AP ENVIRONMENTAL SCIENCE (lorax, mm fish)

Reading Assignment : read Chapter 1

Living in an exponential age:

WHAT IS ENVIRONMENTAL SCIENCE?

Environmental science is a study of how the earth works, how we interact w/ the earth and how we deal with environmental problems.

Ecology

Study of relationships between living organisms and their environment

The environment is the sum of all living (biotic) and nonliving (abiotic) things.

What does sustainability mean?

Sustainability is the ability of the earth's various systems to survive and/ or adapt to changing environmental conditions indefinitely (forever).

a. **Natural Capital**: Is Natural resources + natural services that keep all species alive.
b. Solar capital: 99% of the energy used on earth
c. Human capital: Life support and economic services

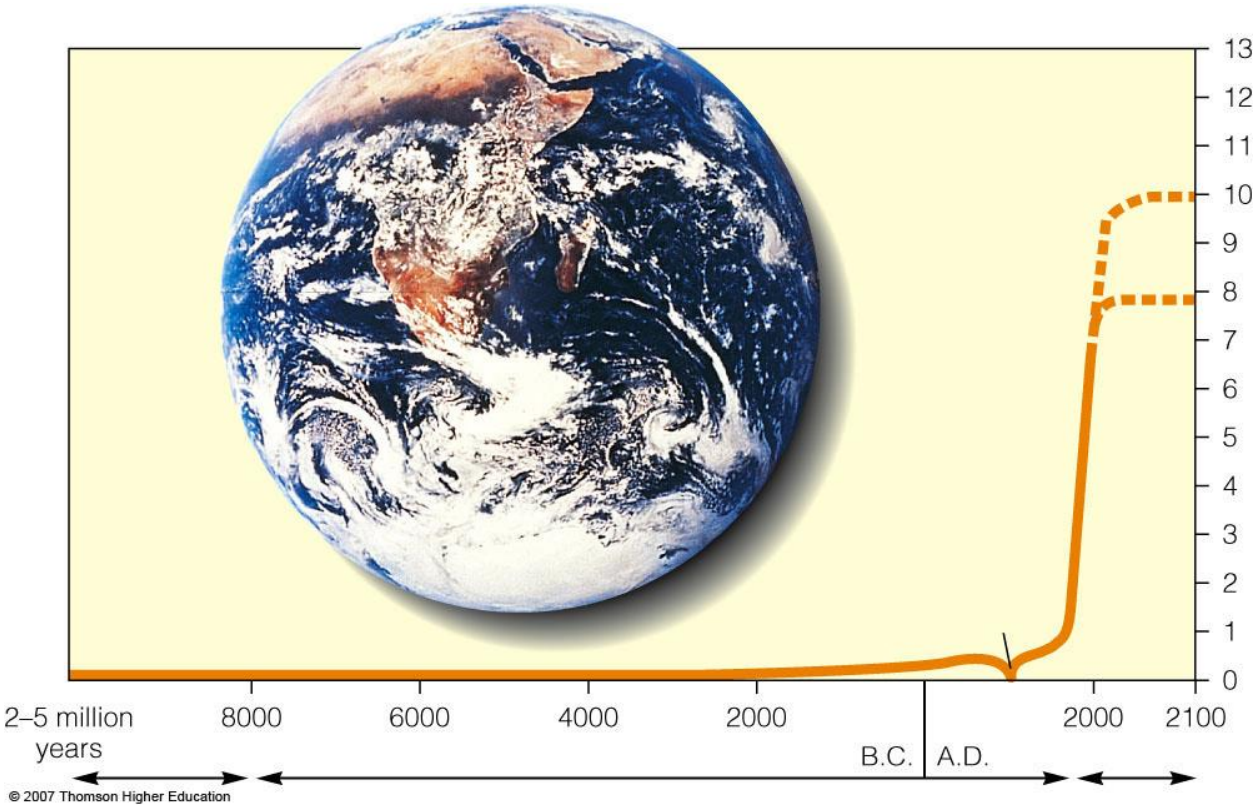
What are some examples of natural capital?

1. **Natural Resources:** from the environment that meet our needs and wants

   a. Air, Water, Soil , Land
   b. Biodiversity
   c. Nonrenewable:minerals (iron, sand, aluminum)
   d. Renewable energy: sun, wind, water flow
   e. Nonrenewable energy
      Fossil fuels, nuclear power,

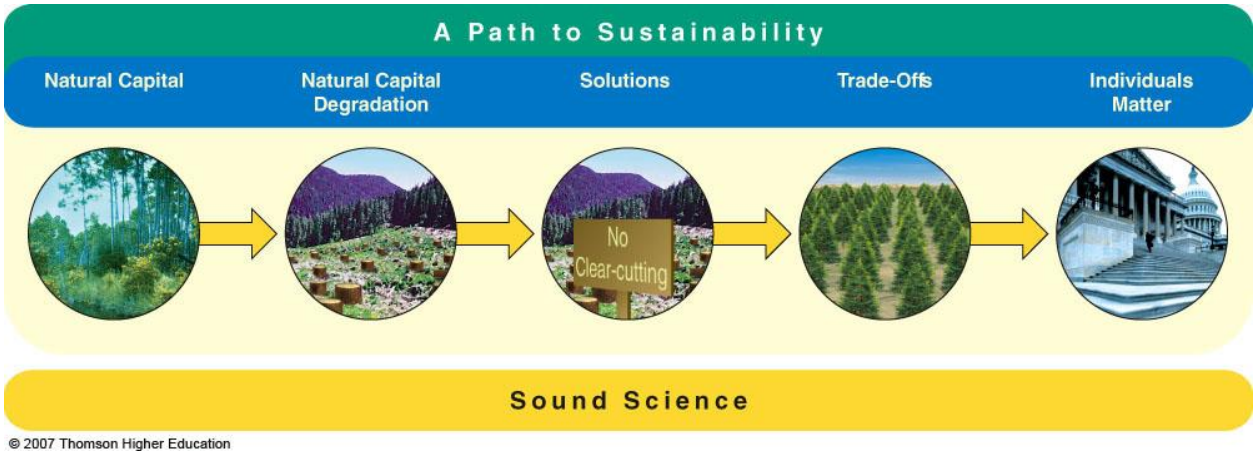
2. **Natural Services:**
   a. Air purification
   b. Water purification
   c. Water storage
   d. Nutrient cycling
   e. Food production
   f. Wildlife habitat
   g. Waste treatment
   h. Pest control
   i. Population control

CAN THE EARTH'S NATURAL CAPITAL BE SUSTAINABLE WITH THE INCREASE IN HUMAN POPULATION?



The Path to Sustainability:

NATURAL CAPITAL-→ DEGRADATION→SOLUTIONS→ TRADEOFFS



CARRYING CAPACITY:

The maximum number of organisms of a local, regional, or global environment can support over a specified period.

World Population growth : video

Current world population = 6.8 billion

1950 = 2.55 billion

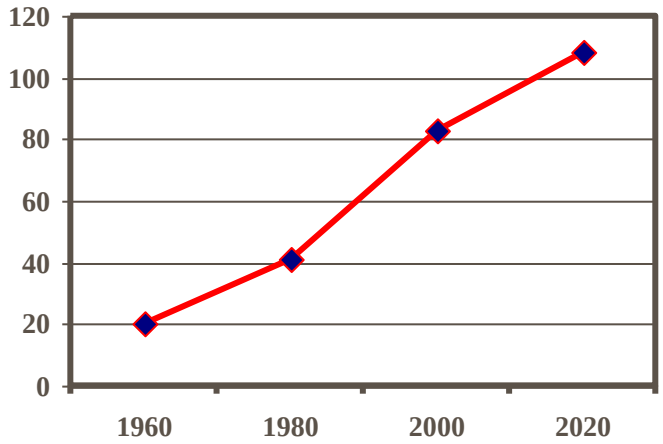
1900 = 1.6 billion

Linear vs Exponential growth:

Linear growth means:

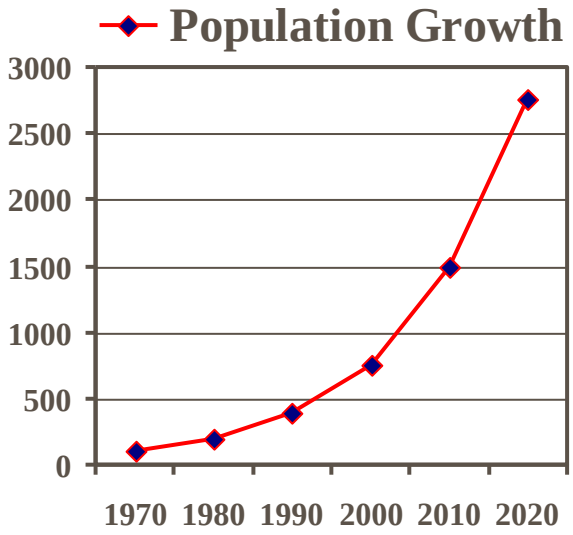
- Quantity increases by a constant amount per unit of time
- 1,2,3,4,5, …
- 1,3,5,7,9, …

When plotted on a graph, growth of money yields a fairly straight line sloping upward



Exponential Growth :

- Starts off slowly, doubles a few times, then grows to enormous numbers 2,4,8,16,64,128,256,
- Quantity increases by a fixed percentage of the whole in a given time as each increase is applied to the base for further growth
- Growth yields a J-shaped curve
- Describes the human population problem that disturbs the environment today



Rule of 70

- **How long does it take to double?**
  - **Resource use**
  - **Population size**
  - **Money in a savings account**
- **Rule of 70**
  - **70 divided by the percentage growth rate = doubling time in years**
  - **70 / 7% means it takes ten years to double**

CAUSES OF ENVIRONMENTAL PROBLEMS AND DEGRADATION. (5 reasons)

1. Population growth
2. Unsustainable resource use
3. Poverty: (china)
4. Simplifying nature w/o enough knowledge about how it works. { Monoculture: planting one species(crops)}
5. Poor environmental accounting (coal fired plants/wk)

Sulfur emissions : SO_3^- + H_2O ⟶ H_2SO_4

Chang W. Lee/The New York Times

Coal-burning factories like the Gu Dian steel plant have given Shanxi Province in China a Dickensian feel. CO_2 emissions high level adding to the greenhouse effect

Coal fired plant emissions

Pollutant	**Hard coal**	**Brown coal**	**Fuel oil**	**Other oil**	**Gas**
CO_2 (g/GJ)	94600	101000	77400	74100	56100
SO_2 (g/GJ)	765	1361	1350	228	0.68
NO_x (g/GJ)	292	183	195	129	93.3
CO (g/GJ)	89.1	89.1	15.7	15.7	14.5
Non methane organic compounds (g/GJ)	4.92	7.78	3.70	3.24	1.58
Particulate matter (g/GJ)	1203	3254	16	1.91	0.1
Flue gas volume total (m^3/GJ)	360	444	279	276	272

CITES: CONVENTION ON INTERNATIONAL TRADE OF ENDANGERED SPECIES: VIDEO (Planet in Peril) (wk 1)

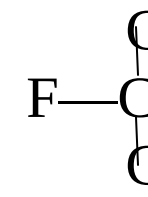
POLLUTION:

Pollutants are chemicals found at high enough levels in the environment to cause harm to people or other organisms.

Pollutants can be man caused or natural

Examples:

CFC's = chlorofluorocarbons



Pesticides

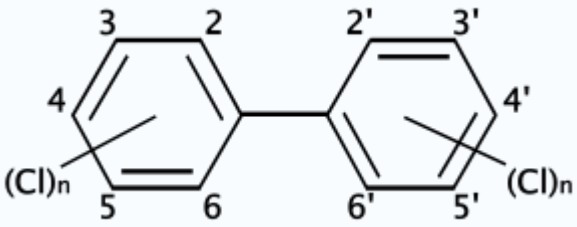
POPs = (peristant organic pollutants) (ddt, PCB, dioxin)

The more chlorine in a POP the more resistant to break down over time

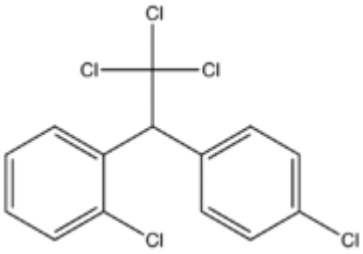
Effects: cancer, endocrine disruption, immune system failure, reproductive and embryonic mutations, death.

(POP's bioaccumulate in fat tissue)

PCB's = poly chlorinated bi phenyls
(used as coolants, pvc pipe coating, hydraulic fluids, adhesives.)



Chemical structure of PCBs. The possible positions of chlorine atoms on the benzene rings are denoted by numbers



o,p-DDT, a minor component in

<u>Pollutants can be</u>

1. Point sources: from a single identifiable source
   Ex. Industrial plant (Kaiser)

2. Non-point sources : from a larger more dispersed and difficult to identify source.
   Ex. Fertilizer runoff from lawns, cars, 2 cycle lawnmowers.

<u>Pollutants can have 3 types of effects.</u>

1. Disrupt life support systems of animals(water pol.)
2. Damage human or organisms health (POPs)
3. Create nuisance: noise, smell , sights, tastes

Prevention vs. Cleanup

ECONOMIC GROWTH VS. ECONOMIC DEVELOPMENT

NOTE: The rate at which the world's population is growing has slowed , but is still increasing rapidly, and is unequally distributed between rich and poor countries.

Economic growth :

(Provides people w/ more goods and services,)

Def: Is an increase in the capacity of a country to provide people w/ goods and services.

Measured by the % change in a country's GDP :

Gross domestic product : GDP the annual market value of all goods and services produced by all organizations operating w/in the country.

Gross National product: GNP is the annual market value for all goods and services produced by a country whether w/in the borders or not.

If measured per person it is called per capita GDP

GDP ÷ total population = per capita GDP

PPP = purchasing power parity
(exchange rates between countries)

Per capita GDP-PPP : TOP 6
USA, Japan, Germany, UK, France, China

Economic development :

(Uses economic growth to improve living standards.)

-Is the improvement of human living standards by economic growth .

The United Nations classifies the world countries as either

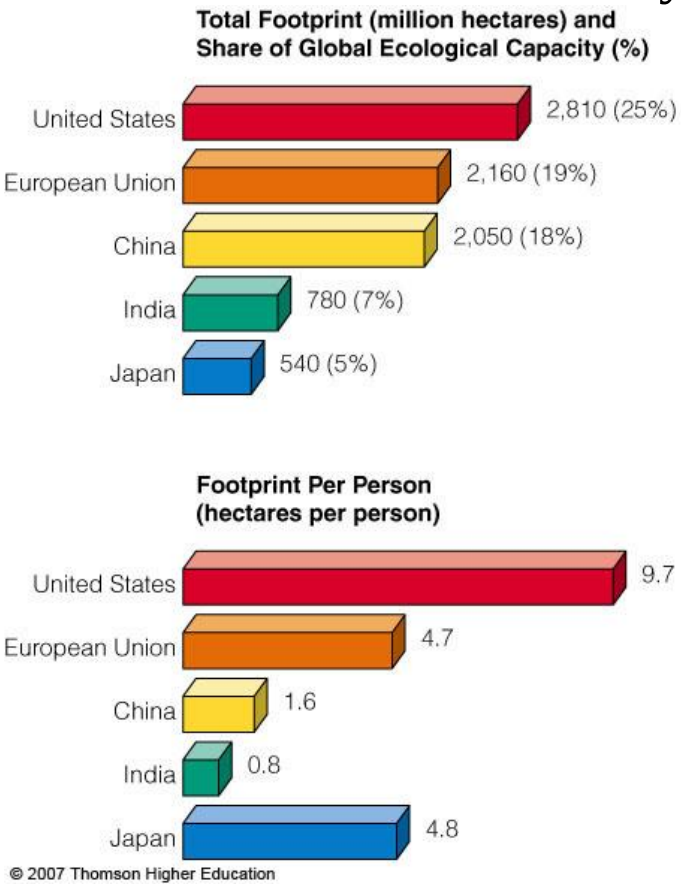
Developed or Developing based primarily on their degree of industrialization and per capita GDP-PPP

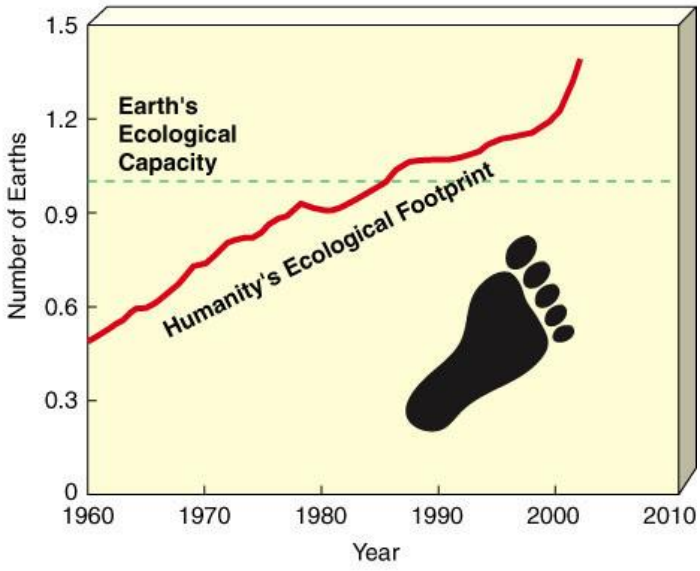
Developed Countries: Europe , USA, Canada, Japan, Australia
High average per capita GDP

Developing Countries: (most in Africa, asia, and latin America) Low average per capita GDP

Ecological Footprint:

-the amount of biologically productive land and water needed to supply an area w/ resources and take care of waste. (We can calculate the footprint for each individual or for a country)





(ecological footprint: earthday.net/footprint) laptops
How many planets do you need?

HUMAN IMPACTS ON NATURAL SYSTEMS

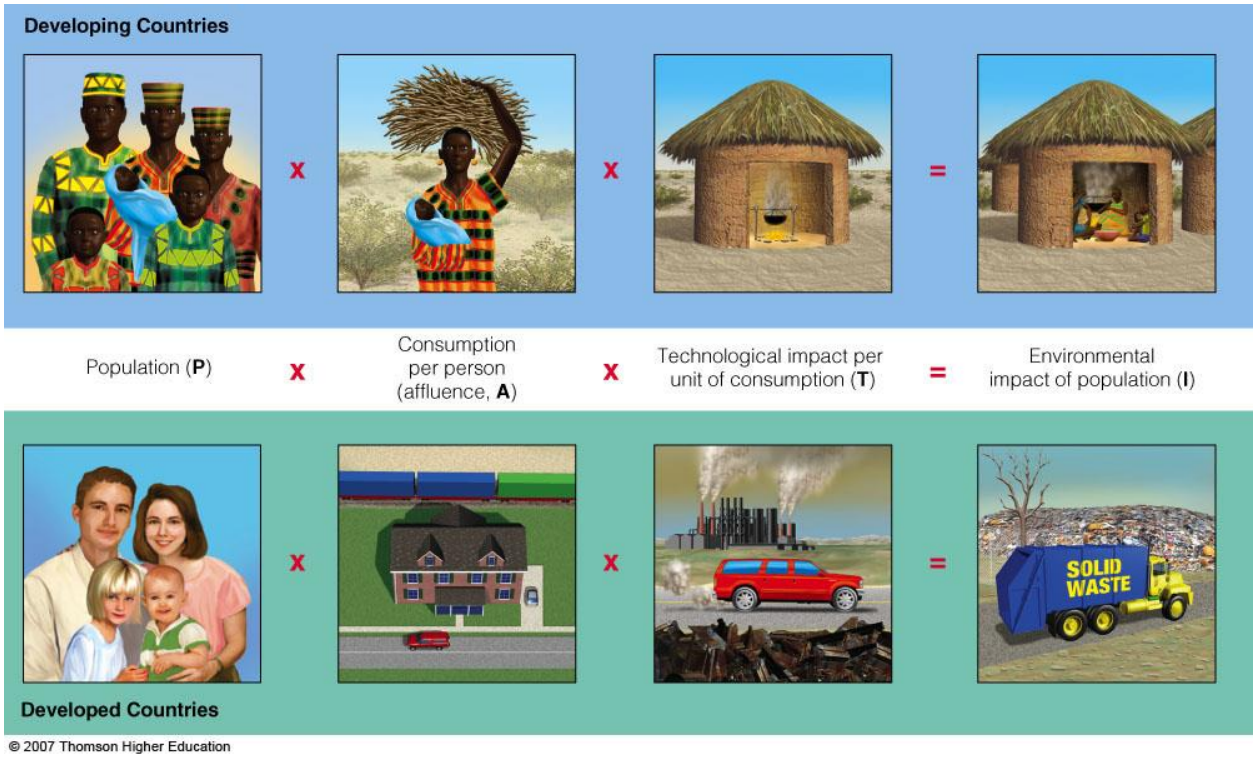
Environmental quality is affected by interactions between 3 main things.

1. Population size (P) total pop. In a given area(country)
2. Affluence (A) the average resource use per capita
3. Technology (T) used to provid and consue each unit

P. + A + T = Impact I = PAT

(Week 2 : MMA : marine mammal act)

Connections between Environmental Problems and Their Causes



ENVIRONMENTAL WORLDVIEWS AND ETHICS:

The way we view the seriousness of environmental problems and how to solve them depens on our environmental worldview and our environmental ethics.

1. **Planetary management worldview**
   - This view holds that we are separate from nature and that nature exists mainly to meet our needs and wants. We can use our technology to manage the earth's life support systems for our benefit. (economic growth is unlimited)
2. **Environmental wisdom worldview**
   - This view holds that we are part of nature and deped on nature for our existence and the existence of all species. It encourages earth sustaining forms of economic growth and development.

(Read Aldo Leopold's environmental ethics pg 23)

3. **Stewardship WorldView**:

-We can manage the earth for our benefit but that we have an ethical responsibility to be caring and responsible managers of the earth.

4. **Frontier environmental worldview**

Viewing undeveloped land as a hostile wilderness to be conquered (cleared, planted) and exploited for its resources as quickly as possible. Compare environmental wisdom worldview, planetary management worldview, spaceship-earth worldview

TRAGEDY OF THE COMMONS:

Def: Renewable resources that are freely available to everyone can be degraded.

In 1968 biologist Garrett Hardin called the degradation of renewable free-access resources the "Tragedy of the commons"

This happens because each user thinks " If I do not use this resource some one else will . The little bit I use or pollute is not enough to matter and these resources are renewable"

Examples?

Camping, hiking, 4 wheeling, fishing, hunting
Dumping oil

Solutions?

Regulating use or access

FOUR PRINCIPLES OF SUSTAINABILITY

1st Principle:

Reliance on solar energy

2nd Principle:

Biodiversity: many species and thus genes allows

greater adaptability to changes in the environs. (monoculture)

3rd Principle:

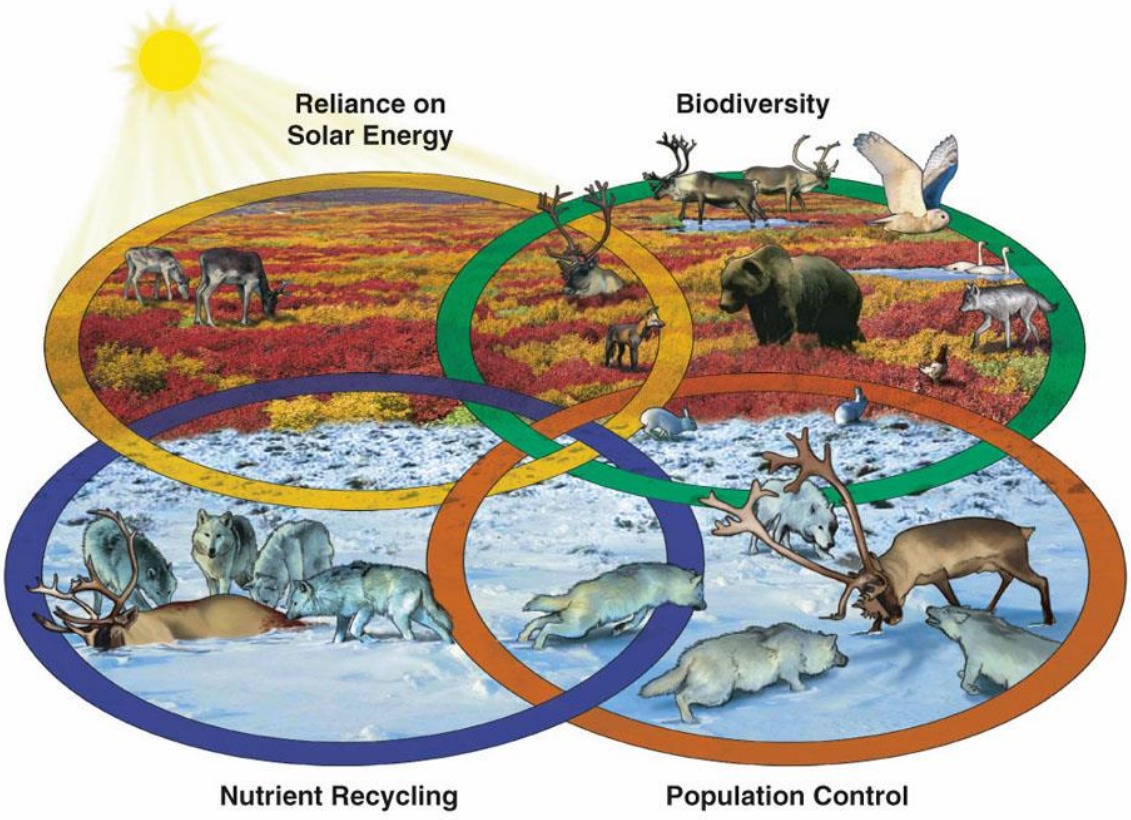
Overgrazing: (population control)

Competition for limited resources controls the population of any one species (Predator – Prey)

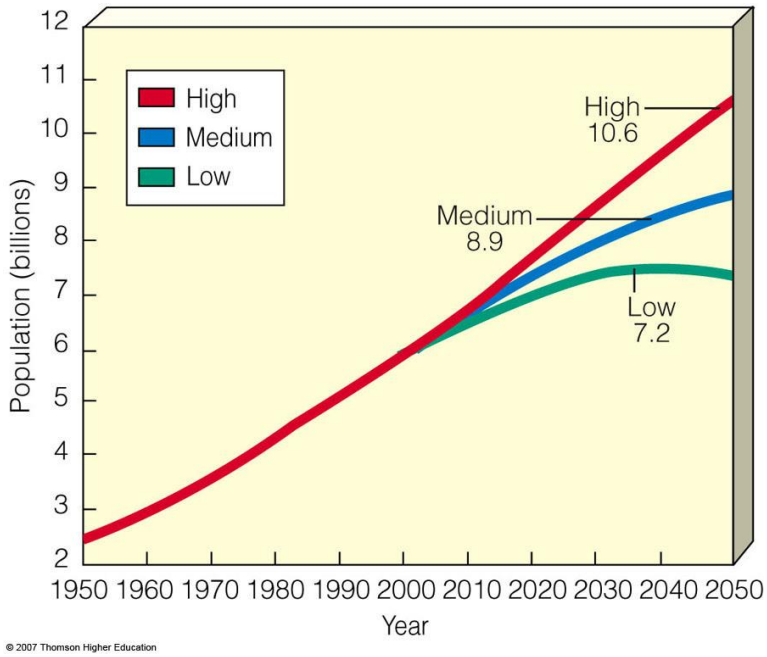
4th Principle:

Nutrient recycling :

Natural processe recycle all chemicals and nutrients that plants and animals need



CHAPTER 9 : THE WORLD POPULATION



- **U.N. world population projection based on women having an average of 2.5 (high), 2.0 (medium), or 1.5 (low) children.(TFR)**

We are at 6.7billion people and at current rate we will reach 9.6 billion by 2050 .

What caused the population explosion world wide?

Major reason: antiseptic techniques and vaccines.
(medicines)

Minor cause: modern agriculture

FACTORS AFFECTING HUMAN POPULATION SIZE:

Three factors:

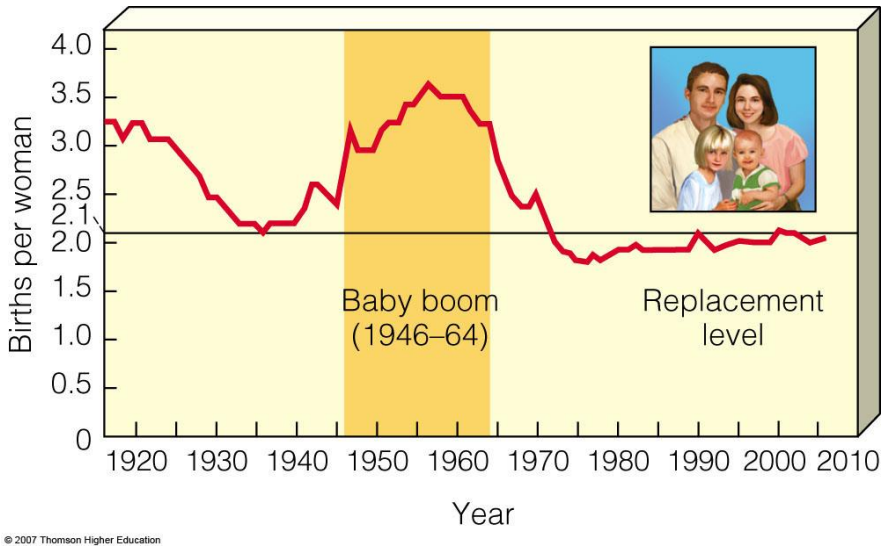
1. Births
2. Deaths
3. Immigration

FERTILITY AND BIRTH RATES IN THE USA.

Population growth in the U.S. has slowed but is not close to leveling off. Why?

1900- 76million
2006- 299million

1946-1964 are known as the baby boom period.



The drop in TFR has led to a slow in the rate of pop growth in the US but the pop. Is still growing faster than any other developed nation.
3 million added in 2006
56% of the growth because birth outnumbered deaths
44% growth due to immigration(legal and illegal)

FACTORS AFFECTING BIRTH RATES AND FERTILITY RATES IN COUNTRIES

1. Importance of children for labor
2. Cost of raising and educating children(much more costly in developed nations)
3. Education and employment of women (value of ♀)
4. Availability and education about birth control and contraceptives.
5. Religious beliefs

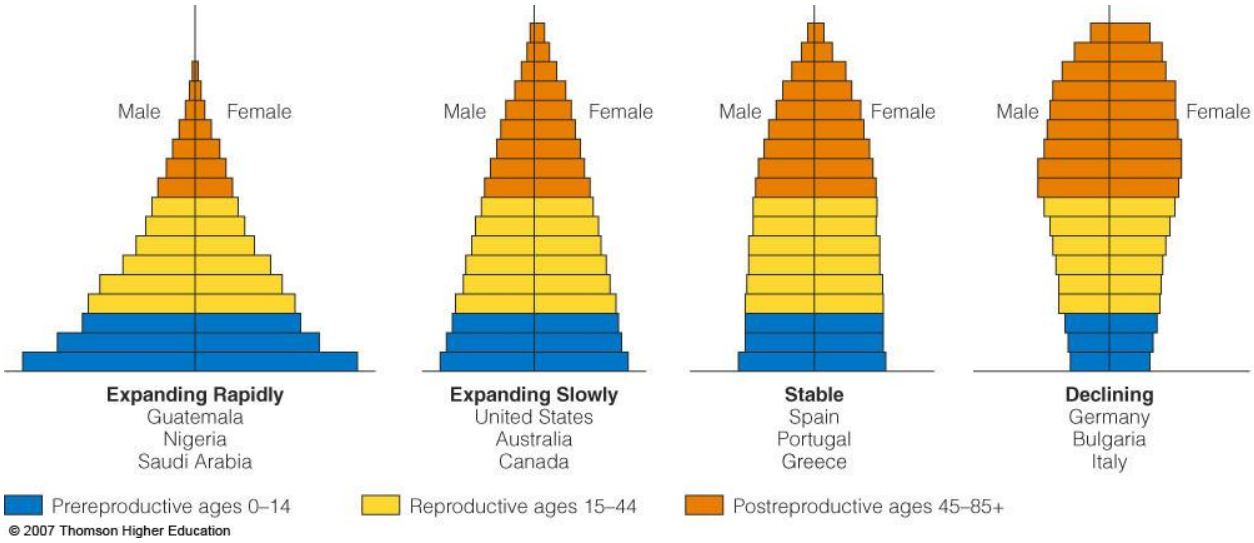
6. Average age of marriage
7. Availability of Pension plans (take care of you in old age)

FACTORS AFFECTING DEATH RATES:

1. Increased food supplies
2. Better nutrition
3. Better medicine
4. Better sanitation
5. Safer water supplies

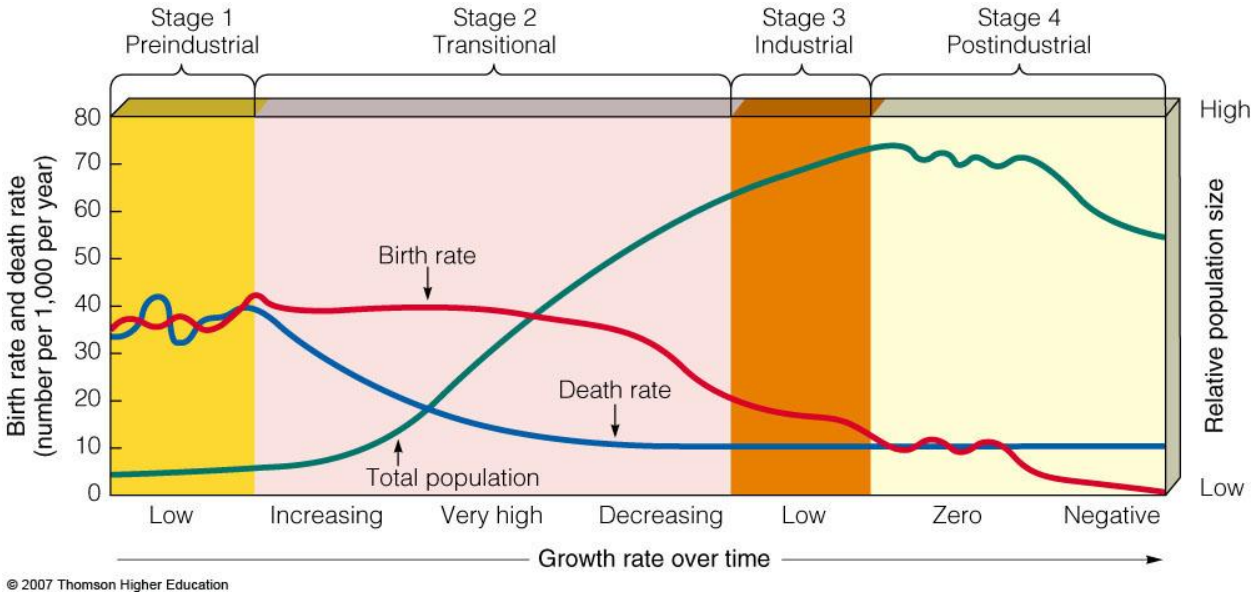
DEMOGRAPHIC TRANSITION :

Transition of a country from undeveloped or developing to a developed country as the birth and death rates decline.



POPULATION AGE STRUCTURE

- ***Demographic Transition***: As countries become economically developed, their birth and death rates tend to decline.
  - ***Preindustrial stage***: little population growth due to high infant mortality.
  - ***Transitional stage***: industrialization begins, death rates drops and birth rates remain high.
  - ***Industrial stage***: birth rate drops and approaches death rate.



- The best way to slow population growth is a combination of:
  - Investing in family planning.
  - Reducing poverty.
  - Elevating the status of women

SLOWING POPULATION GROWTH IN INDIA AND CHINA

- For more than five decades, India has tried to control its population growth with only modest success.
- Since 1970, China has used a government-enforced program to cut its birth rate in half and sharply reduce its fertility rate

India's Failed Family Planning Program

- Poor planning.
- Bureaucratic inefficiency.
- Low status of women.
- Extreme poverty.
- Lack of administrative financial support.
- Disagreement over the best ways to slow population growth.

China's Family Planning Program

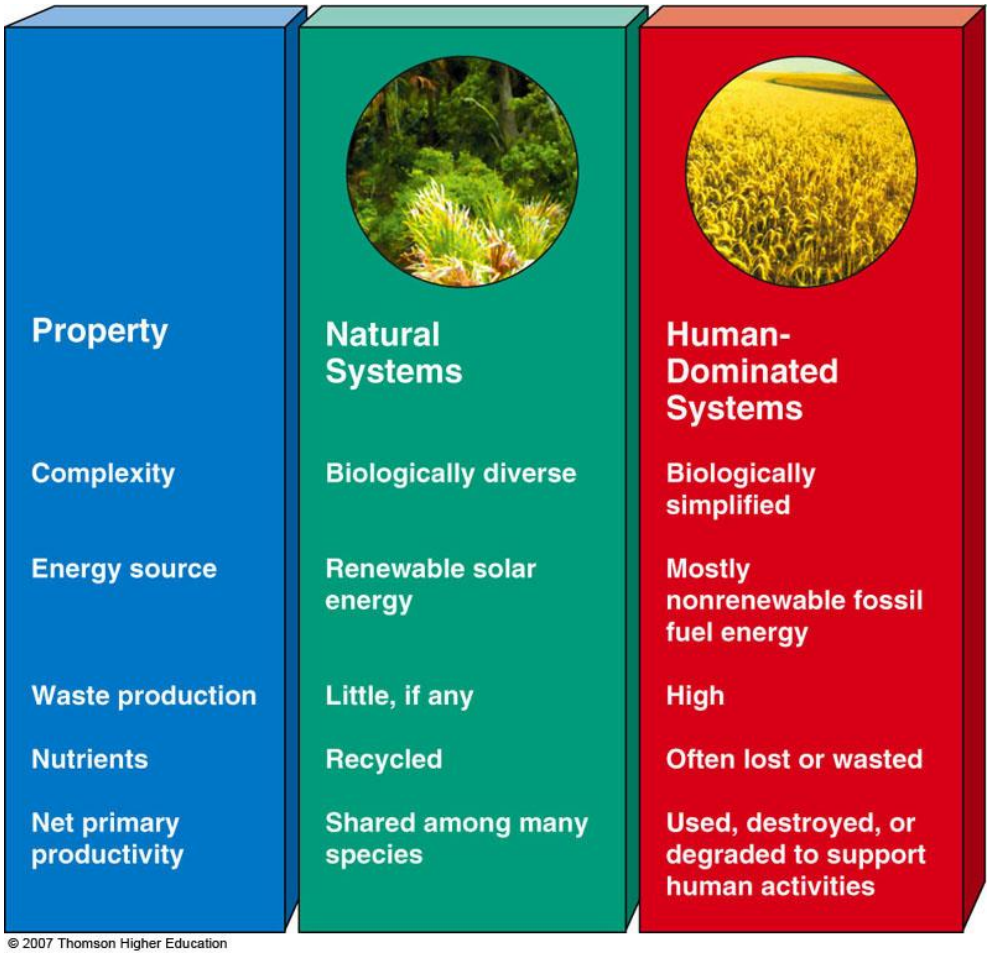
- Currently, China's TFR is 1.6 children per women.
- China has moved 300 million people out of poverty.

- Problems:
  - Strong male preference leads to gender imbalance.
  - Average population age is increasing.
  - Not enough resource to support population.

From 1972 to today TFR went from 5.7 to 1.6 per capita

Chinas population will peak about 2040 at current rate

HUMAN ASPECTS ON NATURAL SYSTEMS



Developing nations use older technology for energy

1. Biomass: burning wood or coal to generate steam
2. Old antiquated Coal fired plants

Problem: few if any regulations on them
Pollution much greater than more technologically advanced countries

LDC: Less developed countries will continue to increase in energy consumption because they will increase in

1. Population I=PAT
2. Technology
3. Affluence(each family will have more money and thus consume more

New technologies for energy that are sustainable?

1. Wind
2. Solar (both passive and active)
3. Geothermal systems
4. Wave energy
5. Tidal Energy

Excluding Antarctica, human activities have affect about 83% of the earths land surface.