increase/decrease effects of coastal storms.
7. Lunar cycles affect the actions of living creatures.

https://www.youtube.com/watch?v=6MP920xMC0Q What if the Moon Disappeared? 4 min

The presence of the moon has also been an influence in human cultural development:

1. Used to measure time.
2. Used as a calendar.
3. Guide/signal to events, including religious rites.
4. Has given rise to stories of unusual behaviors and explanations: lunacy, eclipses, werewolves, etc.

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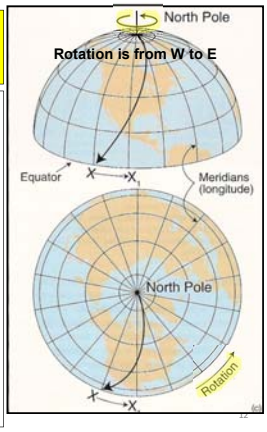
Rotation and the CORIOLIS EFFECT

❖ **CORIOLIS: the apparent deflection of moving bodies not attached to the surface** (caused by the earth's rotation).

Amount of deflection is based on the speed of rotation at any latitude.

The earth rotates under the object (or away from its path) so it ***seems*** that the object is curving off course (deflecting away from a straight path).



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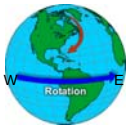
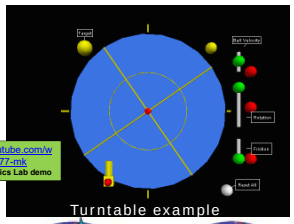
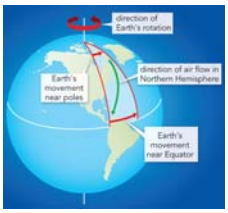
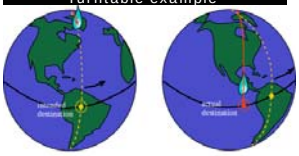
CORIOLIS EFFECT



https://www.youtube.com/watch?v=dt_XJp77-mk
2.5 min MIT Physics Lab demo







https://www.youtube.com/watch?v=i2mec3vgeaI
3 min Coriolis Animation

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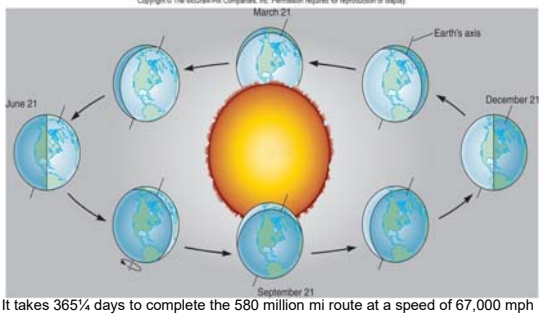
REVOLUTION

The earth revolves around the sun in a counterclockwise elliptical orbit.



It takes 365¼ days to complete the 580 million mi route at a speed of 67,000 mph

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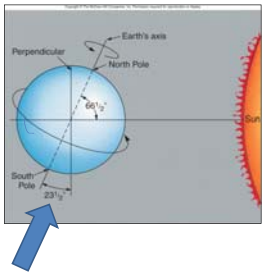
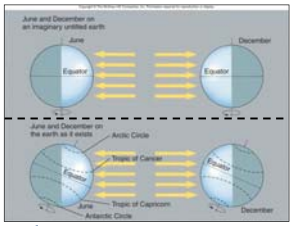
INCLINATION

The earth's axis is inclined at a 23½° angle.





Because of inclination, the intensity of the sun's rays varies at any latitude throughout the year, as opposed to an earth without tilt (top diagram).

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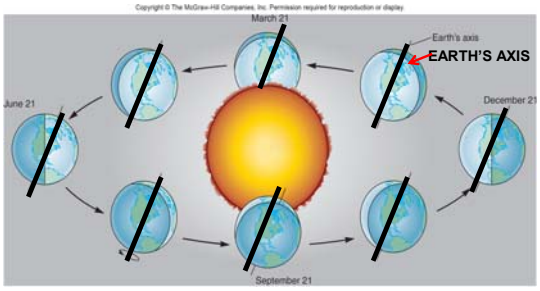
PARALLELISM of AXIS



At every point in its orbit around the sun, the earth's axis is parallel to itself.

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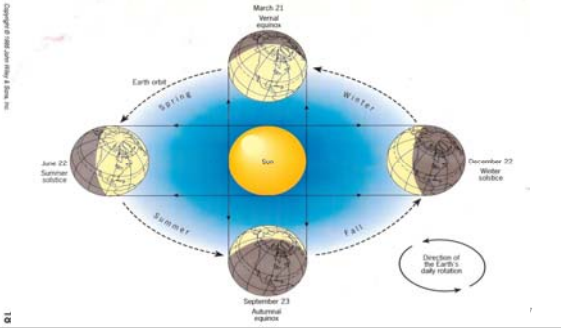
THE SEASONS

Revolution + Inclination + Parallelism = SEASONS



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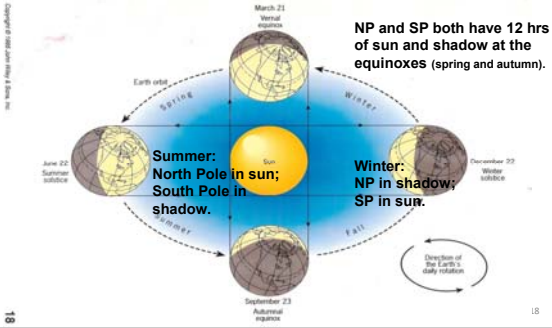
THE SEASONS

Revolution + Inclination + Parallelism = SEASONS



NP and SP both have 12 hrs of sun and shadow at the equinoxes (spring and autumn).

Summer: North Pole in sun; South Pole in shadow.

Winter: NP in shadow; SP in sun.

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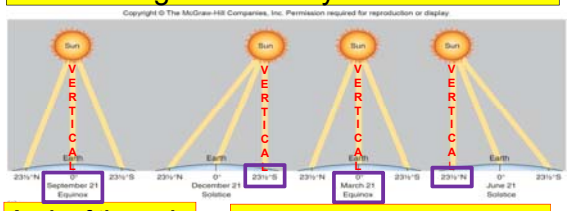
THE SEASONS
Shifting Vertical Rays of the Sun



Angle of the sun's rays varies with both time of year and latitude.

Position of the vertical rays of the sun moves daily between the Tropic of Cancer (23½°N) and the Tropic of Capricorn (23½°S).

https://www.youtube.com/watch?v=tX3Y5bzNDiU
5.5 min Earth-Sun Study Guide video review

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Earth-Sun Relationships

ASTRONOMICAL:
Earth in relation to the sun
1. Cycle duration
2. Precession
3. Tilt variation

SOLAR:
Conditions on the sun's surface
1. Sunspot activity
2. Ultraviolet rays
3. Solar wind

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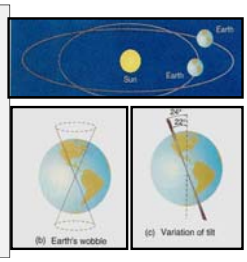
Earth-Sun Variations

ASTRONOMICAL FACTORS

a) **Cycle Duration** - variation of earth's orbit around the sun.

b) **Precession** - the earth wobbles (its spin is uneven like that of a toy top)

c) **Tilt Variation** - earth's axis has tilted at different angles (from present 23½°)



❖**These actions influence the amount of heat received from the sun.**

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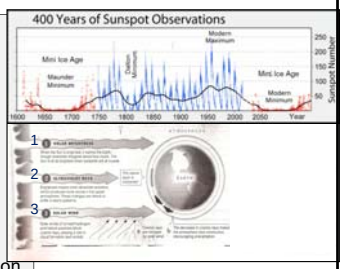
Earth-Sun Variations

SOLAR ENERGY

1. Sunspot Activity - brightness/heat

2. Ultraviolet Rays - upper atmosphere oxygen absorbs UV light to create ozone; ozone effects storm patterns.

3. Solar Wind - ionized particles affect cloud formation and rainfall; strong emissions may effect electronic communications.



✓ **These are short term influences on the earth's temperature.**

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N E X T

The Hydrosphere: Oceans

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