NGSS Lesson Planning Template - Fulbright-Hays GPA by Sue-Anne Alonso

Age Structure Diagram Analysis - Why South Korea has the Lowest Birth Rate in the World

Grade/ Grade Band: 9-12 Environmental Science Adaptations for AP Environmental Science topic 3.6 are included	**Topic:** Age Structure Diagram Comparison	**Human Population Dynamics Science Standards:** **MS-LS2-1:** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **HS-LS2-2:** Analyze population dynamics data to explain how human activities impact the carrying capacity of ecosystems. **HS-LS2-6:** Evaluate the evidence for the effects of environmental changes (including climate change) on the stability of an ecosystem and the dynamics of populations within it. **Standard 6.2 World History** **6.2.12.HistoryCC.5.d**: Relate the lingering effects of colonialism to the efforts of Latin American, African, and Asian nations to build stable economies and national identities.

Brief Lesson Description: Students will learn to read age structure diagrams, compare and contrast trends, and create their own age structure diagrams based on data researched or developed from a class census

Subjects: Environmental Science, Middle School Science, Social Studies, Geography, World History

Specific Learning Outcomes: Explain information contained in different age structure diagram patterns

Narrative / Background Information

Prior Student Knowledge:

Prior Knowledge: Human populations are increasing overall on Earth; 3.5 College Board Environmental Science work on Carrying Capacity; Definition of a developing versus developed country

Interdisciplinary work using Excel Spreadsheets/ GoogleSheets to construct Age Structure Diagrams (optional)

Narrative: Students will learn to read age structure diagrams by interpreting the 3 age cohorts. Students will use their knowledge to predict if a population is increasing, decreasing or remaining stable. Finally, students complete a divergent activity at the end of the lesson sequence to research a country of their choice to construct an age structure diagram and present cause and effect of the patterns found. Students can choose a country they identify with ancestrally or one they visited or would like to visit. An extension instructs students on how to draw an age structure diagram using graph paper or an option to draw age structure diagrams using Excel Spreadsheets or Google Sheets.

Science & Engineering Practices: **Analyzing and interpreting data:** Human population on Earth is growing overall, but in some countries it is increasing, in some countries it is staying the same and in some countries it is decreasing. Students analyze and interpret age structure diagrams to determine each country's potential for growth. **LEARNING OBJECTIVE** **EIN-1.A** Explain age structure diagrams. **SUGGESTED SKILL** Data Analysis **5.C** Explain patterns and trends in data to draw conclusions. **ESSENTIAL KNOWLEDGE** **EIN-1.A.1** Population growth rates can be interpreted from age structure diagrams by the shape of the structure. **EIN-1.A.2** A rapidly growing population will, as a rule, have a higher proportion of younger people compared to stable or declining populations.	**Disciplinary Core Ideas:** **LS2.A:** Interdependent Relationships in Ecosystems **LS2.C:** Ecosystem Dynamics, Functioning, and Resilience AP Environmental Science: **ESSENTIAL KNOWLEDGE** **EIN-1.A.1** Population growth rates can be interpreted from age structure diagrams by the shape of the structure. **EIN-1.A.2** A rapidly growing population will, as a rule, have a higher proportion of younger people compared to stable or declining populations.	**Crosscutting Concepts: (span all subject areas)** **Patterns:** Explain patterns and trends in data to draw conclusions. Students will analyze the overall shapes of age structure diagrams. Rapidly growing populations show a pyramid shape; stable populations show a column-like shape, and declining populations show an inverted pyramid shape **Cause and effect:** Students will consider which factors lead to higher birth rates and which factors may lead to lower birth rates. Students will consider factors that can lead to a gender gap in populations. **Scale, Proportion and Quantity:** Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.

Possible Preconceptions/Misconceptions:
- Students must be able to explain the 3 age cohorts (prereproductive, reproductive and post-reproductive ages).
- Assumption of the ideal shape as a perfect equilateral triangle
- Overlooking gender disparities in age distribution
- Overlooking the fact that mortality patterns and fertility rates can change
- Failure to look within each age group rather than just the overall pyramid shape
- Failure to identify which groups are considered as child-bearing age groups

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LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

Do Now Options: 1)Brainstorm factors you think would cause an increase in population? a decrease in population?

> 2) World Population Clock Students generate questions based on the world population clock.
> What trends do we see on this website? What questions do we have?
> While the world's population is growing overall, certain countries have a dangerously low, declining population.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Look at the images and do a WIS (What I see = observations) WIM (What It Means = inferences)
Accept all answers with explanation.
Guiding questions: How many colors do we see in the images? What might this mean? What are these 4 digit numbers? (years) Describe how each shape differs?
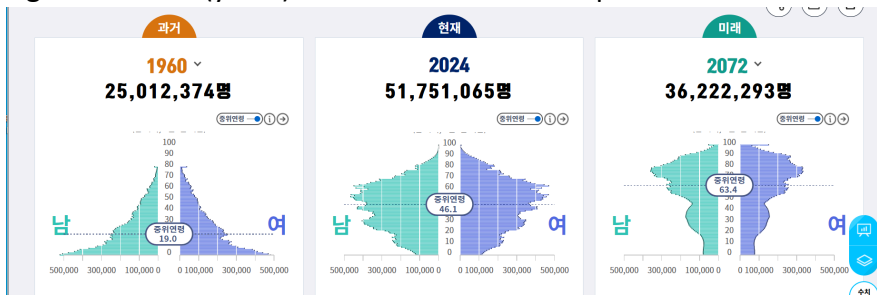
Source: South Korea National Statistics Portal
https://kosis.kr/visual/populationKorea/PopulationDashBoardMain.do

EXPLAIN: Concepts Explained and Vocabulary Defined:

1) Explain 1: Students will watch TEDx: The Population Pyramid and note how to read parts of an Age Structure Diagram
2) Explain 2: Students will return to the Explore diagrams and read them using the knowledge they gained from the video and Google Translate to translate the Hangul characters if desired. Return to the picture shown in "Explore section" to see how student interpretations have changed.
3) Explain 3: Article: The Korea Times: Korea Faces a Rapidly Aging Population
Video: DW News: Why S. Korea has the lowest birthrate in the world
Teacher explanation of changes in South Korea's Population over the Past 75 Years Link

Based on the video and article, what factors are affecting the birthrate in S. Korea?

DIFFERENTIATION: **Direct Instruction as needed to differentiate:** Teach students about the components of age structure diagrams, including 3 cohorts, gender divisions, causes and effects of 3 different demographic trends. May review one example as a class. Use graphic organizers to chunk information needed to read an age structure diagram.

Formative Monitoring (Questioning / Discussion): Analysis of features in age structure diagrams.
Why might there be more male children than female children in China?
Why might there be fewer males in the post-reproductive age than females in Russia?

How would a war affect an age structure diagram?
Why was there a baby boom in America? Why was there a baby boom in South Korea?

ELABORATE: Create Age Structure Diagrams

Option 1: Draw an age structure diagram showing numbers in millions by hand
                On paper: https://www.youtube.com/watch?v=UYoeypdlYoI

Option 2: Class data
- Gather data from students about their living relatives in the United States (approximate age/gender assigned at birth) and use this data to draw a class age structure diagram. Students can put their information into a Google Form to consolidate the data
- Sample Google Form Link (will make a forced copy for you): Class census data google form link

ADVANCED LEARNERS: Use Google Slides/Excel Spreadsheet to construct an age structure diagram

Option 3: Mini-project - student choice
1. Each student/pair chooses a country. Students draw an age structure diagram for this country using data from the U.S. Census Bureau's International Database. (Simple option: Students can download an image of their chosen country from this website)
   a. Click on World. Type in country of choice.
   b. Click on Population by Age (near top banner).
   c. Click on the Age Table (on left).
   d. Click on 5 year age groups (on left).
   e. Copy data into an Excel Sheet.
   f. Follow Video link below for making an age structure diagram in Google Sheets:
   Video Link for making an age structure diagram in Google Sheets (advanced using **percentages**)
   S. Korea 2024 Population data in Excel Sheets

   Computer graphing of an age structure diagram using Google Sheets video (graphing population **numbers**) https://www.youtube.com/watch?v=g0jMAWjw6us

2. Higher level students will graph % of the population for each age group (mathematical thinking to divide each segment by the total population in the country) versus the total number of people in each segment.
   Video Link for making an age structure diagram by hand based on numbers in millions (simple).
3. Make a Google Slide presentation.
4. Share personal connections with this country and reasons for choosing it.
5. Compare the age structure diagram of your chosen country to the United States.
6. Describe patterns in each of the 3 age cohorts and differences in gender.
7. Explain social, economic and historical events that contributed to age structure patterns in your country of choice.
8. Project future population patterns for your chosen country.
9. Verbally present to the class. Presentation Rubric

DIFFERENTIATION: Option to make a video of the presentation instead of presenting live presentation

EVALUATE:

Level 1:

Compare the population growth in the four diagrams below:

1) Rank the diagrams from highest to lowest growth rate. (Use India, U.S., South Korea).
2) How many individuals are in the pre-reproductive cohort?
3) How many individuals are in the reproductive cohort?
4) Which country has the most individuals in the post-reproductive cohort? Justify your answer.
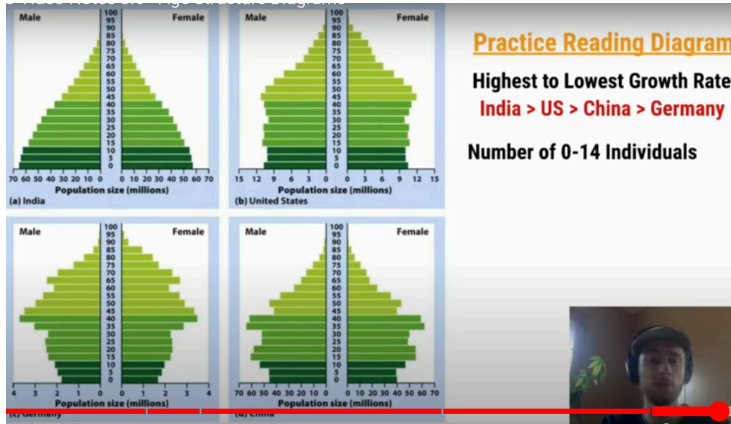
Source: https://www.youtube.com/watch?v=EkLIxk_um9A

Practice test question for AP Environmental Science below

Level 2: Assessment Link below:
📄 Age Stucture Assessment Questions Level 2

Summative Assessment:

1. Students will choose a country of their choice to complete an age structure diagram for. Students will reproduce the age structure diagram and explain the cause and effects of historical events that caused the patterns observed in the age structure diagram (content rubric and presentation rubric)

2. **Standardized test question practice:**

FRQ practice for AP College Board Exam included below with scoring guide

AP® ENVIRONMENTAL SCIENCE FREE-RESPONSE QUESTIONS

Male [ ] Female — Number of People in Country X (in millions) — 10 5 0 5 10

Male [ ] Female — Number of People in Country Y (in millions) — 4 2 0 2 4

Male [ ] Female — Number of People in Country Z (in millions) — 10 0 10

■ Ages 0–14   □ Ages 15–44   ▨ Ages 45–85+

4. The figures above show the age structures of human populations in three countries, X, Y and Z.

    (a) Which of the three countries has the largest rate of population growth? Which has the smallest rate? Explain.

    (b) Compare the infant mortality rates that are likely in Countries X and Y. Explain your reasoning.

    (c) Describe the changes in both the birth rate and the death rate for a country making the transition from a preindustrial society to an industrial society.

    (d) Describe one incentive that the government of a country could offer its citizens that would favor a reduction in the growth rate of its population. Explain how this incentive would work, and describe one possible drawback.

Materials Required for This Lesson/Activity
Description
Teacher Slide Link
Graph paper for paper graphing extension
Colored pencils/highlighters for paper graphing extension
Chromebooks for digital graphing extension
Smartboard for projection of videos

Vocabulary: Level 1, simple terms are highlighted in yellow boxes

demographer	population pyramid: age structure diagram that is widest at the base and smallest at the top (which is typical of a	immigration	emigration

	developing country)		
pre-reproductive age cohort	reproductive age cohort	post-reproductive cohort	increase
developed country	developing country	life expectancy	decline
extreme pyramid/less extreme pyramid	inverse pyramid	mortality rate	gender gap
Dependency Ratio (advanced)	population momentum = continued population growth even after measures to reduce the population have been implemented	Total Fertility Rate (TFR)	Replacement Level Fertility

More Resources
Development Aid (2024) Countries with the Highest Population Decrease
https://www.developmentaid.org/news-stream/post/152772/top-20-countries-with-the-highest-rate-of-population-decline

Dischinger-Smedes, Joran, APES Video Notes 3.6 - Age Structure Diagrams
https://www.youtube.com/watch?v=EkLIxk_um9A

DW News: Why S. Korea has the lowest birthrate in the world
https://www.youtube.com/watch?v=gSE66c9OQhw

Khan Academy:
https://www.khanacademy.org/science/ap-college-environmental-science/x0b0e430a38ebd23f:populations/x0b0e430a38ebd23f:human-populations/a/age-structure-diagrams

Mr. Sinn (2023) How to Analyze Population Pyramids
https://www.youtube.com/watch?v=t7YWthXWhDo

Pew Research Center (2022) Global population skews male, but UN projects parity between sexes by 2050
https://www.pewresearch.org/short-reads/2022/08/31/global-population-skews-male-but-un-projects-parity-between-sexes-by-2050/#:~:text=The%20United%20States%20has%20had,is%20expected%20to%20be%2099.

Population Reference Bureau https://www.prb.org/resources/human-population/

TED-Ed, Preshoff, Kim
https://www.youtube.com/watch?v=RLmKfXwWQtE

Texas A&M University, South Korea has the Lowest Fertility Rate in the World and that does not bode well for its Economy
https://artsci.tamu.edu/news/2023/06/south-korea-has-the-lowest-fertility-rate-in-the-world-and-that-doesnt-bode-well-for-its-economy.html

United Nations, South Korea
chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.un.org/en/development/desa/population/publications/pdf/ageing/replacement-chap4-ko.pdf
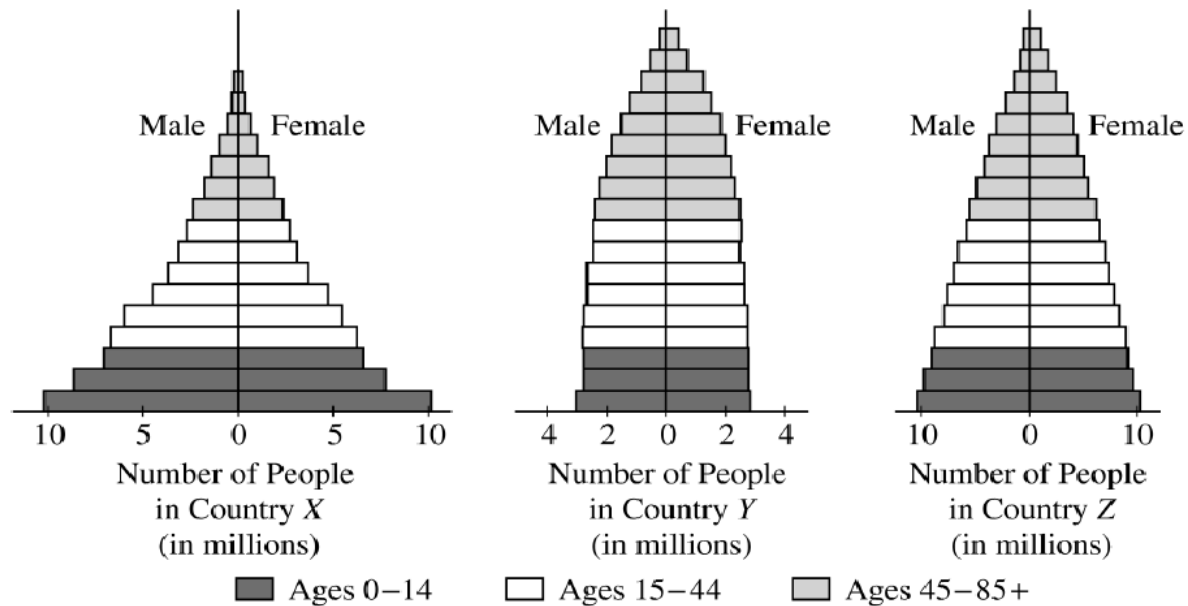
World Population Data Sheet (2024)
https://2024-wpds.prb.org/

Age Structure Diagram Assessment

Male △ Female   Male △ Female   Male △ Female

10   5   0   5   10   4   2   0   2   4   10   0   10

Number of People
in Country *X*
(in millions)

Number of People
in Country *Y*
(in millions)

Number of People
in Country *Z*
(in millions)

■ Ages 0–14   □ Ages 15–44   ▨ Ages 45–85+

The figures above show the age structures of human populations in three countries, *X, Y and Z.*

Directions:
Where explanation or discussion is required, support your answers with relevant information and/or specific examples and/or calculations. Write in complete and coherent sentences.

1) Which of the three countries has the largest rate of population growth? Which has the smallest rate? Explain your reasoning.

2) Identify an example of a country with a similar age structure diagram to one of the countries above. Explain your reasoning.

3) Compare the infant mortality rates that are likely in Countries *X and Y*. Explain your reasoning.

4) Describe the changes in both the birth rate and the death rate for a country making the transition from a preindustrial society to an industrial society.

5) Describe one incentive that the government of a country could offer its citizens that would favor a reduction in the growth rate of its population. Explain how this incentive would work, and describe one possible drawback.

6) Explain the four age structure diagram stages of growth for a developing country. Use the image below to help you.

Age
65

15

Males (%) Females (%)   Males (%) Females (%)   Males (%) Females (%)   Males (%) Females (%)
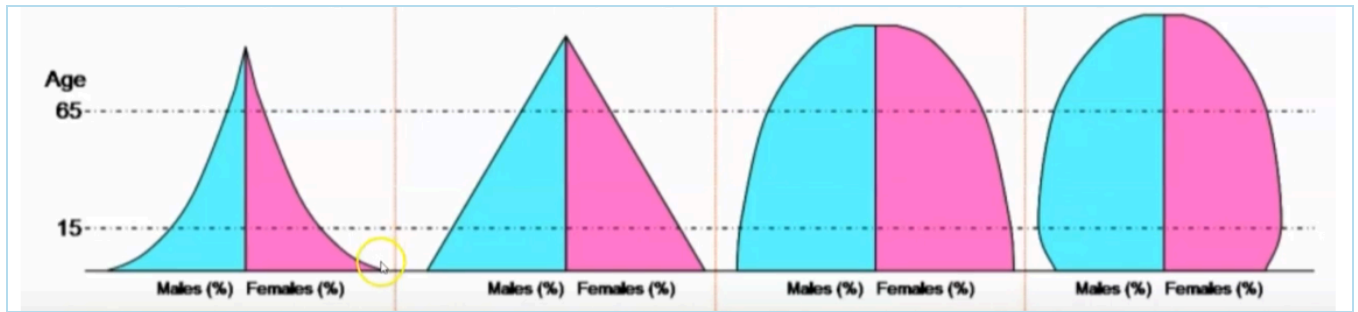
South Korea – A Study of Age Structure Diagrams

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Fulbright-Hays GPA 2024

- Lesson Plan Link:
  https://tinyurl.com/SouthKoreaAgeStructure2024
- Student Handout Link

Do Now:

Click on the link below.
What questions do you have?

https://www.worldometers.info/world-population/

Explore: WIS–"What I See" make observations
WIM– "What it Means" make inferences
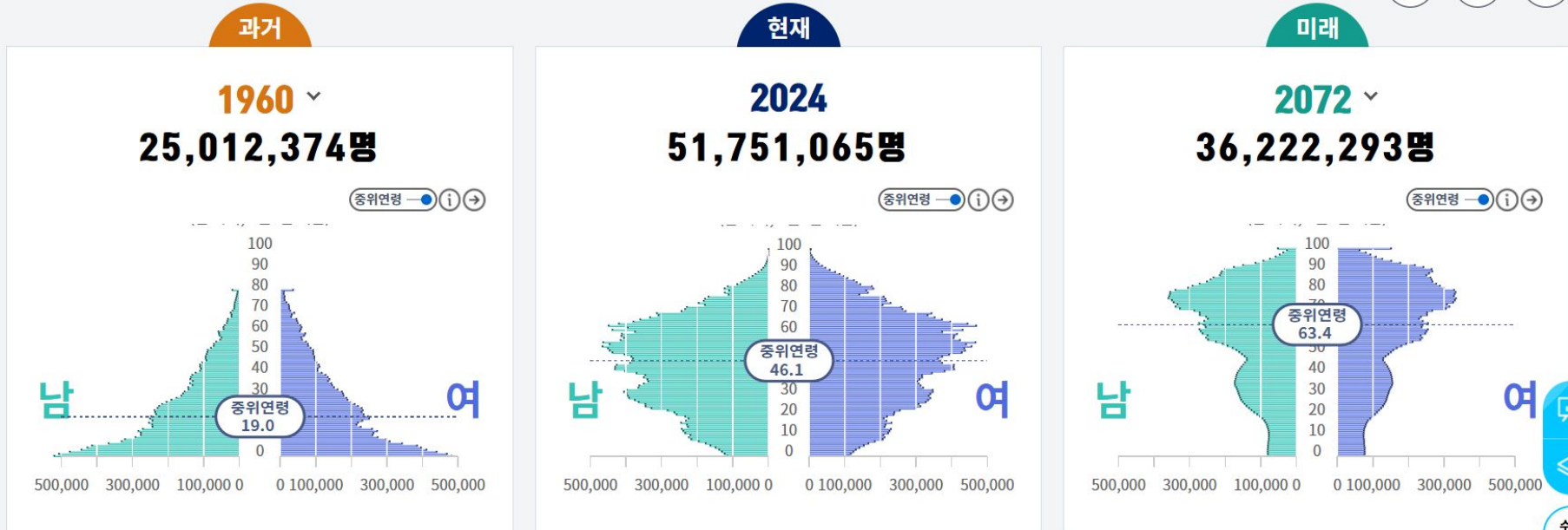
Explore:

Click on the link below.
Answer questions on your handout.

https://www.census.gov/popclock/

Vocabulary

- <u>Demography</u>: The study of human populations and population trends

- <u>Demographers</u>: Scientists who study human populations and population trends

Objectives:

We will work as demographers to:
- Compare and contrast age structure diagrams
- Analyze trends in age structure diagrams based on a country's history
- Create an age structure diagram based on data

Watch the video. Complete the Explain 1 section of your handout:
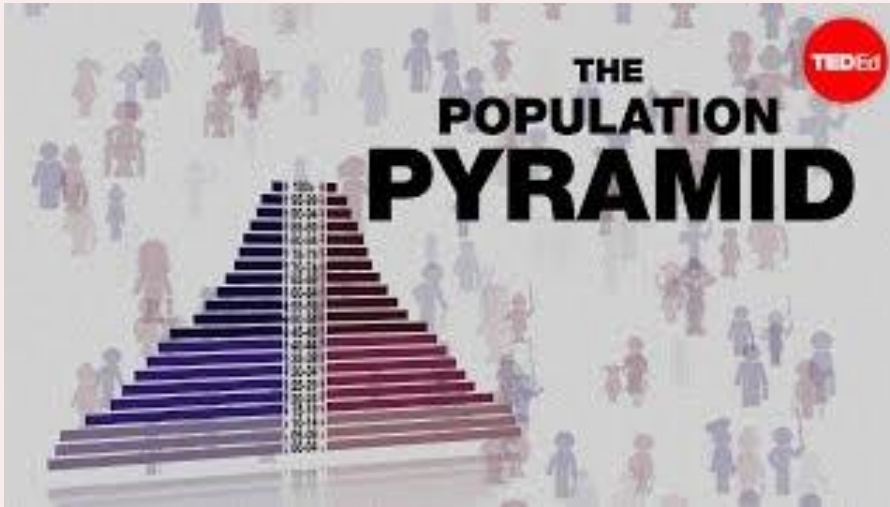
Explain 2: Analyze these age structure diagrams for South Korea (hint use google translate if you want to translate the words)
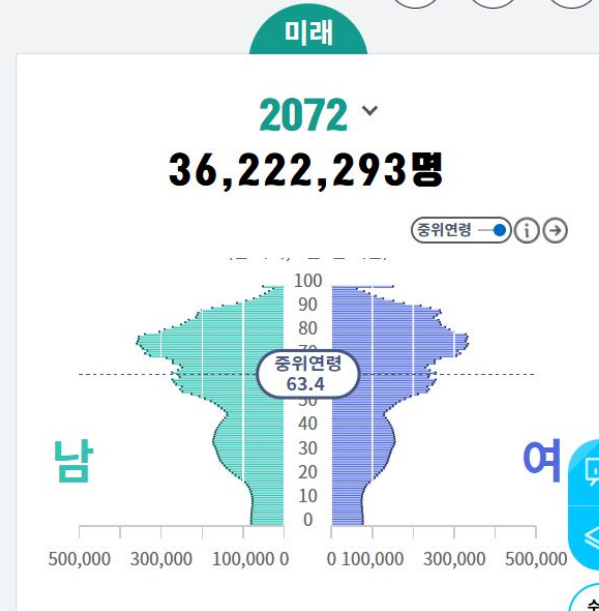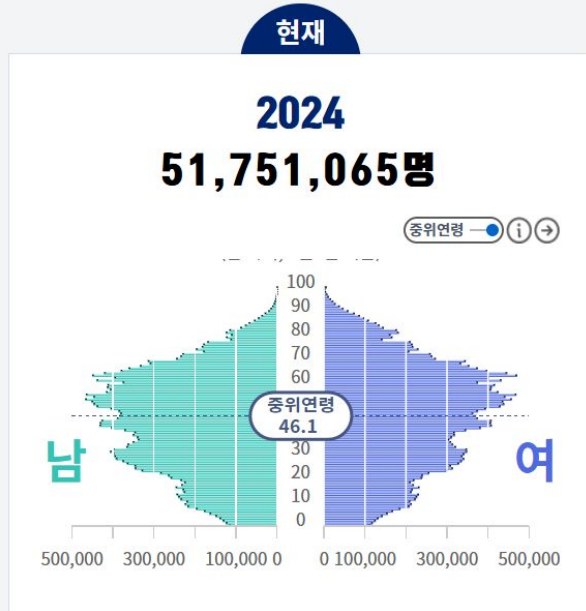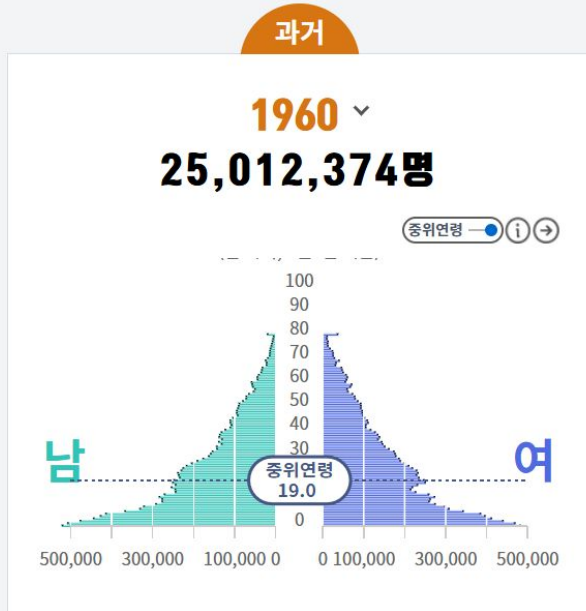
Explain 3: Korea Times Article Link

Ratio of elderly over 65

(Unit: %)

13.1 — 2015
24.3 — 2030
32.3 — 2040
40.1 — 2060

Graphic by Cho Sang-won
Source: Statistics Korea
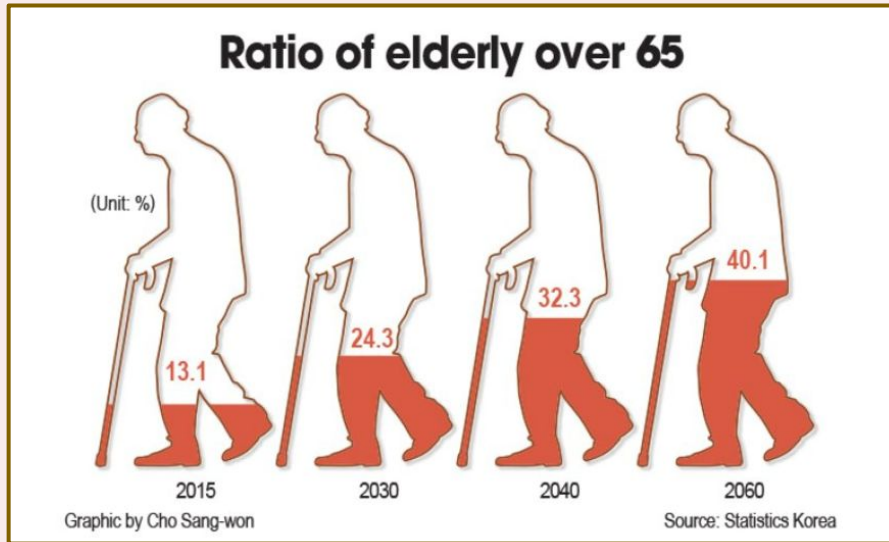
What is causing changes in the population structure of South Korea?
Additional Information: Video: DW News: Why S. Korea has the lowest birthrate in the world?

Discussion Questions:

1. Why might there be more male children than female children in China?
2. Why might there be fewer males in the post-reproductive age than females in Russia?
3. How would a war affect an age structure diagram?
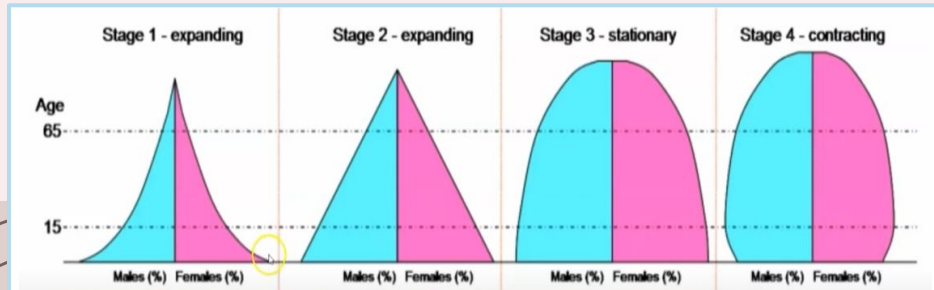4. Why was there a baby boom in America? Why was there a baby boom in South Korea?

Elaborate:
a. Explain the stages in age structure diagram for a developing country
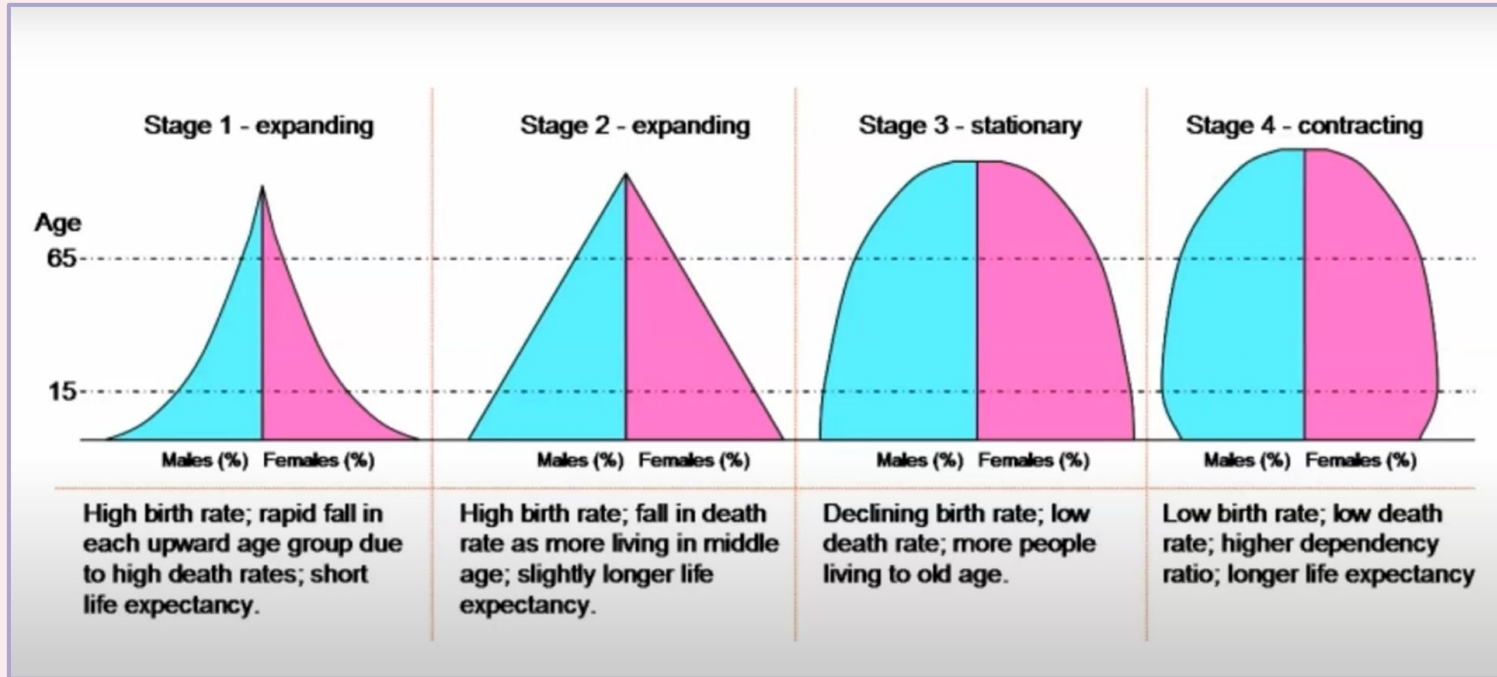b.Describe which stage South Korea is currently in
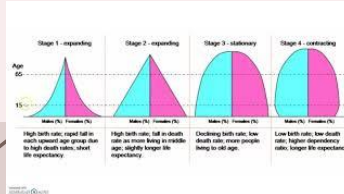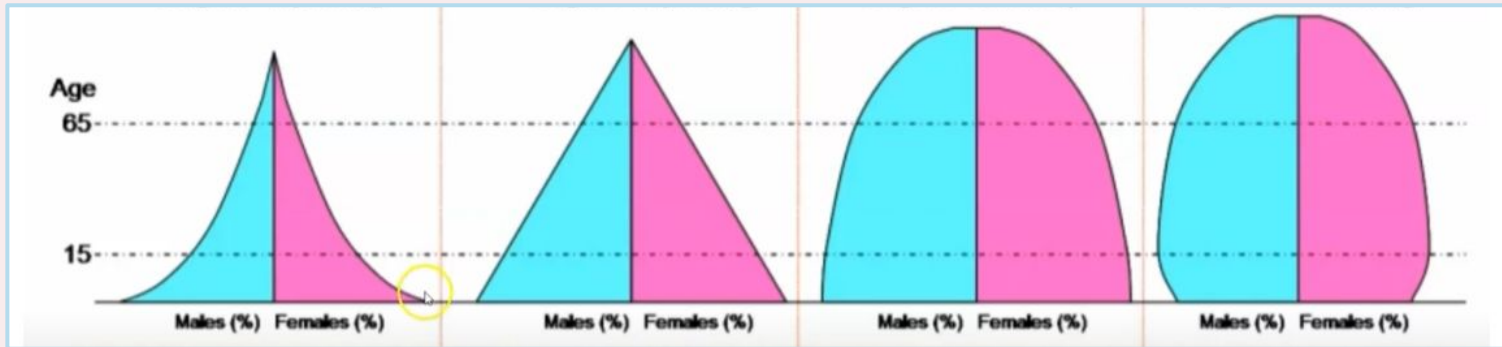
Elaborate:
a. Explain the stages in age structure diagram for a developing country

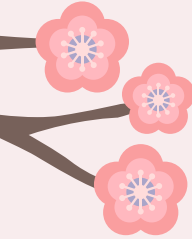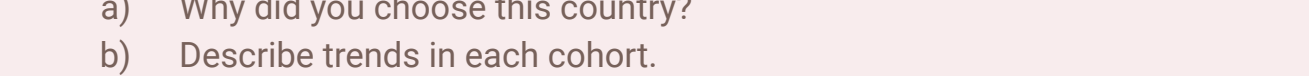b.Describe which stage South Korea is currently in. Justify your answer.

| Stage 1 - expanding | Stage 2 - expanding | Stage 3 - stationary | Stage 4 - contracting |

Age
65

15

Males (%) Females (%)   Males (%) Females (%)   Males (%) Females (%)   Males (%) Females (%)

Stages of an Age Structure diagram:

Stage 1 - expanding

Stage 2 - expanding

Stage 3 - stationary

Stage 4 - contracting

Age
65
15

Males (%) Females (%)

Males (%) Females (%)

Males (%) Females (%)

Males (%) Females (%)

High birth rate; rapid fall in each upward age group due to high death rates; short life expectancy.

High birth rate; fall in death rate as more living in middle age; slightly longer life expectancy.

Declining birth rate; low death rate; more people living to old age.

Low birth rate; low death rate; higher dependency ratio; longer life expectancy

Mini-Project

1. Choose a country you are interested in.
2. a)Find data to make an age structure diagram using [U.S. Census Bureau's International Database](#).
   b) Use the following resources to help you draw an age structure diagram
      i) On graph paper[: https://www.youtube.com/watch?v=UYoeypdlYoI](https://www.youtube.com/watch?v=UYoeypdlYoI)
      ii) Digitally:

3. Make a presentation to show your age structure diagram analysis:
   a) Why did you choose this country?
   b) Describe trends in each cohort.
   c) Explain social, economic and historical events that have led to the current population pattern.
   d) Describe which stage of development the country is currently in.
   e) Do you predict the country's population will increase, decrease or remain the same? Justify your answer.
   f) Verbally present to the class: [Presentation Rubric](#)

THANKS!

DO YOU HAVE ANY QUESTIONS?

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