

Objectives for this Chapter

- A student reading this chapter will be able to:
 1. Define the attributes of populations including birth and death rates, growth rate, density, and mobility (immigration and emigration).
 2. Calculate rate of natural increase from birth and death rates, and mathematically demonstrate the effects of age-sex composition on a population.

HUMAN POPULATION - Moore

2

Objectives for this Chapter

4. Define biotic potential and maximum growth rate, and list the various limits to growth
5. Identify, list, and explain the population growth forms.
6. Recognize and explain the concept of population explosion with respect to complete and incomplete demographic transition. Define population implosion and discuss the conditions that lead to this phenomena.

HUMAN POPULATION - Moore

3

Objectives for this Chapter

7. Explain the role of urbanization in influencing sustainability of populations.
8. Explain global population projections and differentiate between developed and lesser developed countries with respect to those projections.
9. List and discuss the various options for fertility control methods, while contrasting the effectiveness, risks, and benefits of each type.

HUMAN POPULATION - Moore

4

LIVING WITH THE EARTH

HUMAN POPULATION INTRODUCTION

- Understanding the dynamics of human populations is a first order of business in beginning the study of environmental health.
- There is growing realization that surging populations, environmental degradation, and ethnic conflict are strongly intertwined.

HUMAN POPULATION - Moore

5

LESSER DEVELOPED COUNTRIES

- Overpopulation, infectious disease, unprovoked crime, few resources, and the influx of more refugees, increases the erosion of nation-states leading to the empowerment of private armies, security firms and international drug cartels.

HUMAN POPULATION - Moore

6

LESSER DEVELOPED COUNTRIES

- This is a vision of the early 21st century in many parts of the lesser developed countries (LDCs), and threatens to expand along with the growth of human populations.

HUMAN POPULATION - Moore

7

THE CHARACTERISTICS OF POPULATIONS

- Species
 - A **species** is normally considered to be a group of organisms that can breed together with the production of a viable and fertile offspring.
 - Different species not only have differing physical attributes, but they also differ in the population characteristics.

HUMAN POPULATION - Moore

8

Population

- A **population** is considered to be the breeding group for an organism.
- Each population has characteristics that help to identify it.
- Some of these characteristics are birth rate, death rate, rate of natural increase, age distribution, and sex ratio.

HUMAN POPULATION - Moore

9

Birth Rate

- **Birth rate** refers to the number of individuals added to a population through reproduction (live births) and is normally expressed as the number of live births per 1,000 population (counting the population at the midpoint of the year)(Fig. 2-1).

HUMAN POPULATION - Moore

10

Death Rate

- **Death rate** is also similarly calculated using total deaths divided by the mid-year total population (Fig. 2-1).

HUMAN POPULATION - Moore

11

Rate of Natural Increase

- The **rate of natural increase** is determined by subtracting the death rate from the birth rate (Fig. 2-1).
- The rate of natural increase reflects the growth rate in which migration is not considered.
- The growth of a population in the absence of migration must depend on the birth rate being higher than the death rate.

HUMAN POPULATION - Moore

12

Fig. 2-1

Birth rate equals the number of live children born in a year per 1,000 total population

$$\text{Birth rate in year Y} = \frac{\text{Number of live children born in year Y}}{\text{Midyear population in year Y}}$$

$$\text{Birth rate in year 1998} = \frac{4,345,600 \text{ (children born in 1998)}}{271,600,000 \text{ (population in mid-1998)}} = 16/1000$$

$$\text{Death rate in year Y} = \frac{\text{Number of deaths in year Y}}{\text{Midyear population in year Y}}$$

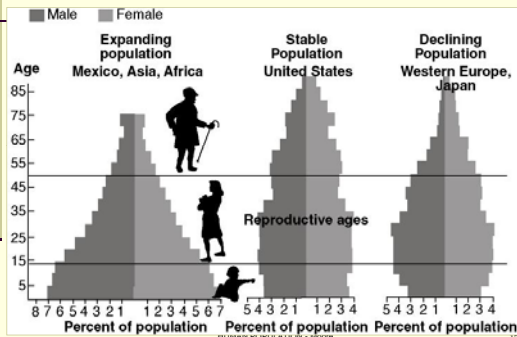
$$\text{Death rate in year 1998} = \frac{2,172,800 \text{ (deaths in 1998)}}{271,600,000 \text{ (population in mid-1998)}} = 8/1000$$

Rate of natural increase in year 1998 = (Birth rate - Death rate) = 8/1000 or 0.8 percent
 *These are approximate numbers for the United States used only for example.

Age Distribution

- The **age-sex composition** of the population has a profound effect on the birth and death rates of a country because the probability of dying or giving birth within any given year depends upon the age and sex of the population members Fig. 2-2.

Age Distribution (Fig. 2-2)



THE CHARACTERISTICS OF POPULATIONS

- Total Fertility Rates
 - Total fertility rates (TFR)** represent the number of children a woman in a given population is likely to bear during her reproductive lifetime providing that birth rates remain constant for at least a generation.

THE CHARACTERISTICS OF POPULATIONS

- Immigration
 - In nature, when the density of organisms becomes too great, the intense competition for food, water, and other resources damages the entire population. Some species have the ability to disperse or migrate out of the area and in doing so, temporarily relieve the overcrowding.
 - This process is called **emigration**.

Immigration

- When species emigrate from an area, they must **immigrate** or enter into another area.
- Driven by natural disasters, war, disease, and disappearing resources, the numbers of refugees worldwide may exceed 15 million, with about 880,000 to 1.4 million immigrants entering the United States each year, including more than 200,000 who enter illegally.

POPULATIONS DYNAMICS

- There are periodic upsurges in many populations that lead to overwhelming numbers.
- Whether these population explosions occur in rabbits, lemmings, soldier ants, or locusts, there is always some natural pressures that bring the population back into balance with their natural surroundings.

HUMAN POPULATION - Moore

19

POPULATIONS DYNAMICS

- Biotic Potential
 - The unrestricted growth of populations resulting in the maximum growth rate for a particular population is called its **biotic potential**.

HUMAN POPULATION - Moore

20

POPULATIONS DYNAMICS

- The biotic potential of species differs markedly and is influenced by:
 1. The frequency of reproduction
 2. The total number of times the organism reproduces
 3. The number of offspring from each reproductive cycle; and
 4. The age at which reproduction starts.

HUMAN POPULATION - Moore

21

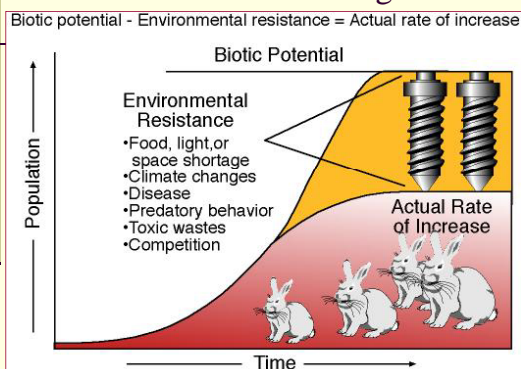
POPULATIONS DYNAMICS

- Environmental Resistance
 - **Environmental resistance** refers to those pressures that limit population and may include such factors as disease, wars, predatory behavior, toxic waste accumulation, or species competition (Fig. 2-3).

HUMAN POPULATION - Moore

22

Fig 2-3

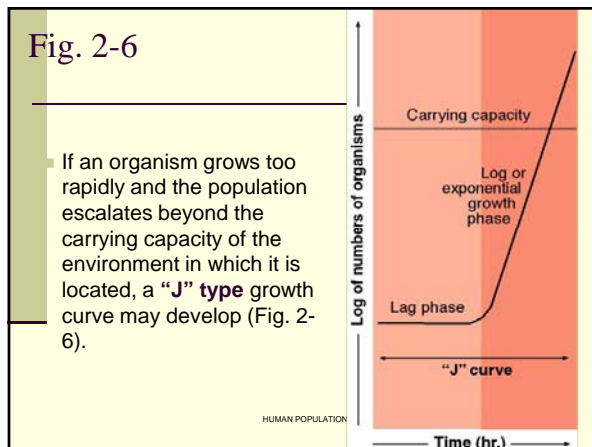
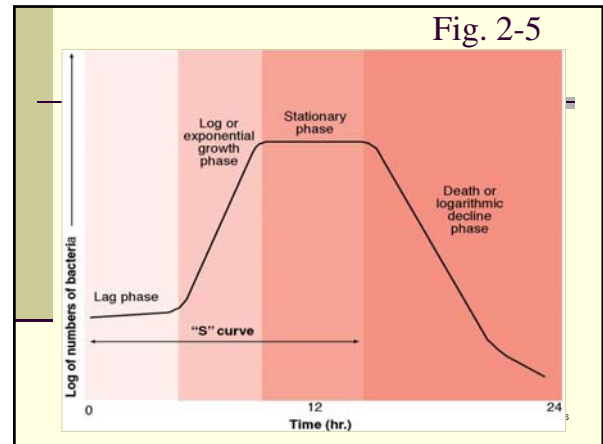
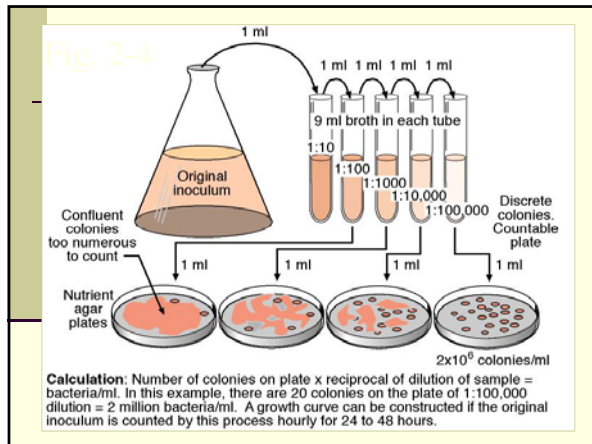


POPULATIONS DYNAMICS

- By plating bacteria as outlined in figure 2-4, one can examine and then plot a bacterial growth curve (Fig. 2-5).
- Lag Phase
 - The initial part of the curve in which the organisms show no increase in growth rate, but are preparing for the exponential growth phase which follows.

HUMAN POPULATION - Moore

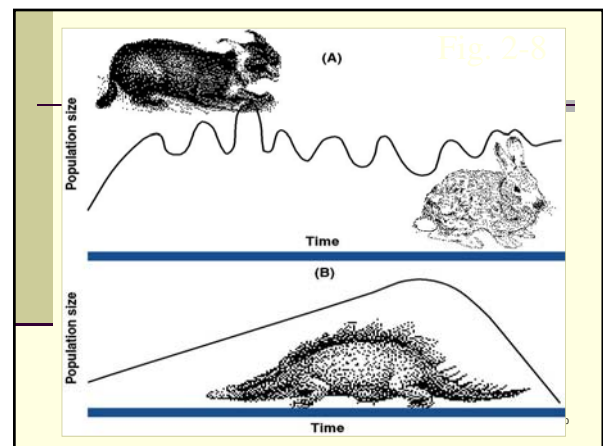
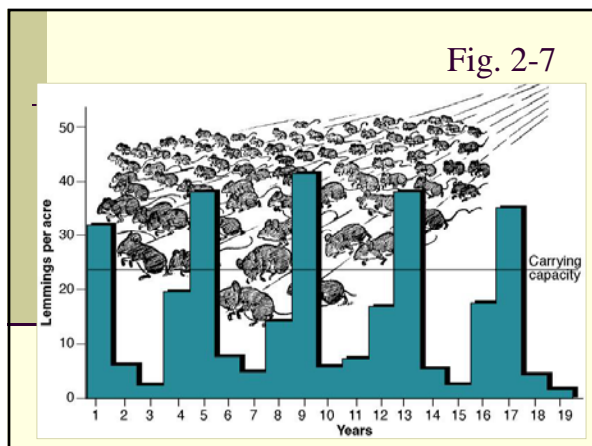
24



POPULATIONS DYNAMICS

- This behavior sometimes oscillates every few years as in the case of lemmings that inhabit the arctic tundra north of the Canadian forest.
- Every 3 to 4 years the population explodes, then crashes the following year, followed by a 2 year cycle of slow recovery (Fig 2-7).
- Figure 2.8 shows the effects of predators on populations.

HUMAN POPULATION - Moore 28



POPULATIONS DYNAMICS

- k-Strategy (type I")
 - When large organisms with relatively long life spans have only a few offspring, but devote their energies to protecting and nurturing the offspring to enhance their individual survival until they can reproduce (Fig.2-9).
 - Density dependent factors include such items as food supply, which becomes more limiting as the size of the population grows.

HUMAN POPULATION - Moore

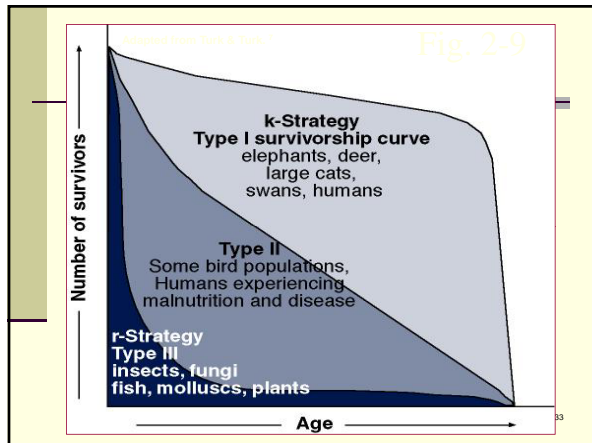
31

POPULATIONS DYNAMICS

- r-Strategy
 - r-strategy populations are typically small, short-lived organisms, which produce large numbers of offspring and receive little or no parental care (Fig. 2-9).
 - These organisms are limited by density-independent factors such as a drought that dries up a pond, or sudden climactic changes such as El nino which alters the temperature of the water making it uninhabitable for certain species.

HUMAN POPULATION - Moore

32



33

POPULATION TRENDS IN THE WORLD

- Demographers use the information on population size, fertility rates, migration, birth and death rates, growth rates, infant mortality, density, age-sex composition and other factors to statistically characterize human populations.
- Their purpose is to predict what will happen to that population over time.

HUMAN POPULATION - Moore

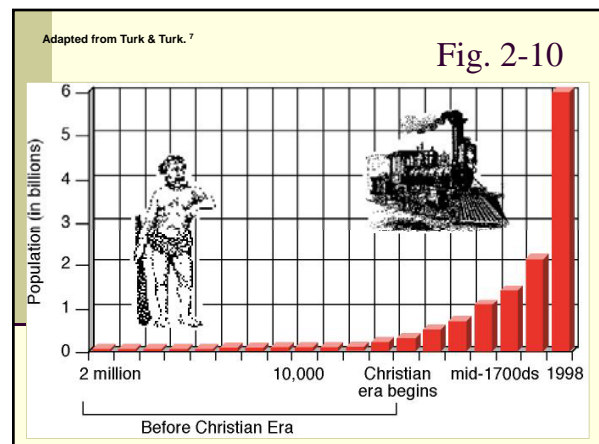
34

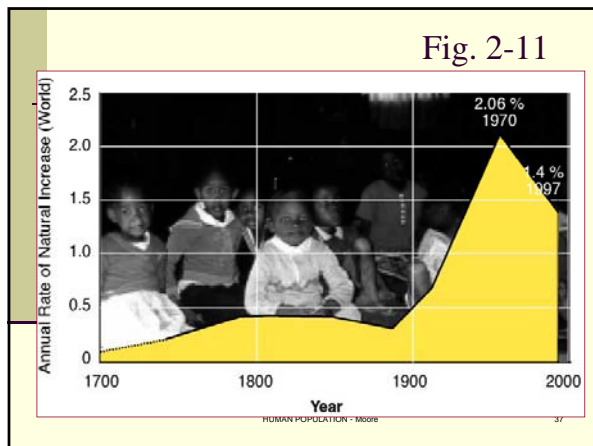
POPULATION TRENDS IN THE WORLD

- Historical Trends
 - After earth's temperature stabilized about 10,000 years ago, humans began to domesticate animals and cultivate crops, this allowed the human population to increase (Fig. 2-10).
 - Since then, the world growth rate has increased dramatically, although we are currently experiencing a downward trend (Fig 2.11).

HUMAN POPULATION - Moore

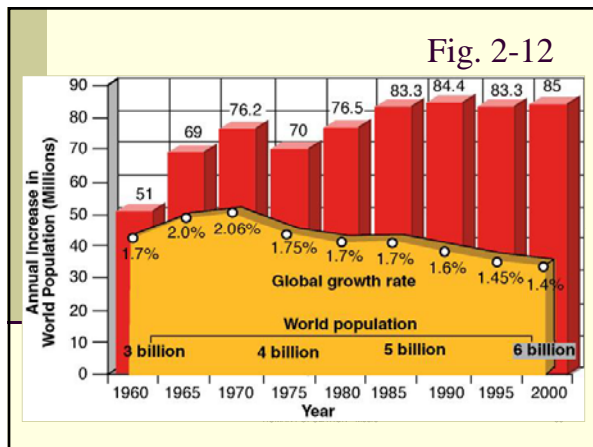
35





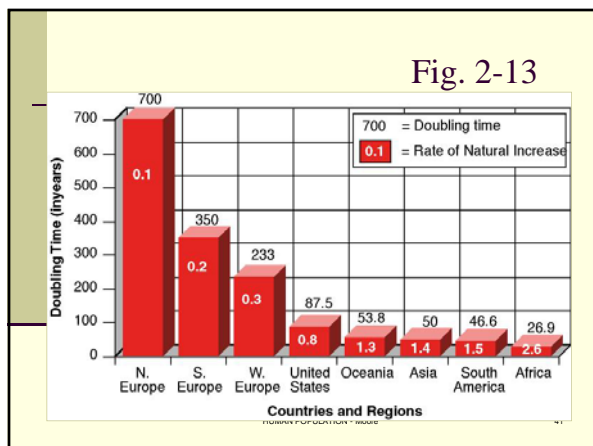
Historical Trends

- Growth Rate
 - The **rate of births** is the ratio of births to the population, and death rates represent the ratio of deaths to the population.
 - **Growth rate** is then determined by the birth rate minus the death rate.
 - The population has grown so much, that even the smaller growth rates lead to additions of larger numbers of people to the global population (Fig 2-12).



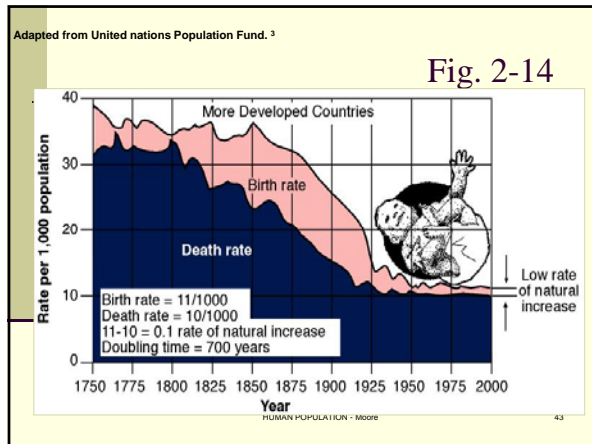
Historical Trends

- Doubling Time
 - Another useful way to demonstrate growth rate is to present it as **doubling time** (Fig. 2-13), or the number of years for a human population to double its size. The doubling time can be calculated according to the following relationship:

$$\text{doubling time} = 0.70 / \text{growth rate}$$


Historical Trends

- Demographic Transition
 - Developed countries have exhibited slowly declining birth and death rates over the last century.
 - This has resulted in a diminishing difference between birth rates and death rates and a very low rate of natural increase resulting in a stable population with very long doubling times (Fig. 2-14).

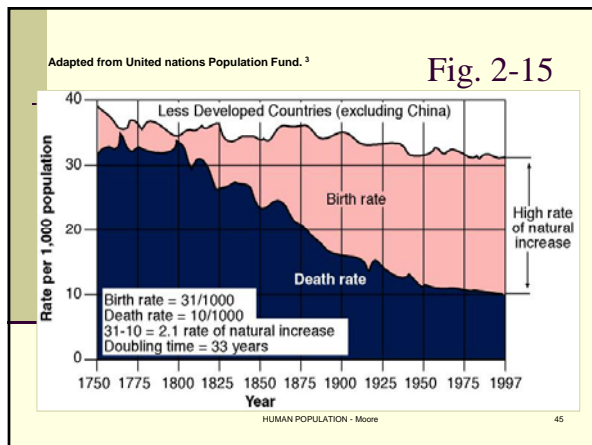


Historical Trends

- Incomplete Demographic Transition
 - LDCs do not have the resources to institute social security, and have unstable policies that fail to capture the trust of its citizens.
 - The populations had remained stable with high birth rates and high death rates.
 - Developed countries introduced better sanitation and nutrition to LDCs, resulting in a decrease of the death rate (Fig. 2-15).

HUMAN POPULATION - Moore

44



Current Population Trends

- The world's population is growing at a rate of 1.4 percent annually and is expected to reach six billion people by the middle of 1999
- Almost 98 percent of the annual increase in the world's population is occurring in the LDCs.

HUMAN POPULATION - Moore

46

Population Decreases in the Developed Countries

- Declines in Fertility
 - In 1970 there were 19 countries reporting declining fertility rates while in 1997 over 57 countries have reported below-replacement fertility rates.
 - By the year 2060, Europe will have lost almost 25 percent of its population.

HUMAN POPULATION - Moore

47

Population Decreases in the Developed Countries

- Concerns About Decline
 - There is a concern throughout Europe and Japan that the declining population will result in decreasing house and land prices as the demand declines along with the population.
 - In the southern island of Kyushu, Japan, officials are offering a gift of \$5,000 to parents who have a fourth or subsequent child.

HUMAN POPULATION - Moore

48

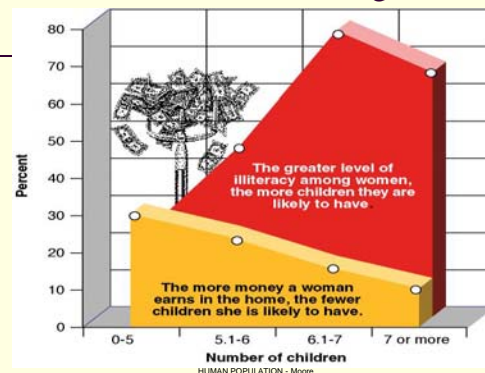
Population Decreases in the Developed Countries

- Concerns About Decline
 - Higher education for women with new aspirations and higher incomes, is considered to be a factor for declining fertility rates in many countries.
 - In fact, as illiteracy among women decreases in a country, the average number of children born to those women declines (Fig. 2-16).

HUMAN POPULATION - Moore

49

Fig. 2-16



50

Population Decreases in the Developed Countries

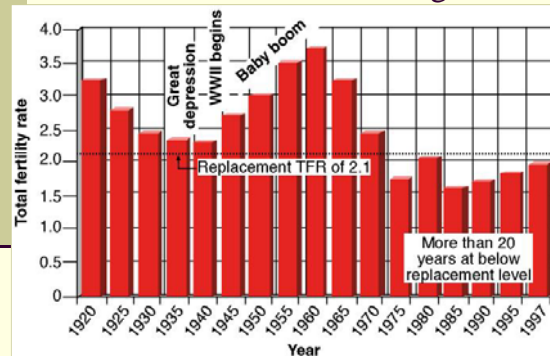
- Fertility Rates in the United States
 - The replacement TFR level for most countries is accepted as being 2.1.
 - Subtle changes in social attitude appeared to produce rather significant changes in fertility rates (Fig. 2-17).

HUMAN POPULATION - Moore

51

Source: U.S. Bureau of the Census

Fig. 2-17



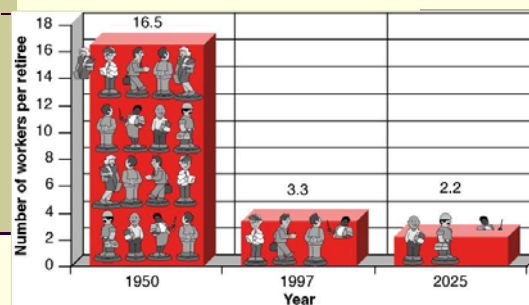
Population Decreases in the Developed Countries

- Immigration and the Changing Racial Landscape in the United States
 - Although the TFR has remained below replacement levels, immigration adds at least another 850,000 to 1.2 million people to the United States each year.
 - The expanding population of elderly white will be expecting support from a working population of tremendous diversity and proportionally fewer workers per retiree (Fig. 2-18).

HUMAN POPULATION - Moore

53

Fig. 2-18



HUMAN POPULATION - Moore

54

Current Population Trends in the Less Developed Countries

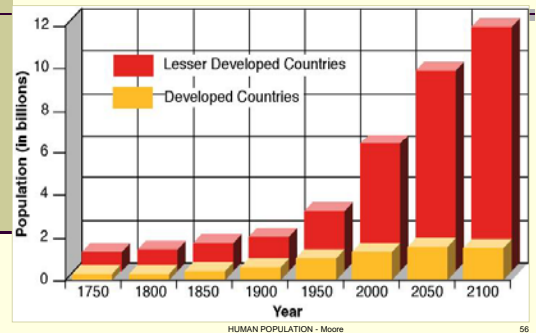
- More than 80 percent of the world lives in the LDCs.
- In the next 20 years 1.76 billion children will be born in the LDCs (Fig. 2-19).

HUMAN POPULATION - Moore

55

Fig. 2-19

Adapted from Population reference Bureau² and the United Nations Population Fund.³



HUMAN POPULATION - Moore

56

Predicted Future Trends in Populations

- The median or best estimate by the United Nations is that the world population will stabilize at 11.5 billion people around the year 2150 if the world fertility rate drops to 2.06 and life expectancy is 85 years (Fig.2-20).

HUMAN POPULATION - Moore

57

Adapted from Doyle¹⁸ and Motavallui.¹⁹

Fig. 2-20

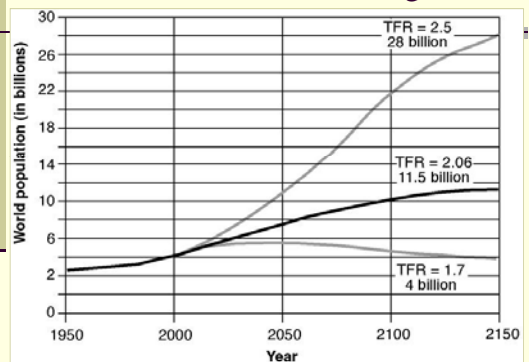
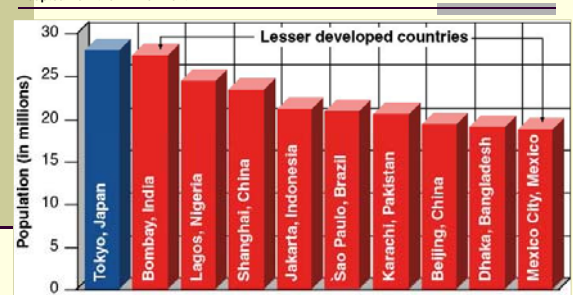


Fig. 2-21

Adapted from the Environment.¹⁷



HUMAN POPULATION - Moore

60

Urbanization - What is it?

- The mass migration of people to the cities.
- Megacities
 - Defined as having a population of more than 10 million, will be commonplace by the year 2015, with 9 of the 10 largest cities being in the the developing countries. (Figs.2-21, 22).

HUMAN POPULATION - Moore

59

Fig. 2-22. Borders of W. Africa merged by megacities



Urbanization

- Facilitates the spread of disease.
- Potential increase in violence
- Environmental degradation

HUMAN POPULATION - Moore

62

THE CONTROL OF POPULATION

- Empowerment or Force
 - Countries attempting to bring population growth under control without first empowering women and providing effective birth control have often resorted to oppressive population control policies.

HUMAN POPULATION - Moore

63

Population Policies in Some Countries

- India
 - India was the first country to introduce family planning in 1951, with the rhythm method.
- China
 - China continues to enforce a one-child policy in the nation's largest cities such as Beijing and Shanghai.

HUMAN POPULATION - Moore

64

Family Planning Versus Population Control

- Population Control
 - Government directed programs that set a policy for establishing an optimum population size.

HUMAN POPULATION - Moore

65

Family Planning Versus Population Control

- Family planning
 - Population control is in contrast to family planning programs that are directed at assisting couples in having the number of children they desire regardless of how many.

HUMAN POPULATION - Moore

66

METHODS OF FERTILITY CONTROL

- Introduction
 - Methods that prevent fertilization of the egg are called contraception.
 - Methods vary in their risks to health, their efficacy in preventing pregnancies, ease of use, acceptance, and costs.

HUMAN POPULATION - Moore

67

Contraceptive Methods that are Reversible

- Natural Birth Control and Family Planning
- Hormonal
 - Oral Contraceptives (Fig. 2-23)
 - Depo-Provera
 - Norplant (Fig. 2-24)

HUMAN POPULATION - Moore

68

Fig. 2-23



HUMAN POPULATION - Moore

69

Fig 2-24



Contraceptive Methods that are Reversible

- Spermicides (Fig. 2-25)
- Barrier Methods
 - Male Condom (Fig. 2-26)
 - Female Condom (Fig. 2-27), Diaphragms, and Cervical Caps (Fig. 2-28)
- Intrauterine Devices (IUD's) (Fig. 2-29)

HUMAN POPULATION - Moore

71

Fig. 2-25



HUMAN POPULATION - Moore

72

Fig. 2-26



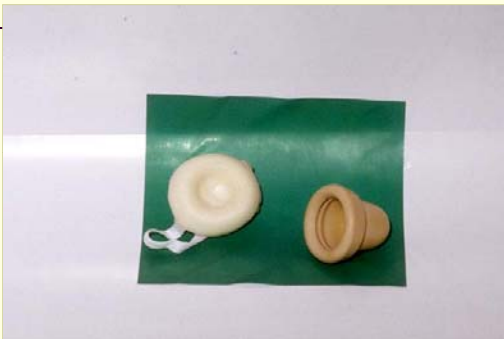
HUMAN POPULATION - Moore

75

Fig. 2-27



Fig. 2-28



HUMAN POPULATION - Moore

75

Fig. 2-29



HUMAN POPULATION - Moore

76

Contraceptive Methods that are Permanent

- Sterilization has become one of the most popular methods for contraception in the United States among married couples who have achieved their desired level of parenthood

HUMAN POPULATION - Moore

77

Contraceptive Methods that are Permanent

- Vasectomy
 - Male sterilization by making an incision on either side of the scrotum and snipping out a piece of the vas deferens.
- Tubal Ligation
 - Blocks the entry of eggs into uterus, eggs released from the ovaries dissolve and are reabsorbed into the body.

HUMAN POPULATION - Moore

78

Contraceptive Methods that are Permanent

- Abortion
 - The medical means of terminating a pregnancy.
 - Nearly 60 million abortions occur annually on a worldwide basis.
 - Abortion can also be safely induced within the first 9 weeks of pregnancy by administering the drug RU-486.