

Sustainability



Sustainability

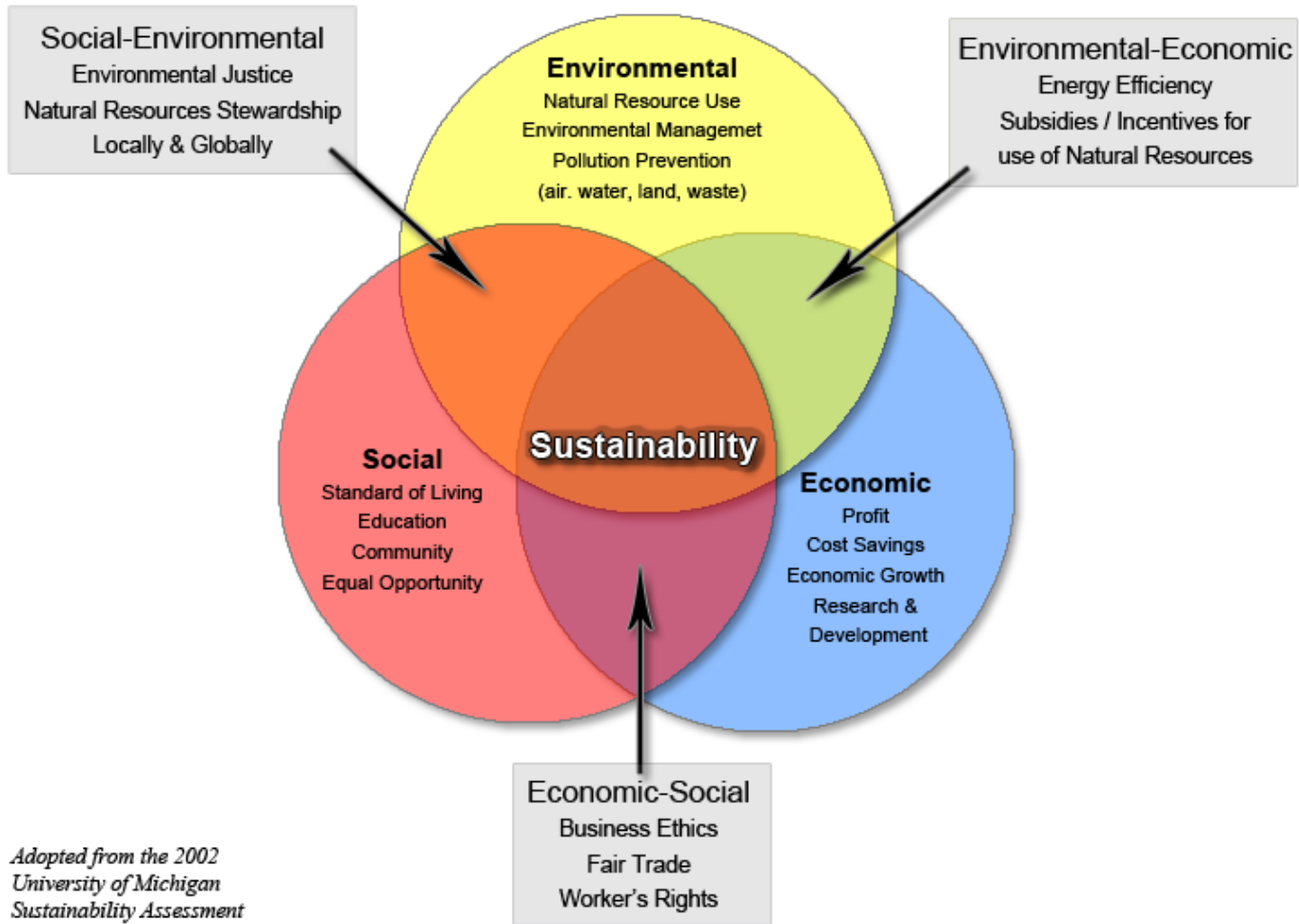
- The capacity to endure
- **Sustainability** is a search for ecological stability and human progress that can last over the long term.
- **Sustainable development is** “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

Sustainability

- **Environmentally sustainable society** as the ultimate goal of sustainability; a society that meets the current and future basic resource needs of its people in a just and equitable (fair) manner

Sustainability

The Three Spheres of Sustainability



*Adopted from the 2002
University of Michigan
Sustainability Assessment*

Sustainability

- Three major components:
 - Natural capital: supported by solar capital
 - Natural resources
 - Natural services
 - Degradation of natural capital through human activities
 - Scientific solutions to environmental problems

Natural Capital

- Key component of sustainability
- The **natural resources** and **natural services** that keep us and other forms of life alive and support our economies

Natural Resources

- **Resource:** Anything obtained from the environment to meet our needs and wants
- **Natural Resources:** Materials and energy in nature that are essential or useful to humans

Natural Resources

- Some directly available for use
 - ✓ Solar energy
 - ✓ Fresh air
 - ✓ Fresh surface water
 - ✓ Fertile soil
 - ✓ Wild edible plants



Natural Resources

- Some not directly available
- Made available with technology and some effort
- ✓ Petroleum
- ✓ Underground water
- ✓ Iron
- ✓ Cultivated crops



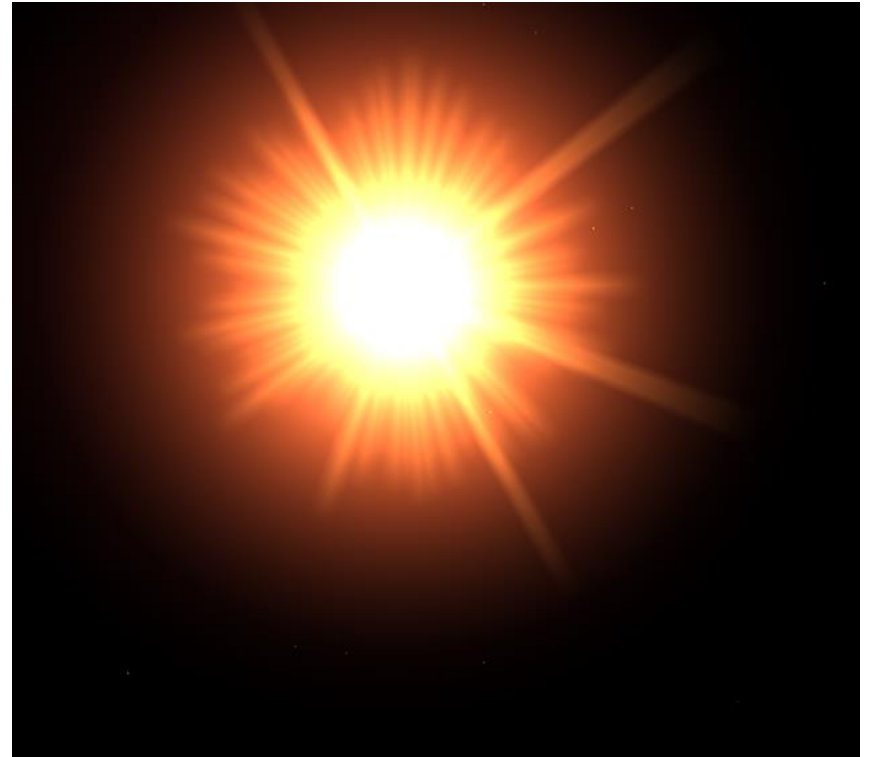
Natural Resources

Classified by Renewability

Perpetual Resources

are renewed
continuously.

Solar energy expected
to last six billion years!!



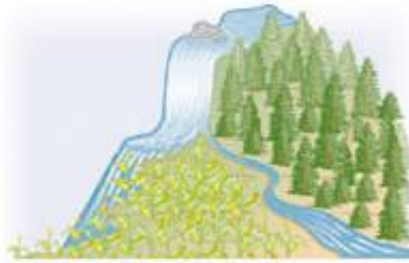
Natural Resources

Classified by Renewability

- **Renewable:** replaced by natural processes in a matter of hours to hundreds of years
 - Fresh water
 - Plant and animal populations
 - Forests
- **Non-renewable:** finite; not replaceable
 - Minerals (metals, nutrients)

Natural Resources

Continuum of Renewability



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
- Gold, silver, and other metals

Natural Resources

Renewable does not mean inexhaustible!!

- **Timescale of “renewability” varies**
 - Human timescales (100 years or less)
 - Longer-than-human timescales: non-renewable “for practical purposes”

**Fossil Fuels:
Non-renewable in practice**



**Striped Bass:
Human timescale**



Natural Resources

Renewable does not mean inexhaustible!!

- **Renewable resources can be overexploited.**
 - “Used up” faster than can be replaced
 - Degraded beyond ability of natural processes to replace

Blue Crabs



Tropical Rainforest



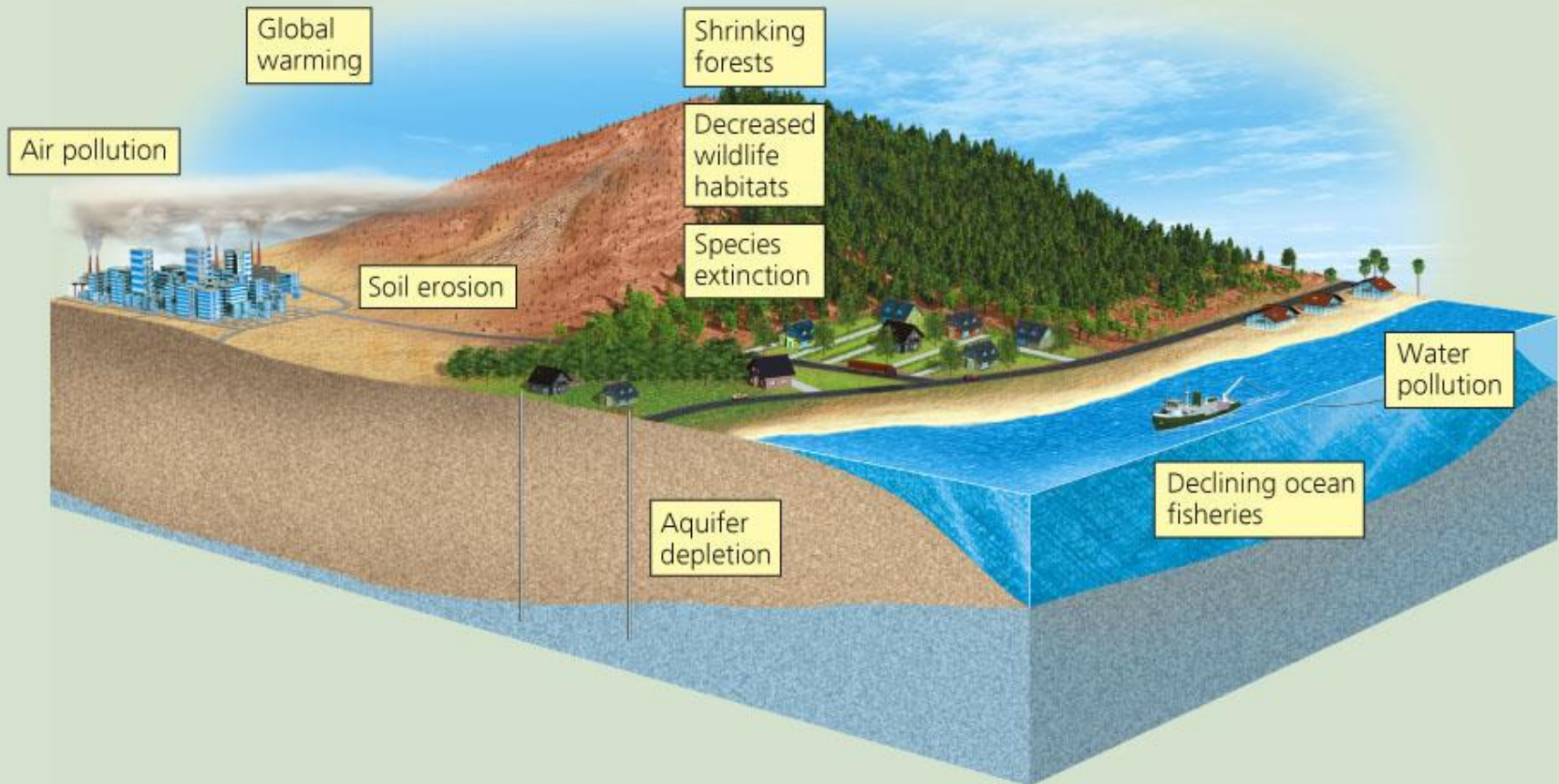
Natural Resources

Renewable Resources

- **Sustainable yield:** the highest rate at which a renewable resource can be used indefinitely without reducing its available supply
- **Environmental degradation:** occurs when a renewable resource's natural replacement rate is exceeded and the available supply begins to shrink

NATURAL CAPITAL DEGRADATION

Degradation of Normally Renewable Natural Resources



Natural Resources

Non-renewable Resources

- Exist in fixed quantity or stock in the earth's crust
- Renewed by geological processes on a timescale of millions to billions of years
- May be depleted faster than they are formed

Natural Resources

Non-renewable Resources

- *Energy resources* (coal, oil)
- *Metallic mineral resources* (copper, aluminum)
- *Non-metallic mineral resources* (salt, sand)

Natural Resources

Non-renewable does not mean rapidly exhausted!!

Some non-renewable resources can be reused or recycled.



Natural Resources

Non-renewable does not mean rapidly exhausted!!



Natural Resources

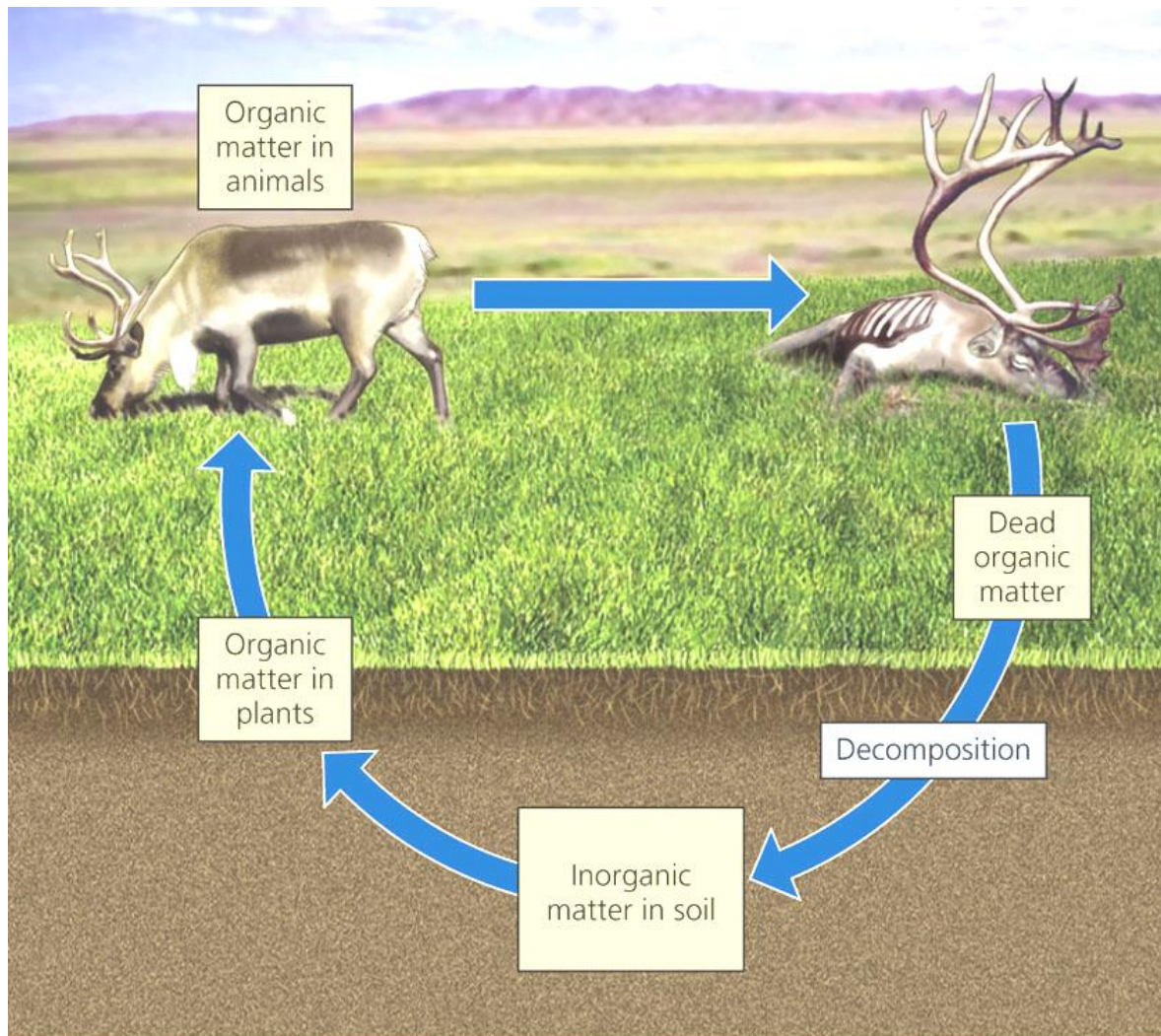
- **Conservation:** Management of natural resources with the goal of minimizing resource waste and sustaining resource supplies for the current and future generation

Natural Services

- **Natural Services:** Functions of nature such as purification of water and air; provided at no cost by ecosystems

Natural Services

Nutrient Cycling

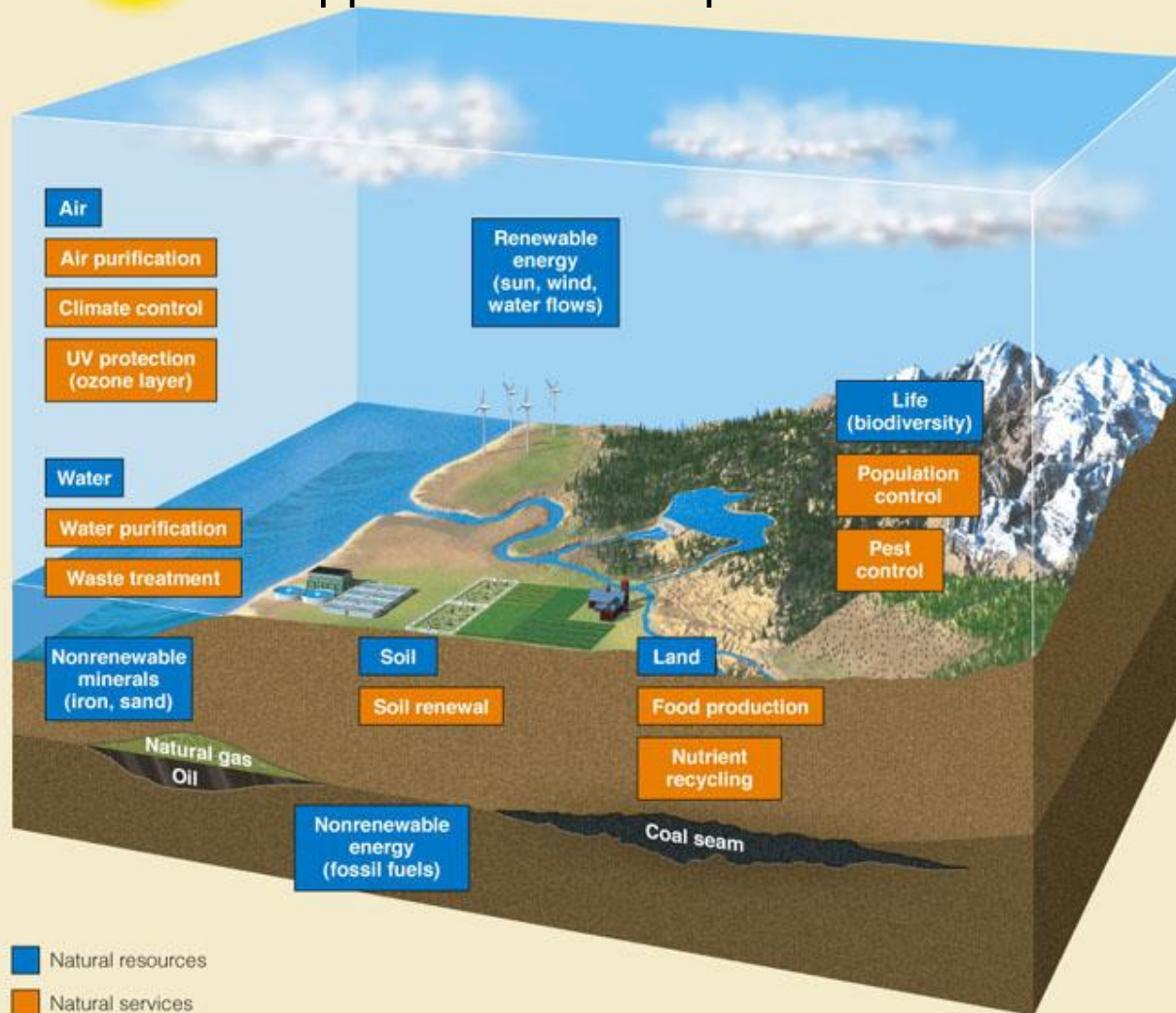


NATURAL CAPITAL

Natural Capital = Natural Resources + Natural Services

Solar capital

Solar Capital: energy from the sun; supports natural capital



Ownership of Resources

- Three types of property or resource rights
 - **Private property:** Individuals or firms own the rights to land, minerals or other resources
 - **Common property:** The rights to a certain resource are held by large groups of individuals.
 - **Open access renewable resources:** Owned by nobody and available for use by anybody at little or no charge.

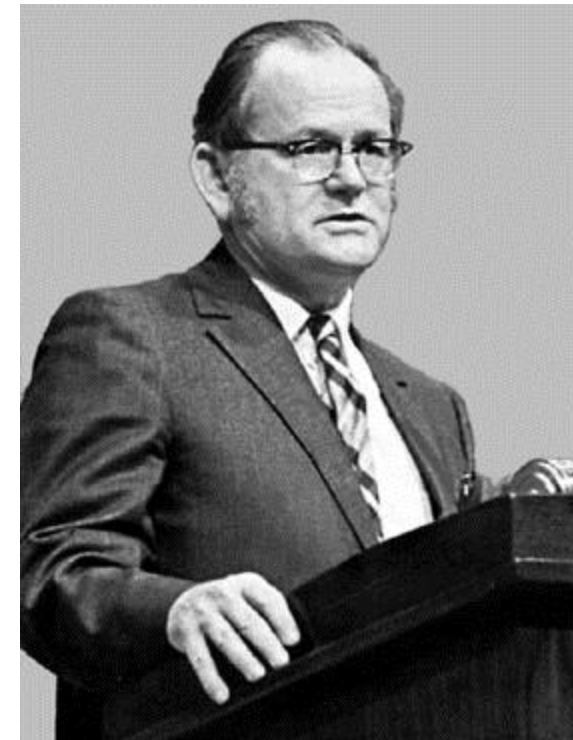
Ownership of Resources

- Many common property and open access renewable resources have been degraded!
- “If I do not use this resource, someone else will. The little bit that I use or pollute is not enough to matter and anyway, it’s a renewable resource!”
- Problematic when many people think this way

The Tragedy of the Commons

Garrett Hardin

- 1968: coined by Garrett Hardin, a biologist at UC Santa Barbara



Tragedy of the Commons



Tragedy of the Commons

- Behavior that makes sense from the individual point of view, when repeated by enough individuals, ultimately proves disastrous to society

Tragedy of the Commons

Each individual

- Is self-interested
- Behaves so as to advance his or her own self-interest
- Gains financially or otherwise by consuming a natural resource
- Sees little harm in doing so since the resource is huge in size and his/her impact on the resource is small

Tragedy of the Commons

- Tragedy occurs when each of the many individuals with unrestricted access to a natural resource consume and destroy the resource – a disaster or tragedy to all.

Tragedy of the Commons



Copyright © 2005 Pearson Education, Inc., publishing as Benjamin Cummings

Tragedy of the Commons

- Plays a major role in causing most, if not all, the resource, pollution and population problems the world now faces

Tragedy of the Commons

- The cause of such environmental problems as
 - Air and water pollution
 - Global warming
 - Acid rain
 - Ozone depletion
 - Deforestation
 - Loss of biodiversity
 - Depletion of key energy resources

Solutions to the Tragedy of the Commons

- How can the consumption of a resource by individual members of a society be restrained so as to avoid the destruction of the resource?
- How can behaviors that conserve the resource be encouraged?

Solutions to the Tragedy of the Commons

- Use shared resources at rates lower than their estimated sustainable yields (reducing use or regulating access to resource)
- Convert open access resources to private ownership – Is it practical? What is to be done with open oceans and the atmosphere?

Solutions to the Tragedy of the Commons

- The use of government laws, regulations and incentives to encourage pro-social behavior
- Programs of education that give people information and try to change their attitudes
- Informal non-governmental social processes that operate in small social groups and communities
- The use of moral, religious or ethical appeals

Solutions to the Tragedy of the Commons

- Hardin advocates the first approach.
- **Mutual coercion mutually agreed upon**
- Only government laws, regulations and incentives (including privatization) work because they make pro-environmental behavior in each individual's best interest.

Living Sustainably

- Growing body of scientific evidence that we are living unsustainably by wasting, depleting and degrading the earth's natural capital at an exponentially accelerating rate

Living Sustainably

- “...Human activity is putting such a strain on the natural functions of Earth that the ability of the planet’s ecosystems to sustain future generations can no longer be taken for granted.”

Millennium Ecosystem Assessment,

United Nations, 2005

Living Sustainably

- Living off the earth's natural income without depleting or degrading the natural capital that supplies it

Living Sustainably

- Protecting natural capital and living off the income it provides = **Natural income!**
- Using renewable rather than non-renewable resources
- Providing the human population with adequate and equitable access to this natural income for the foreseeable future

Living Sustainably

Making the shift to more sustainable societies and economies through building *social capital*:

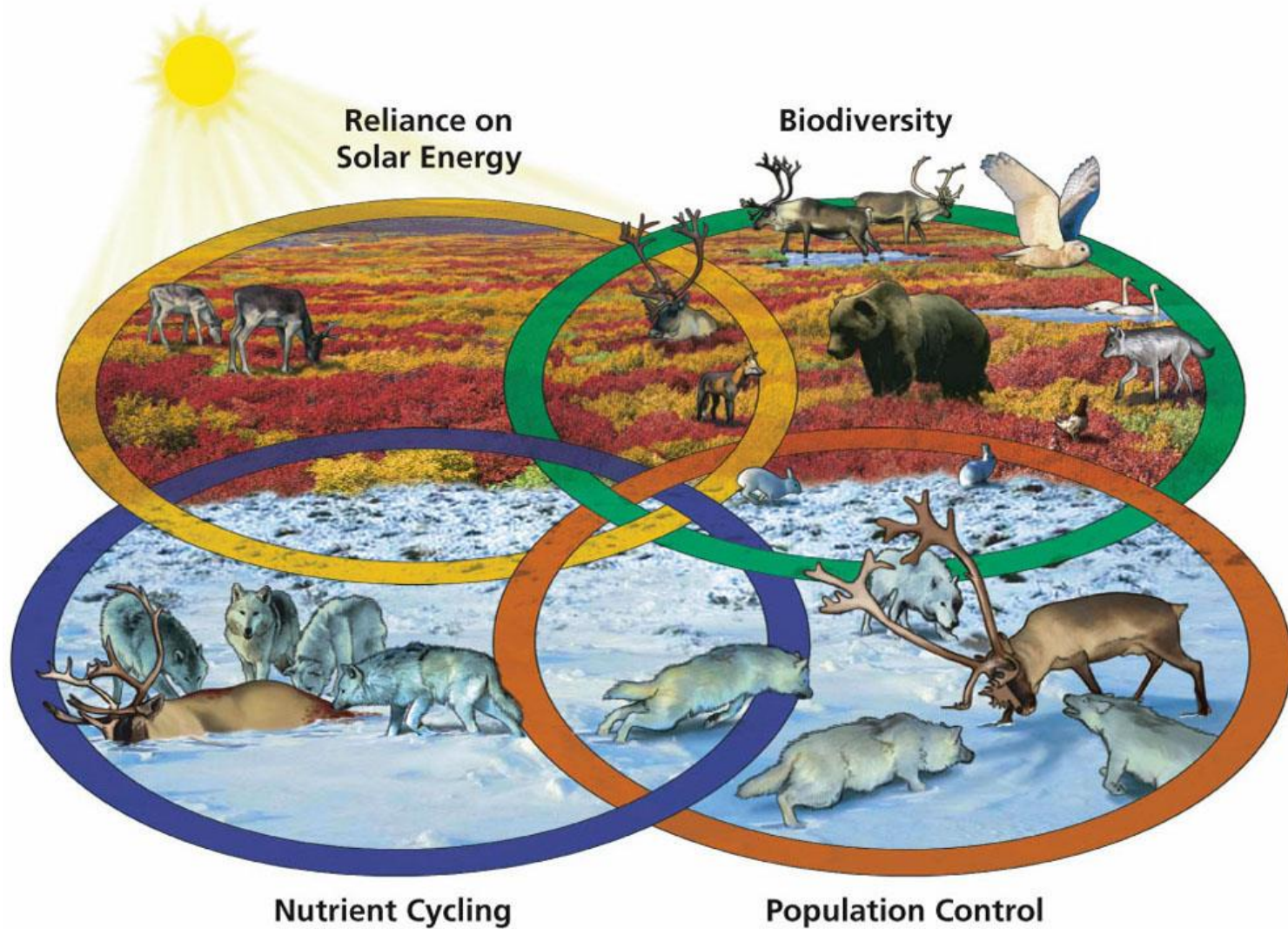
- Getting people with different views and values to talk and listen to one another, find common ground based on understanding and trust and work together to solve environmental as well as other problems
- Nurturing openness, communication, cooperation and hope
- Discouraging close-mindedness, polarization, confrontation and fear

Living Sustainably

To live sustainably:

- Understand how life on Earth has survived and adapted to major changes in environmental conditions for billions of years
- Apply the lessons learned from nature to our lifestyles and economies

Scientific Principles of Sustainability



Scientific Principles of Sustainability

Reliance on Solar Energy:

- The sun warms the planet.
- The sun supports photosynthesis, which provides plants, us and most other animals with food.

Scientific Principles of Sustainability

Biodiversity (Biological Diversity):

- The variety of organisms, their genes, and the ecosystems in which they exist
- Biodiversity and the natural services they provide allowed life to adapt to changing environmental conditions throughout Earth's history.

Scientific Principles of Sustainability

Population Control:

- Competition for resources among different species limits population growth.

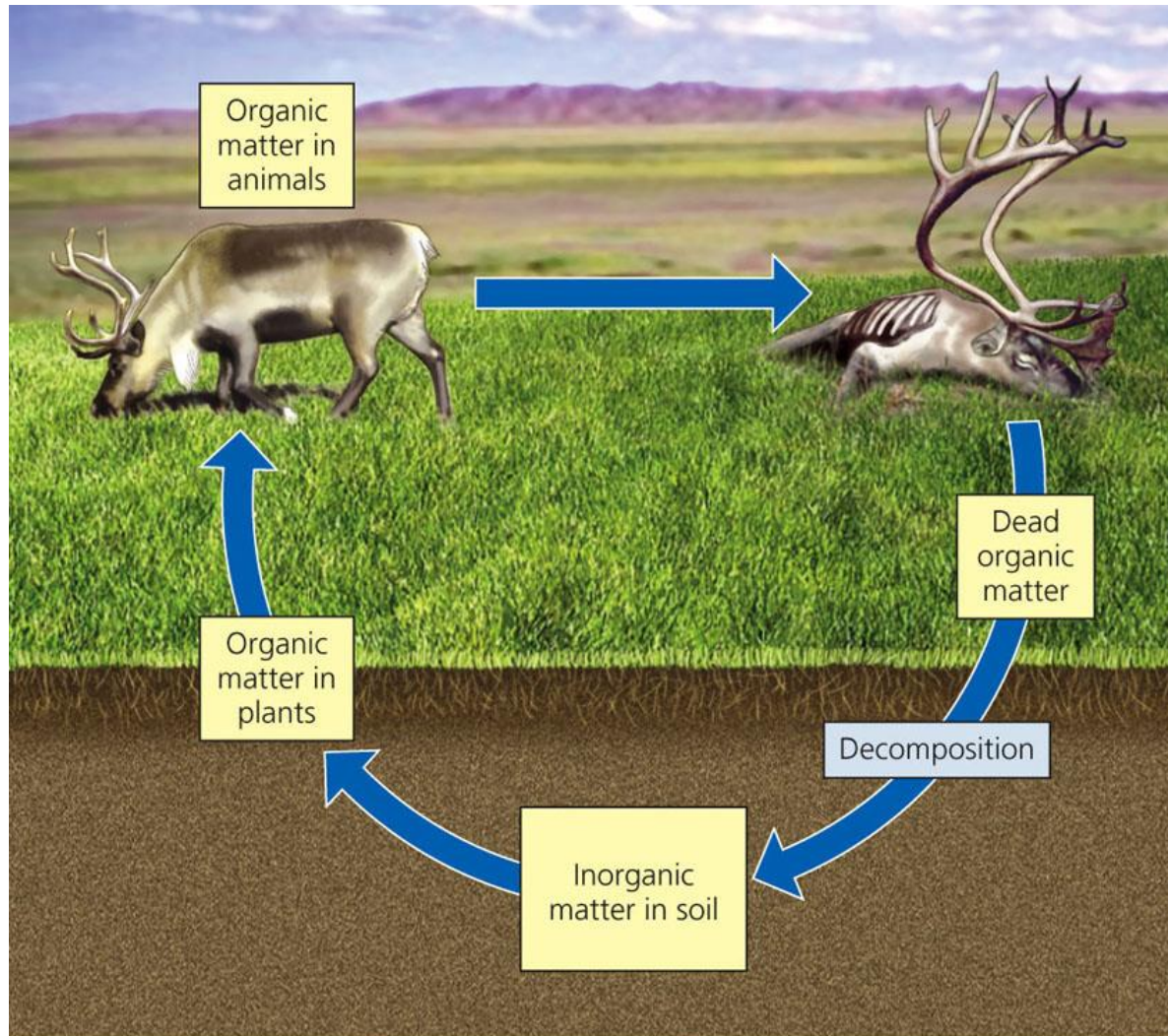
Scientific Principles of Sustainability

Nutrient Cycling:

- Natural processes recycle nutrients (chemicals that organisms need to stay alive and reproduce).
- **There is little or no waste in natural systems.**

Scientific Principles of Sustainability

Nutrient Cycling



Scientific Principles of Sustainability

- Using the four scientific principles of sustainability to guide our lifestyles and economies could help us bring about an **environmental/ sustainability revolution.**

Scientific Principles of Sustainability



Scientific Principles of Sustainability

- We have 50 to no more than 100 years to make such changes.
- Everything you do, or you do not do, will play a role in our collective choice of the path we will choose.

YOUR DECISION MATTERS!!

I Matter....You Matter....We Matter

- Most social change results from individual actions and individuals acting together (social capital?) to bring about change.
- It takes only 5 to 10% of a community, a country or the world to bring about major social change.
- Significant social change can occur much more quickly than people think.

I Matter...You Matter...We Matter

“Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.”

Margaret Mead
Anthropologist



Sustainable Societies and Economic Growth

- **Economic development:** Using economic growth to improve living standards
- Based on their degree of industrialization, the world's countries are divided into two groups:
 1. **Developed countries**
 2. **Developing countries**

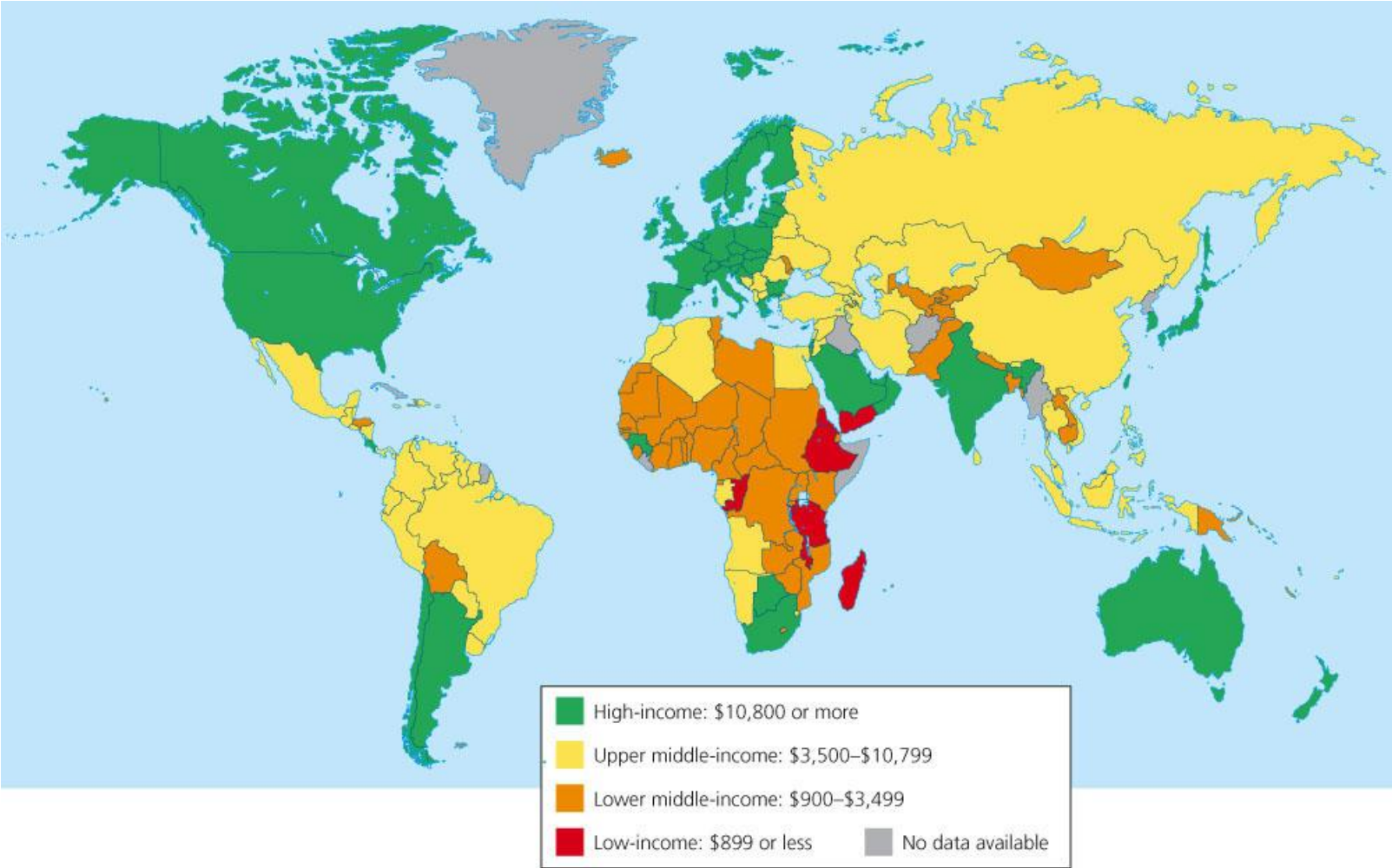
Developed Countries

- ca. 1.2 billion people
- Highly industrialized
- High per capita GDP PPP
- USA, Canada, Japan, Australia, New Zealand, most of Europe

Developing Countries

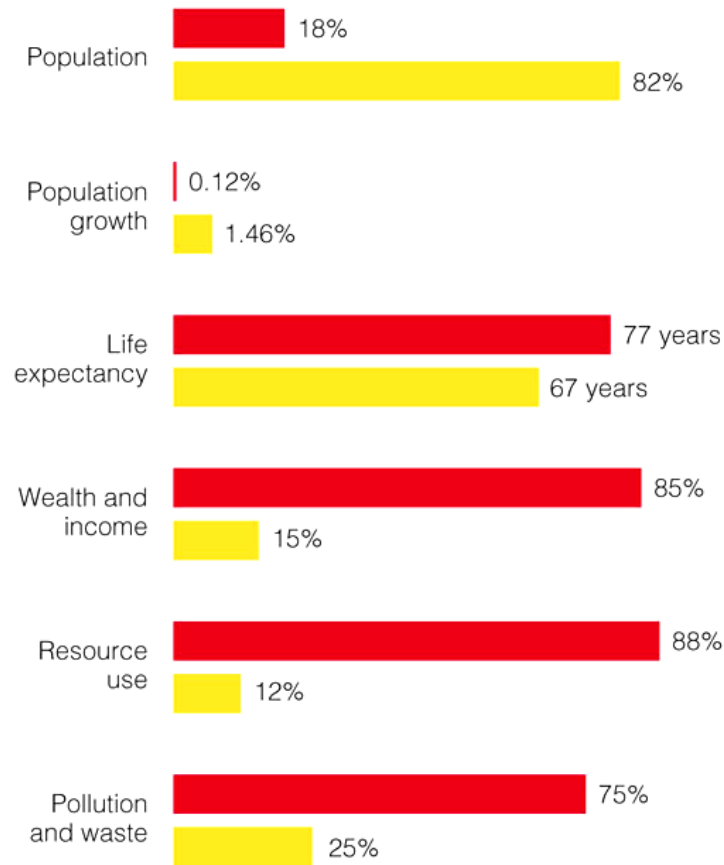
- ca. 5.5 billion people
- Most in Africa, Asia and Latin America
- Middle-income, moderately developed: China, India, Brazil, Turkey, Thailand, Mexico
- Low-income, least developed:
 - 49 countries with 11% of the world's population
 - per capita GDP PPP steadily declining
 - Angola, Congo, Belarus, Nigeria, Nicaragua

Developed and Developing Countries



Developed and Developing Countries

Percentage of
World's:



Developed countries Developing countries

Sustainable Societies and Economic Growth

- Some economists call for continuing conventional economic growth!
 - Helped increase food supplies
 - Allowed people to live longer
 - Stimulated mass production of useful goods and services
 - Growth as a cure for poverty?

Sustainable Societies and Economic Growth

- Environmentally sustainable economic development
 - Discourage environmentally harmful and unsustainable economic growth that degrades natural capital
 - Encourage environmentally beneficial and sustainable economic growth that sustains natural capital

Environmental Worldview

- Set of assumptions and values reflecting how you think the world works and what you think your role in the world should be
- The main reason behind the different views about the seriousness of our environmental problems and what we should do about them

Environmental Worldview

- Involves **environmental ethics**: our beliefs about what is right or wrong with how we treat the environment

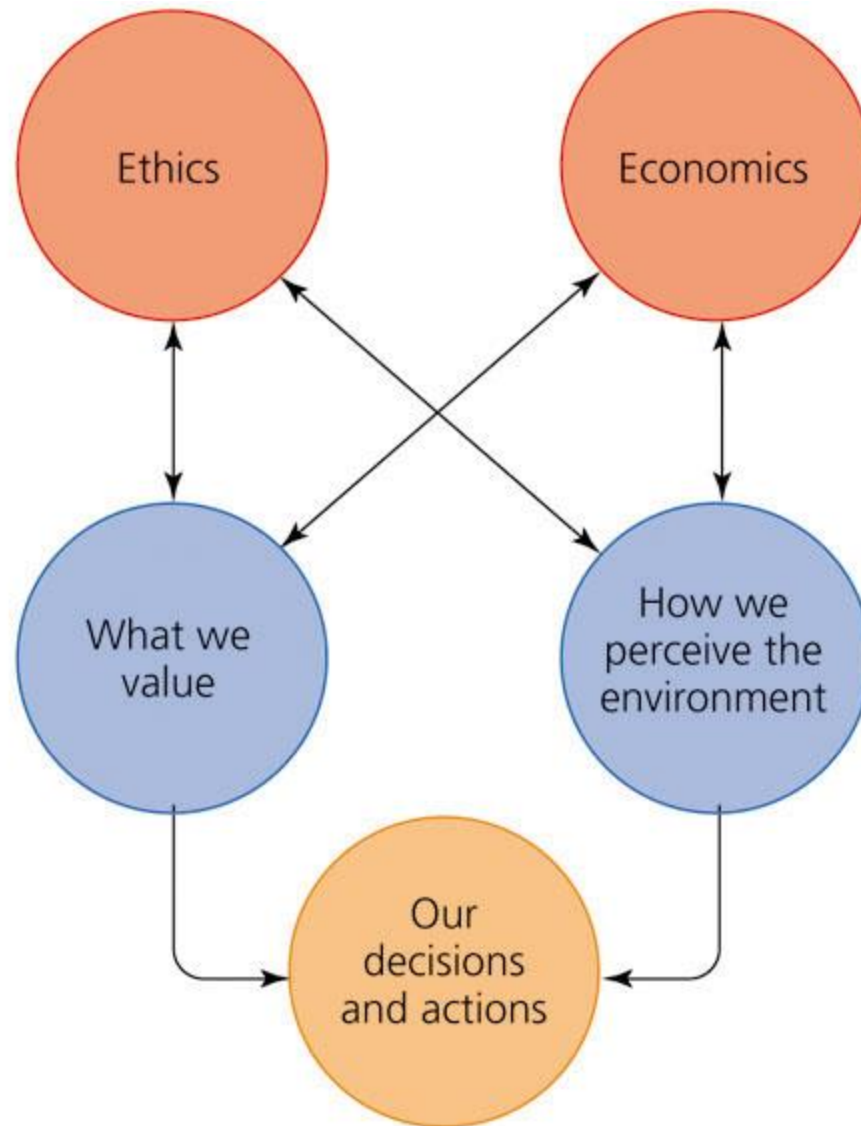
Important Ethical Questions Related to the Environment

- Why should we care about the environment?
- Are we the most important beings on the planet?
- Do we have an obligation to see that our activities do not cause the pre-mature extinction of other species?
- Do we have an ethical obligation to pass on to future generations the natural world in a condition at least as good as what we inherited?
- Should every person be entitled to equal protection from environmental hazards?

Environmental Worldview

- People with different environmental worldviews can arrive at different conclusions starting from the same data, and being logically consistent.
- This is because they start with different assumptions and moral, ethical and religious beliefs.

Environmental Worldview

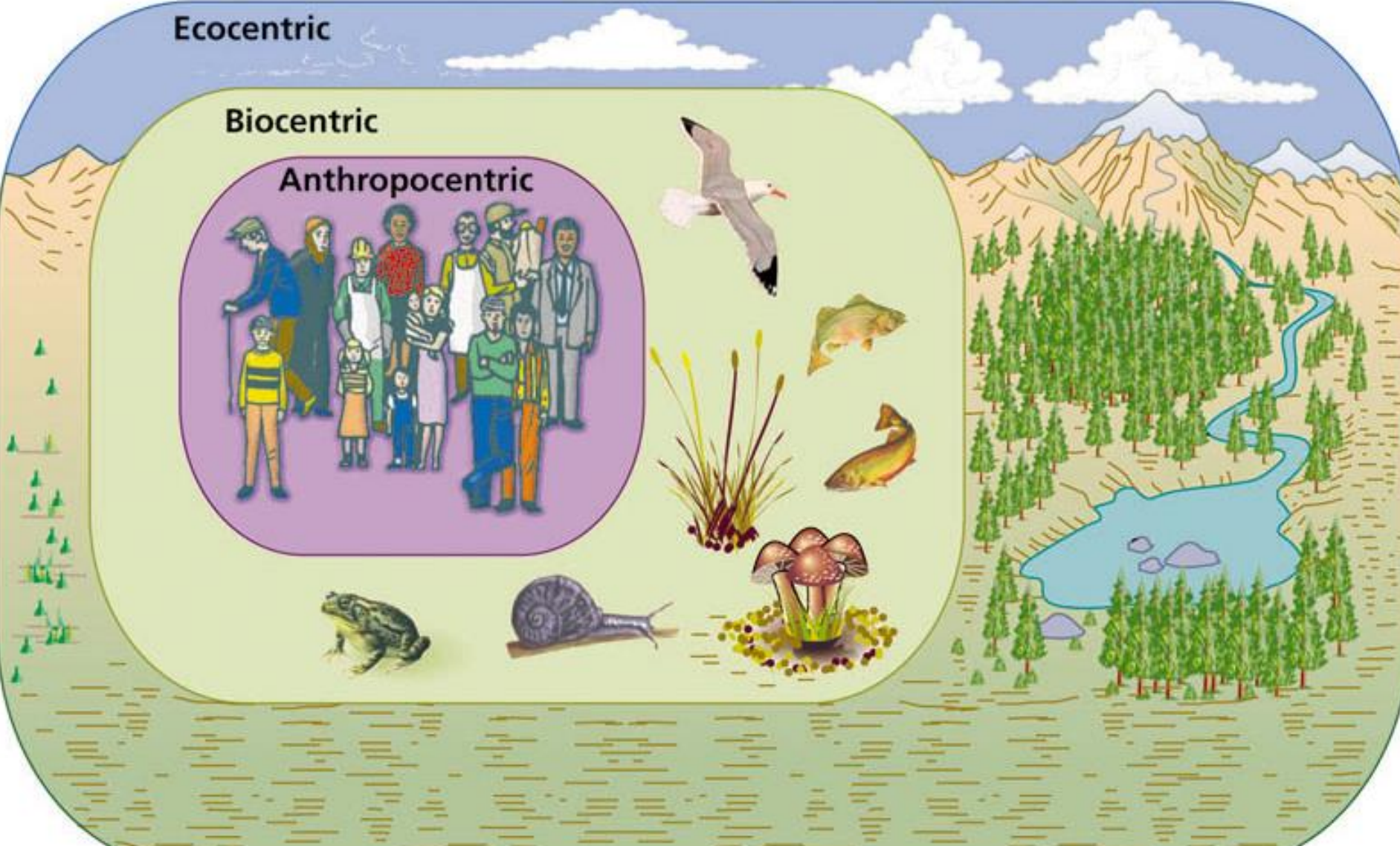
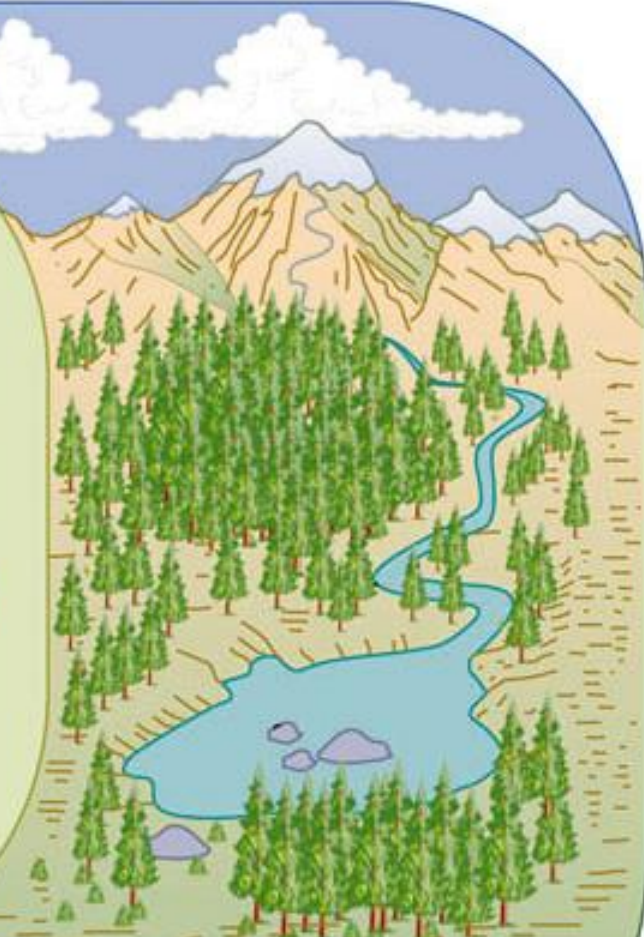


Environmental Worldview

Ecocentric

Biocentric

Anthropocentric



Environmental Worldview

Planetary Management Worldview

- We are separate from nature.
- Nature exists mainly to meet our needs and increasing wants.
- We can use our ingenuity and technology to manage the earth's life-support systems, mostly for our benefit, indefinitely.

Environmental Worldview

Stewardship Worldview

- We can and should manage the earth for our benefit.
- We have an ethical responsibility to be caring and responsible managers (stewards) of the earth.
- Encourage environmentally beneficial forms of economic growth and development and discourage harmful ones.

Environmental Worldview

Environmental Wisdom Worldview

- We are part of, and totally dependent on nature.
- Nature exists for all species, not just for us.
- Encourage earth sustaining forms of economic growth and development and discourage earth degrading forms
- Learn how life on earth sustains itself and integrate this environmental wisdom into the ways we think and act

Environmental Worldview

