

# Environmental Science

## CLASS 5 (Journal Entry 5)

- **1:30-2:15:**
  1. **Reminders:**
    1. Did your team email me with team name and team members? If not, please do so in class today
    2. Quiz 1 next Thursday – Open Journal
      - Is your journal complete?
  2. Check out my faculty website
  3. **Slides:** Introduction to Ecology and Ecosystems
- **2:15-3:05:**
  1. Team Activity: Ecosystem Structure
  2. Each team share 1 terrestrial and 1 aquatic system with class



# Ecology & Ecosystems

# Four Global Challenges

1. Increasing population growth

2. **Declining Ecosystems**

– Ecosystem resources and services, aka, natural wealth, in jeopardy

– Ecology: A branch of Env Sci

3. Global Warming and Climate Change

4. Loss of Biodiversity

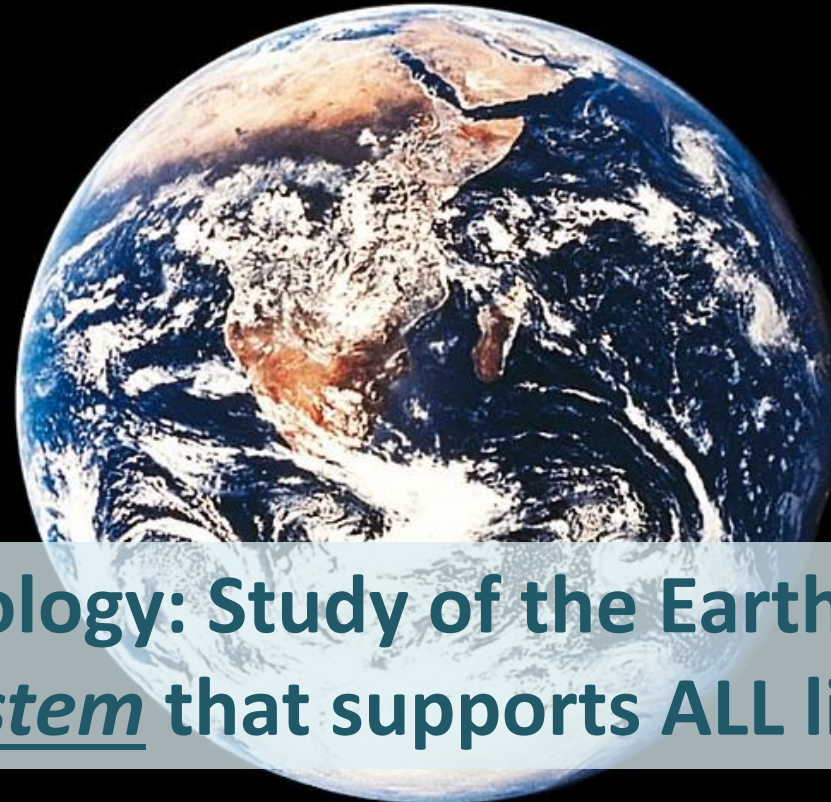
– Loss of life at many scales

# Ecology

Two Greek words

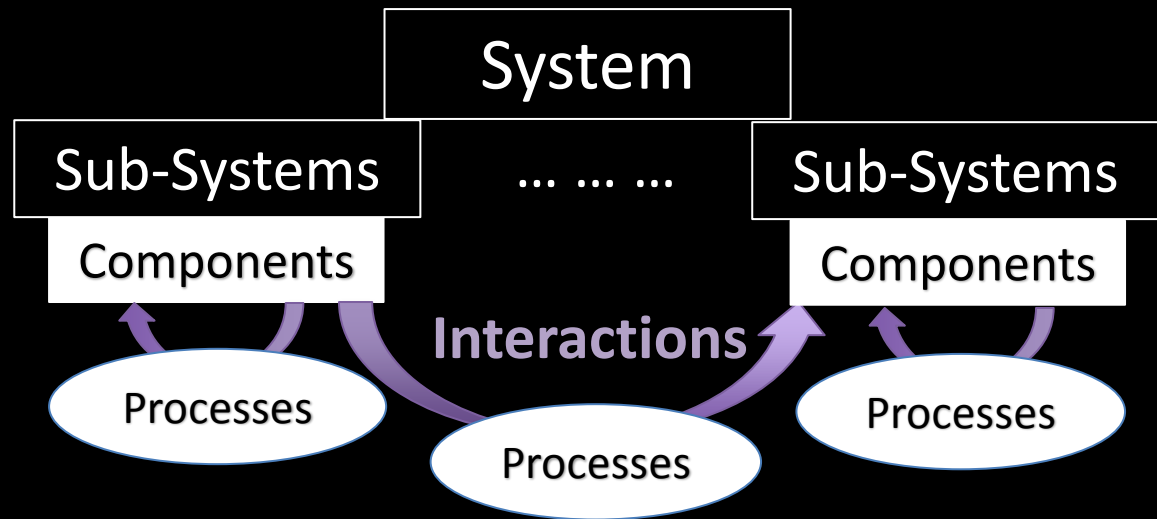
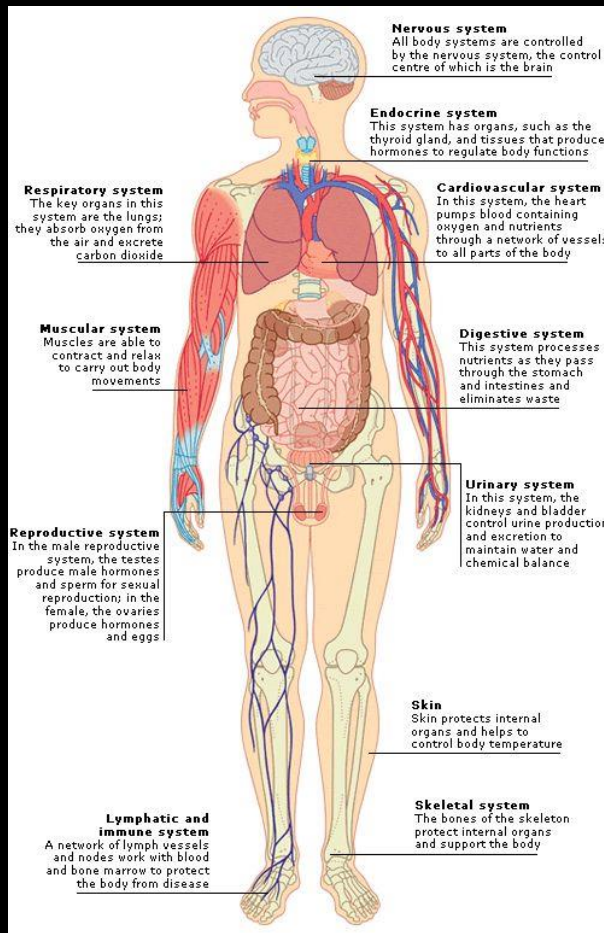
“oikos” = “house” or “place to live”

“logos” = “systematic study of”



Ecology: Study of the Earth as a System that supports ALL life

# System – A familiar example

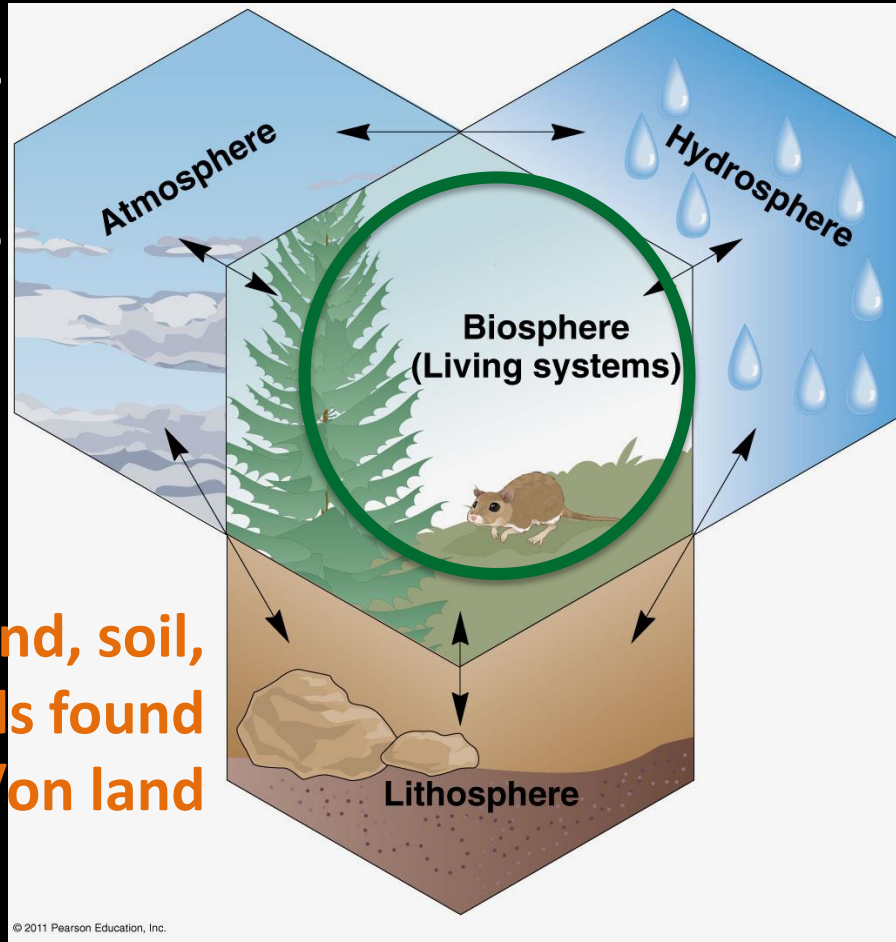


## Hierarchy

- **System:** Human body
- **Sub-systems:** Digestive, Circulatory, Endocrine, ...
- **Components:**
  - Mouth, Stomach, Digestive Enzymes
  - Endocrine glands, Hormones
- **Processes:** Blood circulation, Nerve impulse transmission, Muscle contraction, ...

# Earth's Systems

Atmospheric-  
layers, air and  
its components



Land, soil,  
chemicals found  
in/on land

Water bodies,  
water and  
chemicals  
dissolved in it

## Processes

### Geological

- *Non-living systems*

### Biological

- *Biosphere*

### Bio-geo-logical

- *Biosphere ↔  
Non-living systems*

**Ecosystem = Biosphere + Bio-geo-logical Interactions**

**Ecology = Study of Ecosystem**

# *Understanding Ecosystems*

➤ *How are they structured? Components*

*How do they work? Processes*

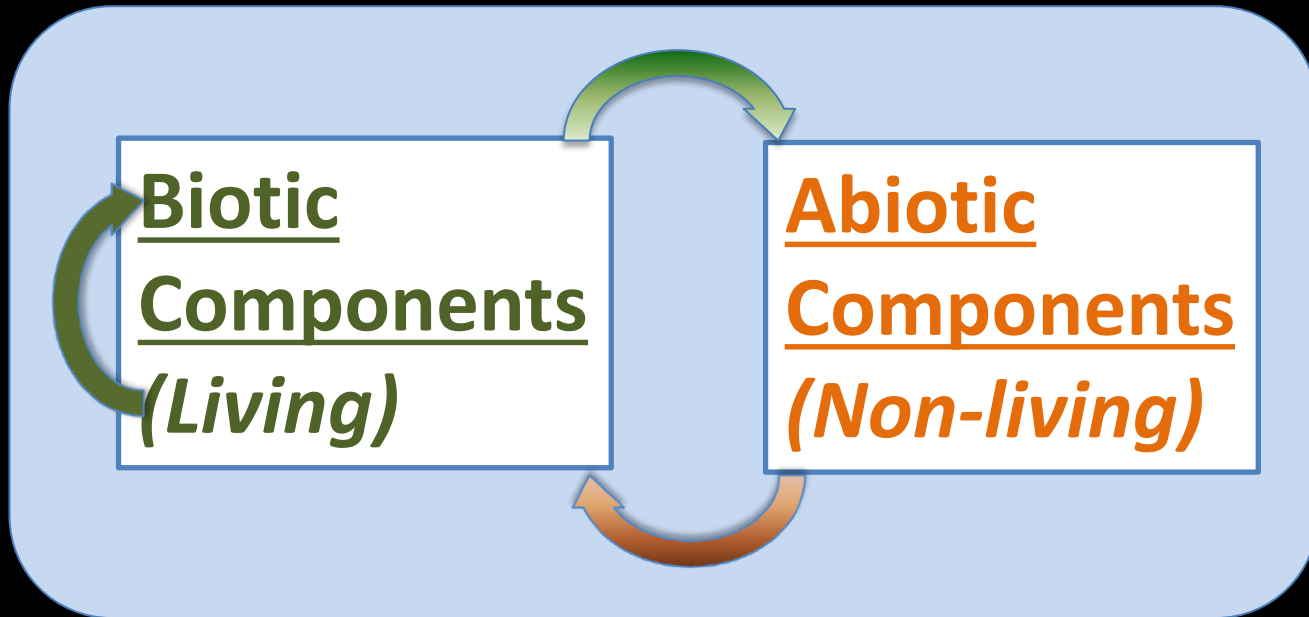
*Why are they important? Services*

*How do they change over time? Dynamics*

*Why are they long-lasting? Sustainability*

*Can we sustain them? Stewardship*

# *Ecosystem Structure*



Interacting Unit

What are the Biotic and Abiotic components?  
How do we begin to understand this complexity?

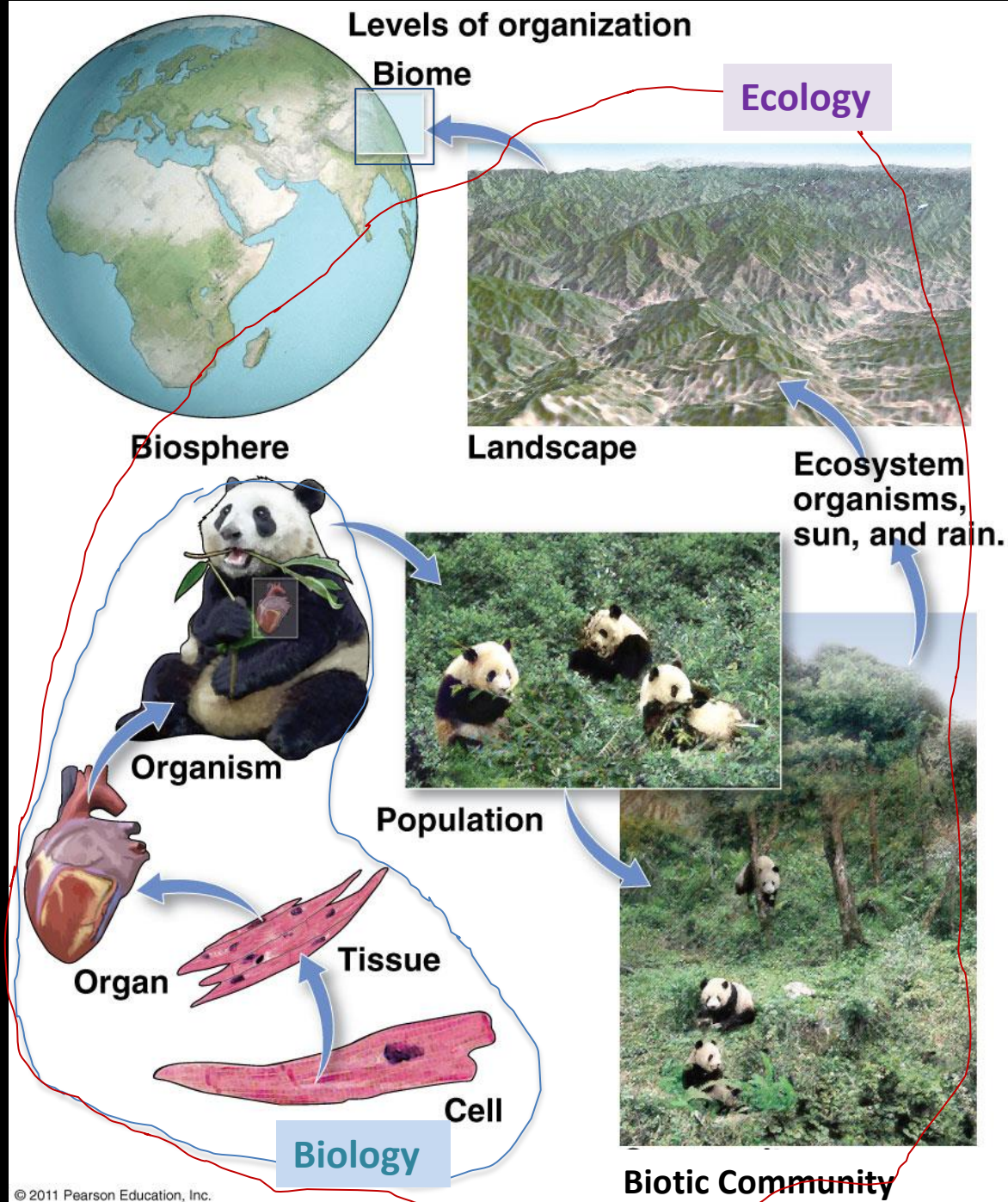
**Look for patterns of organization**



# Biotic Components

## Ecological Hierarchy

## The Hierarchy of Life



# *The Ecological Hierarchy*

- **Organism**
  - **Population**
  - **Habitat**
  - **Niche**
- **Biotic Community**
- **Ecosystem**
- **Landscape**
- **Biome**

In a typical SF Bay Area natural landscape with mixed forests, grassland meadows with California poppy and chaparral

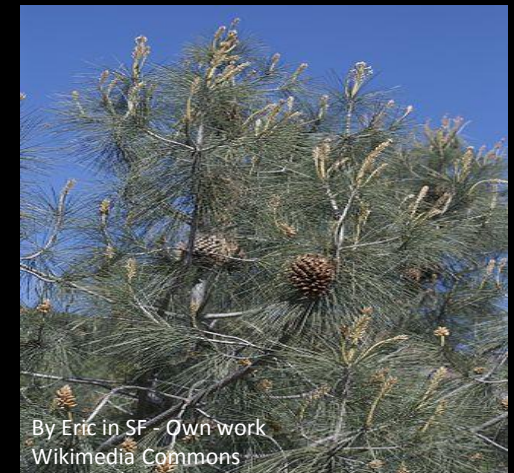


# Organism

## Biological Species

### Interbreeding organisms

- Differ in small visible details
- Often determined by genetics



# Population

Group of Individuals  
of the same species  
in a given location



# Habitat

- Place where a species (individual or population) is typically found
  - Environment that meets the species needs
  - **E.g., California Poppy's habitat requirements**
    - Open to sunshine
    - Wet winter, Dry summer (Mediterranean)
    - Moderate temperatures and rainfall
    - Poor soil okay
    - Insects to reproduce
    - **Typical of "Mediterranean" Grasslands**



# Biotic Community

- Multiple species (populations)  
(bacteria, protists\*, fungi, plants & animals)
- Living together in a particular area
  - Exposed to the same Abiotic environment
  - Interacting with each other
- *E.g., grassland community*

\*Protists are single-celled organisms, e.g., amoeba

How can so many species live and thrive in the same space?



Robbin Thorp



Yathin S Krishnappa, via Wikipedia.org



Cathartes aura -Florida -USA -flying-8-4c

# They avoid competition by occupying an **Ecological Niche**

- The **specific way** a species uses the habitat
  - Enabled by special **adaptations**
  - Gives rise to **roles** in ecosystem
  - e.g., hunter, pollinator, grazer, de-tri-ti-vore

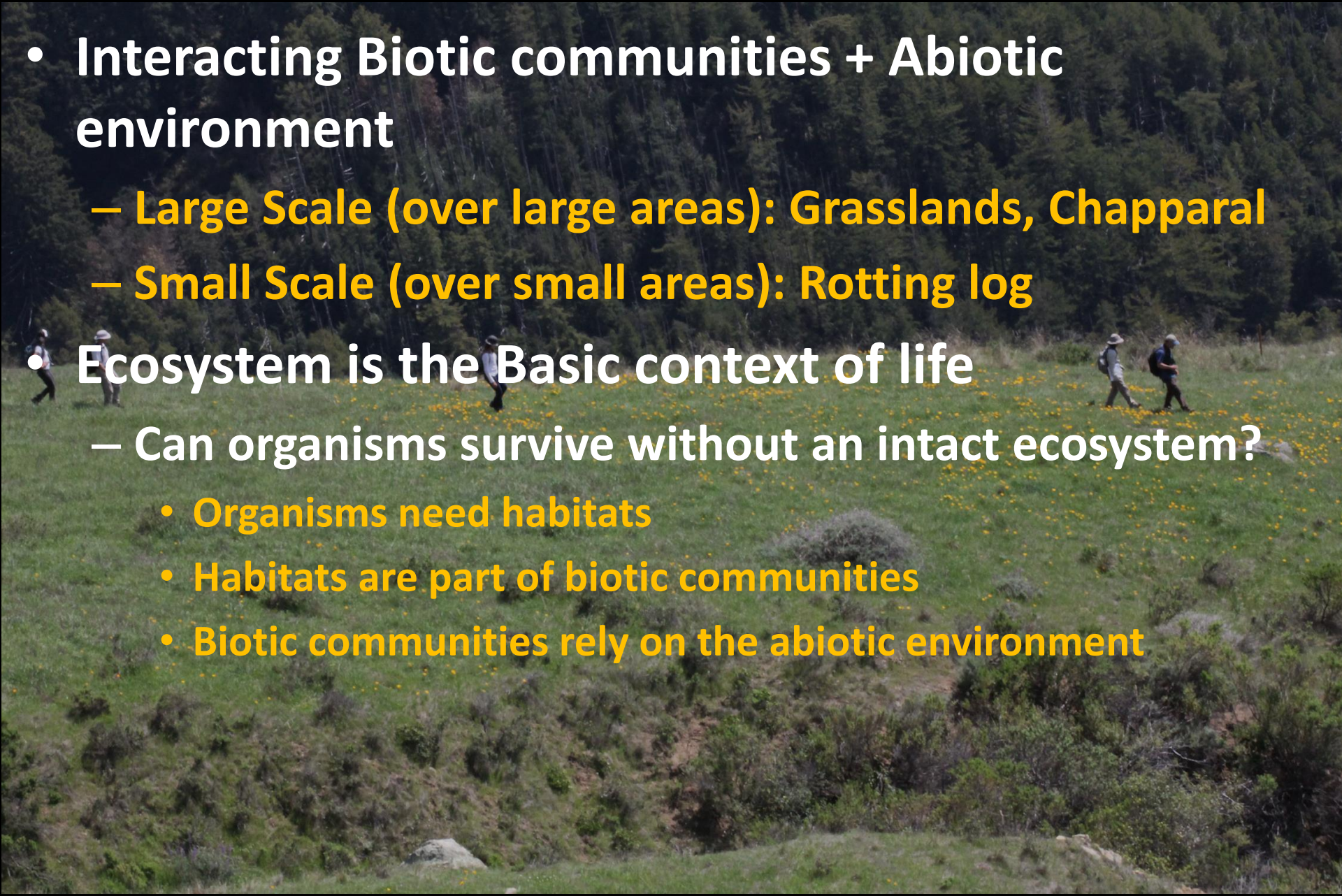
© R. Curtis/VIREO



Kevin Cole from Pacific Coast  
Yathin S Krishnappa, via Wikimedia Commons

# Ecosystem

- **Interacting Biotic communities + Abiotic environment**
  - **Large Scale (over large areas): Grasslands, Chapparal**
  - **Small Scale (over small areas): Rotting log**
- **Ecosystem is the Basic context of life**
  - **Can organisms survive without an intact ecosystem?**
    - **Organisms need habitats**
    - **Habitats are part of biotic communities**
    - **Biotic communities rely on the abiotic environment**





# Further Examples



**Tropical Rain  
Forest**

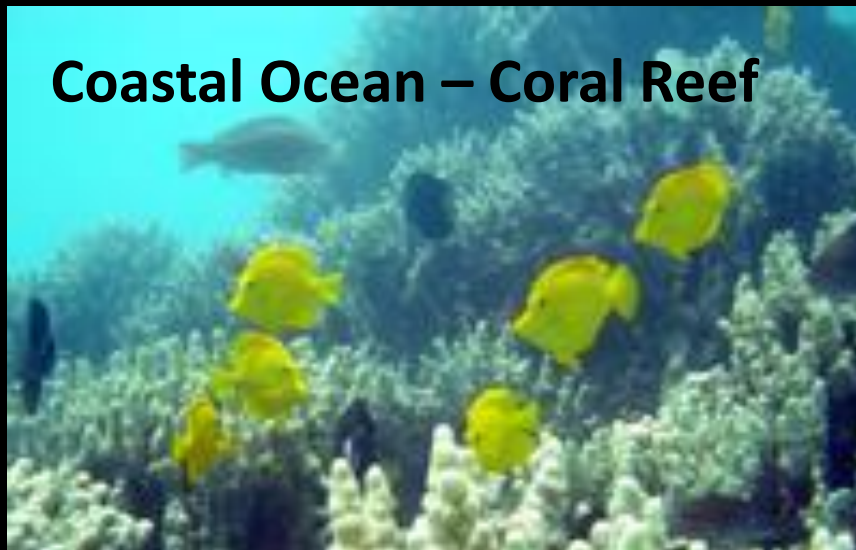
monteverdeinfo.com/sky-walk.htm



Quinn Dombrowski - Wikimedia

**Desert – Saguaro  
community**

W Clarke – Wikimedia

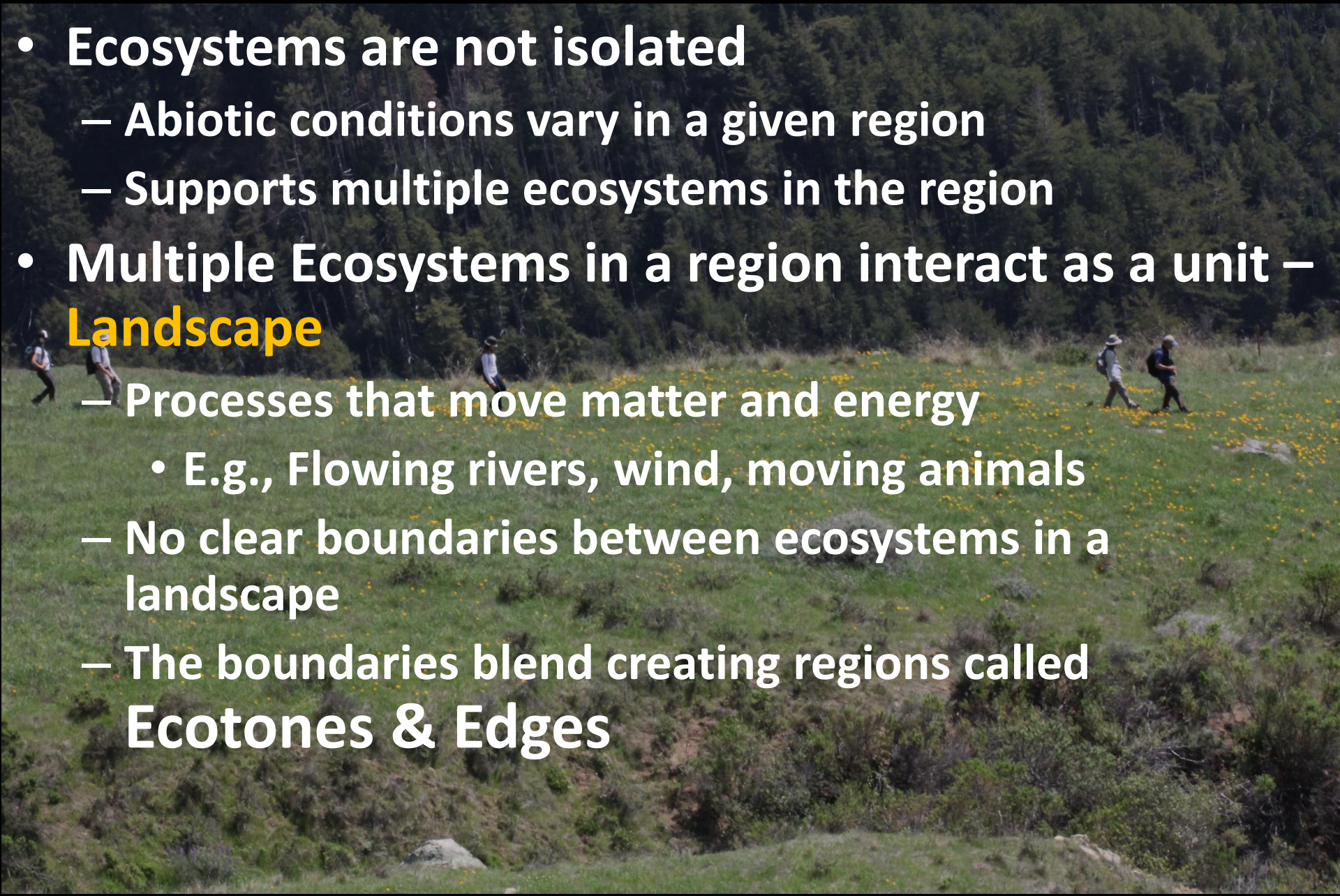


**Coastal Ocean – Coral Reef**

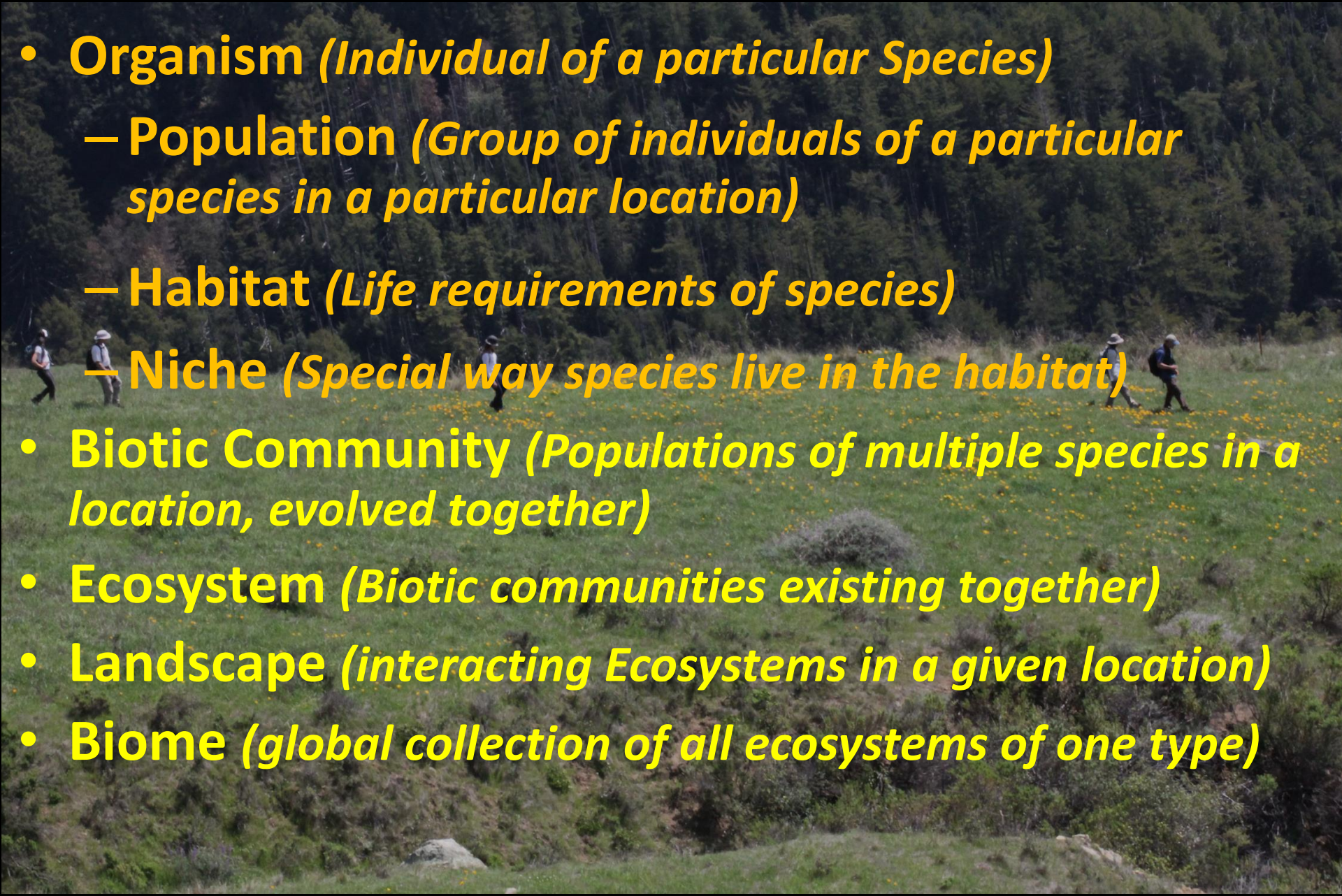
## Ecosystems and Niches

# Landscape

- **Ecosystems are not isolated**
  - Abiotic conditions vary in a given region
  - Supports multiple ecosystems in the region
- **Multiple Ecosystems in a region interact as a unit – Landscape**
  - Processes that move matter and energy
    - E.g., Flowing rivers, wind, moving animals
  - No clear boundaries between ecosystems in a landscape
  - The boundaries blend creating regions called **Ecotones & Edges**



# The Ecological Hierarchy

- **Organism** (*Individual of a particular Species*)
    - **Population** (*Group of individuals of a particular species in a particular location*)
    - **Habitat** (*Life requirements of species*)
    - **Niche** (*Special way species live in the habitat*)
  - **Biotic Community** (*Populations of multiple species in a location, evolved together*)
  - **Ecosystem** (*Biotic communities existing together*)
  - **Landscape** (*interacting Ecosystems in a given location*)
  - **Biome** (*global collection of all ecosystems of one type*)
- 
- A photograph of a grassy field with yellow wildflowers and a forest in the background. Several people are walking in the field.

An aerial photograph of the San Francisco Bay Area, showing the bay, surrounding mountains, and urban areas. Red lines are overlaid on the image, tracing the coastline and various inland boundaries. The text is overlaid on the central part of the image.

*...A unit of interacting  
Ecosystems  
The SF Bay Landscape*

*What do you  
see?*

# *Abiotic Components*

## Environmental Factors

Vary in Space and time

### Environmental Conditions

**Not consumed**

#### Examples

**Temperature**

**Wind**

**Acidity**

**Salinity**

**Humidity**

**Light**

### Environmental Resources

**Consumed**

#### Examples

**Food**

**Water**

**Oxygen**

**Carbon Dioxide**

**Space**

**Minerals**

*Environmental Factor*  
*Condition or Resource?*  
*Depends on the situation!!*

**Water**



# *Abiotic Environmental Factors*



*List all the abiotic conditions of this place*

# *Abiotic Environmental Factors*



*List all the abiotic resources of this place*



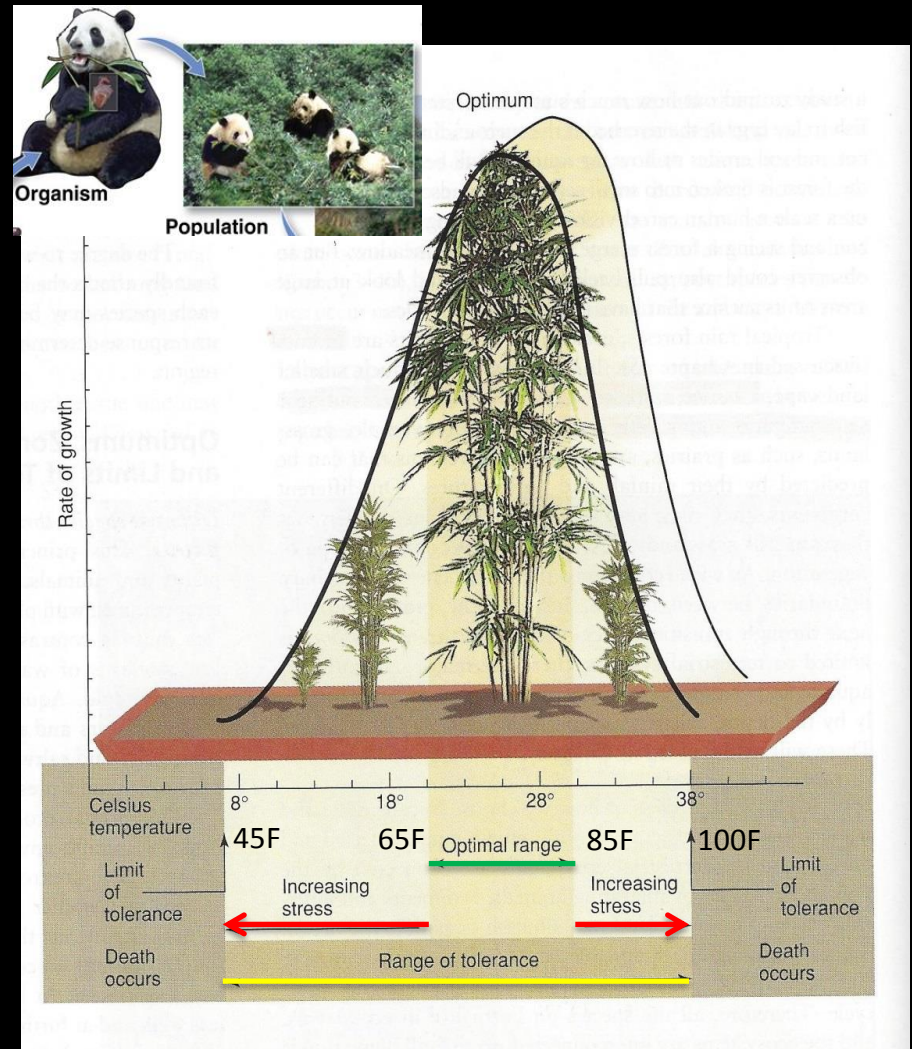
# Abiotic Factors Impact Ecosystems

## Through Growth of Species

- *Growth of Individuals (to reproduce)*
- *Growth of population (species viability)*

## Through Cascading Impacts

- *How does this species impact other species?*



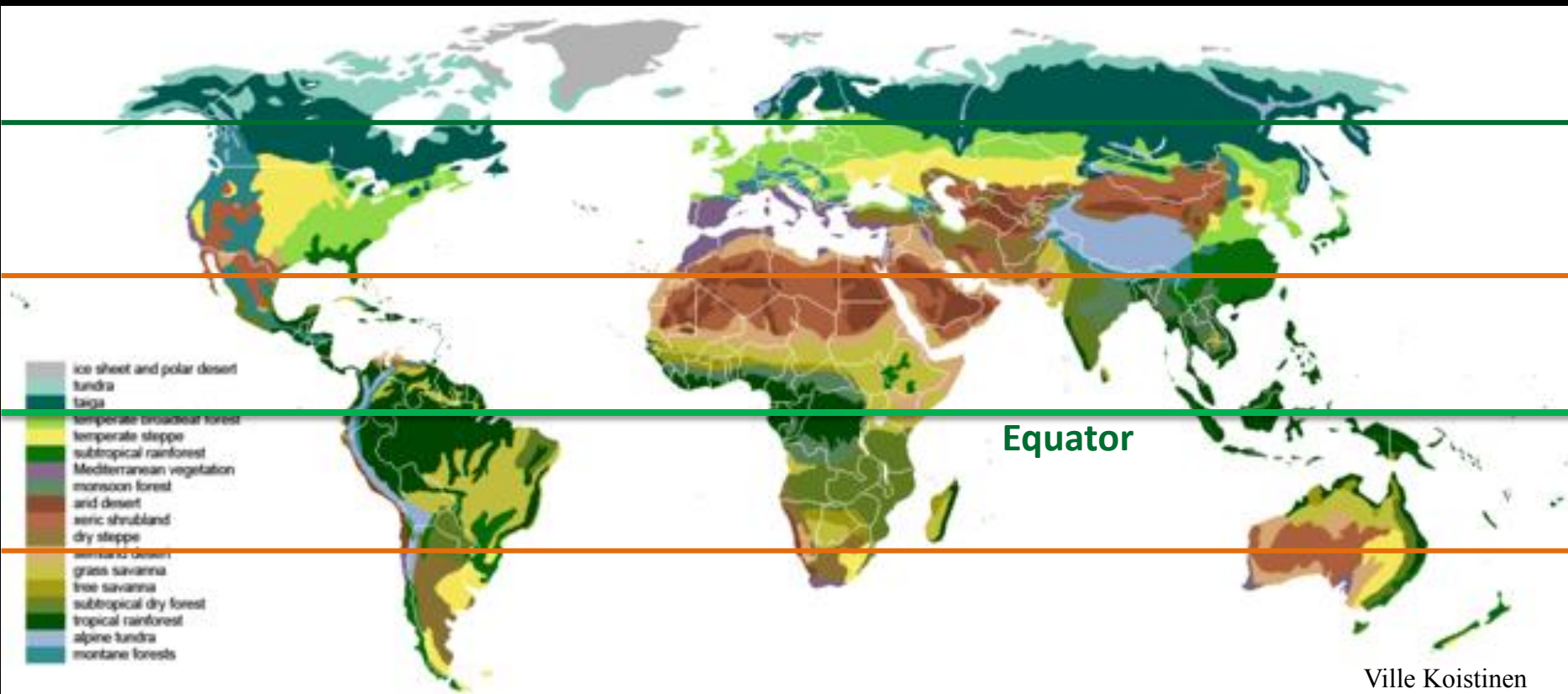
## A Fundamental Biological Principle

Every species has, for every abiotic factor

**Optimal Range, Limits of Tolerance, Zones of Stress**

- **Similar abiotic environments support similar biotic communities**
  - **Climate** (temperature, rainfall), **Geography** (latitude, altitude, aspect), **Soils**
  - Similar Ecosystems are replicated in different parts of the globe
- **E.g., Tropical Rain Forests**
  - Occur in areas of high humidity and high temperatures
  - Near the equator *all around the globe*

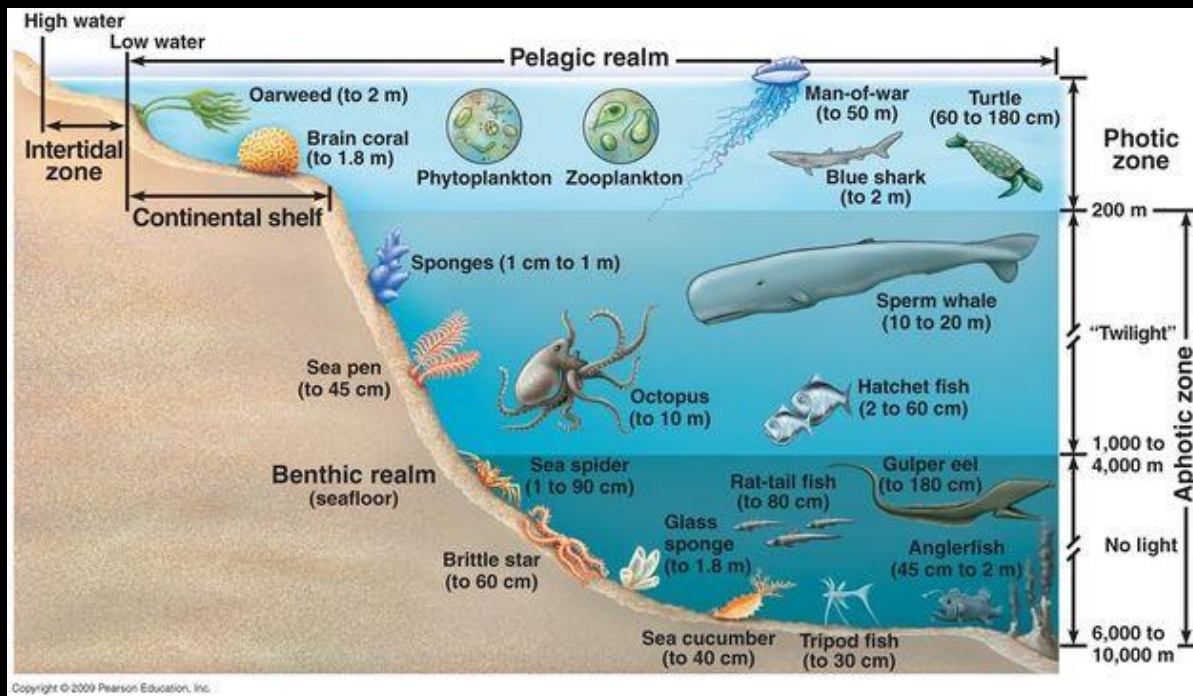
## Terrestrial Biomes



# Aquatic Biomes

Similar **aquatic abiotic environments** support similar **aquatic ecosystems** around the globe

- **Water depth, Water flow, Salinity**
- **Example**
  - **Deep ocean:** Past the continental shelf, deep water, high salinity
  - **Coastal ocean:** Shallow water, in photic zone, Coral reefs, Kelp forests



# Class 5 Team Activity: Ecosystem Structure

Source: Textbook, Environmental Science, Wright & Boorse, 12<sup>th</sup> Ed.

- Fill out the abiotic factors and biotic factors that characterize each of the ecosystems listed.
- List at least two places in the world where you would find them.
- When you return to class, write down your team name under one terrestrial biome OR one aquatic biome that you will present to the class.

# *Terrestrial Ecosystems in CA*

- Desert: *Death Valley*
- Temperate Forest: *Redwood National Park in Northern California*
- Grasslands (mostly converted): *Central Valley, CA*
- Rivers and Streams: *Coyote Creek, Stevens Creek*
- Saltwater Marsh: *Palo Alto Baylands*
- Lakes (Natural): *Lake Tahoe, Crater Lake*
- Deep Ocean: *Pacific Ocean*
- Coastal Ocean: *Along CA Coast*

# Ecosystems - Structure

## Part 2