

Environmental Geology -- Philosophy

- General Introduction to Environmental Geology
- Environmental Ethics
- The Environmental Crisis
- Fundamental Concepts of the Environmental Sciences



<http://wapi.isu.edu/envgeo/index.htm>

Environmental Geology -- Philosophy

Environmental Geology = Applied Science

- Evaluate Natural Hazards
 - floods, landslides, volcanic activity
 - earthquakes, weather events
- Environmental Impact Analysis
 - site selection, land-use planning
- Assess Earth Materials
 - minerals, rocks, soil, WATER
 - analysis of chemical properties
 - analysis of physical properties

Environment = “everything” (surroundings, habitats, etc.)

- Physical Conditions: air, water, gases, landforms
- Social and Cultural: ethics, economics, aesthetics, politics, religion

Environmental Geology -- Philosophy

ENVIRONMENTAL ETHICS

“Quiet Crisis” - Stewart Udall

-crisis of survival, new awareness, belief?

Evolution of Ethics

Land Ethic -- Assumes Responsibility for:

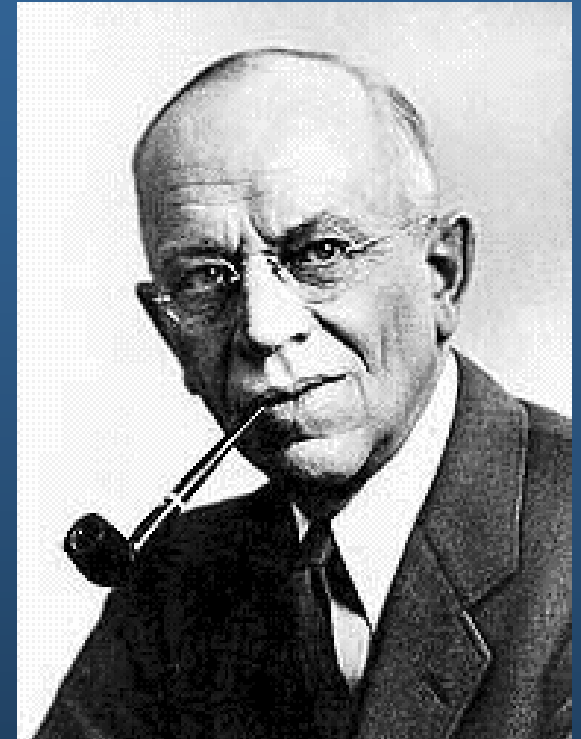
-other individuals

-society

-total environment (plants, animals, soil, water, atmosphere, etc.)

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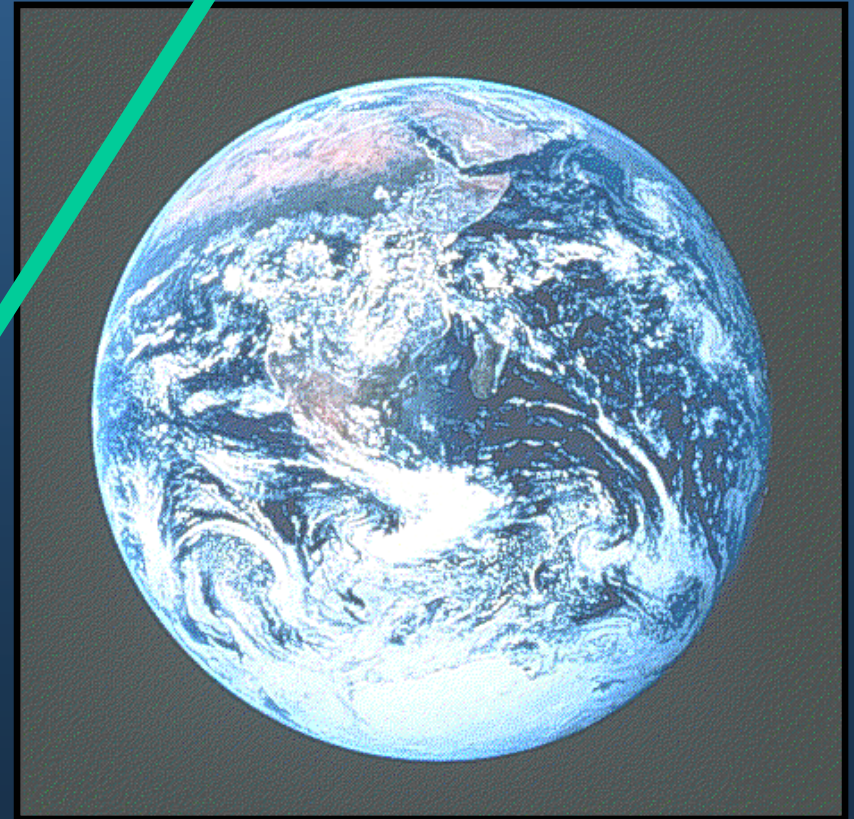
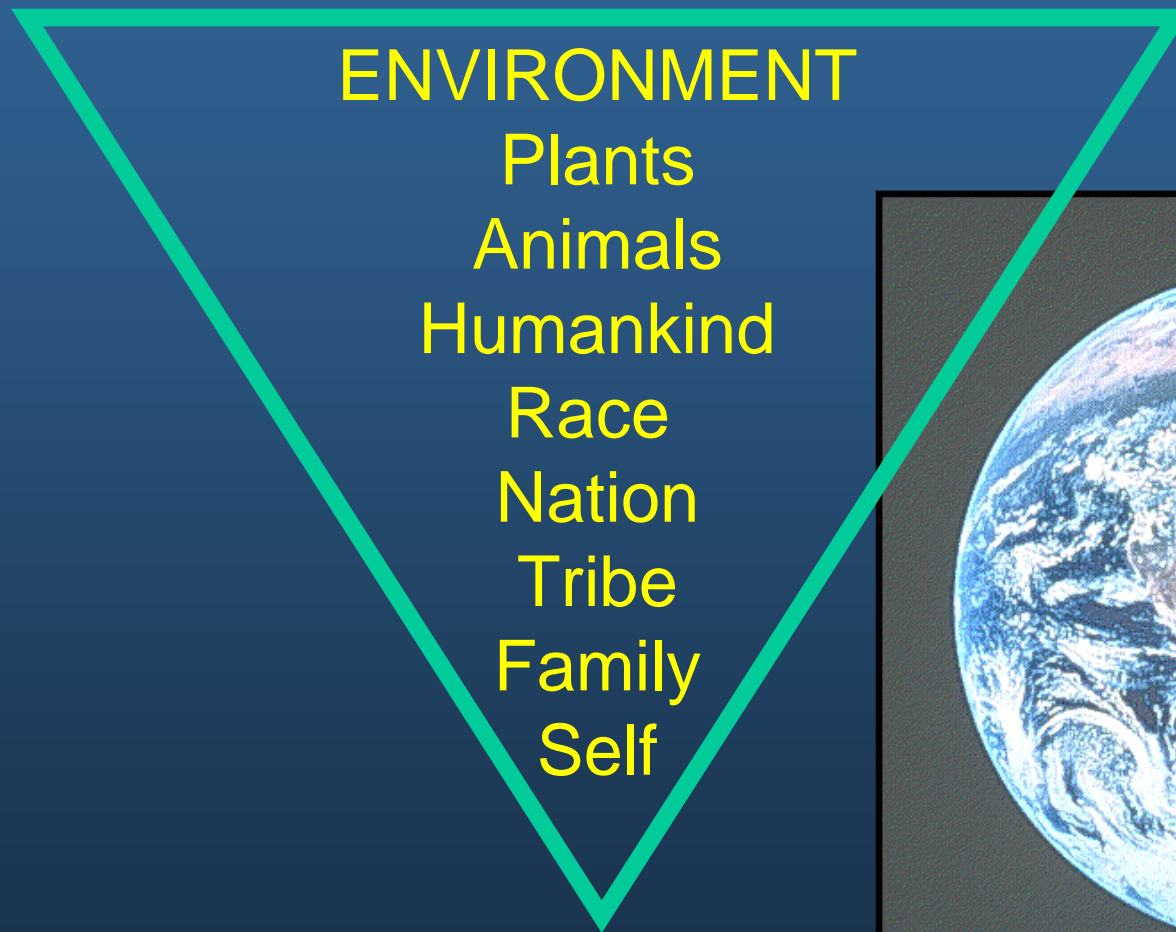
In the early 1950's, Aldo Leopold, a forester and professor of wildlife management at the University of Wisconsin, urged Americans to embrace a "land ethic," a new concept which enlarged our sphere of concern to include the entire physical environment including animals, plants, and landforms. This sense of responsibility has been strengthened by photographs of Earth taken from space. Such images strongly suggest the earth is a single, whole biological/physical system surrounded by vast empty space.



"A land ethic of course cannot prevent the alteration, management, and use of these 'resources,' but it does affirm their right to continued existence, and, at least in spots, their continued existence in a natural state."

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Roderick Nash - Inverted Ethics Triangle:



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Problems in America:

- Early colonists brought
 - new technology
 - organizational plan
 - concept of LAND OWNERSHIP
- **Myth of Superabundance** (the LAND MYTH)
 - Inexhaustible Resources
 - Management Unnecessary
(farmland wasted, hydraulic mining, deforestation, soil erosion)
 - Effects still visible (fur seal, Am. bison, passenger pigeon, dust bowl of 1930's)

Problems in China?

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ENVIRONMENTAL CRISIS

Convergence of three entities:

RESOURCES

NEEDS

WASTE

CRISIS

The diagram illustrates the convergence of three entities into a crisis. Three red arrows point from the words 'RESOURCES', 'NEEDS', and 'WASTE' to a central grey oval containing the word 'CRISIS'. 'RESOURCES' is at the top left, 'NEEDS' is in the middle left, and 'WASTE' is at the bottom left. The 'CRISIS' oval is on the right side of the diagram.

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- Present Condition - no quick solutions
 1. Absence of moral direction in treatment of Natural Resources
 2. Inability for social institutions to adjust to reduce environmental stress
 3. Abiding faith in technology
- Immediate Cause for Crisis:
 - overpopulation, urbanization, industrialization
- Cause for Optimism:
 - increased awareness, changes in political and social systems

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Aesthetics (Impact of Personal Preference)

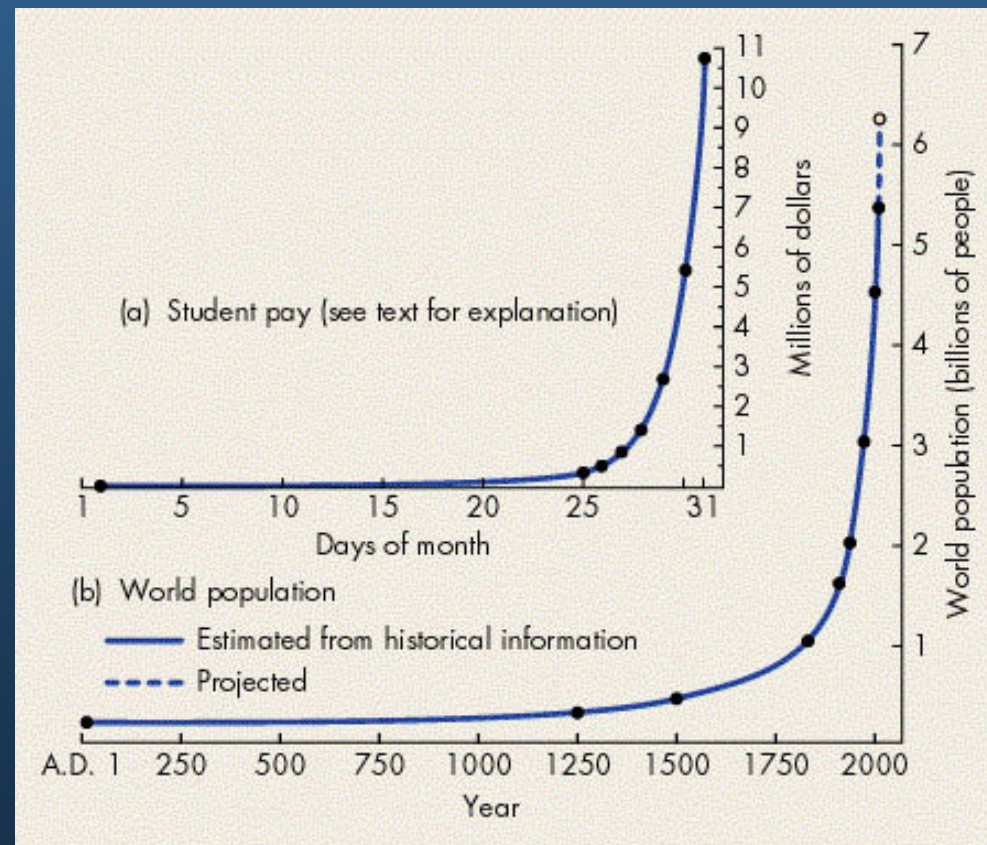
Three basic criteria:

- Unity -- quality of wholeness
- Vividness -- visually striking scene
- Variety -- diversity and uniqueness

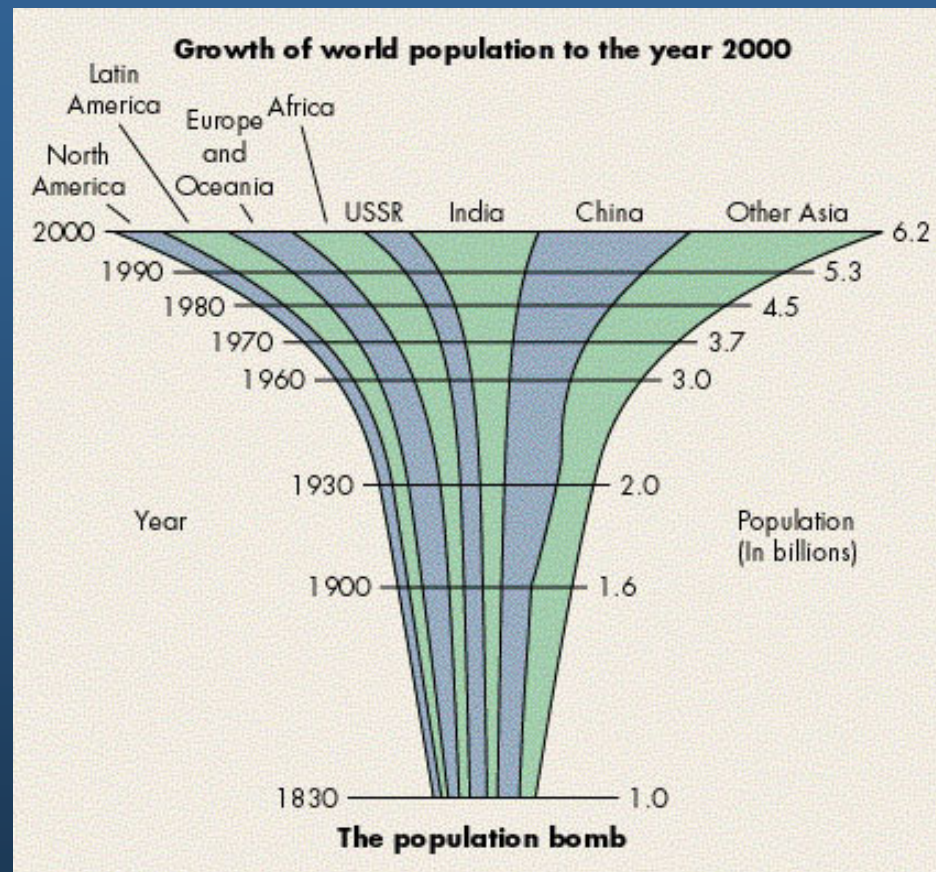
Philosophy: Regardless of personal feelings, it is important to study **concepts** and **processes**.

Fundamental Concepts

I. The NUMBER ONE Environmental Problem is the Increase in Human Population.



Fundamental Concepts



Fundamental Concepts

Exponential growth:

growth rate = measured as percentage

doubling time = time for quantity to double

Growth Rates:

Start with Decay Equation: $N = N_0 e^{-\lambda t}$

where $\lambda = \ln 2/\text{half-life}$, $t = \text{time}$

$N_0 = \text{initial number}$

then Growth Equation: $N = N_0 e^{\lambda t}$

where $\lambda = \ln(1 + \text{rate})/\Delta t$ units

or $\lambda = \text{rate}/\Delta t$ units (approximately)

(if $t = \text{years}$ then Δt units = 1 year)

Fundamental Concepts

Example: 7% growth rate per year

$$\lambda = \ln(1 + 0.07)/1 = 0.06766$$

year:	1	10	30	50	100	200
number:	100	197	761	2,946	86,772	75×10^6

(after 1000 years, number = 2.4×10^{31})

WORLD POPULATION

WHAT IS THE ANNUAL POPULATION GROWTH RATE?

Assume 1.36% per year: If 6.2 billion people in 2000,

24.1 billion (2.4×10^{10}) people in 2100

8.3 trillion (8.3×10^{12}) people in 2200

407 quadrillion (4.1×10^{17}) people in 2500

Fundamental Concepts

II. SUSTAINABILITY is the environmental objective:

How to define? - resources, **economy**, lifestyles?

- population - multiple organisms in ecosystem, in harmony
- energy policy - minimize pollution
- utilize renewable resources - need plan
- utilize nonrenewable resources - need plan
- social, legal, political system → sustainable global economy (with balance of nature approach)

Fundamental Concepts

To Achieve a Sustainable Global Economy

- develop effective population control strategy
(education)
- completely restructure energy programs
- institute economic planning, financial aid and tax incentives
- institute social, legal, political, and educational changes with goal to maintain environmental quality

Fundamental Concepts

III. SYSTEMS: Earth is a System

(actually an open system made up of sub-systems)

- Mutual Interaction of:
 1. atmosphere
 2. hydrosphere
 3. biosphere
 4. lithosphere
- Earth is NOT STATIC
matter \longleftrightarrow **energy** (constant interaction)
- FEEDBACK: Positive vs. Negative
(vicious cycle vs. self-regulation)

Fundamental Concepts

Changes in Systems -- Steady State vs. non-S.S.

- A) Input = Output (Managed System)
- B) Input < Output (e.g. Depletion)
- C) Input > Output (e.g. Pollution)

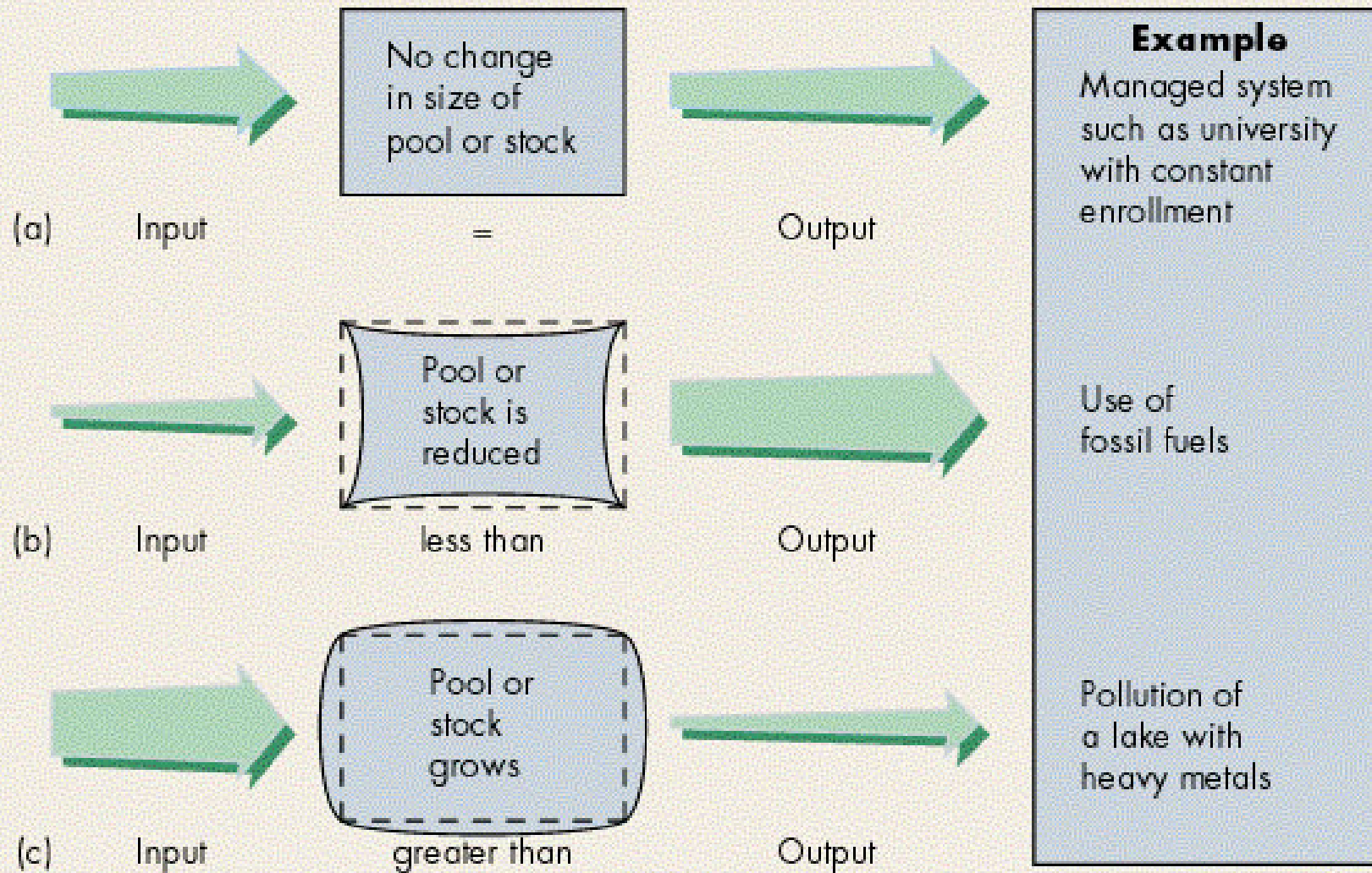
Evaluate Rates -- Residence Time

- Average Residence Time (A.R.T.) = time for total stock or supply to be cycled through the pool

A.R.T. = total size of pool/average rate of transfer

***SEE TABLES 1.1 and 1.2 in TEXT**

Fundamental Concepts



Fundamental Concepts

IV. LIMITATION OF RESOURCES:

Earth is the only suitable habitat we have, and the resources are limited.

- some resources renewable, others not
- need large-scale recycling of many materials

Recycling: Pollutants = Resources out of place

Two Opposing Viewpoints

1. Finding resources is less problematic than finding ways to use existing ones -- technology and ingenuity will overcome lack of resources.
2. Resources are finite, so the above reasoning is fallacious -- population increase with a finite resource base cannot be sustained.

Fundamental Concepts

V. UNIFORMITARIANISM:

A fundamental concept in geology -- today's physical processes of modifying the landscape have operated through time.

Natural vs. Artificially-induced changes in the **MAGNITUDE and FREQUENCY** of processes

- floods
- landslides
- erosion
- subsidence

Fundamental Concepts

VI. HAZARDOUS EARTH PROCESSES:

There have always been Earth processes that are hazardous to people.

- recognition and avoidance

Natural processes:

- Exogenetic = at or near surface, weathering, mass wasting, erosion, etc.
- Endogenetic = internal, volcanic activity, diastrophism

(Which of these can be human-assisted?)

Fundamental Concepts

VII. AESTHETIC CONSIDERATIONS:

Land and Water use planning must strive for a balance between **economics and aesthetics**.

- Difficult to separate aesthetics from economy in the
LONG TERM

Evaluate this Balance:

- **before** building, development, civilization

Fundamental Concepts

VIII. FUTURE GENERATIONS:

- Effects of land use are CUMULATIVE and we have an obligation to future generations

"Think not forever of yourselves, Oh Chiefs, nor of your own generations. Think of continuing generations of our families, think of our grandchildren and of those yet unborn, whose faces are coming from beneath the ground."

The Peacemaker of the Iroquois Confederacy - He Who Keeps Them Awake

Fundamental Concepts

IX. GEOLOGY -- ENVIRONMENTAL SCIENCE:

The fundamental component of every person's environment is the GEOLOGIC FACTOR.

Broad-based approach

- geomorphology
- petrology
- sedimentology
- hydrogeology
- pedology
- economic geology
- engineering geology

"This we know. The earth does not belong to man, man belongs to the earth. All things are connected like the blood that unites us all. Man does not weave the web of life, he is but a strand in it. Whatever he does to the web, he does to himself."

Chief Seattle, 1852

Fundamental Concepts

Assignment #1 -- 25 Points: A Lesson in Observation

- Observe small-scale features that relate to geological and environmental problems.
- Record in your notes **six problems** that seem significant, including location, situation, and cause. If possible, record the type of problem as well as the clues that a problem exists.

NOTE: Any potential problem is appropriate to list, but the solution may be beyond the scope of this course.

- Describe each one of the six problems in two sentences.

Fundamental Concepts

- Select **ONE** of the six items on your list and write **NO MORE THAN** two paragraphs describing in detail the environmental problem and what you perceive to be the likely cause.
- Include a statement or two that addresses the likely future scenario (e.g. additional problems if this one is ignored) as well as what you think might be possible remedial measures.
- Write down the **topic for your term project**.
- This entire assignment can be done on one or two pages.
- Handwritten reports are okay if they are neat.

DUE: Two Weeks

Fundamental Concepts

Terms to understand:

(look up each one and relate it to topics covered in lecture)

exponential growth

carrying capacity

environmental unity

open and closed systems

steady state

negative and positive feedback

growth rate

doubling time

input-output analysis

residence time

threshold

disturbance

complex response

The next lecture will cover the geologic cycle, Earth systems, and geologic materials.