Module 22: Human Populations

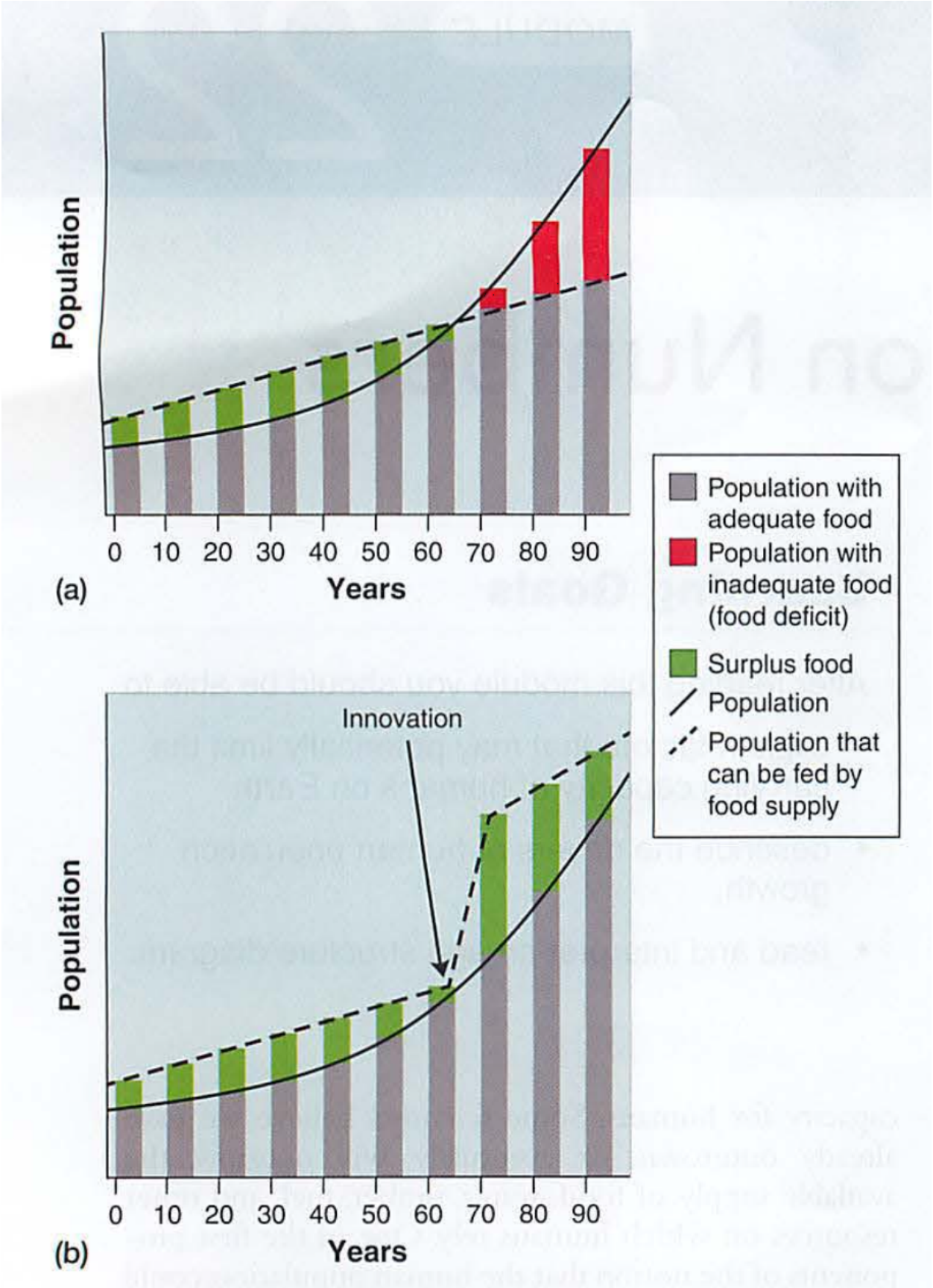
Every day:

- 2.1 million infants are born (2,100,000)
- 800,000 people die
- result: global population increases by 1.3 million (2.1-0.8 = 1.3)
- this assumes no aliens landing, nobody going to Mars (yet)

We describe this as a population growth rate in percent this way:
Growth rate % = (crude birth rate - crude death rate)/10

Real numbers:
CBR = 20%
CDR = 8%
20-8 = 12, so growth rate is 1.2%. (12/10)

Long ago, before clean water, health care and agriculture, CBR and CBR were about equal, so very low growth rate
Malthus: Top graph



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A similar thing happened in the 1960's in Mexico, when population was increasing much faster than food supply, until Norman Borlaug created dwarf wheat, by creating a hybrid between heavy kernels and short stalks.

Population growth as a system: Inputs and outputs:



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Nations are a bit different: people can immigrate (come in) and emigrate (leave for somewhere else)
n.b. the global population stays the same, they are just moving around the planet

National model:

$$\frac{((\text{CBR} + \text{Immigration}) - (\text{CDR} + \text{emigration}))}{10}$$

Try this:
Doofania has a CBR of 12%, CDR of 4% with an immigration rate of 2% and emigration rate of 3%
What is the % growth rate for Doofania?

There is a very easy way to use this to calculate number of years for a population of ANYTHING to double:
70/% = number of years to double ("doubling time")
So, Doofania would take 70/7 or 10 years to double.
Watch:
70/3.5 = 20 years
70/14 = 5 years
On the AP exam, all questions will use a multiple or fraction of 7 (35, 3.5, 7, 14, 28, etc.)

Fertility: (also known as "fecundity")
TFR is the total fertility rate, the average number of children each women will have.
n.b. TFR is not based on 1000 people like CBR and CDR, but is about EACH woman
TFR in the US was 1.8 a few years ago. This changed with COVID (why?)

Replacement level fertility: TFR needed to keep the population stable in a country
Where lifespan is short, TFR must be higher (war, famine, poor water, no food, no healthcare)
One reason families hundreds of years ago had many children (many did not survive to adulthood)
Present numbers are about 1.2 for TFR (some children don't survive, or have children themselves)

DO THE MATH Comparing Population Growth in Two Countries

Preparing for the AP® Exam

Hungary and Sweden are two European countries each with approximately 10 million people. When will the population of each country double? Hungary has a CBR of 10 and a CDR of 13. Sweden has a CBR of 12 and a CDR of 9. Ignore migration in and out of each country and calculate the national population growth rate of each country.

1. Hungary

$$(\text{CBR} - \text{CDR}) \div 10 = \frac{10 - 13}{10} = -0.3$$

So the growth rate is -0.3%.

The doubling time is $\frac{70}{-0.3} = -233$. Because this is a negative number, it means the time for the population to double will never occur.

At current birth and death rates, Hungary will never double in population.

2. Sweden

$$(\text{CBR} - \text{CDR}) \div 10 = \frac{12 - 9}{10} = 0.3$$

So the growth rate is 0.3%

The doubling time is $\frac{70}{0.3} = 233$ years.

At current birth and death rates, Sweden will double in size in 233 years.

YOUR TURN The Dominican Republic has 10.7 million people and a national population growth rate of 1.5 percent. Paraguay has 6.8 million people and a national population growth rate of 1.5 percent. In how many years will each country double in size?

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LDC (lesser developed countries)
Look at the average lifespan distribution-what do you see?

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Men have shorter lifespans: war, work, testosterone, heart disease, smoking, cancer
Look up the life expectancy of men and women your parents' age
Compare with someone born in 1900
How many were farmers then?

Now compare the life expectancy image with this one: (infant deaths before age 1, child deaths under age 5)
One reason the one year birthday is such a big deal here in Hawaii

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Why?

- clean water
- health care

- food supply
- sanitation
- lower pollution

Global IMR: 32
US: 5.8
Sweden: 2.5
Why?
Not just about countries...
US: 5.8
African American: 12
Native Americans: 7.6
Caucasians: 5.3
Closer to home:
Hawaii: 4.9
Native Hawaiians, Pacific Islanders: 9.4
Why?
Social, education, income, food supply, food deserts, diet

Crude death rate also depends on demographics:
Mexico: 6% over 65, CDR is 5/1000
US: 15% over 65, CDR is 8/1000

National Net migration rate: people in - people out
US: 1 million in, very few out, so 1/325 = .003 or 3/1000
US: TFR of 1.8 (below replacement level of 2.1)
but: many immigrants, so population is still growing

DO THE MATH Calculating Population Growth

Preparing for the AP® Exam

In 2012, New Zealand had a population of 4.3 million people, a TFR of 2.1, and a net migration rate of 2 per 1,000. How many people will New Zealand gain in the following year as a result of immigration? If the TFR stays the same for the next century, and the net migration rate stays the same as well, when will the population of New Zealand double?

$$\text{Net migration rate} = \frac{\text{number of immigrants/year}}{\text{number of people in the population}}$$

A TFR of 2.1 for a developed country suggests that the country is at replacement-level fertility and, therefore, the population is stable. The migration rate suggests that

$$\frac{2}{1{,}000} = \frac{x}{4{,}300{,}000}$$

and therefore that

$$x = 8{,}600 \text{ people/year}$$

So, 8,600 people are added to New Zealand each year by migration. If there is no growth due to biological replacement, then the rate of increase is

$$\frac{8{,}600 \text{ people/year}}{4{,}300{,}000 \text{ people/year}} = 0.002 \times 100\%/\text{year} = 0.2\%/\text{year}$$

YOUR TURN How many years will it take for the New Zealand population to double if the population increases due to migration only? Recall that to calculate doubling time, we use the rule of 70:

$$\text{Doubling time (years)} = \frac{70}{\text{growth rate}}$$

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Age Structure Diagrams: (so cool!)