FOOD SECURITY (HS)

Population age structures

Focus question	What is an age structure diagram? How does age structure affect population growth? Why is this important in food production?
Learning target	Students analyze graphic data to make predictions about population growth.
Vocabulary	Population age structure (population pyramid), reproductive age, pre-reproductive age, post-reproductive age, malnourished, undernourished

HS-LS2.A: Interdependent Relationships in Ecosystems

Performance expectation HS-LS2-2	**Classroom connection:** Students use mathematical representations (population age structures) to identify and predict changes over time in the numbers of humans within the countries.

Science and engineering practices

Using Mathematics and Computational Thinking	**Classroom connection:** Students use computational thinking to determine how the population age structures are important mathematical representations that predict and explain population growth in various countries.

Disciplinary core ideas

LS2.A: Interdependent Relationships in Ecosystems	**Classroom connection:** Students identify the given explanation(s) supported by factors affecting human carrying capacity (i.e. the number of humans in the population vary as a function of the physical and biological dynamics of the ecosystem) which includes food security, child mortality and other factors.

Cross-cutting concepts

Scale, Proportion, and Quantity	**Classroom connection:** Students compare age structure diagrams among countries with different populations to see the difference in numbers/scale/proportion.

Prior knowledge

Students need to be able to read graphical representations and make predictions from the data they gather.

Teacher preparation

This lesson introduces students to a mathematical representation of human populations. The student lesson gives them information about how to read the diagrams and determine their predictive power. Before starting the lesson with students, you may want to visit index.mundi.com to select age structure diagrams of interest to your students or your curriculum.

Background

A population age structure diagram is the proportion of the population (and of each gender) at each age level. (Each level in the above graphic represents an age group in increasing order, youngest at the bottom and oldest at the top.)

Differentiation

Other ways to connect with students with various needs:

- **Local community:** Students may investigate the population age structures in their town, city, state or home country (U.S.: `census.gov` Access Local Data).
- **Students with special needs (language/reading):** Structures may be increased in size for easier determination of numbers in each age group.
- **Extra support:** Video: `youtu.be/RLmKfXwWQtE` Population pyramids: Powerful predictors of the future - Kim Preshoff. This video helps to combine this lesson and the following one on Demographic Transition. There is also a lesson plan here: `ed.ted.com/lessons/population-pyramids-powerful-predictors-of-the-future-kim-preshoff`
- **Extensions:** Students can research previous events that have affected the population changes (i.e. World War II, changing cultural norms in a country, etc.).

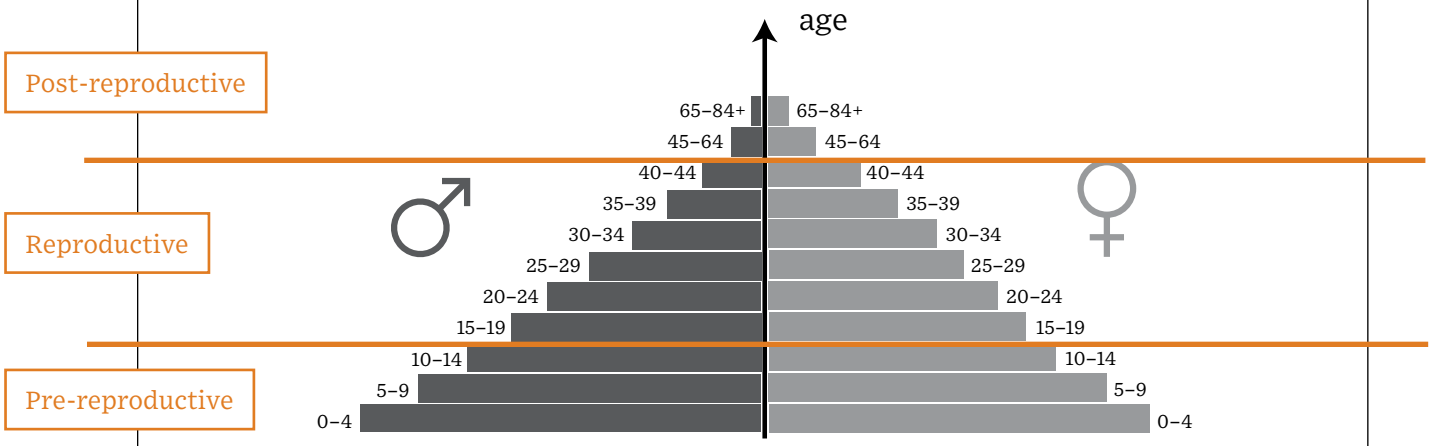
Student handout

POPULATIONS (HS) LESSON 2

Population age structures

Focus questions	What is an age structure diagram? How does age structure affect population growth? Why is this important to food production?
Vocabulary	Population age structure (population pyramid), reproductive age, pre-reproductive age, post-reproductive age, malnourished, undernourished

A population age structure diagram is the proportion of the population (and of each gender) at each age level. (Each level in the above graphic represents an age group in increasing order—youngest at the bottom and oldest at the top.)



Procedure

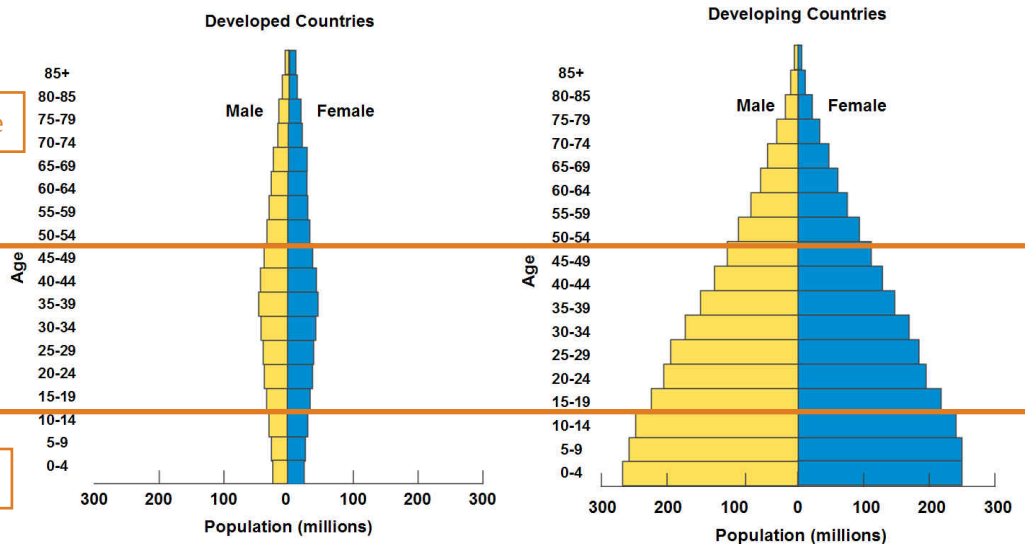
1. Draw two lines on the pyramid above.
   a. The first line should be drawn above the third level of the pyramid which encompasses the age groups 0–14. Label this area of the pyramid the **pre-reproductive** age group.
   b. The second line includes the next six levels, so draw it above the 35-44 portion. Label this area of the pyramid the **reproductive** age group.
   c. Above the line drawn in b is the 44–85+ age group. Label this area of the pyramid the **post-reproductive** age group.

Student handout

Post-reproductive

Reproductive

Pre-reproductive



2. These diagrams help to determine how a country's population will grow. Take a look at the two structures above. Label the 3 categories in these diagrams as you did above.
   a. Calculate approximately how much the population could increase if each female of reproductive age from a developed country has only 1 child in her lifetime.

There are approximately 230 million women of reproductive age in the diagram. If each has one child, the population would increase 230 million.

   b. Calculate approximately how much the population could increase if each female of reproductive age from a developing country has 2 or more children in her lifetime.

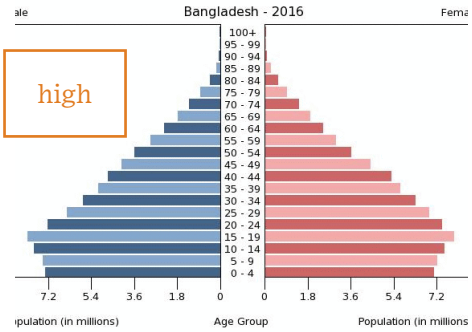
There are approximately 1,205 million (or 1.2 billion) women in the diagram. If each has 2 children, the population would increase by 2.4 billion.

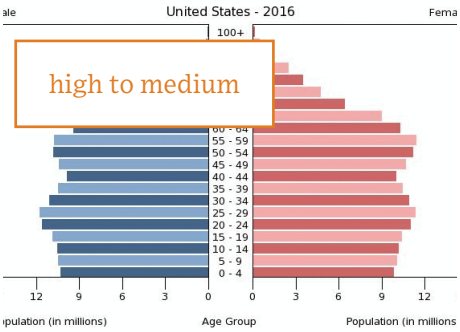
   c. Which of the structures above shows imminent population growth?

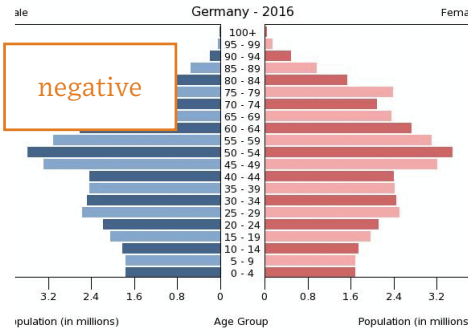
The one of developing countries.

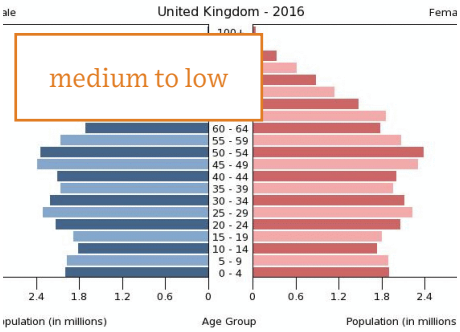
3. Look at the age structures below. Predict the growth of the populations in each country as high, medium, low, or negative. Write your answers next to each country. (Visit **indexmundi.com** to compare the actual numbers of individuals in each age group.)

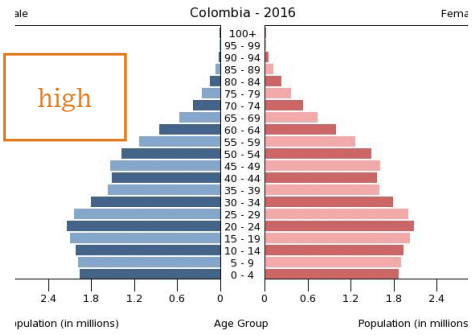
Student handout

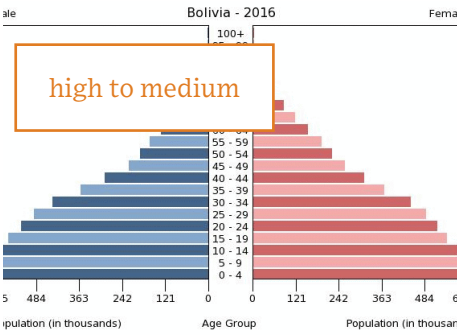


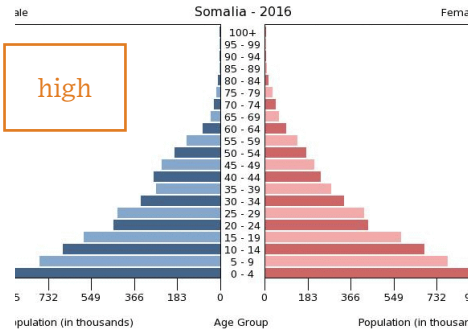












Student handout

Reflection

1. Looking at the countries that have the largest potential for population growth, what are the causes of their large population growth?

Possible answers: more people in the reproductive age groups, lack of education of women, infant and child mortality, lack of access to contraception

2. Are these causes related to resource availability? Why do you think this?

Possible answers: Yes, not just natural resources but economic resources including health care, education, technology, etc.

3. What might a country do to decrease population growth? What has been done (i.e. policies in China, Thailand, India)?

Possible answers: China had a one-child policy; Thailand offered incentives to people who used birth control (but government workers also received incentives and it led to coercion); India instituted forced sterilizations.

4. What is meant by ecosystem limits?

Possible answers: We may not know until it is too late (*Collapse* by Jared Diamond: "Twilight at Easter"); it is difficult to predict because we have not exceeded the limits but we can see the signs of overgrazing, soil salinization, desertification.

5. What innovations have humans introduced to alter ecosystem boundaries and limits?

Possible answers: student responses will vary

Student handout

2. Are these causes related to resource availability? Why do you think this?

Possible answers: more people in the reproductive age groups, lack of education of women, infant and child mortality, lack of access to contraception

Possible answers: Yes, resources including health care, education, technology, etc.

3. What might a country do to decrease population growth? What has been done (i.e. policies in China, Thailand, India)?

Possible answers: We may not know until it is too late (Collapse by Jared Diamond: “Twilight at Easter”); it is difficult to predict because we have not exceeded the limits but we can see the signs of overgrazing, soil salinization, desertification.

3. What might a country do to decrease population growth? What has been done (i.e. policies in China, Thailand, India)?

Possible answers: technology that allows for growing food in non-native environments; genetic modification; precision farming methods that help to lessen the impact on ecosystems while still growing food

Assessments

How well do age structure diagrams predict growth of populations within countries? Are there other models that would work as well or better? What factors do age structure diagrams take into account? Are these factors always going to be predictive of population growth?

Rubric for assessment

Skill	Beginning	Satisfactory	Exemplar
Use mathematical representations (population age structures) to identify and predict changes over time in the numbers of humans within the countries.	Unable to read and interpret the mathematical representation (age structure diagram)	Able to read, analyze and interpret the meaning of an age structure diagram; ability to predict population growth	Able to read, analyze and interpret the meaning of the diagram; ability to make prediction from the diagram and identify the limitations of the predictive ability.

Rubric for self-assessment

Skill	Yes	No	Unsure
I can read an age structure diagram.			
I can predict human population growth using an age structure diagram.			
I can list the limitations of an age structure diagram to predict human population growth			