

Nature in the Northwest BIS 241


Nature, Natural History & Ecology

Jan 4 – 11, 2010


★ A STAR on a slide indicates material presented in class has been omitted from these notes on that slide

What is "NATURE" ? ★


A continuum of human influence on landscapes, biota and processes





Little human influence



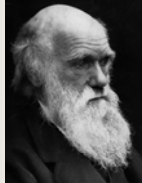
Human domination



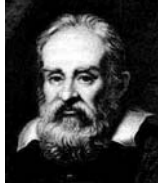





Natural History: the early study of nature



Charles Darwin



Galileo



Alexander von Humboldt

OBSERVATION

Natural History: maturing into a modern science ★

The "Inquiry Cycle"

Observation

The Natural Sciences

Astronomy


Oceanography

Physics

Chemistry

Atmospheric Science

Geography



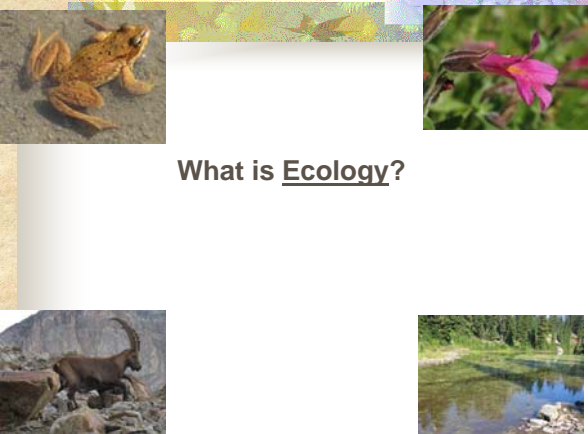
(Mathematics)

Biology

Ecology

Soil Science

Geology



What is Ecology?

Logos (G) –

Logos

ECO

LOGY

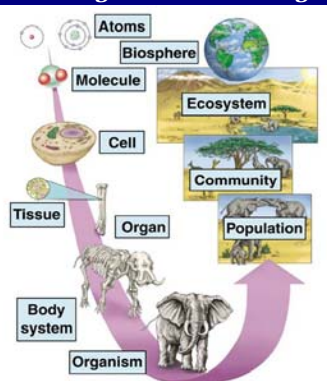
Oikos

Oikos (G) –

ECOLOGY

Ecological Science is organized largely by studies that emphasize different levels of **BIOLOGICAL ORGANIZATION**

Spatial Scales of Organization in Biological Systems



from Raven & Berg (2004)

Defining the levels of organization

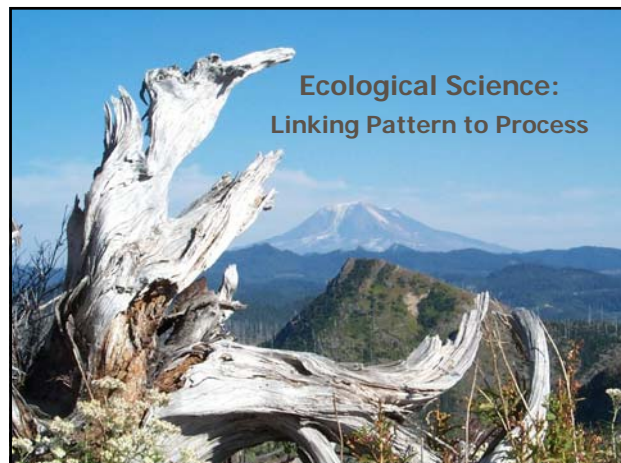
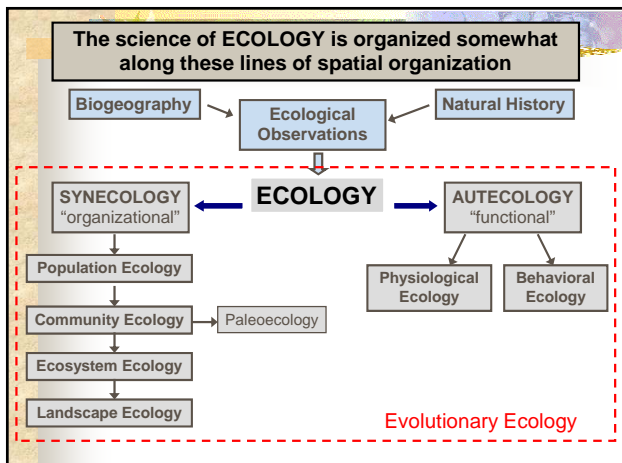
Individual:

Population:

Community:

Ecosystem:

Landscape:



Ecology: Linking Pattern & Process ★

Patterns occur in nature

- Ecologists assume these patterns have some understandable basis; that the world is not governed by chance.

Ecology: Linking Pattern & Process ★

Pattern:

↓

Process:


Pattern:
Isolated patches of biotic development in a barren polar desert landscape

↓

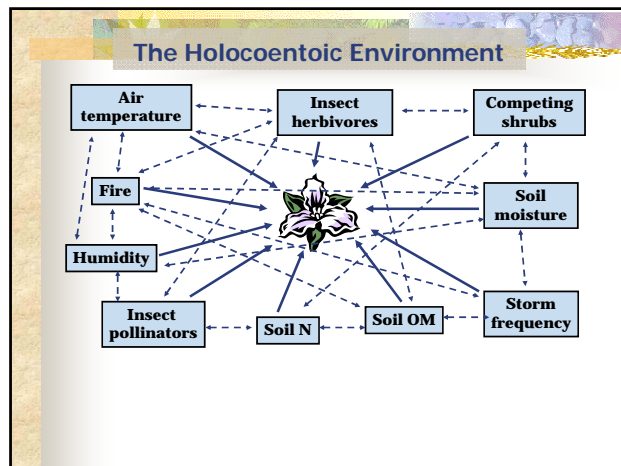
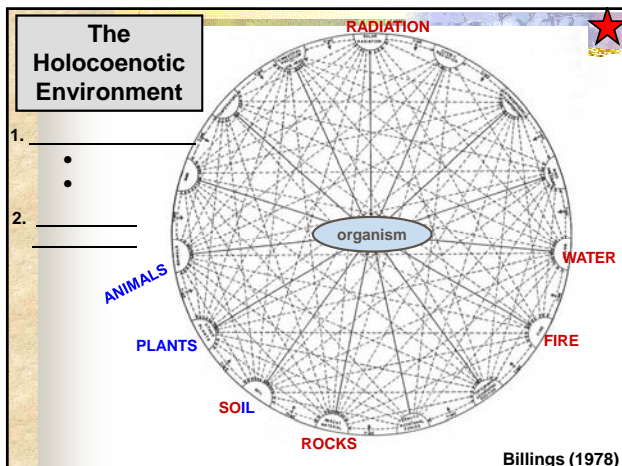
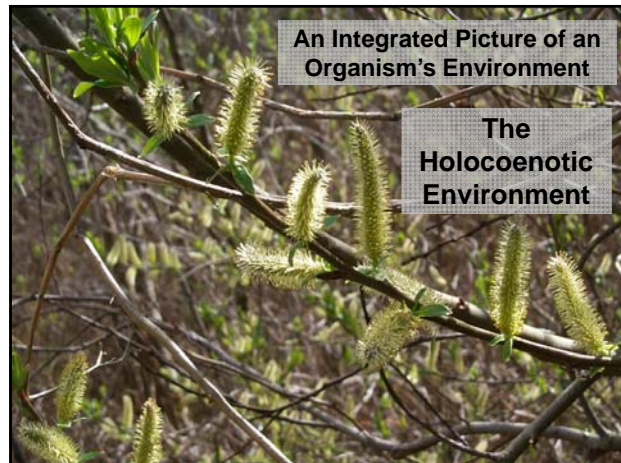
Process: ?



Environmental "Factors"



Classifying Environmental Factors:



The Roles of Environmental Factors

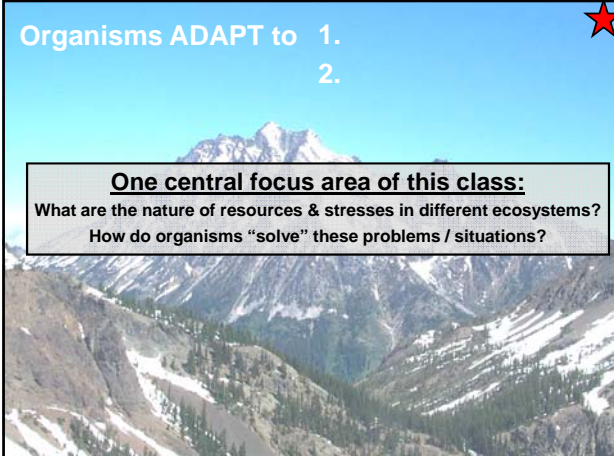
Environmental Factors

Examples ?

Organisms ADAPT to

- 1.
- 2.

One central focus area of this class:
 What are the nature of resources & stresses in different ecosystems?
 How do organisms "solve" these problems / situations?



What is a biological community?


How do we define the boundaries of a community?




**Humans & Boxes:
The unnatural nature of boundaries in nature**

We will examine 2 types of boundaries:

- Boundaries in space**
 - Where does one community / ecosystem stop and another start?
 - What causes things to change through space?
- Boundaries in time**
 - Where does one community / ecosystem stop and another start?
 - What causes things to change through time?



Some boundaries are easy to define




Boundaries in space: how do communities change across the land?

Campus Wetlands: what are the communities?



March 2006

What are we using to draw boundaries?



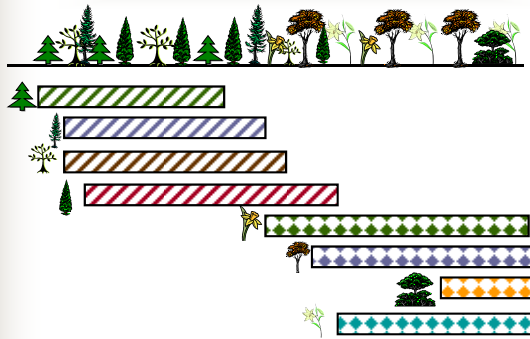
Some boundaries are not so easy to define



Some boundaries are not so easy to define



Defining communities based upon species composition



Humans & Boxes:

The unnatural nature of boundaries in nature



Community Change through Time



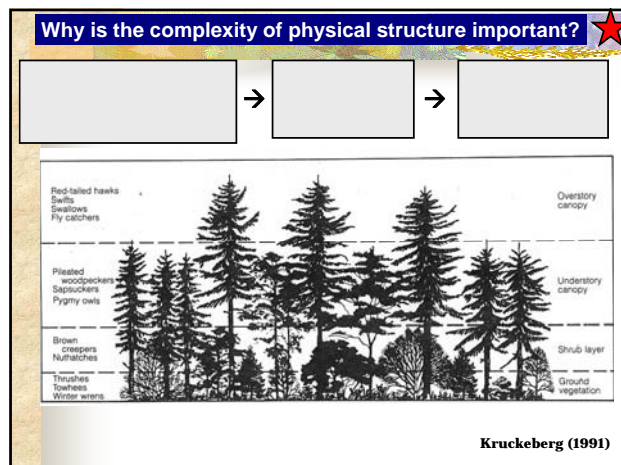
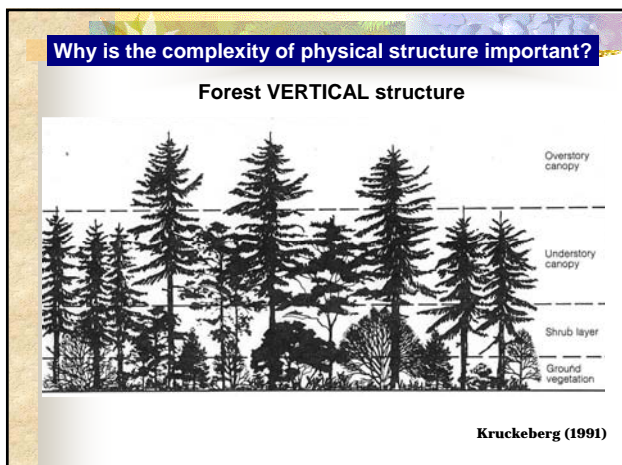
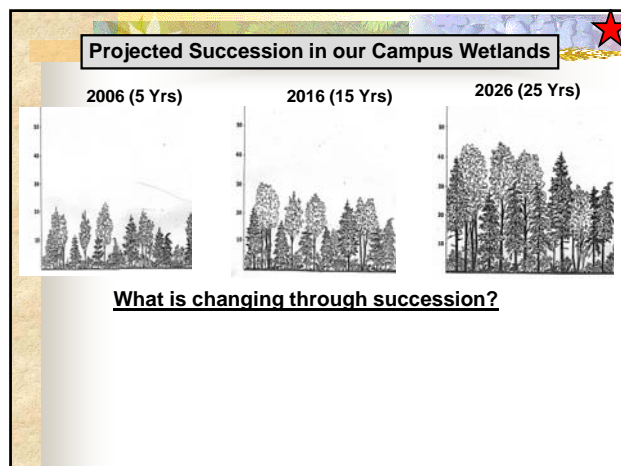
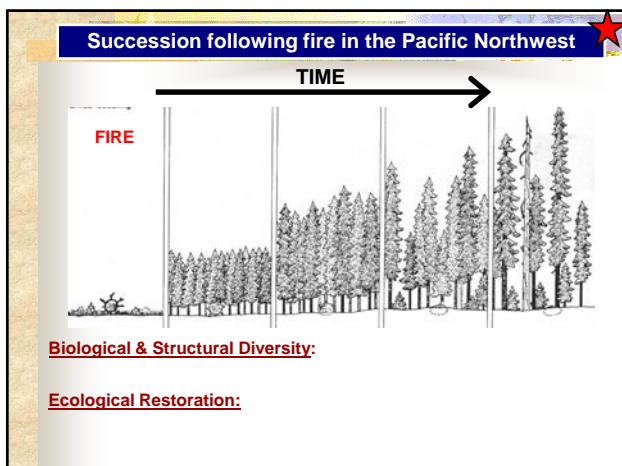
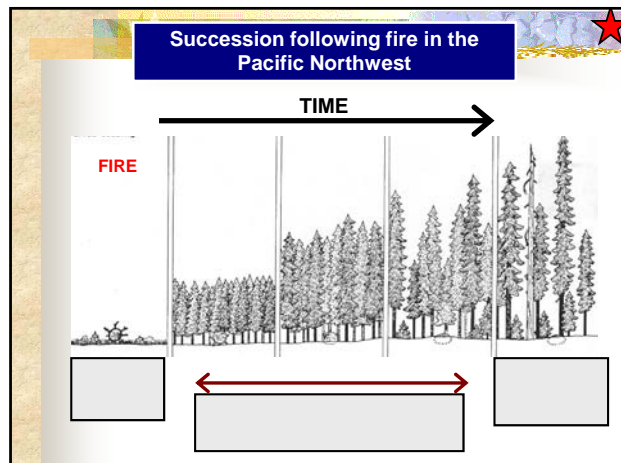
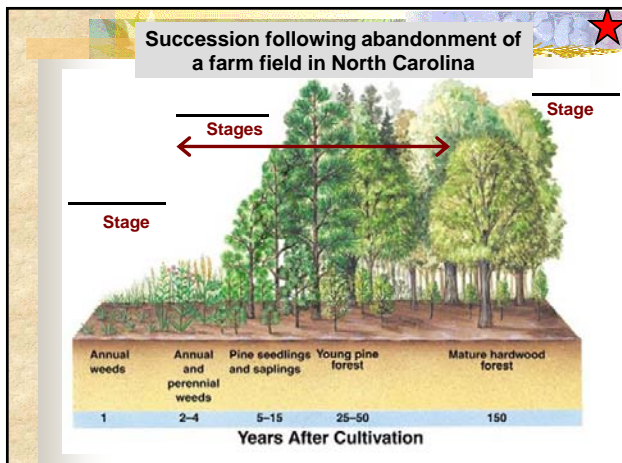
Succession:

Community Change through Time



Lyman Glacier Basin

Trees begin to colonize after 60 years



Horizontal Physical Complexity also provides:

Campus Wetlands: horizontal structure complexity

March 2006

Campus Wetlands: horizontal structure complexity

Forested communities

Meadow - shrub communities

How do we create such structural complexity in ecological restoration?

MOUND

PIT

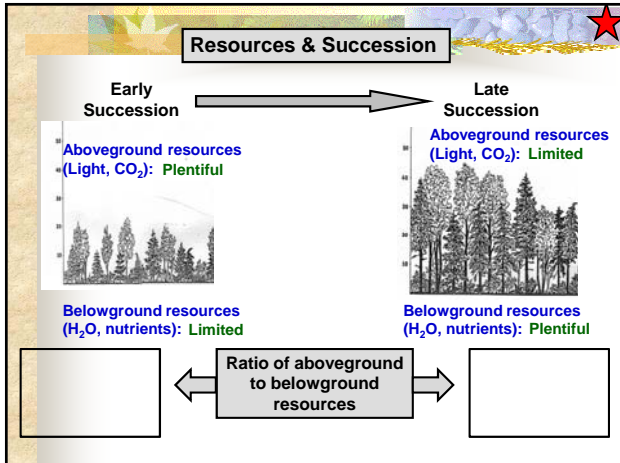
Restoration intentionally creates varying topography to accelerate the development of habitat diversity

Projected Succession in our Campus Wetlands

2006 (5 Yrs) 2016 (15 Yrs) 2026 (25 Yrs)

What is changing through succession?

- 1.
- 2.
- 3.
- 4.

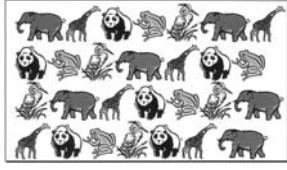


- ### Some Important Characteristics of Biological Communities
1. Species Diversity
 2. Types of Species
 - A. Dominant Species
 - B. Characteristic Species
 - C. Keystone Species
 - D. Ecological Engineers
 - E. Indicator Species
 3. Biological Interactions

Species Diversity of Communities

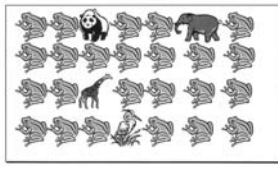
So what is **diversity**?

One community

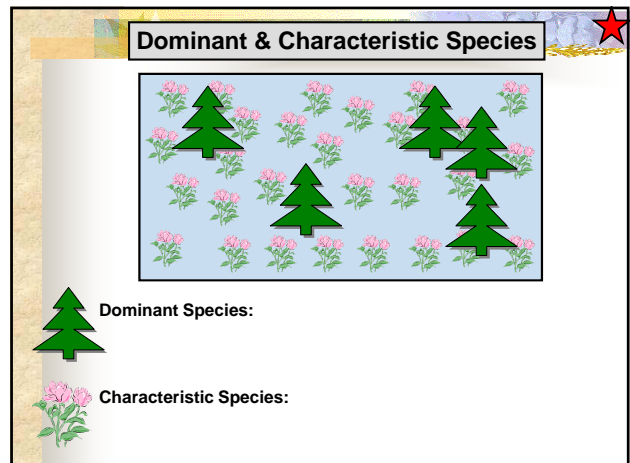
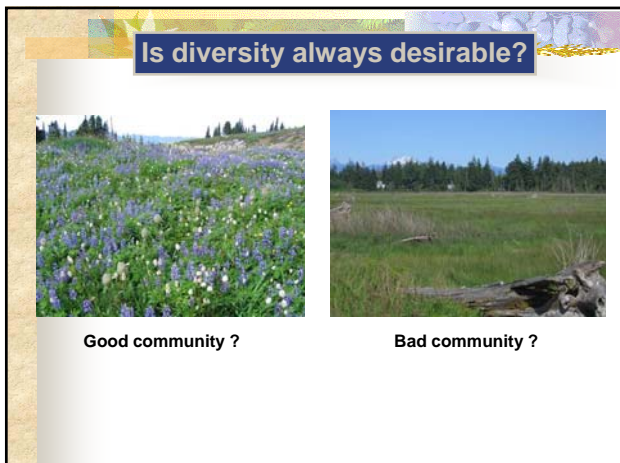
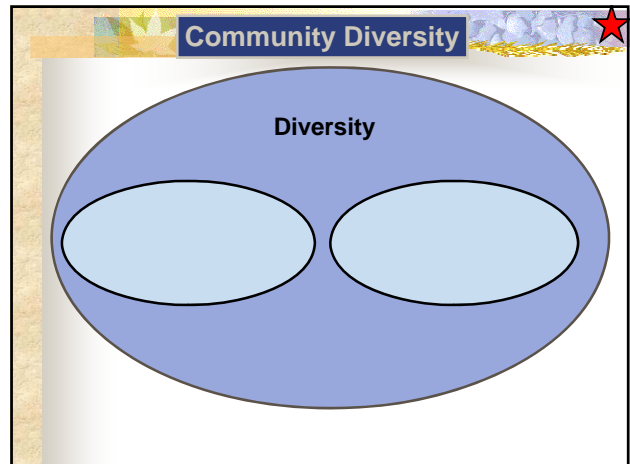


Species =

Is this 2nd community just as diverse?




Species =

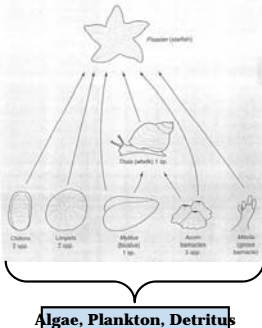


Keystone Species & Ecological Engineers

Keystone species:



Pisaster ochraceus



Algae, Plankton, Detritus

Keystone Species & Ecological Engineers


Ecological Engineers: keystone species that control the physical structure of the biological community

Examples:

Indicator Species


It can be challenging to understand physical & chemical environments

How wet is it? Where? When?



Indicator Species

Plants integrate the environment in TIME & SPACE



Indicator Species
Species with a narrow tolerance of some environmental factor; and thus whose presence indicates something about that environmental factor


Indicator Species

Official US Wetland Indicator Status Categories


Category	% Chance species is in a wetland
Wetland Obligate	
Fac – wet Species	
Facultative Species	
Fac – upland Species	
Upland Species	

Which are the good INDICATOR SPECIES?

Puget Sound Freshwater Wetlands



Lysichiton americanum (OBL)



Salix lucida (FACW+)

Biological Interactions

Characterizing interactions between species

Ecological Interaction	Effect on Species 1	Effect on Species 2
Mutualism (pollination, dispersal)		
Competition		
Herbivory		
Predation		
Disease		

} Consumer – Resource Interactions

Ecosystems

- Energy Flow & Food Webs
- Nutrient Cycling

Energy Flow in Ecosystems

Where does it start?

Where does it enter ecosystem?

This is called

Energy Flow in Ecosystems

This is a **“FOOD CHAIN”**

Efficiency of Transfer?

Energy Flow in Ecosystems

Terrestrial & Aquatic Food Chains in your reading

Carnivores	 Quaternary consumers	Carnivores
Herbivores	 Tertiary consumers	
	 Secondary consumers	
Plants	 Primary consumers	Zooplankton
	 Producers	Phytoplankton

A TERRESTRIAL FOOD CHAIN A MARINE FOOD CHAIN

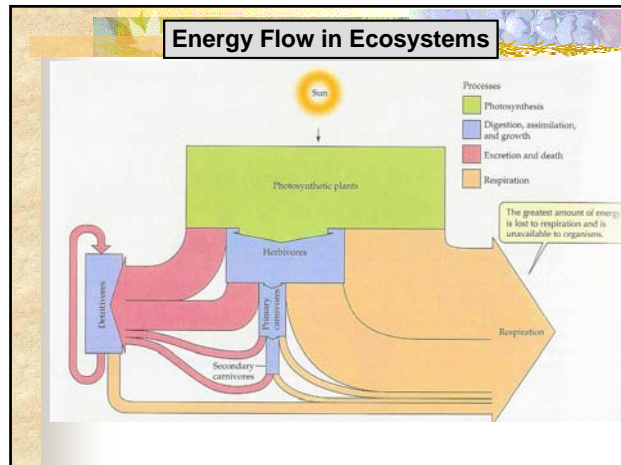
Energy Flow in Ecosystems

Energy Flow is not strictly LINEAR – it is much more complex:

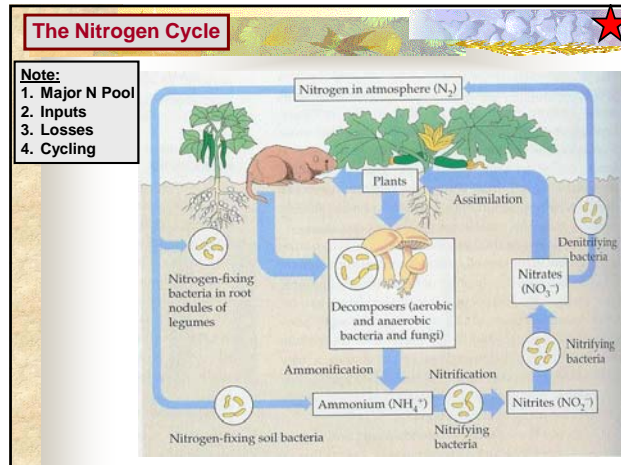
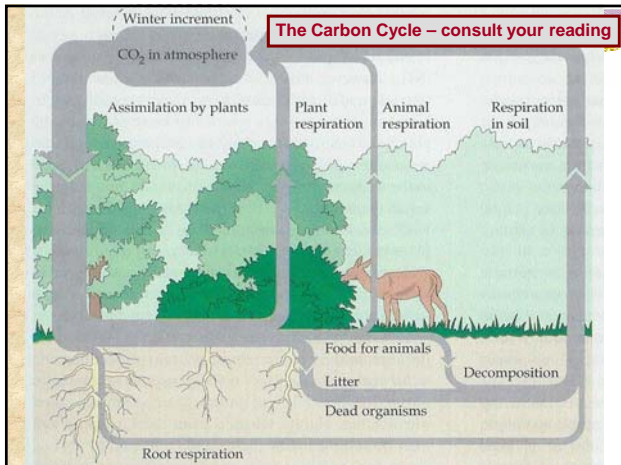
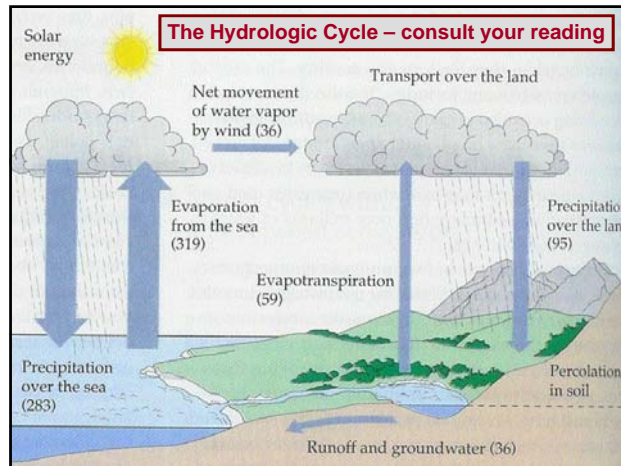
FOOD WEBS

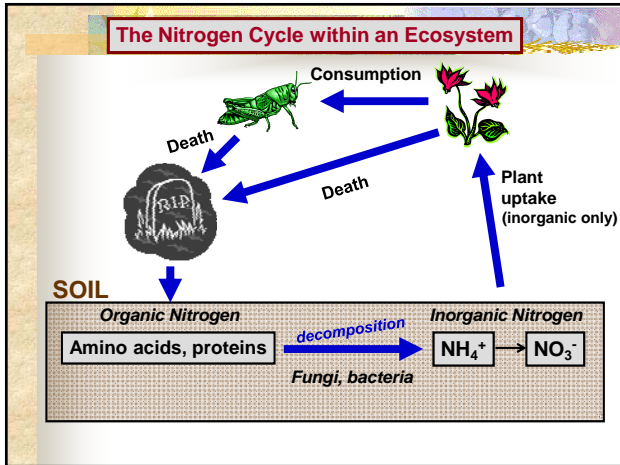
But what CRITICAL energy flow component is missing?

Critical Energy Flow Component Missing:



Matter Cycles through Ecosystems

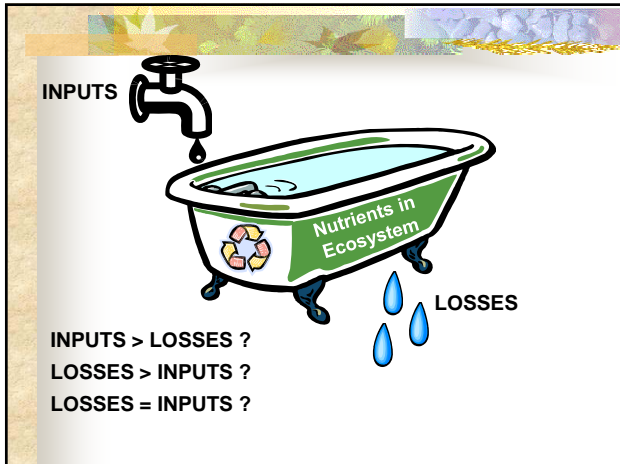




Some Important Lessons of Nitrogen Cycling

1. Important to understand **INPUTS** and **LOSSES** of nutrients to ecosystem

- What are the **INPUTS & LOSSES**?
- What are the magnitudes of **INPUTS & LOSSES**?
- How does human disturbance affect **INPUTS & LOSSES**?



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2. **Cycling depends upon conversion of organic forms to inorganic**

- Decomposers – fungi & bacteria key components
- Conditions making decomposers unhappy slow nutrient cycling

3. **Organisms contain most of the nutrients in many ecosystems**

- Rate of nutrient cycling depends upon rate of death (of all or parts)
- Removing organisms can remove much of the ecosystem's nutrients

