environment THE SCIENCE BEHIND THE STORIES

Third Canadian Edition

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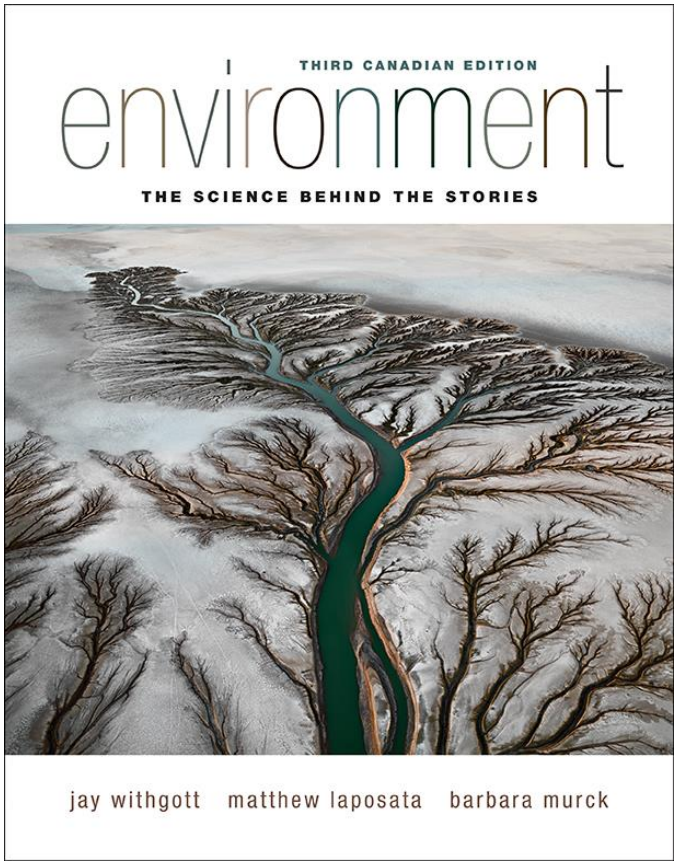
An Introduction to Environmental Science



PowerPoint® Slides prepared by Stephen Turnbull

Upon successfully completing this chapter you will be able to:

- Define the term environment
- Characterize the interdisciplinary nature of environmental science
- Distinguish key terms
- Describe several types of natural resources and explain their importance to human life
- Articulate concepts including carrying capacity, biocapacity, sustainability and sustainable development, tragedy of the commons, ecological footprint, goods and services.

Central Case: Earth from Space:The Power of an Image

- Prior to 1967, no one had seen a photograph of the whole planet
- On November 9, 1967 - a simple photograph from the unmanned *Apollo 4*, showing “crescent” Earth changed both society and history

Our Island, Earth

The environment is more than just our surroundings

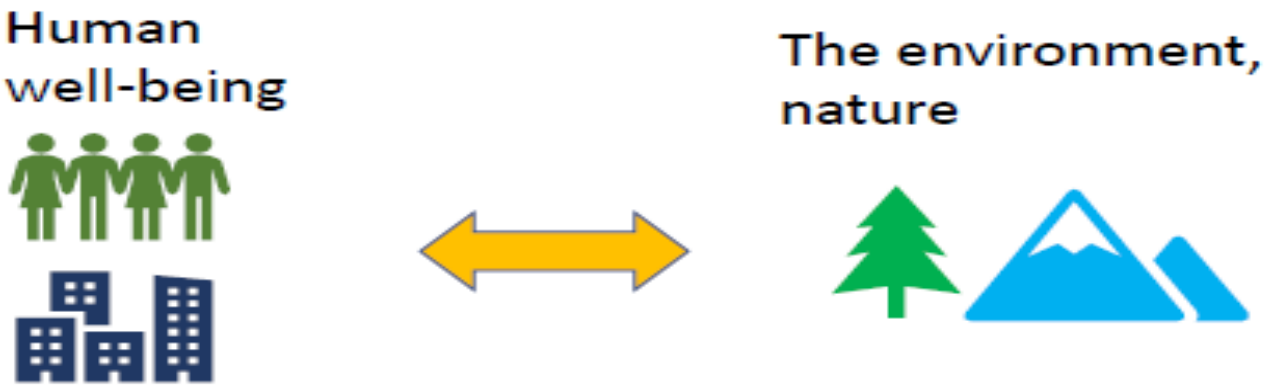
- Biotic (living things)
  - Animals, plants, forests, soils, etc.
- Abiotic (nonliving things)
  - Continents, oceans, clouds, icecaps
- Our built environment
  - Structures, cities, etc.
- Social relationships and institutions

Photo R Friberg

Environmental science explores interactions between people and the natural world

- **Environmental science** is the study of:
  - How the natural world works
  - How the environment affects humans (e.g., benefits)
  - How humans affect the environment (e.g., degradation)
  - Such knowledge is essential in devising solutions to environmental problems

The relationship between people and nature is reciprocal



e.g. Ostrom (2007, 2009); Binder et al. (2013).

The Nature of Environmental Science

Science is a systematic process for learning about the world

Science

- Is a systematic process for learning about the world and testing our understanding of it
- Is the accumulated body of knowledge that results from this dynamic process of observation, testing, and discovery
- Science is essential for
  - Sorting fact from fiction
  - Developing solutions to the problems we face

Recent examples or issues related to policy making?

Science is a systematic process for learning about the world

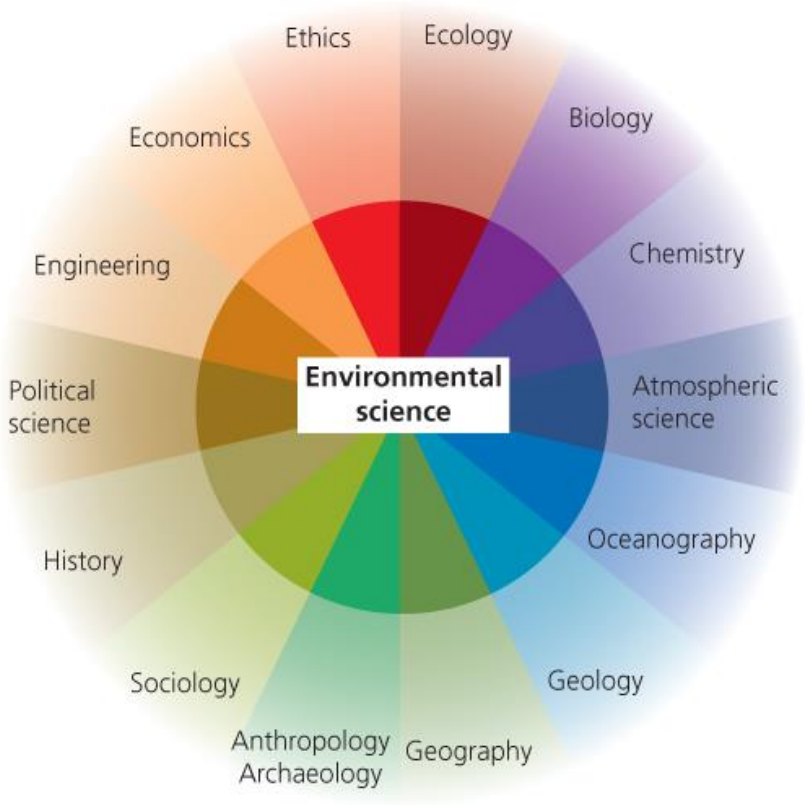
- Scientific Knowledge can be applied in policy and management decisions and in technology.

e.g. forest management policy and wildfires in BC (discussion)

Environmental science is an interdisciplinary pursuit

- Environmental problems are complex and require expertise from many disciplines
- It is interdisciplinary field

- Individuals from diverse professions can make key contributions to effective and lasting solutions



Environmental science is not the same as environmentalism

Environmental science

- The pursuit of knowledge about the natural world
- Scientists try to remain objective

Environmentalism

- A social movement dedicated to protecting the natural world (e.g. advocacy, public and corporate pressure)

Environmental science can help us avoid mistakes made in the past

Evidence points toward the likely collapse of several civilizations due to environmental degradation…the Greek and Roman Empires, the Maya, etc.

Earth’s Natural Resources

Resources range from inexhaustible to nonrenewable

Renewable natural resources

- Sunlight
- Wind energy
- Wave energy
- Geothermal energy

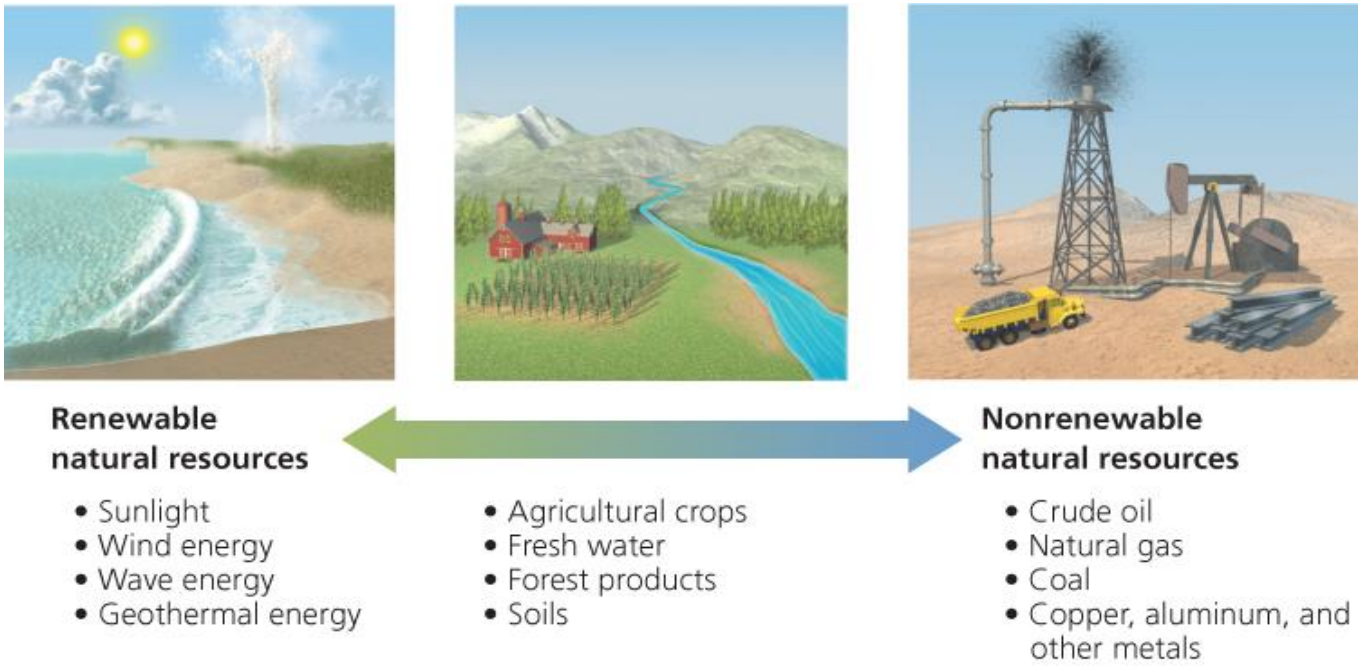
- Agricultural crops
- Fresh water
- Forest products
- Soils

Nonrenewable natural resources

- Crude oil
- Natural gas
- Coal
- Copper, aluminum, and other metals

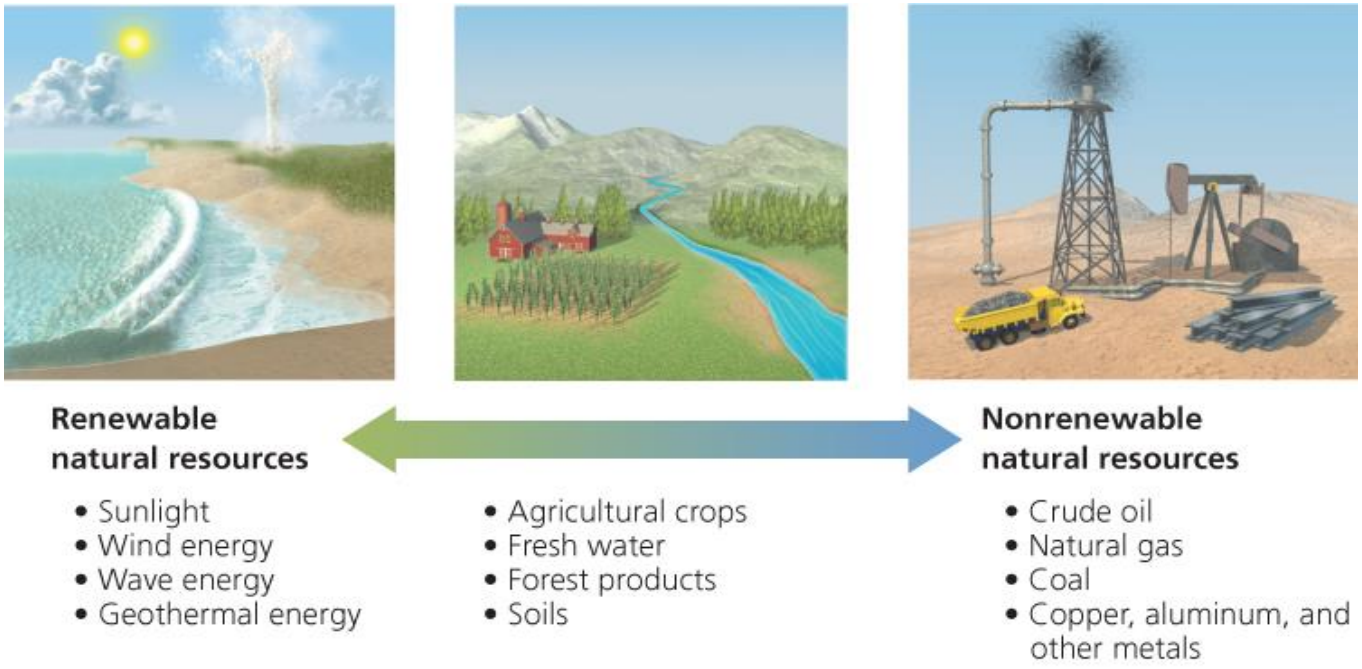
Renewable resources:

- Perpetually available: sunlight, wind, wave energy
- OR renew themselves over short periods: timber, water, soil
  - But can be overharvested



Nonrenewable resources: finite supply; can be depleted

- Oil, coal, minerals
- Will not be available because they will not be replenished on a **humanly accessible time scale**



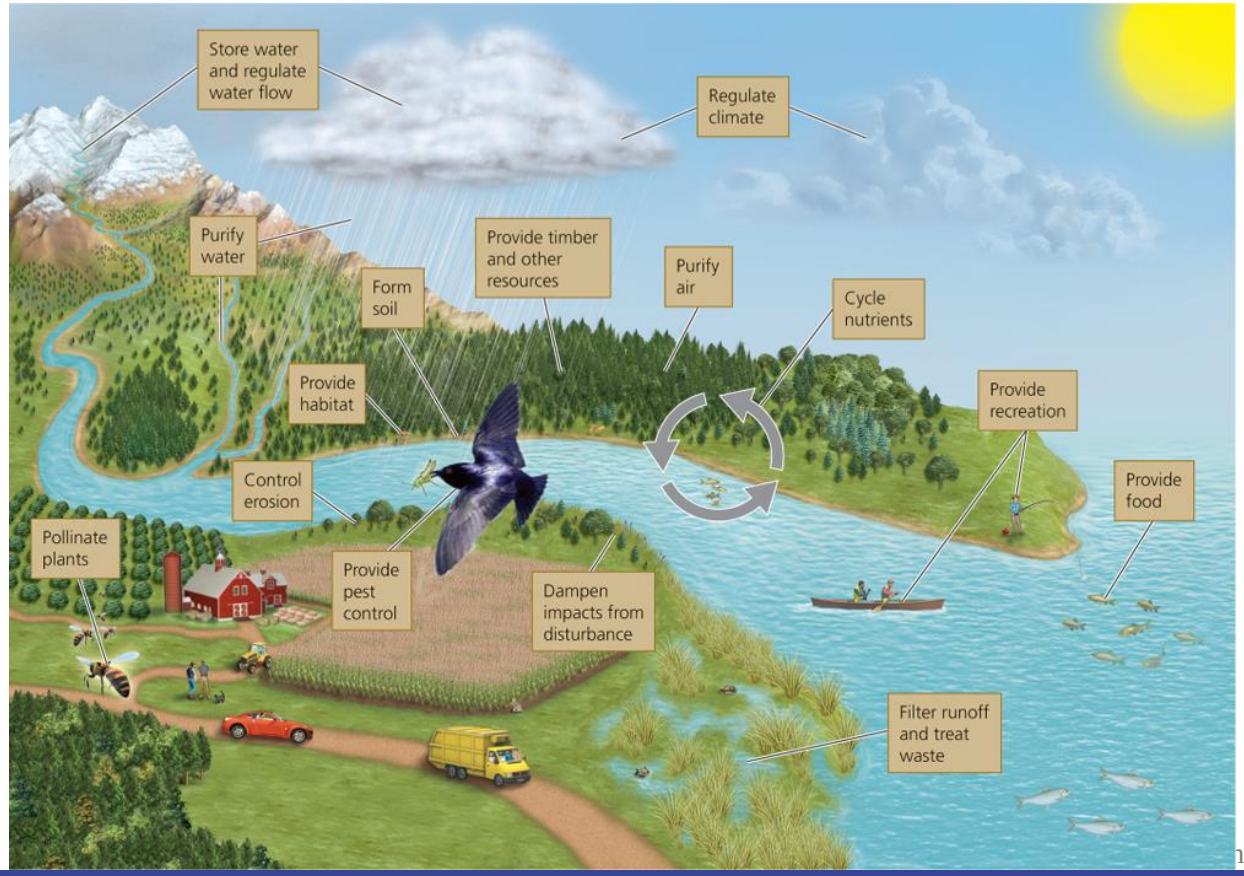
The environment provides goods and services but also has intrinsic value

Goods

- Tangible material things
- Extracted from the environment.
- Examples?

Services

- Functions and processes vital to living organisms
- Examples?



Earth's carrying capacity is limited

Carrying capacity

- A measure of the ability of a system to support life
- Quantified / measured in terms of the **maximum population size** [i.e. number of individuals of a particular species] that can be sustained by the biological productivity of a given environment [e.g. an area of land or an aquatic system] without incurring permanent damage the productivity of the area.

The focus is on maximum population size [versus the biocapacity definition on subsequent slide]

Earth's carrying capacity is limited

Tragedy of the Commons:

- Occurs in contexts of **commonly owned**/shared land or other resources such as oceans
- **Unregulated** exploitation leads to resource depletion
- Resource users are motivated by **self interests** to maximize personal gain, i.e. they are re tempted to increase their own use of the resource until and the resource is depleted or gone.

Discussion

- Local examples?
- Does tragedy of the commons always occur in all contexts?
- Solutions?
  - Private ownership?
  - Voluntary organization?
  - Governmental regulations?

Human Activities and the Environment

People differ in their perception of environmental problems

e.g. DDT, a pesticide

- In many locations DDT is now viewed differently due to recent scientific knowledge & awareness of impacts, but previously it was applied very broadly
  - Stanley Park example
- But in some countries it is still important for killing malaria carrying mosquitoes
- Is it feasible or likely the environment and longer-term concerns can be the highest priority for people in all contexts? Why or why not?

Population growth has driven our environmental impacts

- The World surpassed 7 billion people in 2011

(we'll tackle this issue in detail, e.g. Chapter 6-Human Population)

Ecological footprints help us quantify our impacts

Calculating our ecological footprint:

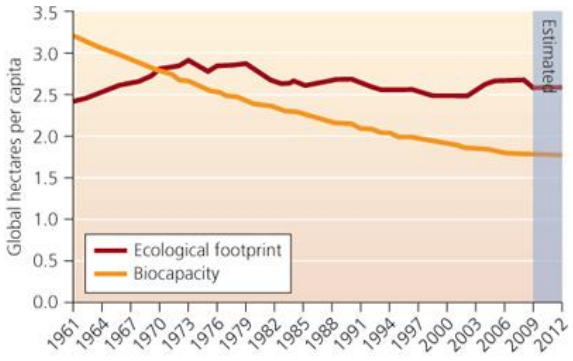
The environmental impact of an individual or population

Expressed in terms of the amount of biologically productive land + water required to provide raw materials a population consumes and absorb the waste produced

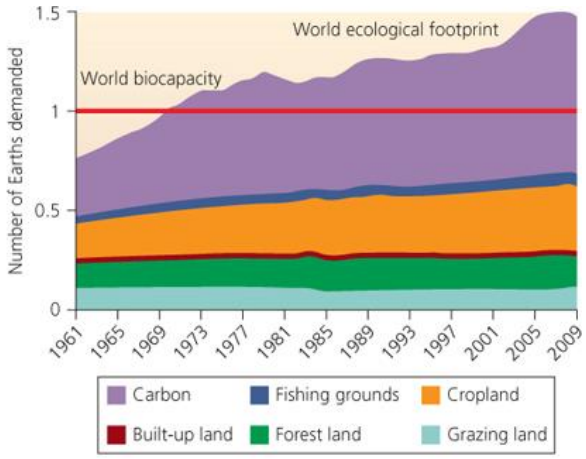
Ecological footprints help us quantify our impacts (cont'd)

- **Biocapacity** (essentially the inverse of footprint)**:** the capacity of a terrestrial or aquatic system to be biologically productive and adsorb waste [like carbon dioxide].
- Whereas ***carrying capacity*** also relates to the idea of biological productivity it is more narrowly focused on maximum population size that can be supported. Biocapacity is a broader concept.
- Humans have surpassed the Earth's capacity

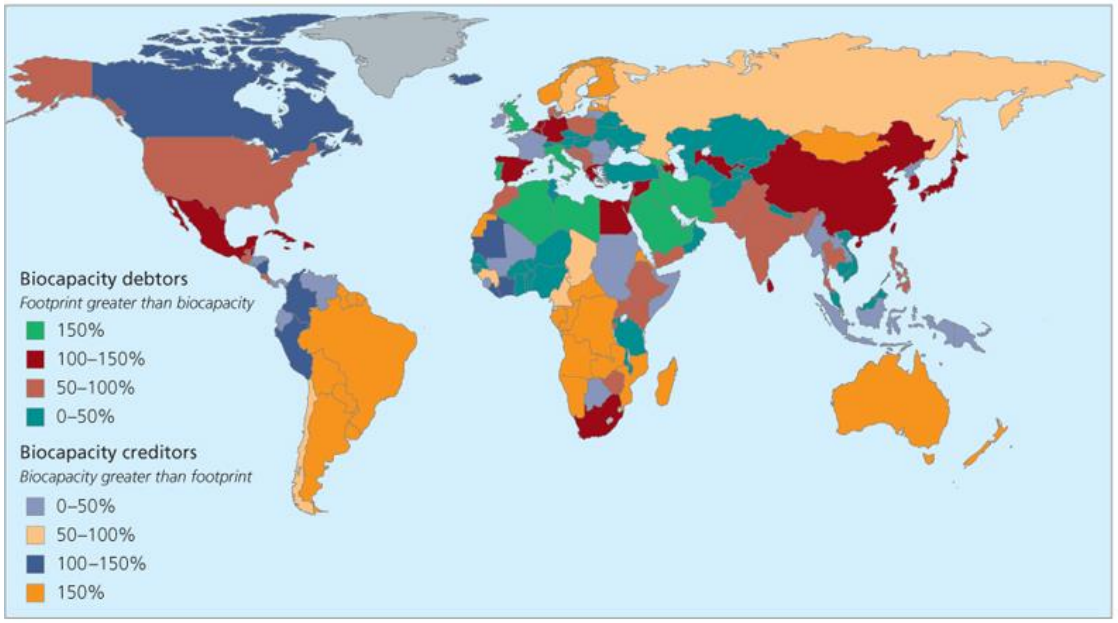
We are using 47% more of the planet's resources than are available on a sustainable basis from all the land!



(a) World ecological footprint and biocapacity



(b) Components of the ecological footprint



(c) Biocapacity "debt"

Biocapacity creditor vs debtor:

Discussion: what are the implications for social responsibility in economically developed versus developing regions?

Sustainability and the Future of Our World

Sustainability meets environmental, social, and economic goals

Sustainability. A guiding principle of environmental science that requires us to live in such a way as to maintain Earth's systems and its natural resources for the foreseeable future.

- Living within our means
- Leaves future generations with a rich and full Earth
- Conserves the Earth's natural resources
- Maintains fully functioning ecological systems

Sustainable development: the use of resources to satisfy current needs without compromising future availability of resources

(a) "Triple bottom line" of sustainability

Are things getting better, or worse, and how can we tell?

- Many people think environmental conditions are better
- Some think things are much worse in the world

Comprehensive & critical thinking about this should consider:

- Impacts to both humans and other organisms, systems.
- The long and the short term.
- All of the costs and benefits e.g. environmental economics later this term

Concluding Thoughts

- Environmental science helps us understand our relationship with the environment and informs our attempts to solve and prevent problems.
- Identifying a problem is the first step in devising a solution to it
- Environmental science can aid us in our efforts to develop balanced and workable solutions to many environmental problems

QUESTION: Review

The term “environment” includes

a) Animals and plants
b) Oceans and rivers
c) Soil and atmosphere
d) All of the above are included in this term

QUESTION: Review

Which of the following is correct about the term "environmentalism"?

a) It always has a science-oriented focus
b) It is a social movement to protect the environment
c) It usually does not include advocacy for the environment
d) It involves scientists trying to solve environmental problems

QUESTION: Review

What is the definition of “sustainable development”?

a) Using resources to benefit current generations, even if it means lower availability later
b) Letting future generations figure out their own problems
c) Using resources to satisfy current needs without compromising future availability