Chapter 1
The Earth as a Rotating Planet
Chapter 1
Earth’s shape - close to **spherical**. Actually **oblate ellipsoid** (flattened at the poles)
1. The Shape of the Earth

Astronaut photo shows the Earth’s curved horizon from low-Earth orbit.

Sunset - Sun below the horizon. At the height of the clouds, Sun is not below horizon, clouds bathed in red and pinkish rays.
1. The Shape of the Earth

Exaggerated geoid, in which small departures from a sphere are shown as very large deviations.
2. Earth Rotation

THE ENVIRONMENTAL EFFECT OF EARTH ROTATION
Rhythms of the Sun cause:
- Day & night
- Daily air temperature cycle
- Motions of atmosphere and oceans
- Weather systems and ocean currents
- Earth’s rotation + Moon’s gravitational pull - rise and fall of tides. Tidal currents - life-giving pulse for plants & animals, clock for human coastal activities
2. Earth Rotation

Earth’s **Rotation** –

A) **counterclockwise** when viewed from above the north pole

B) **West to east** when viewed with the north pole up
3. The Geographic Grid

PARALLELS AND MERIDIANS

LATITUDE AND LONGITUDE
3. The Geographic Grid

**Geographic Grid** – the way to depict the globe on a flat surface. Divided into degrees, 60 minutes and 60 seconds. Provides a “grid” of imaginary lines (parallels and meridians).

Longest parallel of latitude is the **Equator**, midway between the poles. Equator used as reference line for measuring position.
Meridians and parallels define geographic directions.

- **Meridian** - north or south
- **Parallel** - east or west.
- Infinite number of parallels & meridians.

Every point on the Earth has a combination of one parallel and one meridian, defined by the intersection.
**Latitude** (Parallels)

1 degree latitude = constant 111 km
**Longitude** (Meridians)

1 degree of longitude = 111 km at the equator and 0 at the poles

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3. The Geographic Grid
A. **Latitude** is the angle between a point on a parallel and the centre of the Earth and a point on the equator.

B. **Longitude** is the angle between a point on a meridian at the Equator (P) and a point on the prime meridian at the Equator (Q) as measured at the Earth’s center.
Prime Meridian at the Royal Observatory in Greenwich, England
4. Map Projections

- Polar Projection
- Mercator Projection
- Winkel Tripel Projection
- Geographic Information Systems
4. Map Projections

Map Projection – how to display the Earth’s surface.

Oldest maps were limited by a lack of knowledge of the world, rather than by difficulties caused by the Earth’s curvature.
Polar projection centered on North or the South Pole.

- Parallels centered on the pole
- Meridians radiate outward from pole
- Shows one hemisphere, equator at outer edge of the map.
- Intersections of the parallels & meridians form right angles, projection shows the true shapes.
**Mercator** projection shows a line of constant compass bearing as a straight line

- Used to display *directional* features such as wind direction.

Belgian cartographer, Gerardus Mercator, 16th century
MERCATOR PROJECTION

Scale increases rapidly poleward

Scale twice that of equator

Scale x 6

Scale x 2

Scale x 1

Scale same

Portland

Great circle

Compass line

Intersects all meridians at same angle

N 35° E

Rio de Janeiro

Compass line

Great circle

Capetown

Cairo

4. Map Projections
Winkel Tripel -

• Minimizes distortion in area,
  *Cirrocumulus – high, patchy, globular*

• Oswald Winkel (1873 – 1953)
GIS – Geographic Information Systems or Geographic Information Science

Computer based **mapping and analytical ability** provided by complex software.

- Maps, diagrams, satellite images and aerial photographs can be stored and manipulated
- Geographic spatially referenced data
- Spatially-referenced data used to solve complex problems.
5. Global Time

- STANDARD TIME
- WORLD TIME ZONES
- INTERNATIONAL DATE LINE
- DAYLIGHT SAVING TIME
- PRECISE TIMEKEEPING
5. Global Time

Standard time system - global time kept according to adjacent standard meridians, normally differ by one hour.
• Based on the east-west position of the Sun
• Solar day defined by one sun circuit
5. Global Time

A. The outer ring gives the time in hours.

B. The meridians are drawn as spokes radiating out from the pole.

C. Greenwich, England, 0° longitude, 12:00 noon.

D. Los Angeles, about 120°W longitude, 4:00 A.M.

E. New York, about 75°W longitude, 7:00 A.M.

F. Singapore, about 105°E longitude, 7:00 P.M.
5. Global Time

Time is determined by **longitude**, not latitude.

- When it is noon in Chicago, it is 1:00 P.M. in New York and only 10:00 A.M. in Portland.
- Mobile, 1600 km (1000 mi) away, it is also noon.
Standard time system, global time according to nearby standard meridians, normally one hour from each other.
Crossing the **international date** line in an eastward direction, travelers set their calendars **back one day**.
**International Dateline** - 12 hours from Prime Meridian.
- Opposite side of globe or 180 degrees (180th meridian)
- Earth rotates 15° per hour, time zones differ by 1 hour (360°/15° = 24 hours)
- Date changes either side of line
Daylight saving - transfer an hour of light to a time when it will be more useful. Adjust clocks during the part of the year that has a longer daylight period to correspond more closely with the modern pace of society

- United States - daylight saving time begins second Sunday in March, ends first Sunday of November
- European Union daylight saving = *summer time* begins last Sunday in March, ends on the last Sunday in October.
Precise timekeeping - worldwide system of master atomic clocks measures time to better than one part in 1,000,000,000,000.

- Earth has small changes in the angular velocity of its rotation on its axis and variations in the time it takes to complete one circuit around the Sun.
- Adjustments to the timekeeping system are necessary.
- Legal time standard recognized by all nations is *coordinated universal time*, Bureau International de l’Heure, located near Paris.
6. The Earth’s Revolution around the Sun

MOTIONS OF THE MOON

TILT OF THE EARTH’S AXIS

THE FOUR SEASONS

EQUINOX CONDITIONS

SOLSTICE CONDITIONS
6. The Earth’s Revolution around the Sun

**Revolution**
- Circle around the Sun (356 days)
- From north pole in counterclockwise direction
- Elliptical Path
- Orbits on the plane of the ecliptic
6. The Earth’s Revolution around the Sun

Earth is nearest to the Sun at **perihelion**, which occurs on or near January 3.
Farthest away from the Sun at **aphelion**, on or near July 4.
Distance between Sun and Earth varies only by about 3 percent during one revolution.
MOTIONS OF THE MOON

Moon rotates on its axis and revolves about the Earth in the same direction as the Earth rotates and revolves around the Sun. Moon’s rate of rotation synchronized with the Earth’s rotation (one side of Moon permanently directed toward the Earth)
**Phases of Moon** determined by position of the Moon in its orbit around the Earth

- Determines how much of the sunlit Moon is seen from the Earth.
- 29.5 day cycle to go from one full Moon to the next
Earth’s orbit around Sun - plane of the ecliptic.

- Rotational axis remains pointed toward Polaris, the North Star.
- Makes an angle of 66 1/2° with the ecliptic plane.
- Axis of the Earth is tilted at 23 1/2° away from a right angle to the plane of the ecliptic.
Four seasons occur because the Earth maintains a constant orientation (tilted 23½° with respect to the perpendicular to the plane of the ecliptic) as it revolves around the sun.

6. Earth’s Revolution around the Sun
December or winter solstice - December 22
• North polar end of the Earth’s axis leans at the maximum angle away from the Sun, 23 1/2°.
• Southern hemisphere tilted toward the Sun, gets strong solar heating.
• Reversed for June or summer solstice
Equinoxes occur between the solstice dates.

- Earth’s axis is not tilted
- **March equinox (vernal equinox in the northern hemisphere)** - March 21
- **September equinox (autumnal equinox)** - September 23.
- Conditions both equinoxes are identical
Equinox - circle of illumination passes through both poles
- Subsolar point is the equator
- All locations have 12 hours of sunlight, 12 hours of darkness
Solstice ("sun stands still")
June 22, subsolar point is 23½°N (Tropic of Cancer)
Dec. 22, subsolar point is 23½°S (Tropic of Capricorn)
Latitude of the subsolar point marks the sun’s declination which changes throughout the year.
Chapter Review

1. The Shape of the Earth
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