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### The term “ecology” coined in 1866

“By ecology we mean the body of knowledge concerning the economy of nature - the investigation of the total relations of the animal both to its inorganic and its organic environment; including above all, its friendly and inimical relations with those animals and plants with which it comes directly and indirectly into contact - in a word, ecology is the study of all those complex interrelations referred to by Darwin as the conditions of the struggle for existence.”



Ernst Haeckel 1866

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### The Modern Definition

Ecology -



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### **Characteristics of Ecology**

- Studied at several hierarchical levels
- Uses the scientific method
- Is interdisciplinary
- A great way to make a living

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### **Ecology is studied at many hierarchical levels**

Organisms

Populations

Communities

Ecosystems

Landscapes

Ecosphere (A.K.A. The Biosphere)

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\_\_\_\_\_ ecologists



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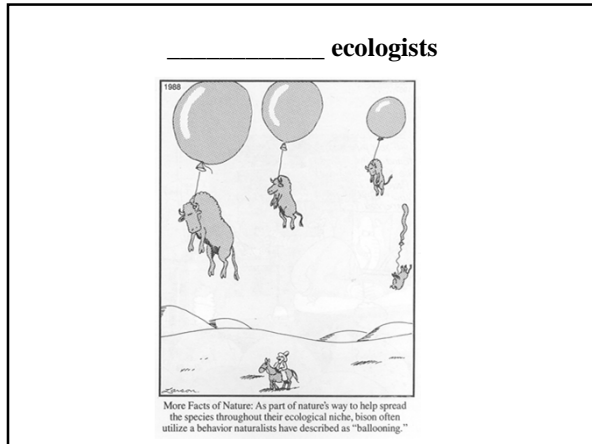
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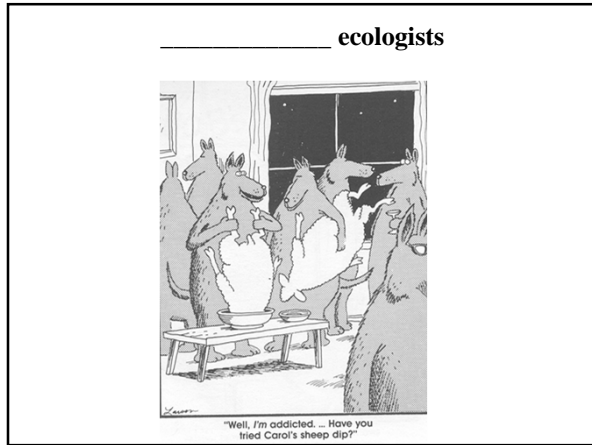
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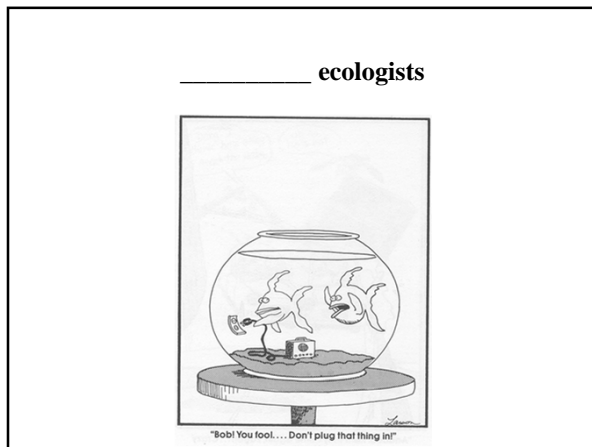
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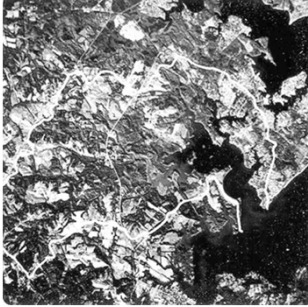
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\_\_\_\_\_ ecologists.



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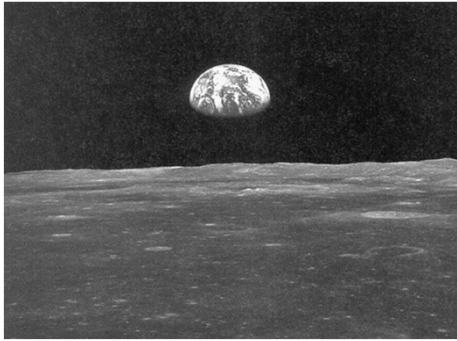
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\_\_\_\_\_ ecologists



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**Ecologists use the scientific method to understand the order of the natural world**

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### Case Study of Ecology in Action

Observations -

In 1989 scientists meeting in England for a herpetology conference discovered that all over the planet their colleagues were noticing amphibian declines and disappearances. No one knew what to make of it.

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### Patterns observed in amphibian decline

Rapid declines are widespread  
16 countries & 5 continents



Stuart et al. 2004; Blaustein & Wake 1990

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### Patterns observed in amphibian decline

- Many species are threatened
- Some declines have been dramatic
- Some populations may have gone extinct
- Not all species within the same regions are affected
- Declines have been noted in remote areas

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## Species Examined

*Hyla regilla* (Pacific treefrog)



*Rana cascadae* (Cascades frog)



*Bufo boreas* (Western toad)




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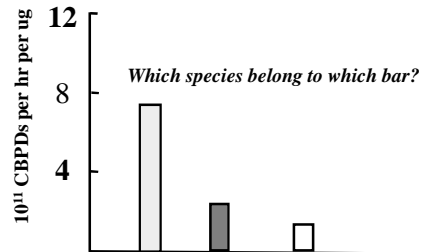
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## Testing in the Lab

Photolyase Activities  
in egg & oocyte extracts




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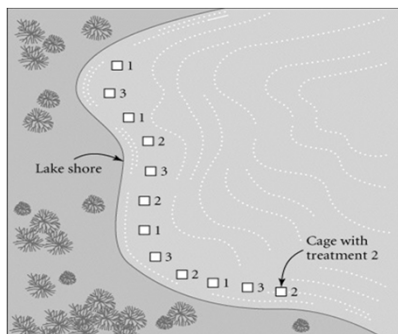
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## Testing in the Field




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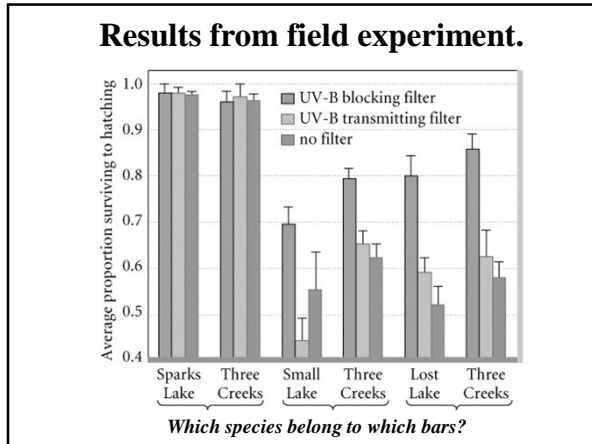
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**Results of similar experiments have been published and have shown both similar and contrasting results.**

**Required Reading Assignment**  
**Articles 1-3**

Stuart et al. 2004. Science  
Blaustein et al. 1995. Ecological Applications  
Blaustein et al. 1999. Ecological Applications

All articles & study questions can be obtained at the Bio. 221 web site

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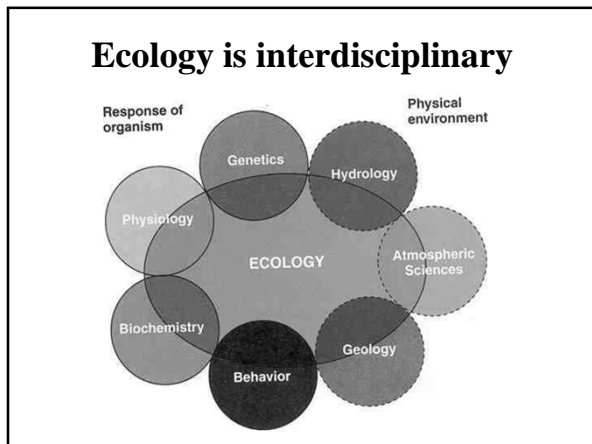
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**It's a great way to make a living!**

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**Career opportunities exist for ecologists !**

Read the profile of at least one ecologist found at the following site:

<http://www.esa.org/ecologist/members/>

On your own, examine the following web site:

<http://wfsc.tamu.edu/jobboard/>

These sites are available at the Bio. 221 web site.

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**Assignment #1**

By the next lecture, write down the name of one of the ecologists whose profile you read along with one interesting thing you learned about them

*(see helpful links page on class web site).*

Bring this information with you to class.

**It may be used as a quiz question!**

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### Assignment #2

By the next lecture, write down the following information about any job or internship opportunity that interests you on the job board web site (see helpful links page on class web site):

- 1) Job title
- 2) Location
- 3) Agency offering the job
- 4) Salary
- 5) Why you find it interesting

Bring this information with you to class.  
**It may be used as a quiz question!**

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### Major Ecological Lessons

The natural world is diverse, complex, and interconnected

The natural world is organized by physical and biological processes

Natural systems recycle essential nutrients

Natural systems are maintained and constrained by processing energy

Good and bad environments exist for every species

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### Major Ecological Lessons

Ecological communities can recover from disturbance but not always

All populations can grow exponentially

No population grows without limits

Nothing in biology makes sense except in the light of evolution

**Humans depend on and affect natural ecosystems**

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“The health of an economy cannot be separated from that of its natural support systems.”

*Lester R. Brown 2006 Plan B 2.0*

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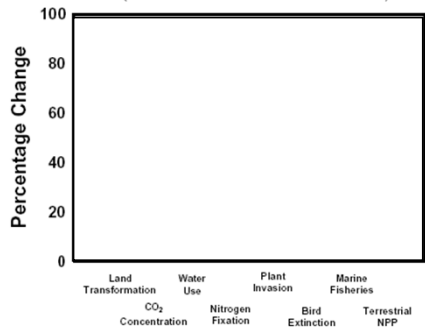
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### Human Domination of Earth's Ecosystems

(Vitousek et al. 1997. Science 277: 494-499)



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**The term “ecosystem” coined in 1935**

*“The more fundamental conception is ... the whole system (in the sense of physics), including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment ...the habitat factors in the widest sense .... Our natural human prejudices force us to consider the organisms ... as the most important parts of these systems, but certainly the inorganic “factors” are also parts, ... and there is constant interchange of the most various kinds within each system, not only between the organisms but between the organic and inorganic. These ecosystems, as we may call them, are of the most various kinds and sizes.”*



A.G. Tansley

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**Practical problems with the ecosystem concept**

If all parts of the systems are to be treated in a similar manner, what common denominator can be used to express their interdependence?

How big is an ecosystem?

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**Energy and matter are exchanged between organisms and between organisms and their physical environment**

*“The trophic dynamic viewpoint, as adopted in this paper, emphasizes the relationship of trophic or “energy-availing” relationships within the community unit”.*



Lindeman 1942

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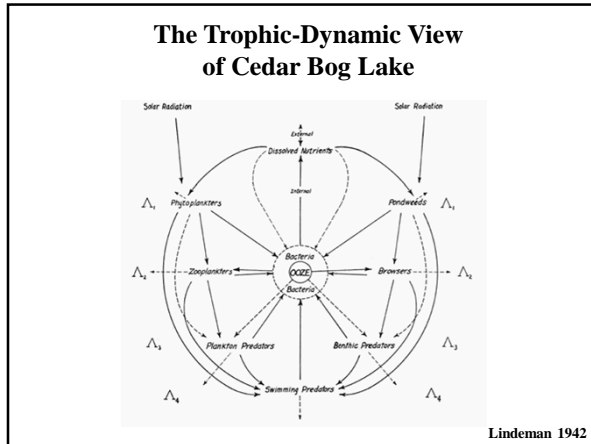
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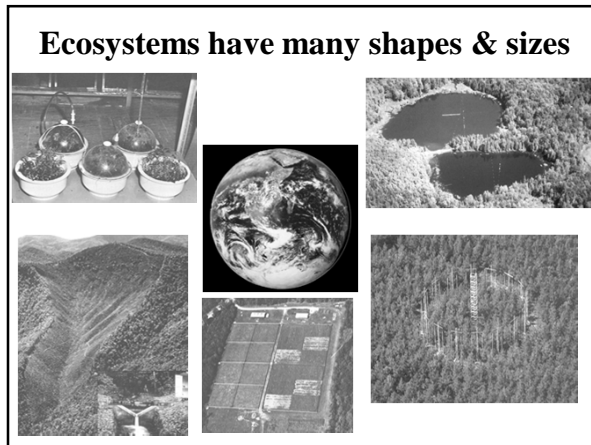
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- ### Types of Systems
- Open
  - Closed

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## Biosphere II



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### Results From Initial “Mission” 1991-1993

- Oxygen decrease from 21% to 14%
- Nitrous oxide increased to levels that threaten human health
- A high fraction of species went extinct
- All pollinators went extinct
- Limbs of large trees became brittle

*“... if humans do not have the capability to reproduce ... [the Earth's] life sustaining processes, then how can ... [anyone] believe that the preservation of the natural environment is not an important goal.”*

*Heather Robertson 2004 WVU Graduate Student*

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### Ecosystems are Maintained by

- A continuous flow of energy
  
  
  
  
  
  
  
  
  
  
- The continuous cycling of essential materials

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**Ecosystems provide a variety of services that benefit humans**

- Moderation of climate.
- Supply of food and fiber.
- Pollination
- Pest control
- Waste purification.
- Maintains a “genetic library”.
- Recycles essential materials.

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**The fundamentals of energy**

- Energy - Ability to produce change in the state or motion of matter.
- Energy comes in many interchangeable forms: heat, mechanical, electrical, chemical, sound, electromagnetic radiation (powers the Earth)
- 1<sup>st</sup> law of thermodynamics - Energy is never created or destroyed.

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**Electromagnetic Radiation**

- Travelling wave of energy.
- Travels at the speed of light ( $3 \times 10^8$  m/s).
- Can travel through the vacuum of outerspace.
- Many types of EMR based on wavelength.

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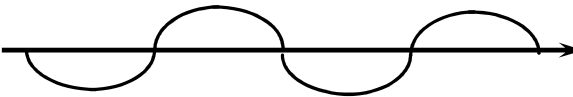
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**Energy content of EMR is related to its wavelength**



$\lambda = \text{wavelength}$

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**Common types of EMR**

Type	$\lambda$	Energy Content
Radio	1-10 m	
Microwaves	0.01-0.3 m	
Infrared	0.71-100 $\mu\text{m}$	
Visible light	0.4-0.71 $\mu\text{m}$	
Ultraviolet	0.1-0.4 $\mu\text{m}$	
X-rays	$10^{-5}$ - $10^{-2}$ $\mu\text{m}$	

$\mu\text{m} = 10^{-6} \text{ m}$

(From Ehrlich et al. 1977)

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**Electromagnetic Radiation (cont.)**

- Everything with a temperature emits electromagnetic radiation.
  - Stephan-Boltzmann Law -  $E \propto T^4$
- Wavelength of maximum emission depends on the temperature of the object.
  - low temp.  $\Rightarrow$  longer  $\lambda_{\text{max}}$
  - high temp.  $\Rightarrow$  shorter  $\lambda_{\text{max}}$

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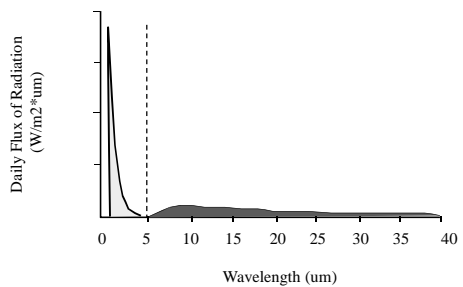
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What does the area under each curve represent?



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