Population, Environmental Impacts, and Sustainability

Reminders

Environment

- External conditions that affect living organisms

Ecology

- Study of relationships between living organisms and their environment

Environmental Science

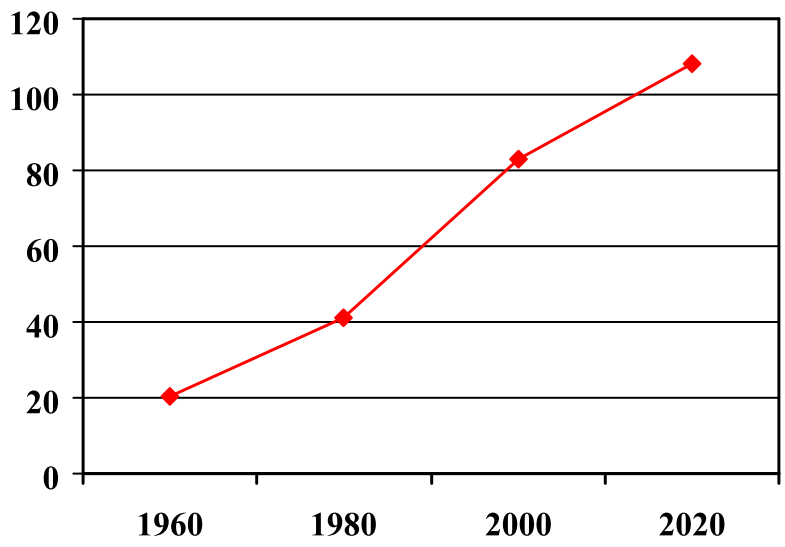
- Interdisciplinary study that examines the role of humans on the earth

Population

- Population: all the organisms of a single species living in the same location at the same time
- Rate of change
  - Positive: births, immigration
  - Negative: deaths, emmigration
- 3 types of growth

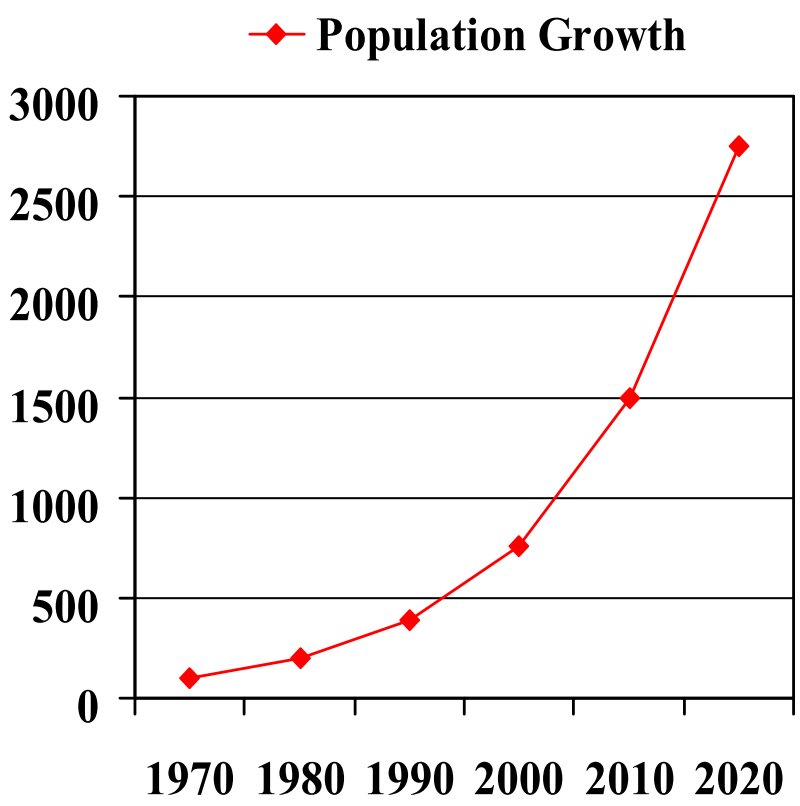
Linear Growth

- Quantity increases by a constant amount per unit of time
- Ex: 1,3,5,7,9, …
- Graph: "straight" line with positive slope
- Global food production follows this model
- Population's resource requirements?



Exponential Growth (Unrestricted)

- Quantity increases by a fixed percentage - starts off slowly, then grows to enormous numbers
- Graph: J-shaped curve with variable positive slope
- Only exhibited by human population now
- No limiting factor in play
- Resource requirements?



Exponential Population Doubling--Rule of 70

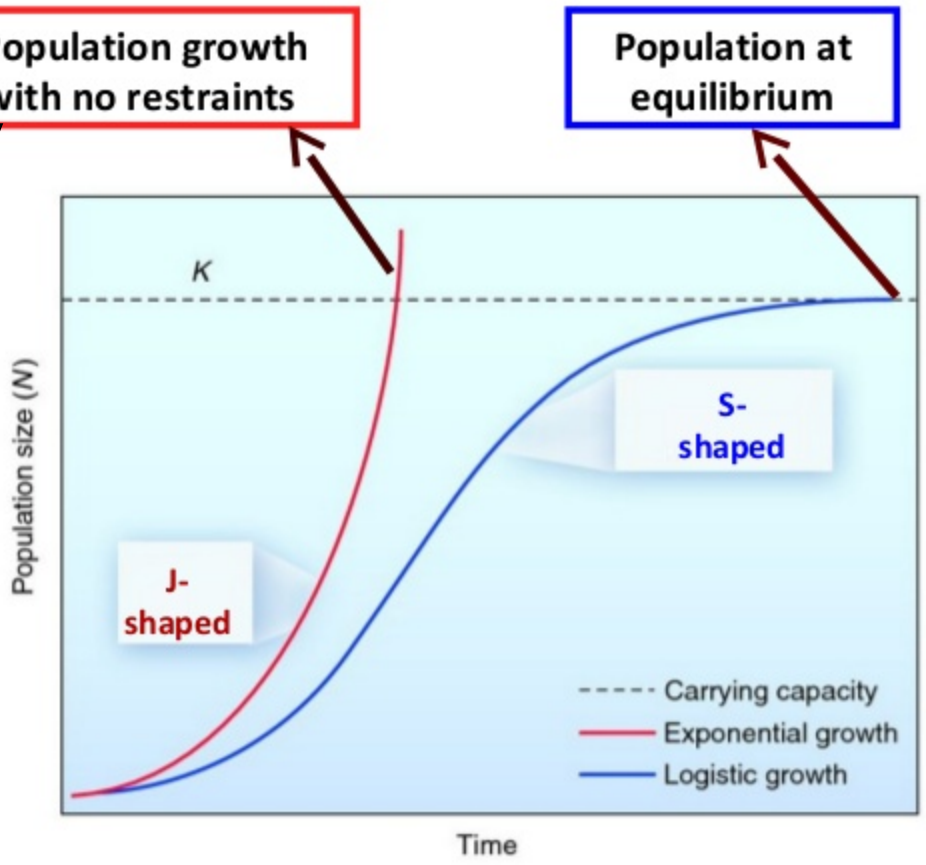
- How long does it take a population to double?
  - Resource use
  - Population size
- Rule of 70
  - 70 ÷ % growth rate = doubling time (years)
  - Currently, the human population growth rate (world wide) is **~1.2%**. In what year, do you predict the world population will have doubled?

How rapidly is the human population growing?

- It took 60,000 years to reach 1 billion
- It took 130 years to reach 2 billion
- It took 30 years to reach 3 billion
- It took 17 years to reach 4 billion
- It took 12 years to reach 5 billion
- It took 10 years to reach 6 billion
- 48% of earth's land area has been modified by man.

Logistic/Exponential Growth (Restricted)

- Begins with exponential growth then transitions to population stability at **carrying capacity**
- Result is an **S-shaped** curve
- Of natural populations studied, **all eventually** make an S-curve--WHY?



Carrying Capacity

- The maximum number of organisms an environment can support over a specified period of time
- Varies with
  - Time (long- and short-term)
  - Location
  - Technology available to extract and process resources & to deal with problems caused by overpopulation

Environmental Impacts

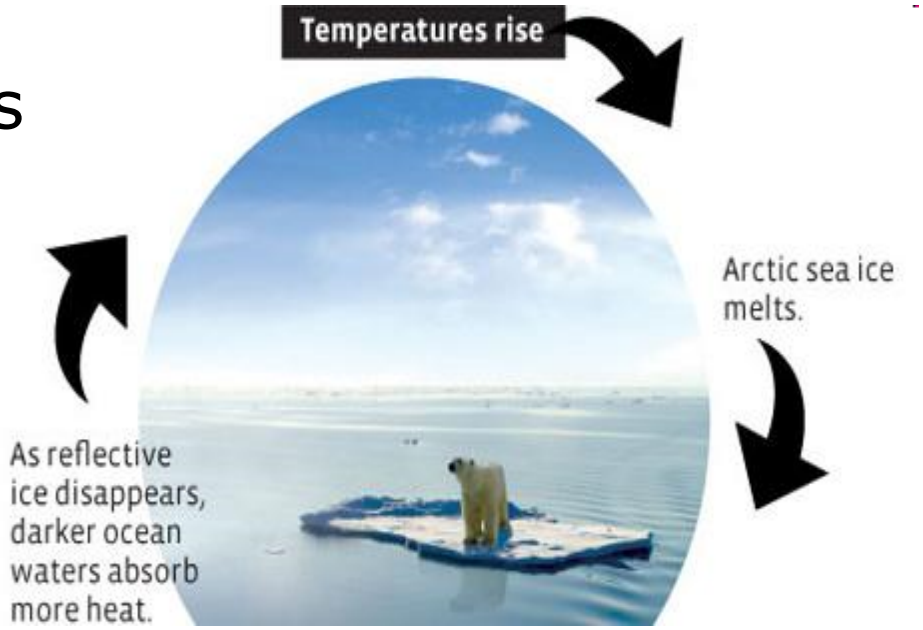
- Environmental Impact: Any change to the natural environment that results from human actions
- Can be positive or negative
- Environmental Impact Assessment
  - Performed prior to beginning a project, implementing a policy, initiating a plan, etc.
  - Attempts to predict environmental impacts
  - Used for approval, revision of design, & determining mitigation requirements

Synergy vs Chaos

- Synergy occurs when two or more processes interact so the combined effect is greater than the sum of the separate effects
- Chaos occurs in a system when there is no pattern and it never repeats itself
  - Noise versus Music

Feedback Loops

- A feedback loop occurs when an output of a system is fed back as an input
- Two kinds of feedback loops
  - Positive
  - Negative



Positive or Negative?

Feedback Loops

- ***Positive loops*** are runaway cycles where a change in a certain direction causes further change in the same direction
  - Melting of permafrost will release methane which will accelerate global warming
- ***Negative loops*** help to maintain stability in a system
  - Ex. Predator/Prey relationships help to maintain balance in populations… OR… blood sugar/insulin

Model of Environmental Impact

P x A x T = I

Population (P)

x

Consumption per person (A)

X

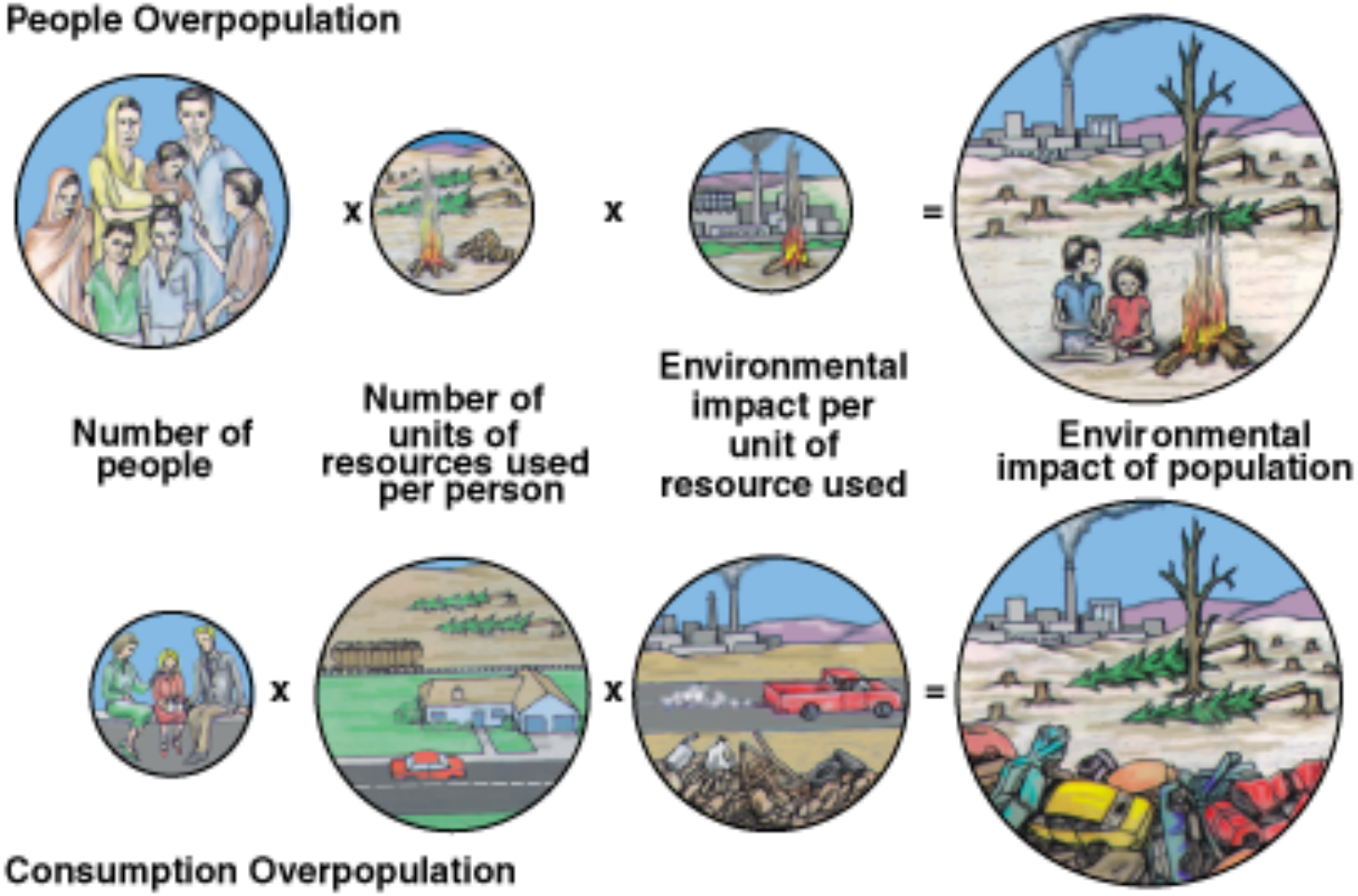
Technological impact per unit consumption (T)

=

Environmental impact of population

See Fig 1-11, p. 13

P x A x T = I


People Overpopulation
x
x
=
Number of people
Number of units of resources used per person
Environmental impact per unit of resource used
Environmental impact of population
x
x
=
Consumption Overpopulation

Environmentally Sustainable Society

- Sustainability: the ability of a system to survive and function over a defined period of time
- Live off the natural income replenished by soils, plants, air and water without depleting/degrading the natural capital that supplies this income
- Manages environmental impacts to provide for the needs of current and future generations

Four Scientific Principles of Sustainability: Copy Nature

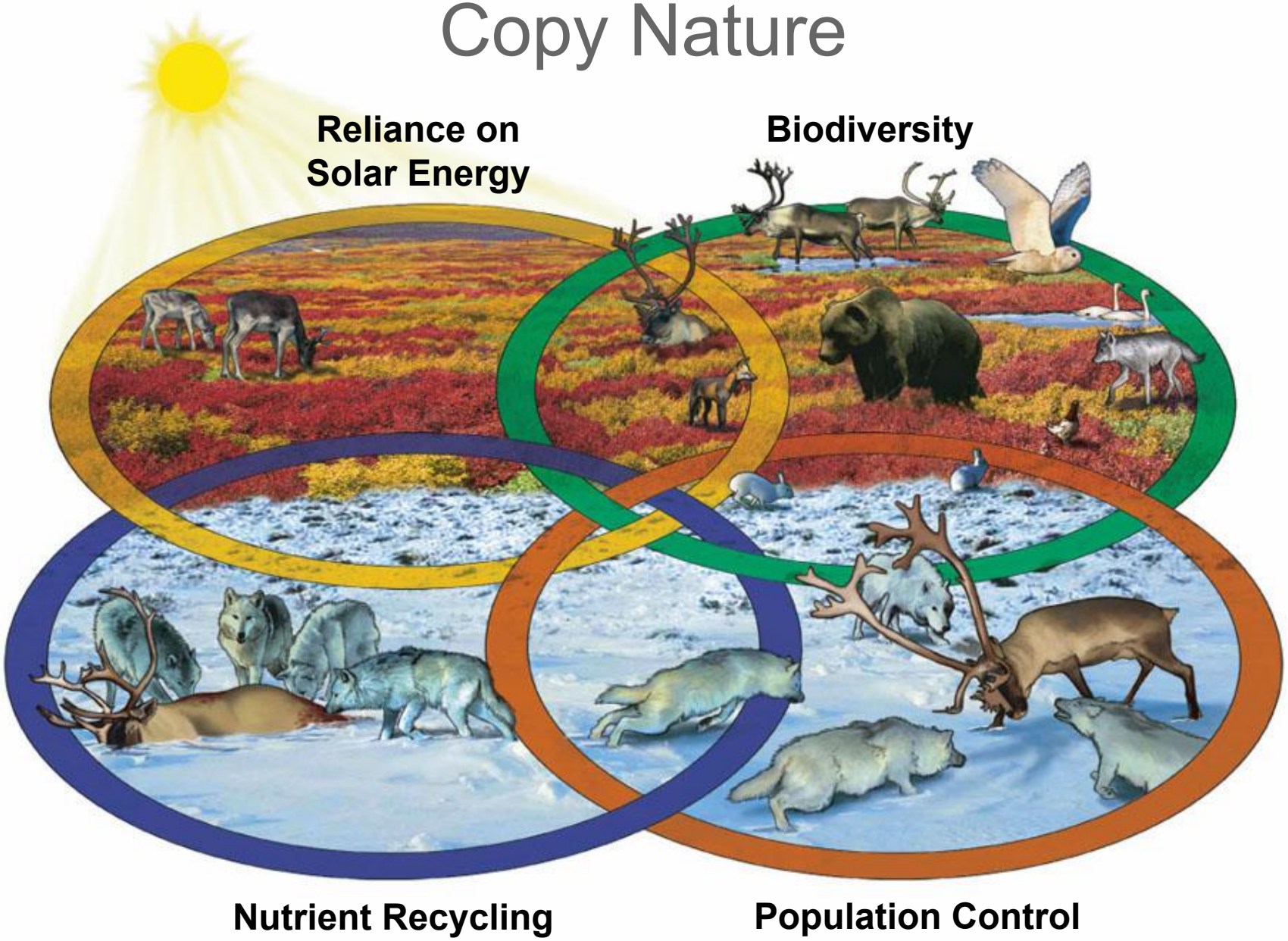
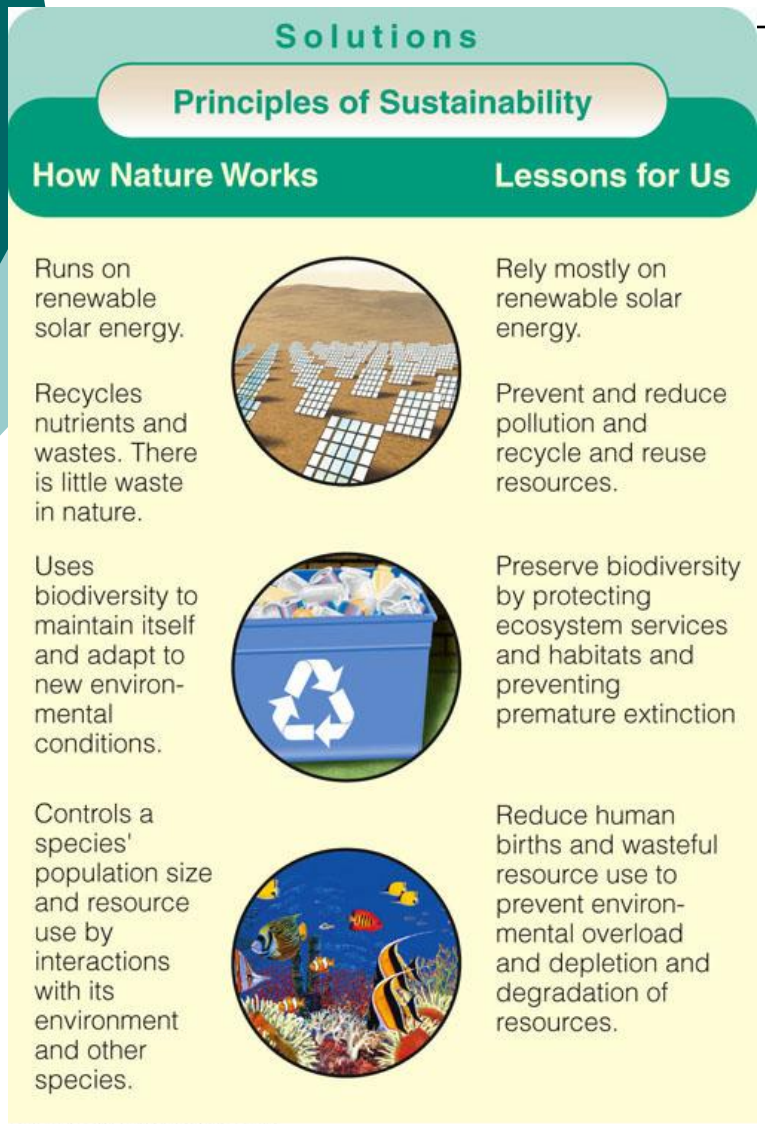


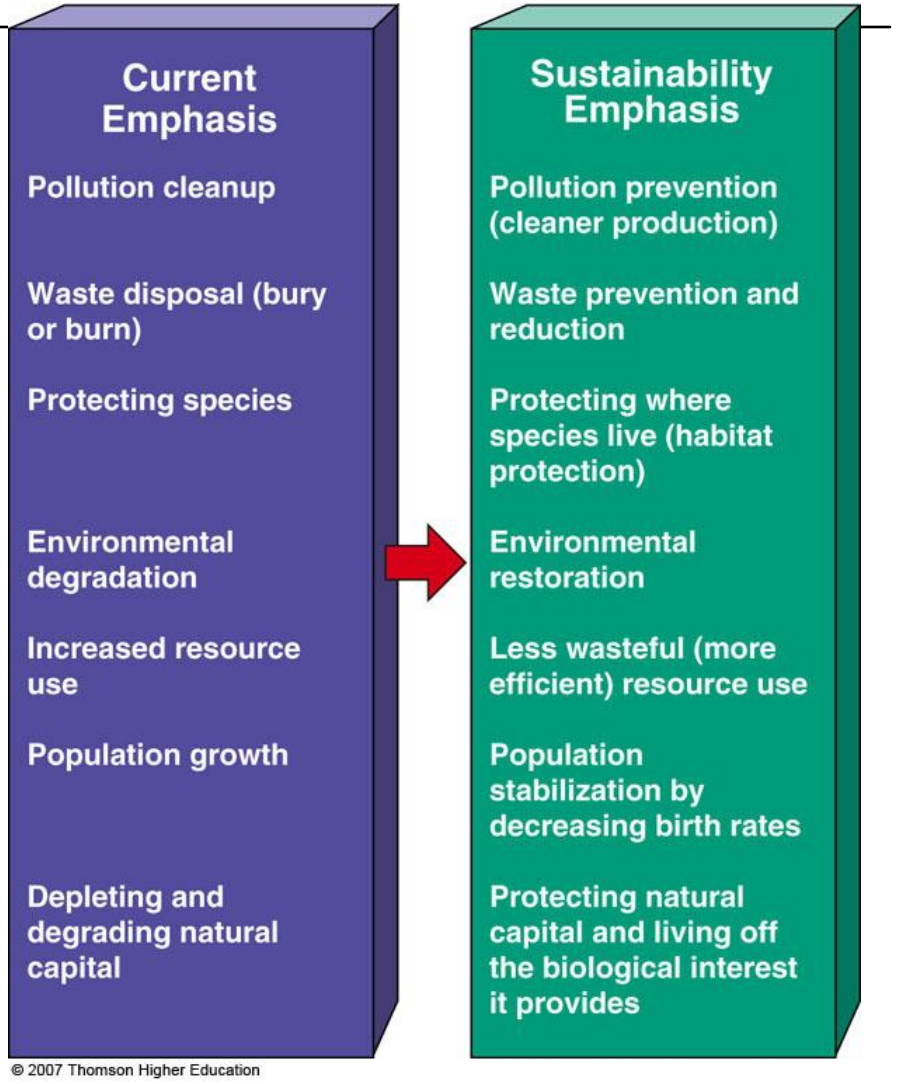
Fig. 1-16, p. 24

Path to Environmental Sustainability

- Sound science is required at each step
- Involves more than just the environment
  - Economics
  - Morality/values
  - Technology
  - Psychology

Implications of the Four Scientific Principles of Sustainability





Figures 1-17 and 1-18