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

- You can make a difference by improving the environment we live in and share with all other living things
- You can have a job you enjoy – one that lets you play outside and call it “work”
- Jobs are available - especially if you're good at what you do!

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**Career opportunities exist for ecologists !**

On your own, examine the following web site:  
<http://wfsc.tamu.edu/jobboard/index.htm>

Read the profile of at least one ecologist found at the following site:  
[http://www.esa.org/education/ecologists\\_profile/EcologistsProfileDirectory/](http://www.esa.org/education/ecologists_profile/EcologistsProfileDirectory/)

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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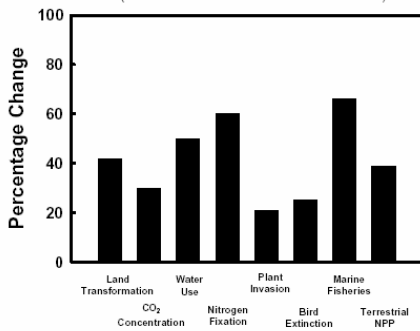
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### Human Domination of Earth's Ecosystems

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



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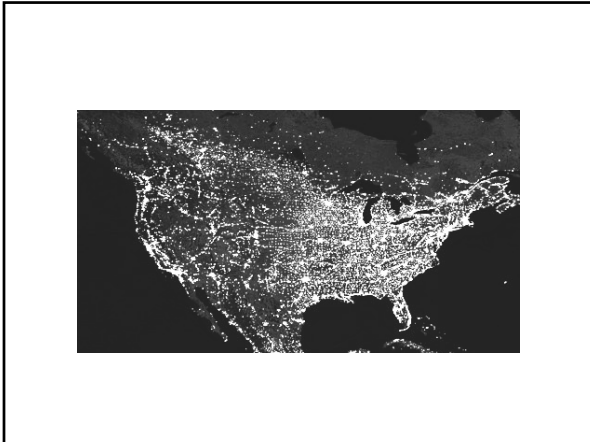
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### The term “ecosystem” coined in 1935

*“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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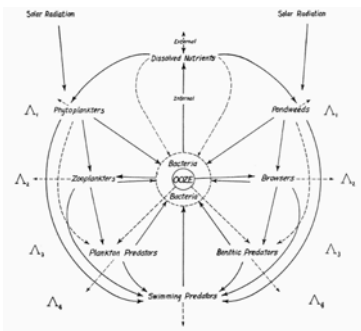
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**The Trophic-Dynamic View of Cedar Bog Lake**



Lindeman 1942

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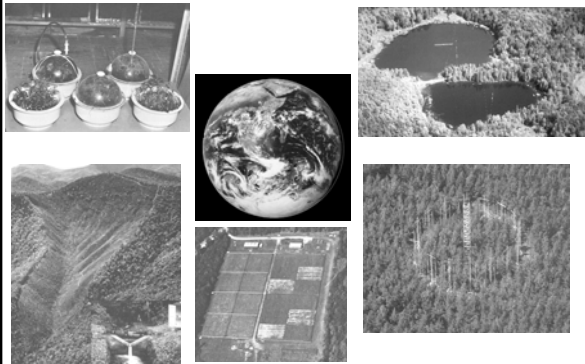
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**Ecosystems have many shapes & sizes**



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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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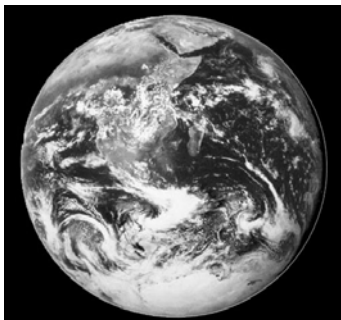
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**Earth as an ecosystem**



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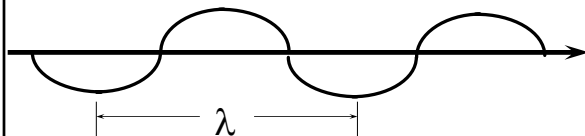
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### Energy content of EMR is related to its wavelength



$\lambda$  = wavelength

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### Common types of EMR

Type	$\lambda$	Energy Content
Radio	1-10 m	Low $\downarrow$ High
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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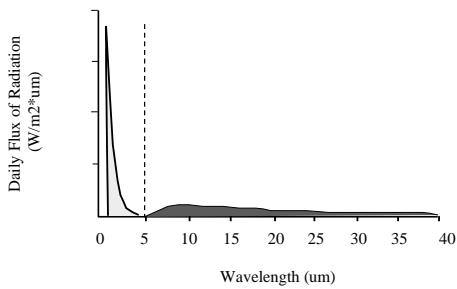
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What does the area under each curve represent?




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