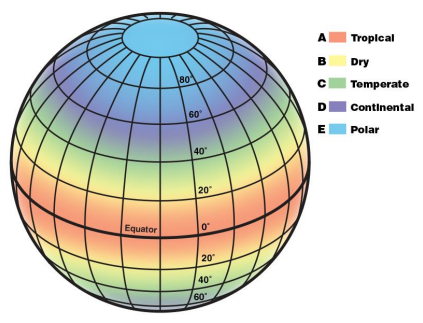
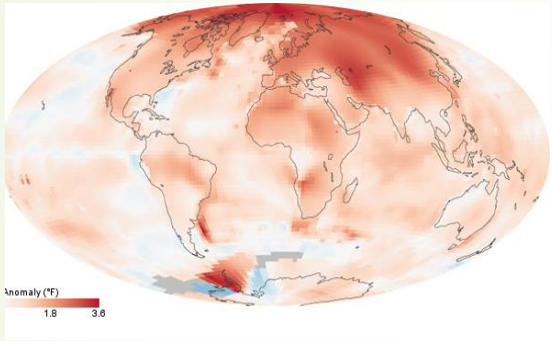
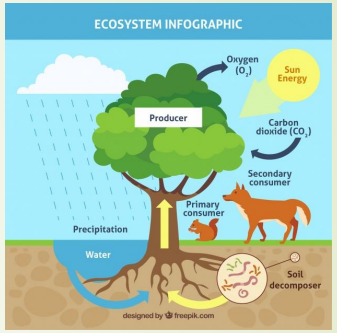
Biodiversity and Climate Change







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Biodiversity and Climate Change

- Contents
  - What is Biodiversity?
  - Importance of Biodiversity
  - Ecosystem Concept
  - What is climate?
  - Global warming and Extreme Events
  - Link between biodiversity and climate
  - Impact of climate on biodiversity

Biodiversity and Climate Change

What is Biodiversity?

The variety and variability among the living beings

Garden - 1

Garden - 2

Biodiversity and Climate Change

What is Biodiversity?

The variety and variability among the living beings

Biodiversity and Climate Change

What is Biodiversity?

The variety and variability among the living beings

India

- Total forest cover – 21.64%
- Total flora ~45,000
- Total fauna ~ 90,000
  - 7.6% Mammals
  - 12.6% Avians
  - 6.2% Reptiles
  - 4.4% Amphibians
  - 11.7% Fishes
  - 6 .0% Flowering plants

Importance of Biodiversity

Healthy Environment
(Habitat)

Healthy Ecosystem

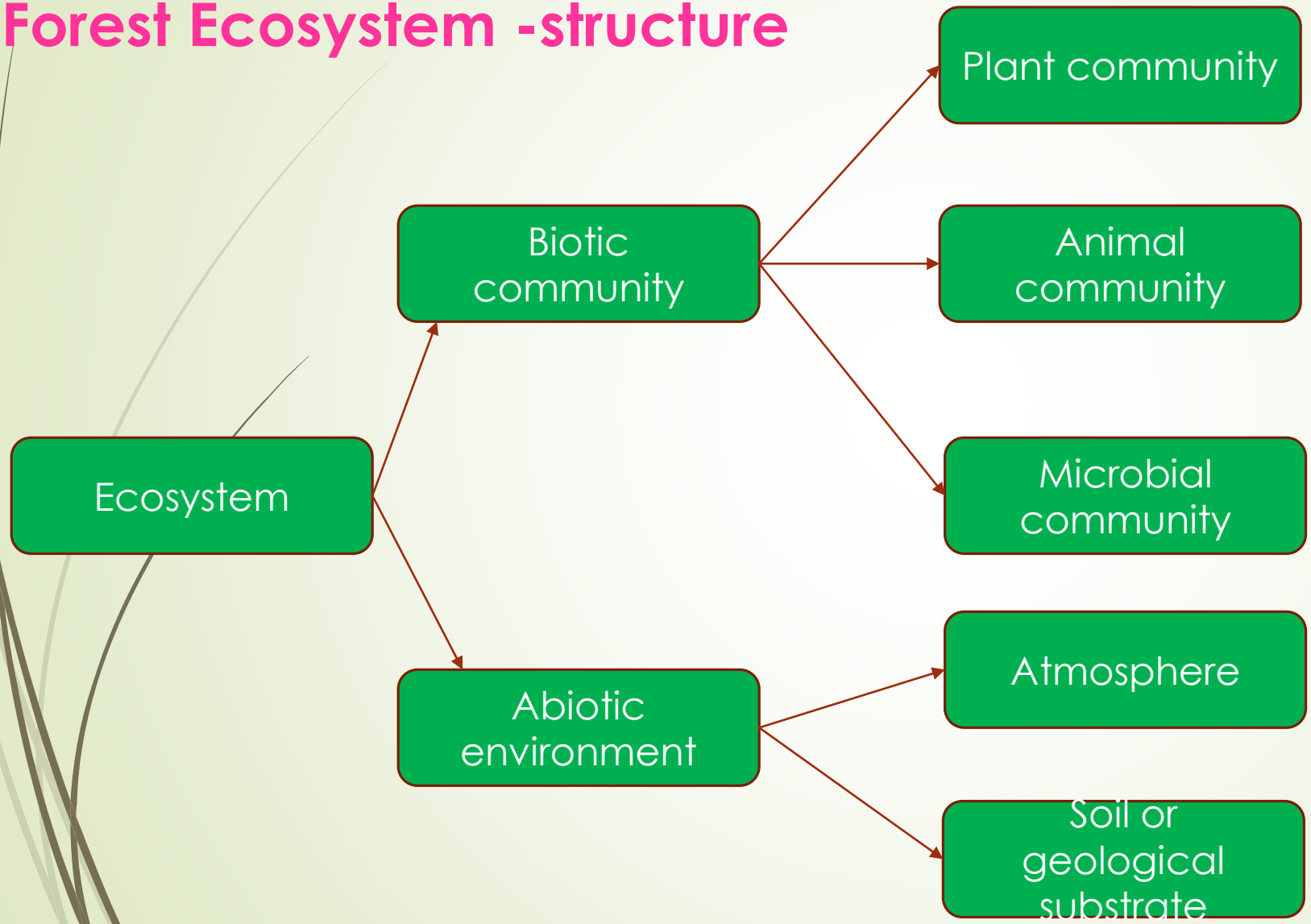
Biodiversity and Climate Change

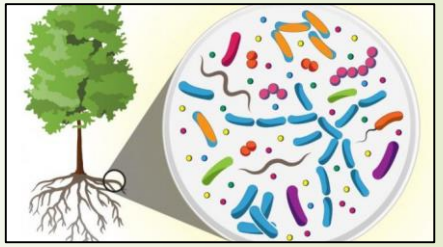
The Ecosystem concept

- Whittaker (1975) "an ecosystem is a functional system that includes an assemblage of interacting organisms (plants, animals and saprobes) and their environment, which acts on them and on which they act"
  - Ecosystem – a concept not a physical entity
  - Ecosystem – five major attributes
    - ❖ Attribute of structure
    - ❖ Attribute of function
    - ❖ Attribute of complexity
    - ❖ Attribute of interaction and interdependency
    - ❖ Attribute of temporal change

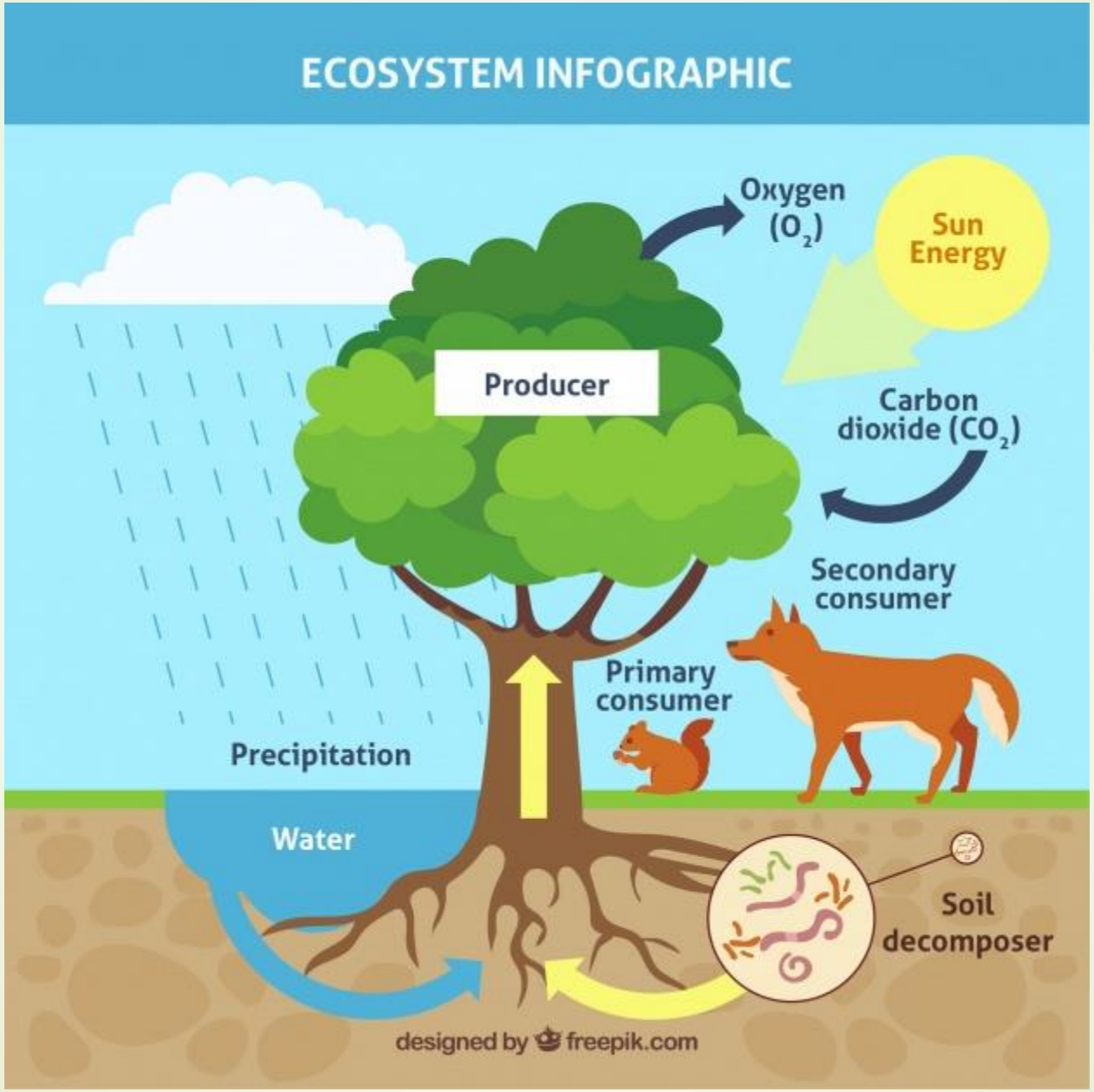
Biodiversity and Climate Change

Forest Ecosystem -structure





Biodiversity and Climate Change



Biodiversity and Climate Change

The Ecosystem concept

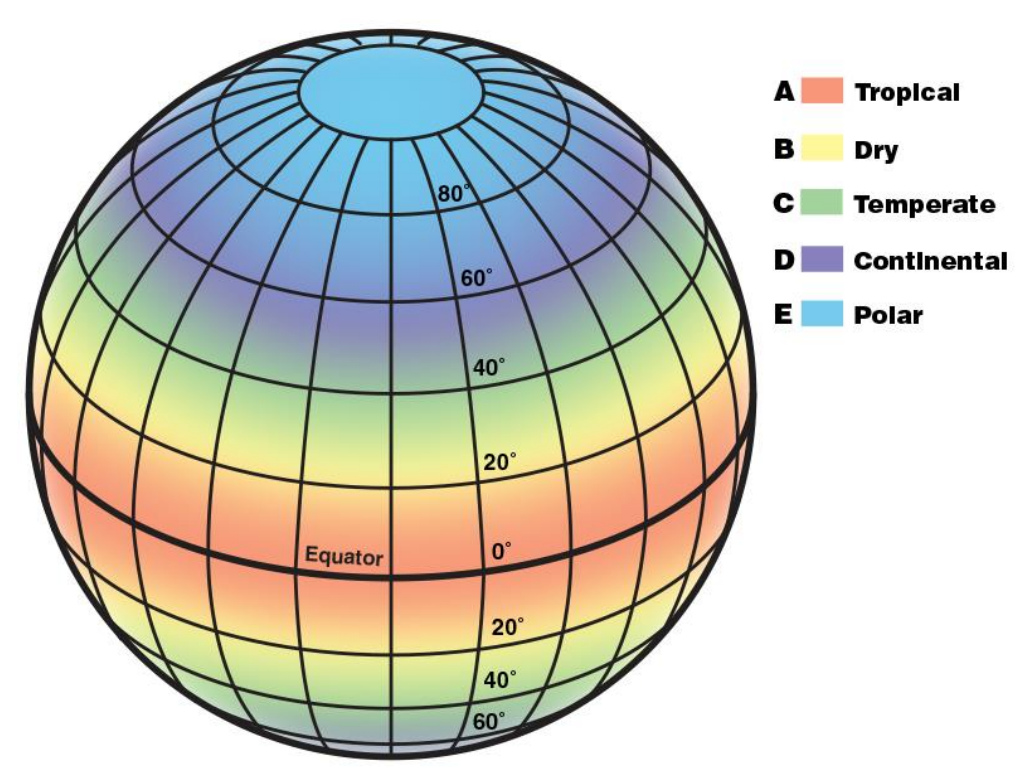
- Attribute of function
  - Exchange of energy between physical environment and living community
- Attribute of complexity
  - High level of biological integration
- Attribute of interaction and interdependency
  - Change in any one will result in a subsequent change in all the others
- Attribute of temporal change
  - Not static, entire structure and function of an ecosystem undergo change over time

Importance of Biodiversity

- Healthy Environment
- Healthy Ecosystem
- Proper Ecosystem function
  - Water purification
  - Air purification
  - Nutrient cycling
  - Soil erosion control
  - Supply of wood and other products
  - Climate regulation
- Wild genetic resources
- Medicinal values

Climate

- Longtime average of weather ~ 30 years



A: Tropical - hot and humid zone, mean temperature >18°C, ~150 cm of rain.

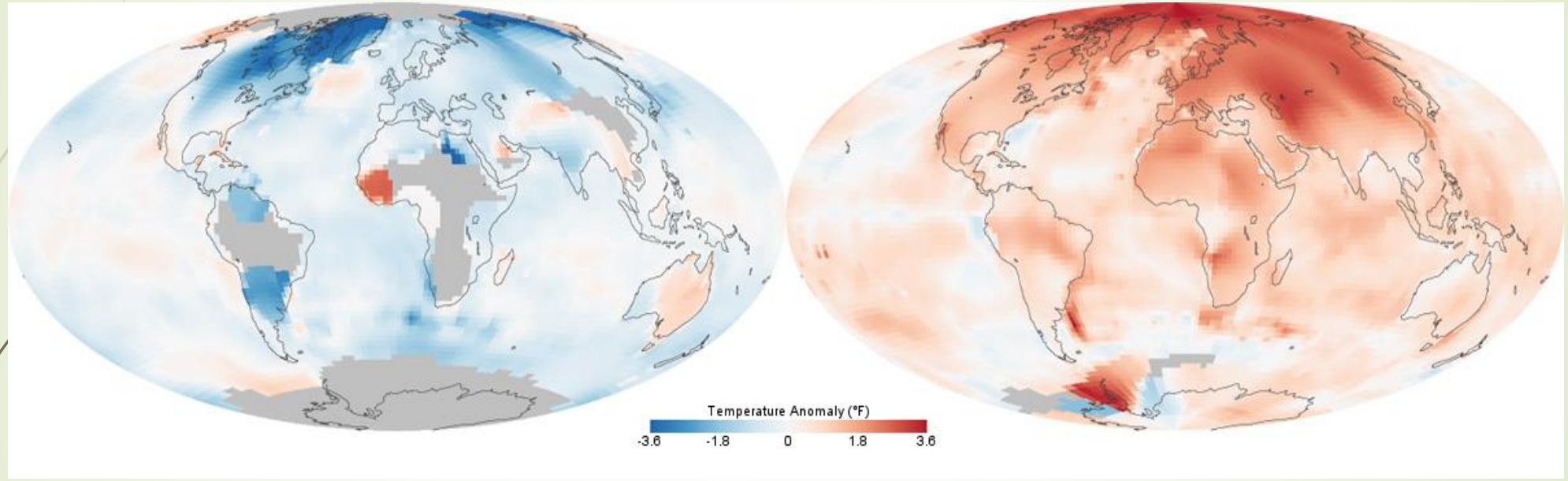
B: Dry - dry and very little precipitation.

C: Temperate - warm and humid summers with thunderstorms and moderate winters.

D. Continental - warm to cool summers and very cold winters. In the winter, this zone can experience snowstorms, strong winds, and very cold temperatures—sometimes falling below -22°F (-30°C)

E: Polar - extremely cold throughout the year

Global Warming

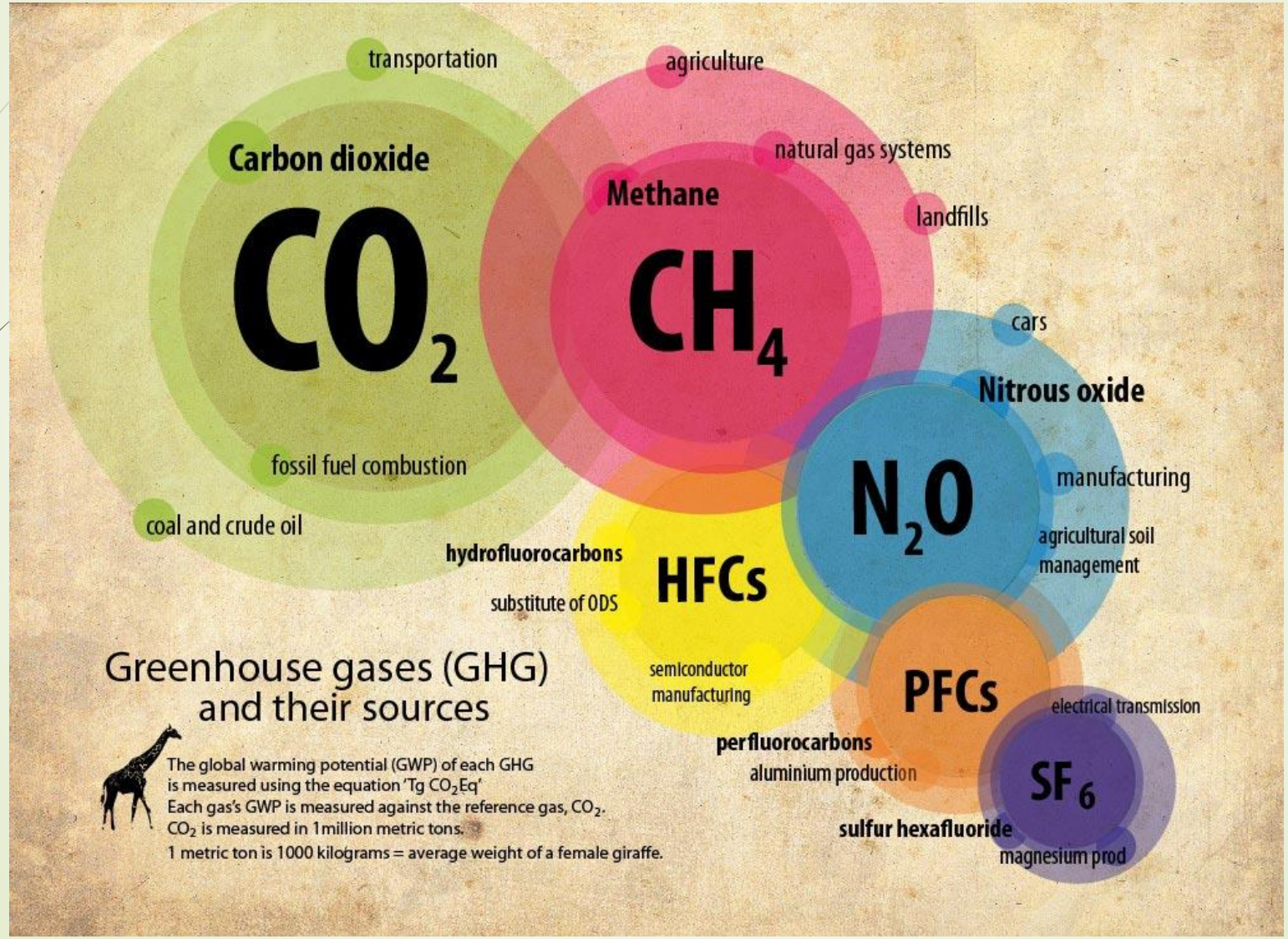


1880

1980

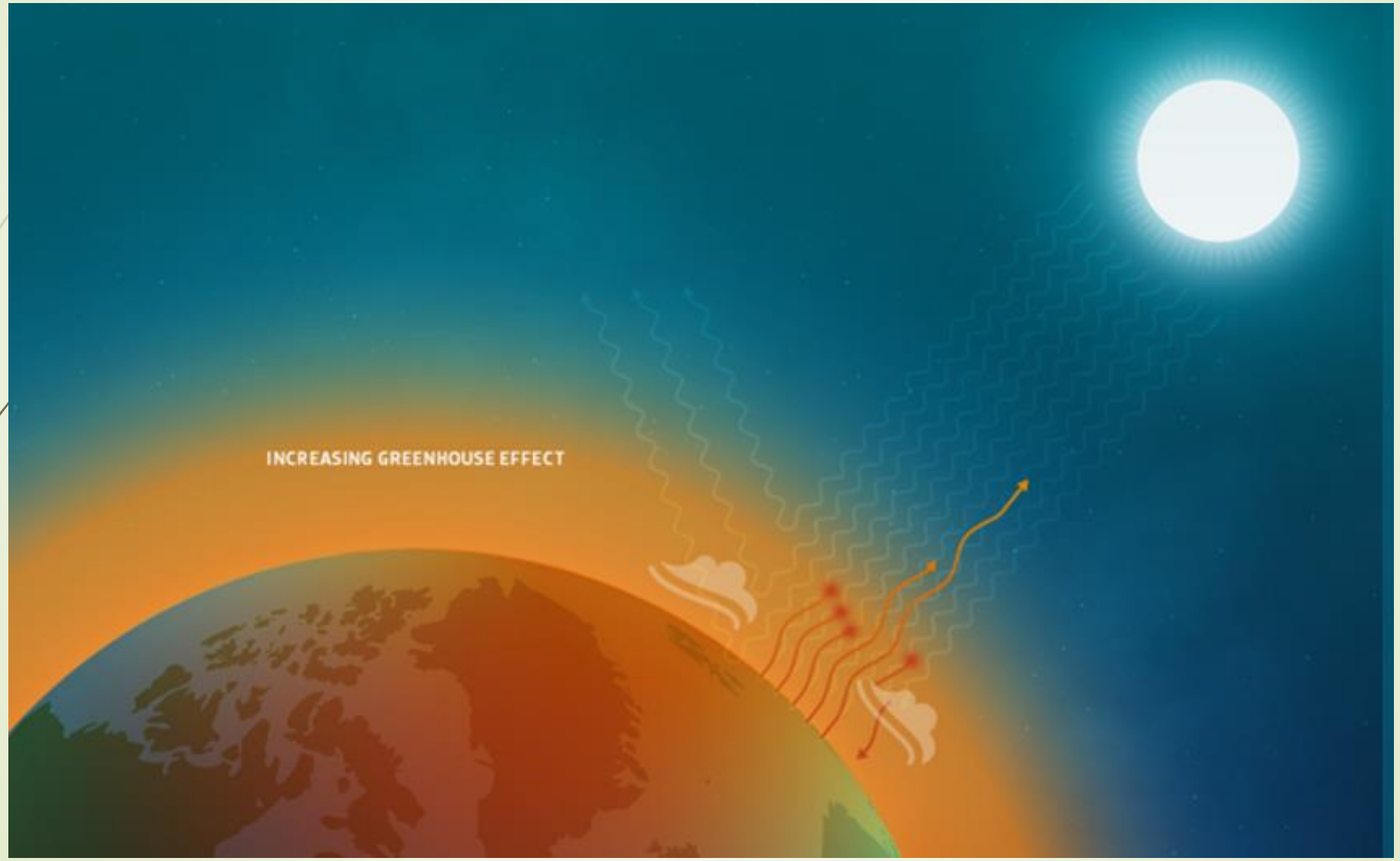
Biodiversity and Climate Change

Green house gases



Biodiversity and Climate Change

Green house effect



Global Warming Potential

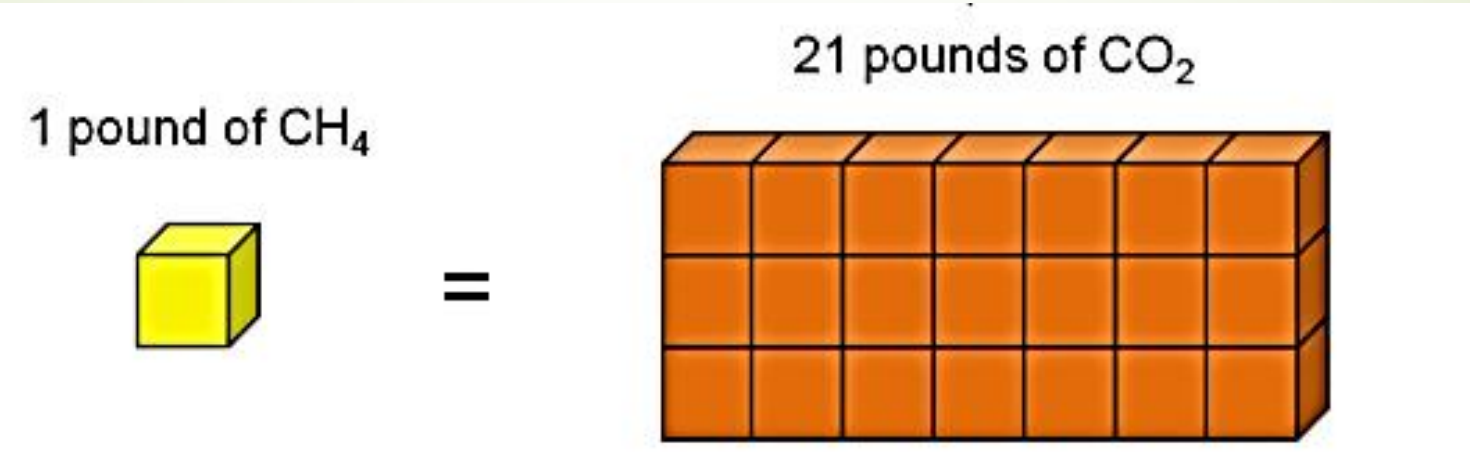
GHG - character

1. How well the gas absorbs energy?
2. How long the gas stays in the atmosphere?

Global Warming Potential (GWP) for a gas is a measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide (CO_2)

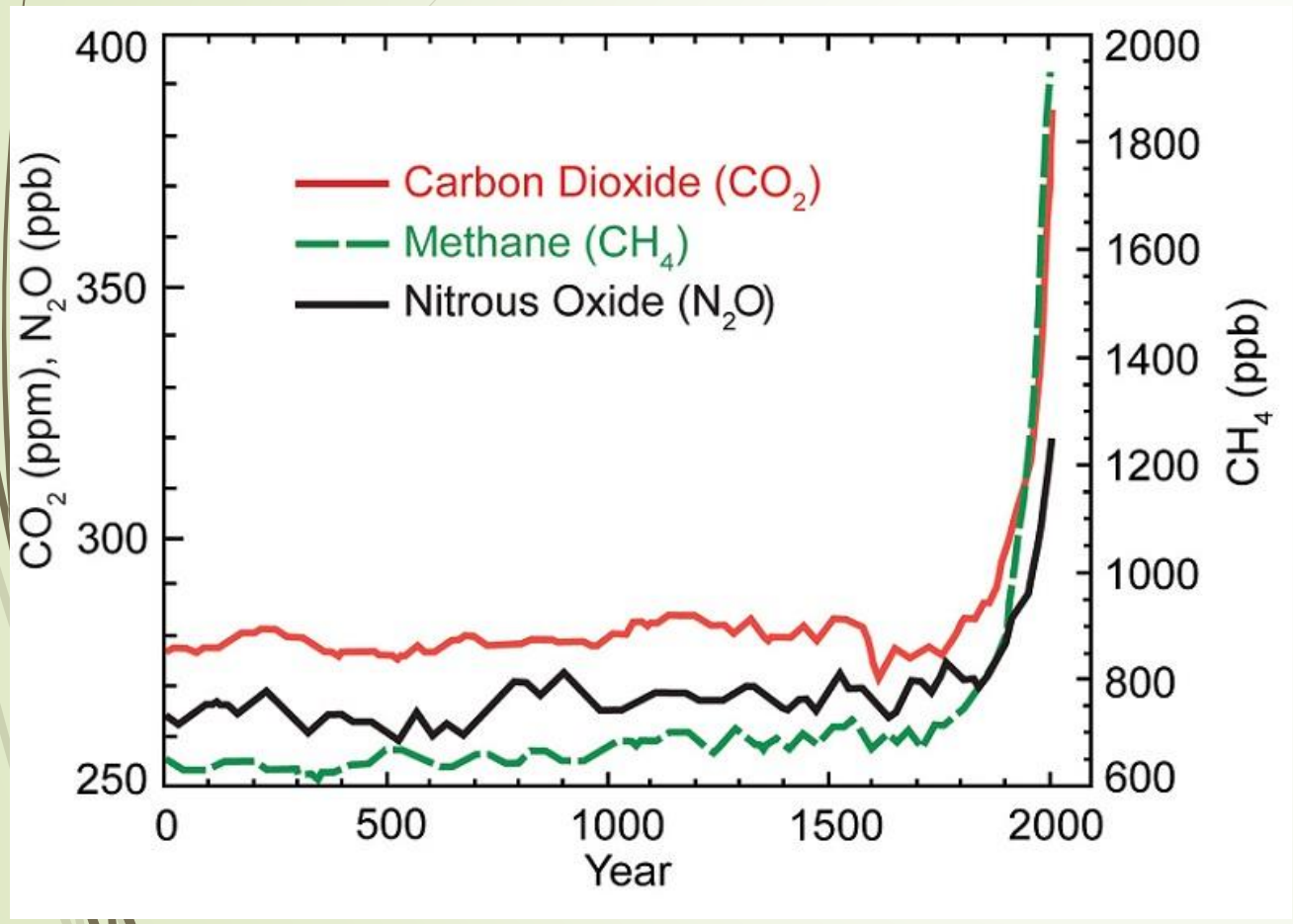
Biodiversity and Climate Change

- Methane's (CH_4) 100-year GWP is 21 – last a decade



- Nitrous oxide (N_2O) has a GWP 300 times that of CO_2 for a 100-year timescale – lasts for 100 years
- Chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6) – High GWP gases

GHG in Atmosphere



In 2019, greenhouse gas concentrations reached new highs.

- Carbon dioxide: 410.5±0.2 ppm
  = **148% of preindustrial levels**
- Methane: 1877±2 ppb
- = **260% of preindustrial levels**
- Nitrous oxide: 332.0±0.1 ppb
  = **123% of pre-industrial levels.**

The State of the Global Climate 2020

Extreme Events

- Largest Wildfire in California and Colorado, USA
- Eastern Australia

Extreme Events

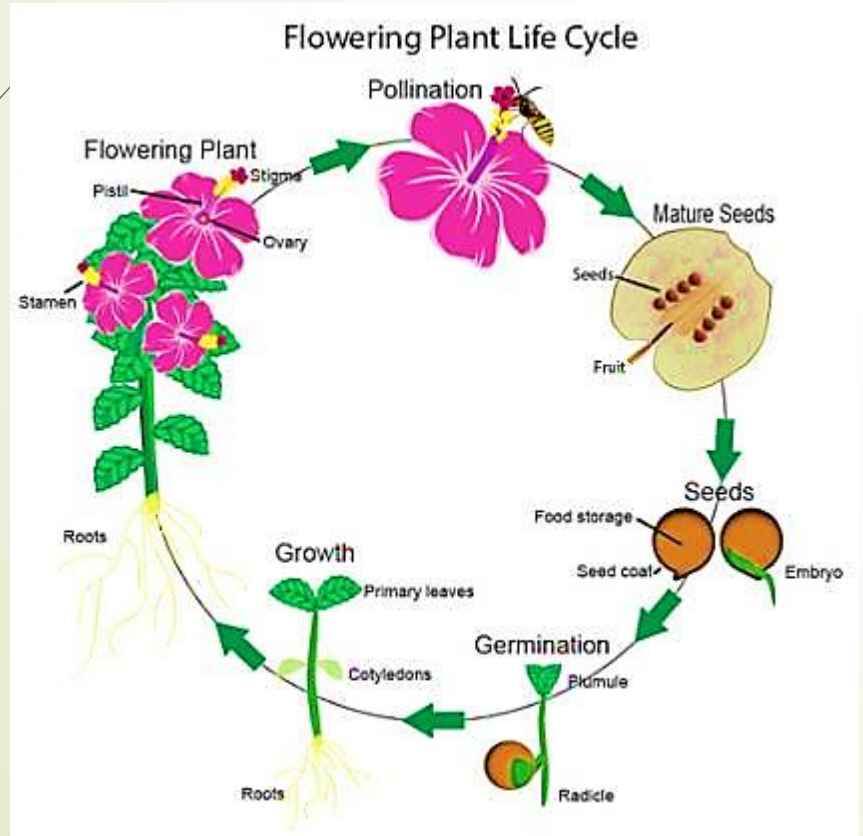
- **Extensive Flood** – Africa (Sudan, Kenya) and Asia (India, Pakistan, Nepal, Bangladesh, Afghanistan, Myanmar, China and Vietnam)
- **Severe drought** – South America (Argentina, Paraguay, Brazil, Uruguay)
- **Heat-Waves** – Russia (Siberia), Australia, Mexico, Cuba, Dominica and Puerto Rico.
- **Cold Waves** – North America (Colorado, Denver, Montana) and South America
- **Severe Storms** – Philippines - Typhoon Goni – wind speed 220 km/h, Korean Peninsula – two typhoons, Vietnam – four tropical cyclone, Madagascar – Cyclone Diane, USA and Australia

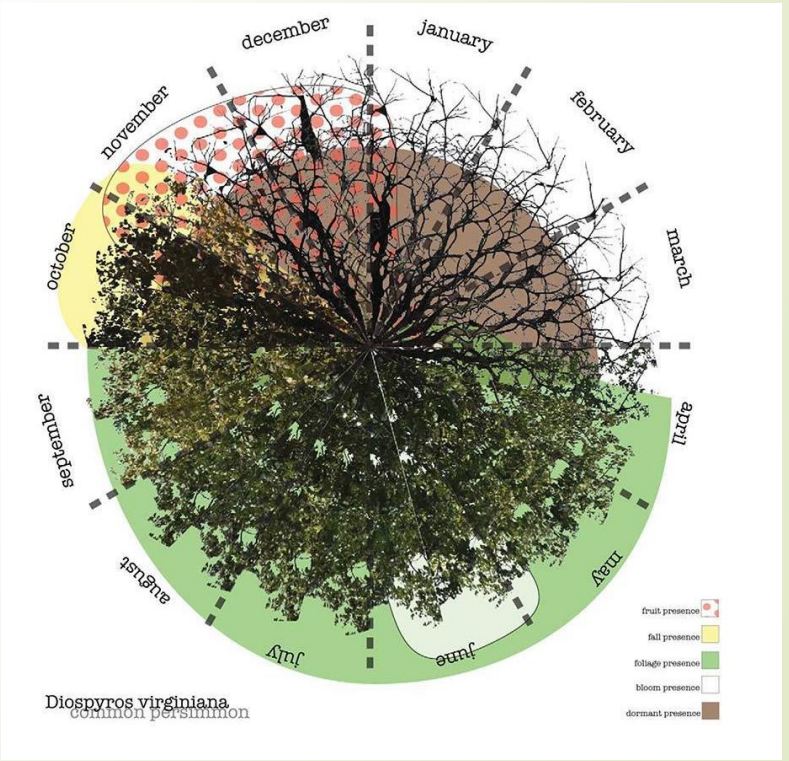
The State of the Global Climate 2020

Link between Climate and Biodiversity

- All the biological events of every organism is dependent on Season.
- Season – the temperature and humidity of air

For Eg.





https://www.asla.org/2014awards/579.html

Link between Climate and Biodiversity

- Rhythms of nature are living processes
- Why does a plant flower when it does?
  - **Photoperiodism**
    - long-day plants
    - short-day plants
    - day length indifferent plants
  - **Vernalisation**
    - Low temperature
    - High temperature

Link between Climate and Biodiversity

- Long-day plants – Green house – Vegetative growth
- Short-day plants – Green house – Vegetative growth
- Number of days of exposure

  Short day plant: Chrysanthemums – budding in LD but opening in SD

  Short day plant: Strawberry - budding in SD and opening in LD

Link between Climate and Biodiversity

- Photoperiodic induction
  - Minimum number of days – LD/SD – ability to form bud

Eg. Mexican sunflower, *Tithonia speciosa*, - needs long nights of about 14 hours for two to three weeks – to form flower buds

Link between Climate and Biodiversity

Vernalisation - many plants must pass through a period of fairly low temperatures before they can flower

- Composition of LD /SD + low/high temperature varies for different plants
- In temperate climates the majority of plants are long-day (flower in the summer).
- In the tropics, they are mostly short-day (flower in winter)

Link between Climate and Biodiversity

The cocklebur
(*Xanthium pennsylvanicum*)

Highly Sensitive:
This plant will never flower in days of 16 hours or more—it just vegetates, and grows to an enormous size. But if it has just one day 15 hours long or less, it starts flowering, and goes on doing so even if the days revert to 16 hours

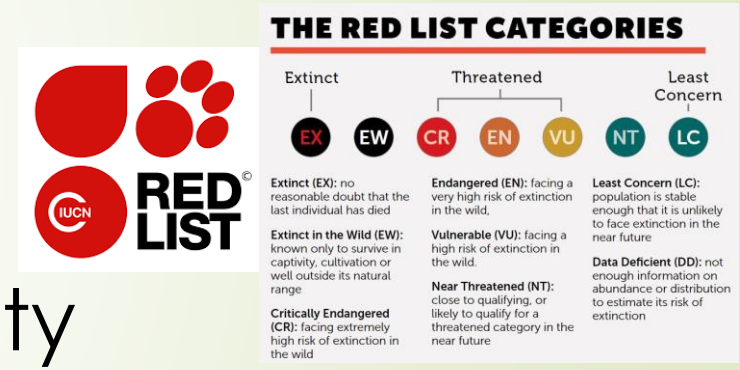
"Not all plants are sensitive"

Impacts of Climate change on Biodiversity

- Change in climate – not uniform
- Climate change – change in start and length of seasons
- Increased extreme weather events
- Change in season affects – species and Ecosystem
  - Species – affects climate envelope of all species
  - Plants – seed germination, establishment, growth, flowering, pollination and seed dispersal, ultimately population
  - Birds and insects – migration, egg laying and breeding
  - Animals – reduced food, increased competition, reduction in population size
- Ecosystem level
  - Distribution, composition and function

Impacts of Climate change on Biodiversity

- Population size of each species varies
- Endemic species – specific climate envelope – low population size
- Plants can not migrate
- Red listed species – more vulnerable
- More invasive species – less biodiversity
- Change in species composition
- Affects Ecosystem structure and function
- Change in climate cannot favor all the species



Thank you