Name: _____

Date: _____

Class: _____

IB Environmental Systems and Societies

8.1 Human population dynamics

Significant ideas:

A variety of models and indicators are employed to quantify human population dynamics.

Human population growth rates are impacted by a complex range of changing factors.

Quantifying population dynamics

1. Define the following terms:

Crude Birth Rate (CBR)

CBR = The number of births per 1000 people over the course of a year.
CBR = (births/population) x 1000.
CBR = *Number* of people per 1000

Crude Death Rate (CDR)

CDR = The number of deaths per 1000 people over the course of a year.
CDR = (deaths/population) x 1000.
CDR = *Number* of people per 1000

Natural Increase Rate (NIR)

The rate of human growth (expressed as a percentage change) per year.
NIR = (CBR-CDR)/10 (the number is divided by 10 to get a percentage rather than out of 1000)
NIR = *Number* % (The population will increase in size by *Number* % per year.)

Total Fertility Rate (TFR)

TFR = The average number of births a woman has in her lifetime in a specific population.
A TFR of 2 is the replacement rate, and will keep a population constant (one for mum and one for dad).
A TRF below 2 will reduce the population, A TRF above 2 will increase the population.

Doubling Time (DT)

DT = 70/NIR
DT = *Number*
This number tells you how long it will take a population to double in size.

2. Look at the data for the nation below and answer the questions. Assume that there is no immigration or emigration.

Country Profile – 2010 data	
Population	5 000 000
Births per year	30 000
Deaths per year	10 000

Calculate the following and show your working where appropriate:

i) The crude birth rate (CBR).

CBR = (births/population) x 1000.
CBR = 30 000 / 5 000 000 x 1000
CBR = 6 births per thousand people

CBR= _____ .

ii) The crude death rate (CDR).

CDR = (deaths/population) x 1000.
CDR = 10 000 / 5 000 000 x 1000
CDR = 2 deaths per thousand people.

CDR= _____ .

iii) The natural increase rate (NIR).

NIR = (CBR-CDR)/10
NIR = (6-2)/10
NIR = 0.4% per annum

NIR= _____ .

iv) In which year will the population be 10 000 000? (Think about "doubling time")

DT= 70/NIR
DT = 70/ 0.4
DT = 175 years to double the population size.

Year: _____ .

3.

a) Explain the term "replacement fertility"

"Replacement fertility" is the total fertility rate at which a population exactly replaces itself from one generation to the next, without migration. This rate is roughly 2.1 children per woman for most countries, because not all children survive, and not all adults reproduce.

b) Replacement fertility is higher than 2. State why this is.

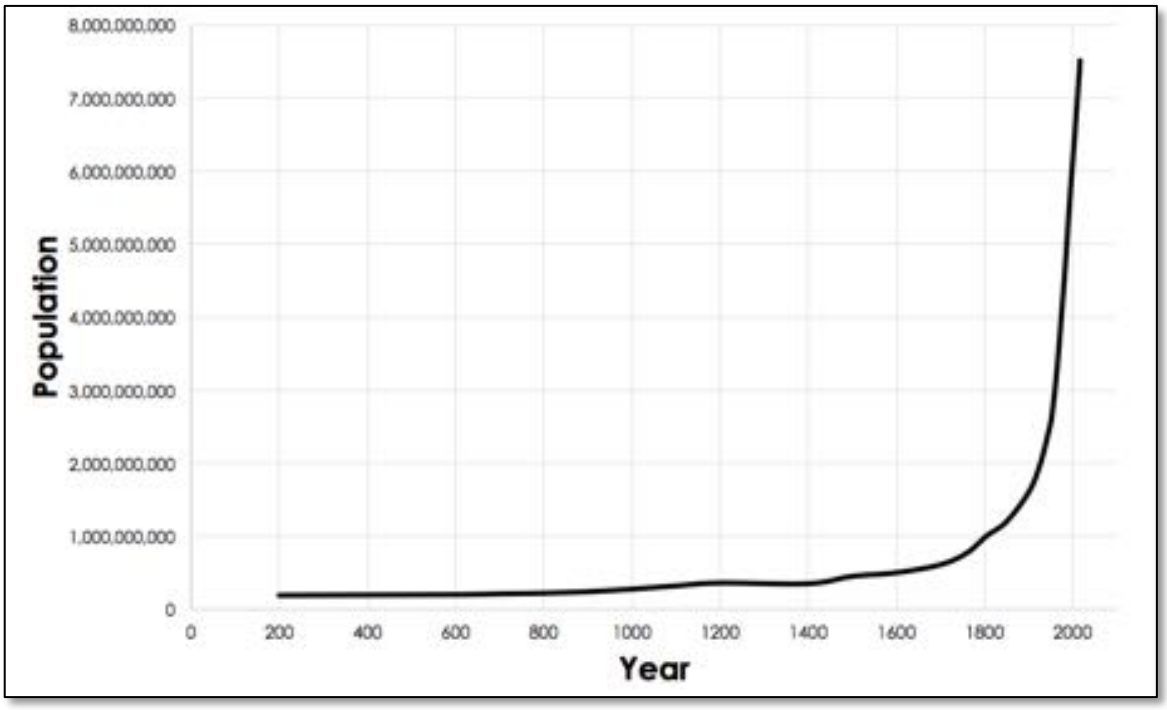
Not all children survive, and not all adults reproduce, so to keep the population at the same number, slightly more than 2 children need to be created per reproductive pairing of adults.

c) Replacement fertility is about 2.16 in LEDCs, but only 2.03 in MEDCs. Explain this difference.

In MEDC's a child is more likely to survive to adulthood, due to better access to heath care, food and eduction. By comparison, more children die in LEDC's and do not make it to adulthood, therefore the number of children born per reproductive pair must be higher to achieve a replacement fertility rate.

Population Growth

1. The diagram below shows the change in world population over about the past 2000 years



Graph 1.1

World population growth 200AD to 2017 (Source: Worldometers)

a) Describe the data

The total human population has stayed below 1 billion for most of human history.
It is only recently, (from the 1800's to 2020) that the population has exponentially grown from 1 billion to 7.4 billion people.

b) Thomas Malthus (1766 – 1834) believed that food production only increased at a linear rate, but human population can increase faster than this. Explain the consequences on the future of the human population if Malthusian theory is accurate.

Human population is growing exponentially, but according to Malthusian theory, food production only increases at a linear rate as it is limited by the amount of fertile land available. as the demand for food increases humanity will be forced to farm more intensively, and in marginal lands. There comes a point where no more food can be produced, (even factoring in technocentric farming solutions) and this point effectively puts a cap (limiting factor) on human population beyond that point. The consequence for human populations of Mathusian theory coming to fruition is a carrying capacity for food production, beyond which humans starve due to limited access to food.

c) Esther Boserup (1910-1999) believed that an increase in population would result in an increase in food production, because we humans would recognize the necessity to provide more, and use new technologies to meet the demand. Explain the consequences on the future of the human population if Boserup's theory is accurate.

This is an optimistic technocentric belief that necessity is the mother of invention. As more people need food, there will be an incentive to find new ways to find food. Thus technologies will be born that enable greater food production to keep up with a booming population

d) In your opinion, how will the human population change in the future? Justify your response and try to be specific

In my opinion, the human population will transition from exponential growth to a plateau at about 8 billion people. I believe this for a number of reasons, the total fertility rate in most countries has already dropped from 5 children per woman to 2 per woman in 50 years. Additionally the percentage of people living in extreme poverty is also decreasing so as more countries transition from LEDC's to MEDC's this trend of decreasing TFR will only continue. In many MEDC's the TFR has already fallen below replacement rate, so their populations theoretically in decline. Their populations are only actually being held constant due to migration (which is not factored in to many of these calculations).

A second line of argument is that is it impossible for the human population to continue increasing exponentially as we are already hitting many planetary boundaries, and limiting factors. Many resources are already stretched to capacity, and cannot be extracted, hunted, produced at higher levels. If they could be, they would be! There is a carrying capacity of our globe, and as a species we may have reached that capacity. It can be stretched with technological developments, but with each development our population numbers climb up a little more, putting more pressure on the system as a whole. Nothing is limitless.

2. Describe the consequences of exponential population growth. Use the headings to guide your answer.

Resource requirements

If the population increases we will require more resources, including water, food, land for housing and agiculture.

Waste

Humans will produce more waste, air pollution, water pollution, consumable products such as plastics and electronics.

Living standard expectations

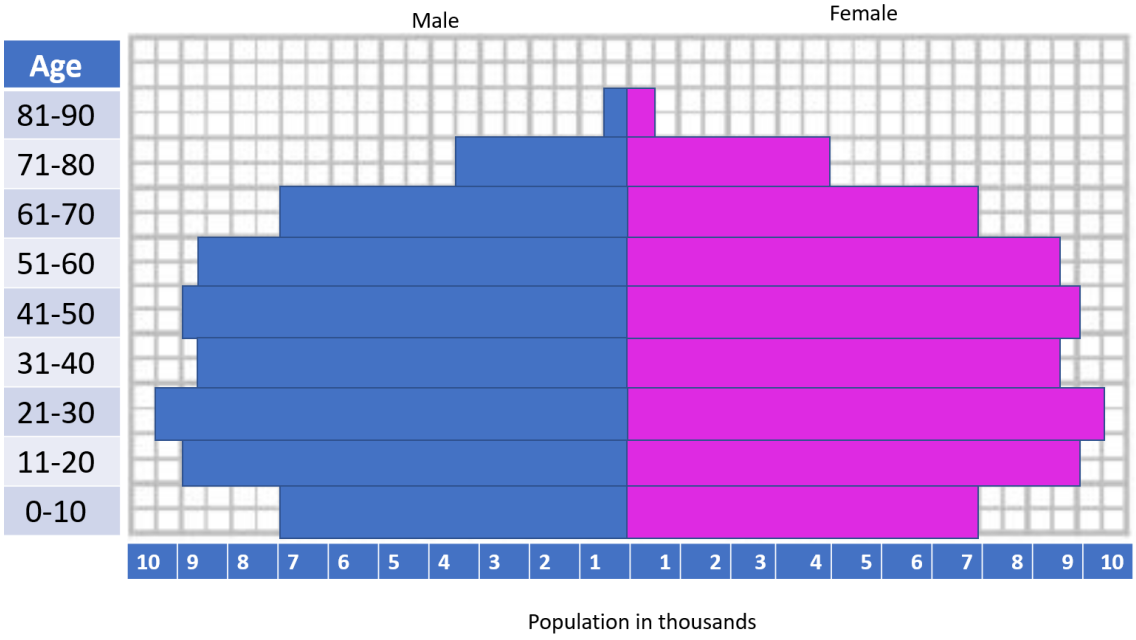
As more people rise out of poverty, they will expect to live lives comparable to people in an average MEDC country, with access to fresh water, electricity, the Internet, a diet higher in meat, air conditioning, and just general access to products. These higher standards of living will put more pressure on cological systems.

Population Pyramids

1. The data in the table below shows the population with respect to age and gender for a nation in a given year.

Age	Female	Male
81 to 90	500	500
71 to 80	3500	3500
61 to 70	7000	7000
51 to 60	8700	8700
41 to 50	9000	9000
31 to 40	8700	8700
21 to 30	9500	9500
11 to 20	9000	9000
0 to 10	7000	7000

a) Present this information on population pyramid below.



b) Based on the graph, what can you conclude about this population's...

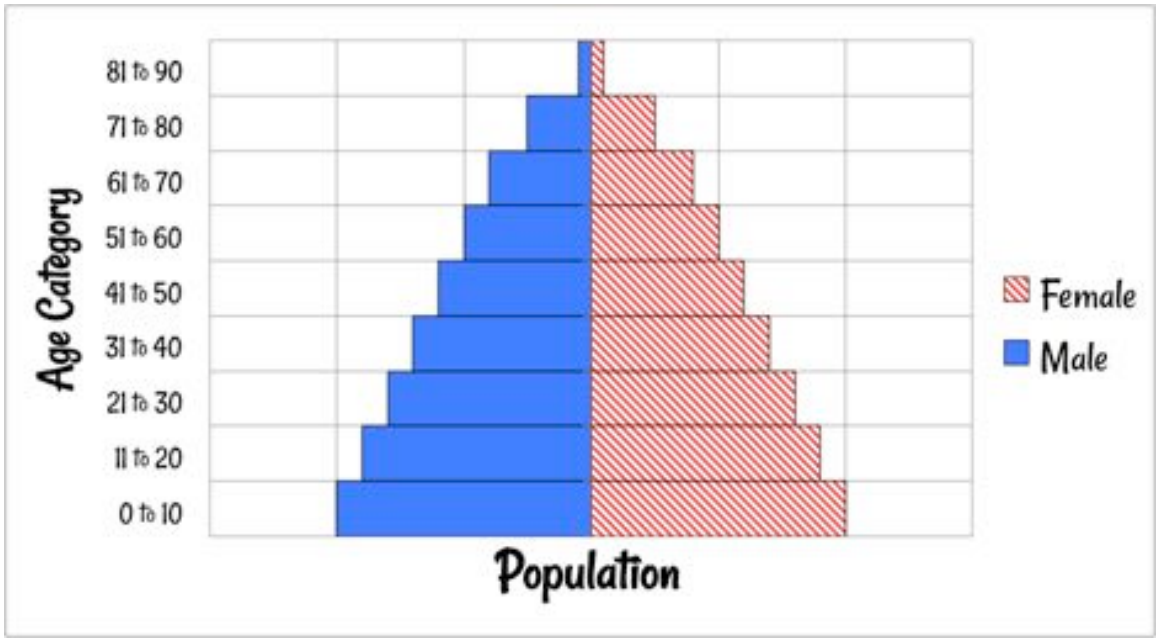
i) birth rate?

Birth rate is decreasing, as 0-10 age range is smaller than other age ranges.

ii) death rate?

Near vertical sides indicate a low death rate

Look at the population pyramid below for a different population.

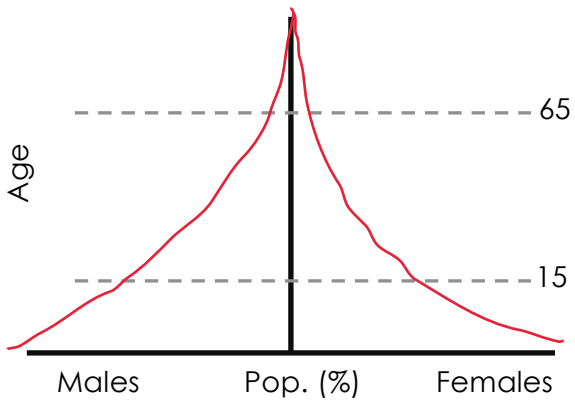
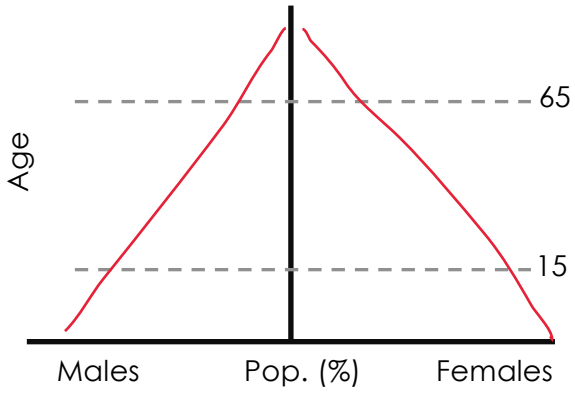
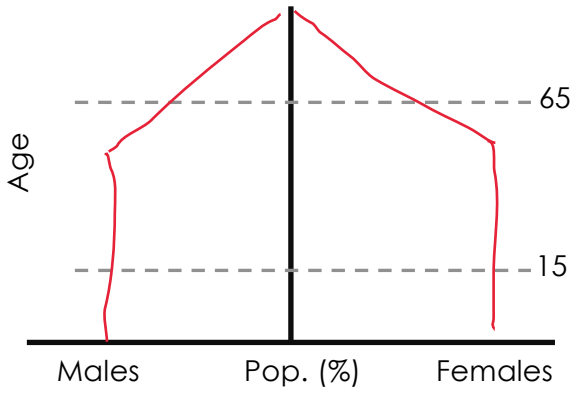


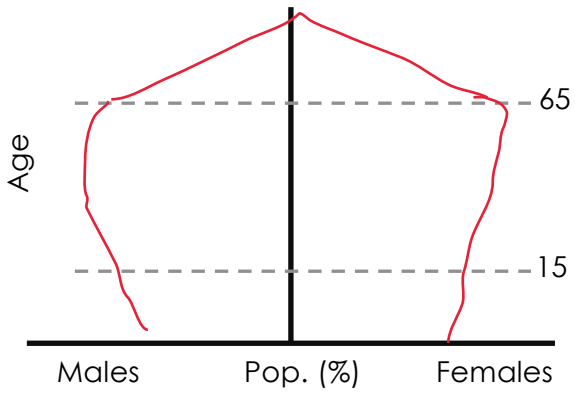
c) Compare this population with the one presented in question 1 a)

The pyramid I drew is most likely representative of an MEDC, with low birth rate, low death rate and a high proportion of adults. It represents a declining population, or stage 4-5 of the DTM.
In comparison the pyramid on this page may represent a LEDC, as it has a high number of births, steep sides indicative of a higher death rate, and represents stage 2-3 of the DTM.

The Demographic Transition Model and Age/Sex Pyramids

1. Complete table below to summarize the demographic transition model. **Briefly explain** the changes in birth rate, death rate, and population:

Stage 1: High stationary Birth rate: high Death rate high Population change: stable	Population pyramid: 
Stage 2: Early expanding Birth rate: high Death rate medium Population change: increasing	Population pyramid: 
Stage 3: Late Expanding Birth rate: high Death rate low Population change: increasing	Population pyramid: 

Stage 4: Low stationary	Population pyramid:
Birth rate: lower Death rate lower Population change: stable	

2. The original demographic transition model had only four stages more recently a fifth stage has been proposed.

Summarise the fifth stage of the demographic transition model.

Note: there is more than one possible answer as different suggestions exist as to what the fifth stage is. If you use further research, remember to cite your source.

3. Discuss the limitations and criticisms of the demographic transition model.

Factors influencing population changes

1. Explain how the following factors influence the average family size of a nation:

Infant/childhood mortality rates

If mortality rates are high, people have larger families to ensure that some of their children survive to adulthood.

The need for care-giving in old age

If parents need to be cared for by family, they will have more children as an insurance policy for their old age.

Children as workers

In agricultural societies larger families can help with manual labour.

Status of women

If women are viewed as primary care givers, who have domestic roles they tend to have larger families. If they can join the workforce, or recieve higher levels of education, they tend to delay having children and have less children as a result.

Availabililty and cost of contraception

If contraceptives are available women tend to have fewer children.

2. Explain how the following measures can act to reduce family size:

Education

If women go to highschool or university, they often delay having children from 15 to their 20's or even 30's. This results in fewer children per woman.

Make contraceptives available

If contraceptives are available after a couple have a few children, they can choose to stop having children.

Improved health care

Better health care means children are more likely to survive into adulthood so couples decide to have fewer children in total. 2 rather than 5.

3. Using the bubble diagrams below, summarise the national and international policies that can be used to reduce and increase population growth rates.

Decreases to population can occur due to:

- Social reform - Educating women, to place them in the workforce rather than the home, making them financially independent.
- Educating people about contraception options.
- Access to contraceptives and family planning.
- Access to sterilization and abortion.
- Governmental policies limiting population numbers i.e. China's One Child Policy.

Increases to population can occur due to:
Generous parental benefits, baby bonus, financial incentive to have babies, maternity/paternity leave.
Subsidize childcare or education.
Making abortion, sterilization and/or contraceptives difficult to access or illegal.