Site Planning

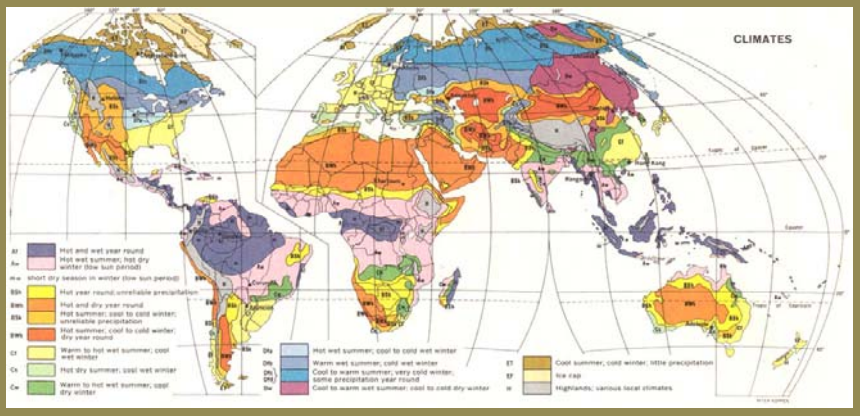
Macroclimate

What is Climate ?

- Climate is the prevailing weather conditions of a region throughout the year averaged over a series of years

- Global Climate Graph
- US Climate Zones
- Weather Defined

Image Source:
http://fp.arizona.edu/kkh/climate/images/Global.climate.map.med..jpg



What is Climate ?

- In the United States Climate is divided into four (4) zones.
- Cool, Temperate, Hot-Arid, Hot-Humid

- Global Climate Graph
- US Climate Zones
- Weather Defined

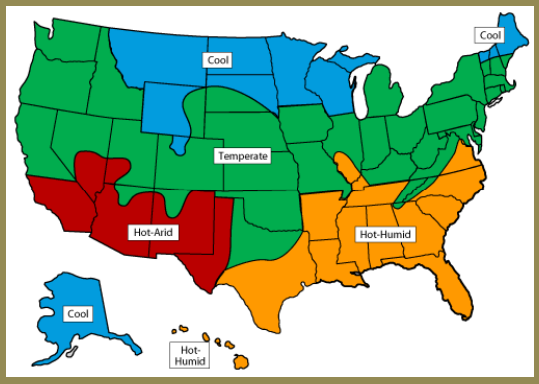
Image Source:
http://www.energysavers.gov/images/climatic_region_map.gif

Cold or Cool
Areas with extremely long and cold winters and limited hours of sunlight in winter

Temperate
Areas with the greatest variation in temperature with four distinct seasons from hot in summer to cold in winter to mild in the fall and spring

Hot-Arid
Areas with hot and dry climate but also known for cold nights

Hot-Humid
Areas of consistently hot and humid weather

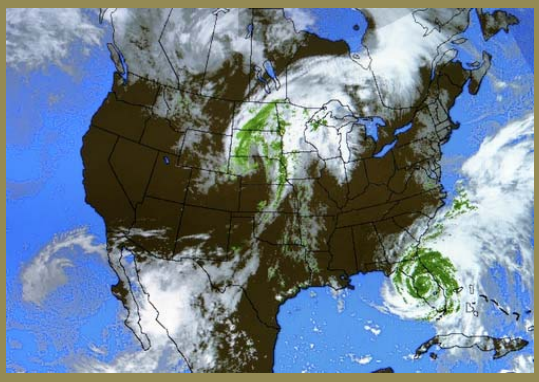


What is Climate ?

- Weather is the state of the atmosphere over a small area at a given time.
- What is the weather today?

- Global Climate Graph
- US Climate Zones
- Weather Defined

Image Source:
http://www.dailygalaxy.com/photos/uncategorized/shutterstock_403008.jpg
http://www.weather.com/weather/wxdetail/11201?dayNum=1



The Sun & Climate

- The sun is the source of all terrestrial energy and it sets in motion the thermal currents of the oceans and the winds.
- We cannot alter the suns global affect

➢The Sun

Image Source:
http://www.luminousnumindus.com/blog/wp-content/uploads/2009/05/sun_tour.jpg

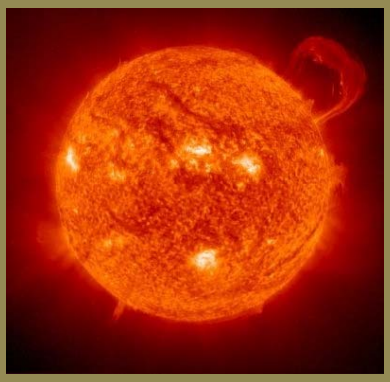
The Sun
Since the sun is the source of all terrestrial energy differences in climate are created by influences that effect this energy after it reaches the earth.

Factors that create climactic differences do so by modifying the heating effects of the sun.

Macroclimate
On the largest scale Macroclimate is the climate over a large area or region. It may be influenced by the location (latitude) or large changes in geography including mountain ranges and oceans.

Mesoclimate
The climate of a smaller area like a city that differs from the surrounding climate and may be influenced by local factors both natural and man made.

Microclimate
The smallest area of local climate that can be as small as the differences in weather on different sides of a small building or on the inside of a garden wall.

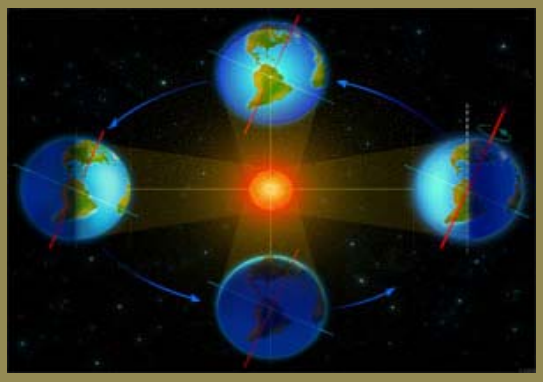


What Causes the Seasons?

- The seasons are caused by the tilt of the earth. the earth rotates around the sun changing the amount of radiation exposure in the different hemispheres.

➢The Sun
➢The Earths Tilted Axis
➢Equinox and Solstice
➢The angle of Incidence
➢Charting the Sun
➢Solar Radiation
➢Designing for the Sun

Image Source:
http://www.seed.slb.com/uploadedImages/Science/Earth_Science/Global_Climate_Change_and_Energy/Related_Articles/cause_seasons_sm.jpg



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- The Sun
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The Earth's tilt creates the seasons.

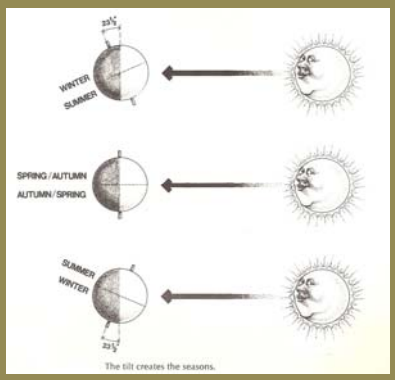
The Winter Solstice
On December 21st the sun is at its lowest point in the sky and we receive the fewest hours of daylight

The Equinox
On September 21st and March 21st the sun is halfway between its highest and lowest points and we receive equal amounts of daylight and nighttime hours.

The Summer Solstice
On June 21st the sun is at its highest point in the sky and we receive the greatest hours of daylight.

- The Winter and Summer Solstices as well as the equinox are all dependent upon the tilt of the earths axis

Image Source:
The Passive Solar Energy Book by Edward Mazria



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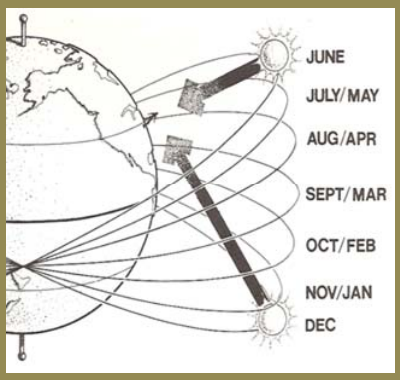
In June at noon:
At 40 degrees North Latitude (NYC) the sun is almost at an angle of 75 degrees.

In December at noon:
At 40 degrees North Latitude (NYC) the sun is at an angle close to 35 degrees.

- In hot summer months the angle of incidence of the sun is closer to 90 degrees and the in the cool winter months it is closer to 0 degrees.

Image Source:
The Passive Solar Energy Book by Edward Mazria



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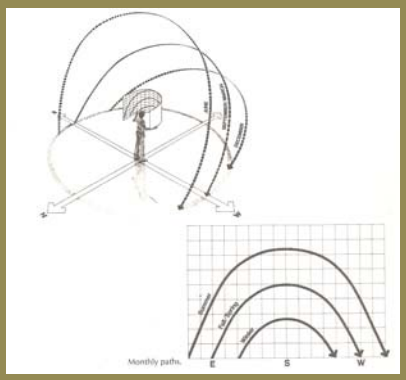
- Standing in a single location we project the path of the sun onto a graph marking its location for every hour from sunrise to sunset

Image Source:
The Passive Solar Energy Book by Edward Mazria



This chart includes the following:

Month of the year
The chart includes an indication of the suns position for each month of the year

The Altitude of the Sun
The angle of the sun above the horizon

Azimuth or Bearing of the Sun
The position or angle of the sun relative to true south

Time of the day
The chart shows the position of the sun for every hour it is above the horizon. (Sunrise to Sunset)

What Causes the Seasons?

- The Sun
- The Earths Tilted Axis
- Equinox and Solstice
- The angle of Incidence
- Charting the Sun
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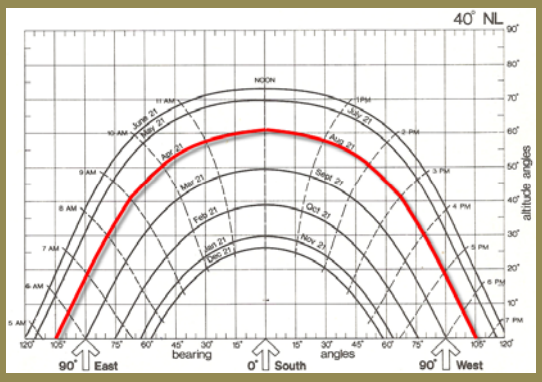
- Designing for the Sun

- The Sun Diagram for New York City at 40 Degrees North Latitude
- This chart is a useful tool when designing in response to the sun

Image Source:
The Passive Solar Energy Book by Edward Mazria



This chart includes the following:

Month of the year
The chart highlights in red the path of the sun for April 21st and August 21st

The Altitude of the Sun
At 12 noon the sun reaches an angle of 60 degrees above the horizon

Azimuth or Bearing of the Sun
When the sun rises its position on the horizon is 105 degrees east of south. It sets 105 degrees west of south.

Time of the day
The sun rises just before 5:30 am and it sets just after 6:30 pm.

What Causes the Seasons?

- The Sun
- The Earths Tilted Axis
- Equinox and Solstice
- The angle of Incidence
- Charting the Sun
- Solar Radiation
- Designing for the Sun

- Not all Solar Radiation will reach the ground
- It may be reflected, absorbed or diffused by the atmosphere

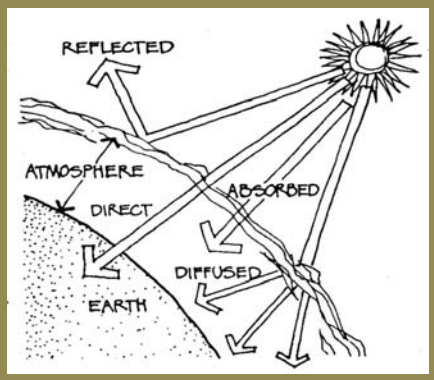
Reflected
31% is reflected by the upper atmosphere

Absorbed
19% is absorbed by dust, ozone and water in the upper atmosphere.

Diffused
4% is diffused into the clouds in the lower atmosphere.

Direct
47% of solar radiation hits the earths surface.

Image Source:
The Passive Solar Energy Book by Edward Mazria



What Causes the Seasons?

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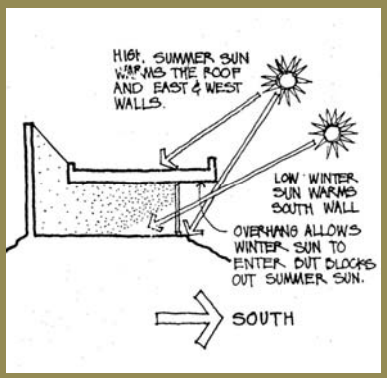
- When we design with the sun in mind we consider the angle of the sun at different times of the year and at different times of the day

Morning and Evening Sun:
Will warm the East and West exposures.

High Summer Sun:
Will warm the roof. In colder climates we look to take advantage of this while in hotter climates we look to minimize the impact.

Designing an Overhang:
A south facing overhand will block the high summer sun reducing heat gain while the low winter sun is allowed to enter warming the interior.

Image Source:
The Passive Solar Energy Book by Edward Mazria



What other factors effect climate?

- Orientation
- Latitude
- Elevation & Altitude
- Geographic Features

- In the Northern Hemisphere a buildings orientation is typically shown on a site plan by indicating its position relative to north.

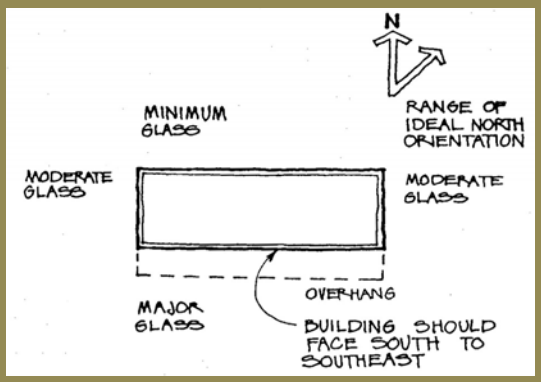
Image Source:
The Passive Solar Energy Book by Edward Mazria

In the Northern Hemisphere:
The greatest amount of solar radiation is on the southern exposure and the least amount is on the north.

North Exposure:
An appropriate design response is to minimize glass to reduce heat loss.

South Exposure:
The majority of the glass exposure should take advantage of the sunlight. A overhang can help limit heat gain in warmer climates and during summer months.

East and West Exposures:
Are both treated in a similar fashion with moderate glass.



What other factors effect climate?

- Orientation
- Latitude
- Elevation & Altitude
- Geographic Features

- Climate is affected by latitude

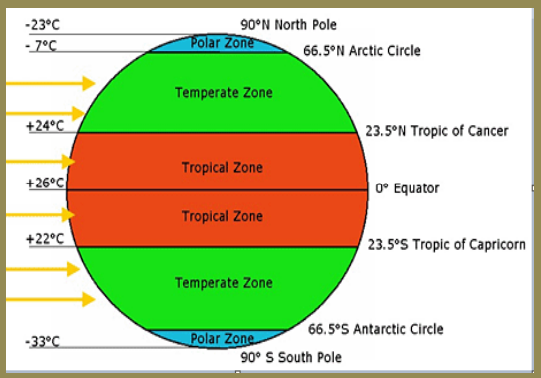
Image Source:
http://www.brockmann-consult.de/iavisa-info-web/images/fallback-climate-zone-classification.gif

Polar Zones:
Are the coldest and are above and below 66.5 degrees north and south latitude.

Temperate Zones:
Are located between the Arctic Circles and the Tropic of Cancer in the North and the Tropic of Capricorn in the South.

Tropical Zones:
Are located between the Tropic of Cancer and the Tropic of Capricorn and the equator.

Deserts:
Typically occur along the Tropic of Cancer or the Tropic of Capricorn.



What other factors effect climate?

- Orientation
- Latitude
- Elevation & Altitude
- Geographic Features

- Elevation or the height above sea level can effect climate.
- At greater elevations the air is thinner and the temperature is colder

Image Source: http://www.3sistersadventure.com/When&what/Everest.jpg

Why is it colder at higher altitudes:

When air is put under increased pressure heat is a by product. When you pump up a bicycle tire the hose and tube get hotter.

When you release pressure it gets cooler. When you spray using a Co2 cartridge the result is cold air.

At higher altitudes the air is thinner and the pressure is lower. As a result it is colder at higher elevations.

What other factors effect climate?

- Orientation
- Latitude
- Elevation & Altitude
- Geographic Features

- Major Geographical features can alter the climate of an area

Image Source: http://www.unitedstates-map.info/topo_map_of_usa.jpg

Lake Effect:
A large body of water like the great lakes can modify local climate. In north western New York the Lake Effect causes a great deal of snow in the winter.

Death Valley:
When the prevailing winds move moist air from California to the east the Sierra Nevada Mountain Range forces this air to rise causing rain on the West side and Dessert conditions on the East including Death Valley and Las Vegas

Ocean Coastal Effect:
Coastal regions are cooler and moister.

End of First Half of Lecture –

Beginning of Second Half Lecture –

How do the four (4) climate zones differ?

- Cold
- Temperate
- Hot – Humid
- Hot – Arid

- The Cold Region includes areas with extremely long and cold winters and limited hours of sunlight in winter.
- Alaska, North Dakota, Minnesota, Maine

Image Source:
http://www.alpine-charms.com/mure_ext_2.jpg

Climate Inventory:
Deep Snow, Strong Winds, High Wind-Chill Factor, Deep Frost, Alternating Freeze-Thaw Cycle, Rapid Spring Melt

Analysis:
Need to minimize heat loss and maximize solar radiation. Need to protect from winter winds.

Design Response:
Massive low-profile, well insulated structures with limited glass areas, maximum sun exposure, minimum wind exposure and protected entries.

How do the four (4) climate zones differ?

- Cold
- Temperate
- Hot – Humid
- Hot – Arid

- Variable temperatures from warm to hot in the summer to cold in the winter and moderate in the spring and fall
- Oregon, Ohio, Pennsylvania, New York

Image Source:
http://www.realestatewebmasters.com/blogs/uploads/Image/Nashville%20Images/DSC_0070.JPG

Climate Inventory:
Seasonal and variable temperatures changes throughout the year. Changing wind directions and violent storms. Alternating periods of drought and flood.

Analysis:
Construction to withstand the worst of the storms and provision for all-weather durability and maintenance.

Design Response:
Minimize need for cooling, heating and ventilation. Orient building to minimize summer heat gain, maximize summer breezes and protect from winter winds.

How do the four (4) climate zones differ?

- Cold
- Temperate
- Hot – Humid
- Hot – Arid

- Categorized by consistently high temperatures and low humidity
- Arizona, New Mexico, Nevada, Death Valley & Southern California

Image Source:
http://www.deadmentellnotales.com/onlinetexts/potc/images/2bayou.jpg

Inventory:
Temperatures relatively high with high humidity, torrential and sudden rainfall, storm winds of hurricane force

Analysis:
Elevate structures above the ground, facing into the breeze, and insect proof critical areas.

Design Response:
Cool by all feasible means; open building plans, high ceilings, louvered openings, breezeways and natural ventilation.

How do the four (4) climate zones differ?

- Cold
- Temperate
- Hot – Humid
- Hot – Arid

- Categorized by consistently high temperatures and high humidity
- Florida, Georgia, Alabama, Mississippi, South Carolina

Image Source:
http://room42.wikispaces.com/file/view/2.jpg/33517415/2.jpg

Inventory:
Temperatures relatively high and dry. Goes from the extremes of hot during the day to cold at night. Annual rainfall is minimal.

Analysis:
Lack of water is a major concern. Provide catchment of spring rainfall from roofs courts and paved areas.

Design Response:
Thick walls, high ceilings, wide overhangs, light colored exterior materials and cool compact dim interior spaces.

End of Lecture