

Teaching Notes
Lesson 7
Looking Back at the Shapes of Kenya and Japan and My Country

Overview:

This lesson looks back at the population of Kenya and Japan in a similar way to the study of the United States in Lesson 6. However, the pyramid graphs and the histograms of these countries tell different stories. The problems in the lesson ask questions that link the graphs and the initial summaries derived in Lessons 2 and 3 to past graphs and summaries. This lesson concludes with students observing the factors of immigration, death, and birth rates on the total population and key age groups highlighted in this lesson.

An alignment of the problems in this lesson to the **Modeling Continuum** are suggested in the following table:

Modeling Continuum Classification			
Level 1	Level 2	Level 3	Level 4
Problems: 4, 9, 10	Problems: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Problems: 11, 12, 13, 14, 15	Problems:

Primary tools students use in this lesson to answer the above problems are:

Arithmetic operations, proportions, percent, extracting and interpreting data from graphs. See the connection of these tools to high school standards in the **Overview of the Module**.

Resources needed for this lesson:

Provide a copy of a complete Lesson 7 for each student. This lesson does not require any additional handouts.

Launch:

Begin this lesson with a whole group discussion of the pyramid graphs and the histograms for Kenya and Japan of 2015. Consider questions similar to the following:

- Describe the different shapes, total population, and the counts of selected age groups for Kenya and Japan.
- What is the count of the 0 – 4 years old age group for each country in 2015? What is the percent of the 0 – 4 years old age group in each country?

After an opening discussion of the two countries, direct students to compare Kenya's population in 1980 to the population in 2015 using the pyramid graphs.

- What do the graphs tell us about the overall changes in Kenya's population from 1980 to 2015?
- Did the country grow, and did any age group significantly increase or decrease in count?

In the same way, highlight the population pyramid graphs and histograms of Japan and ask the same questions. Kenya and Japan have different shapes, and different summaries of the count and percent of the highlighted age groups. How do we know if an age group increased in population over time? What features indicate these changes? For example, is there a change in the scale of the graph that indicates the counts in an age group changed, or is there a change in the area of the graphs? After an opening discussion, direct students to complete the problems.

Implementation Ideas:

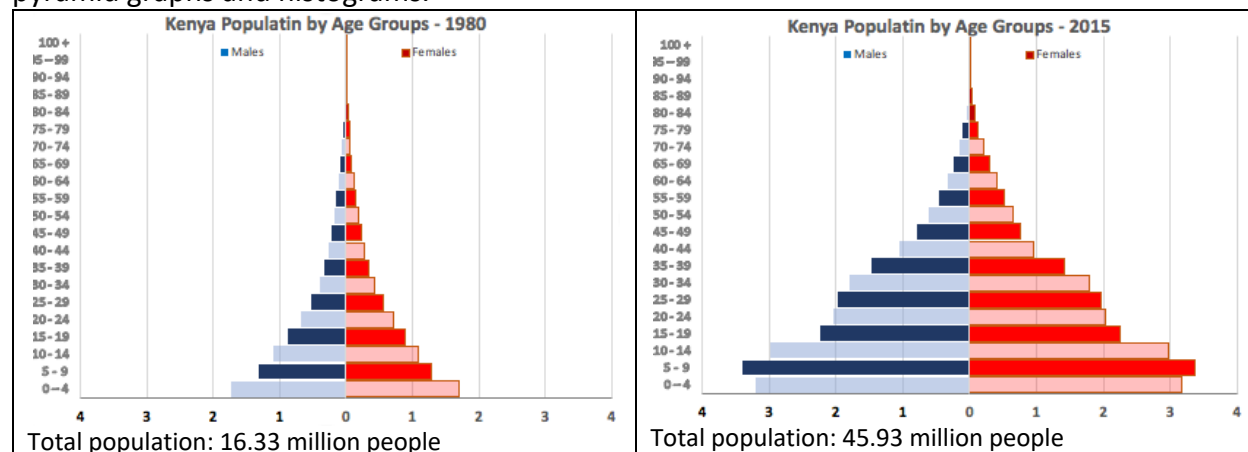
After students complete the problems, discuss selected students' answers as a whole group. Students might be encouraged to research what events happened in Kenya or Japan that would explain the increase or decrease of the count of people over time. This research may result in discussions of other issues (economic conditions, diseases, wars) that you may not wish to discuss as a class, but these factors provide some background to the key events that altered each country's population. The comparison of each country's population to the United States population is an indication why these 3 countries were selected and highlighted in this module. Each country has a unique shape, a changing shape over time, and a different set of challenges over time.

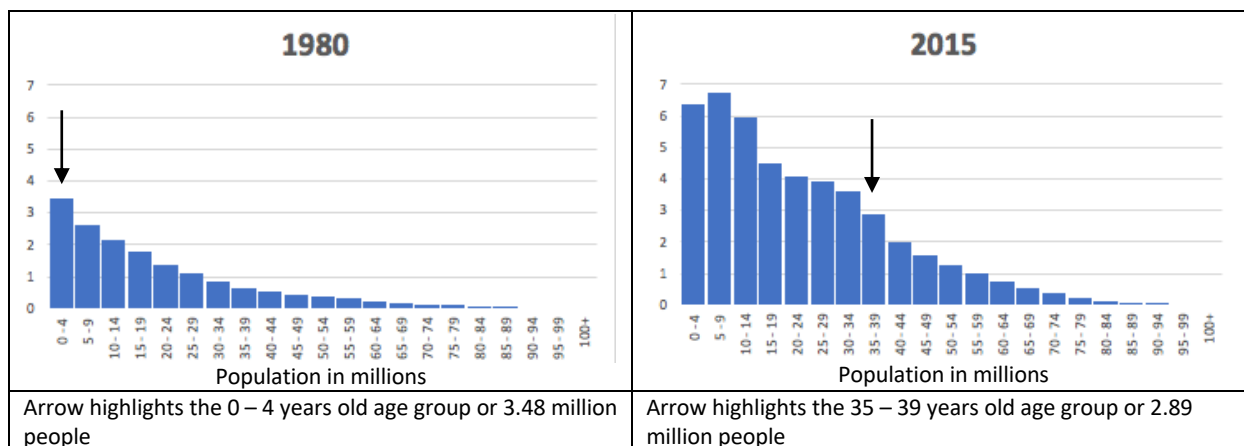
Student responses or descriptions

Lesson 7 - Problems

Kenya

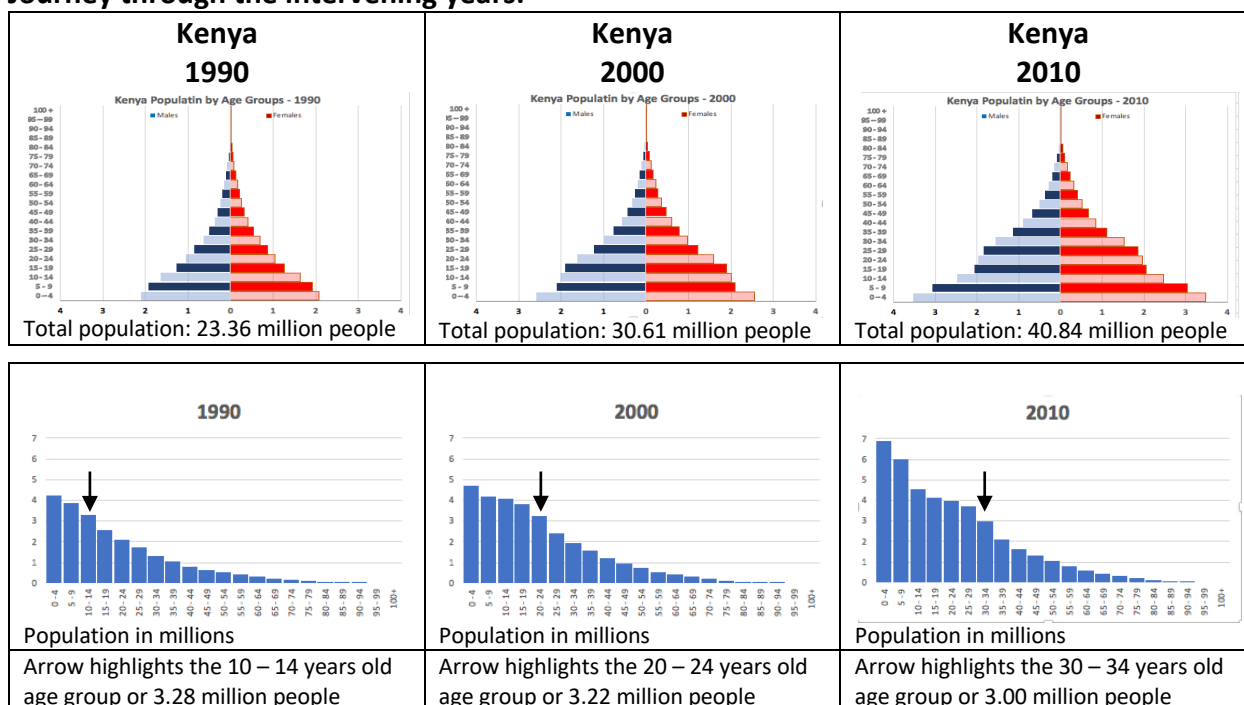
The 1980 population and the 2015 population are summarized by the following population pyramid graphs and histograms.





The population pyramid graphs and histograms of the intervening years of 1990, 2000, and 2010 are also provided. Note the changes in the shape of the population pyramid graphs and histograms.

Journey through the intervening years:



- The information provided above indicates that the total population of Kenya increased from 16.33 million people in 1980 to 45.93 million people in 2015.
 - Calculate the percent increase of the population from 1980 to 2015.
Calculate $(45.93 - 16.33)/16.33$ which is approximately 1.81 or 181%.

- b. Describe how the graphs (either the population pyramid graph or the population histogram) also indicate an increase of the population from 1980 to 2015.
The area of the 2015 histogram is noticeable greater than the 1980 histogram. It is important to indicate that the histograms were used to explain an increase in area as an explanation of an increase in the population. The histograms maintained the same scale for the count of people. The scale for the population pyramid graphs changed, and therefore, the change in area is not as accurate an indication of the change in the population.
2. The 0 – 4 years old in 1980 are highlighted by an arrow in the 1980 histogram. If the people in the 0 – 4 years old age group did not move to another country or did not die in the next 35 years, they were also counted in the 35 – 39 years old age group in 2015. An arrow is used to also identify the 35 -39 years old age group in 2015.
 - a. What count and percent of the people in Kenya were 0 – 4 years old at the beginning of 1980?
The count of 0 – 4 years old is 3.48 millions of people. The percent of 0 – 4 years old is approximately $(3.48/16.33) \times 100$ or 21.3%.
 - b. What count and percent of the people in Kenya were 35 – 39 years old at the beginning of 2015?
The count of 35 – 39 years old is 2.89 millions of people. The percent of 35 – 39 years old is approximately $(2.89/45.93) \times 100$ or 6.3%.
 - c. Explain what factors contributed to the decrease in the population of the age group 0 – 4 years old in 1980 to the 35 – 39 years old in 2015 while the total population of Kenya increased.
The decrease in the count of people from 3.48 millions of people to 2.89 millions of people is primarily explained by people moving out of the country or dying. The increase in the total population is primarily explained by an increase in the number of births.
3. Answer the following questions using the population graphs and the information provided about the total population and the population within highlighted age groups:
 - a. In what age group in the 1990 population were people counted who were 0 – 4 years at the start of 1980?
People counted in the 0 – 4 years old age group in 1980 were 10 – 14 years old in the 1990 population.
 - b. What percent of the people in 1990 belonged to the age group identified in 3(a)?
 $(3.28 \text{ millions of people} / 23.36 \text{ millions of people}) \times 100$ or approximately 14.0%.

4. Continue to use the population graphs and the information provided to answer the following:
 - a. In what age group in the 2000 population were people counted who were 0 – 4 years at the start of 1980?
People in the 20 – 24 years old age group in 2000 were counted in the 0 – 4 years old age group in 1980.
 - b. What percent of the people in Kenya belonged to the age group you identified in 4(a)?
(3.22 millions of people/30.61 millions of people)/30.61 millions of people or approximately 10.5% of the country's population.
 - c. In what age group in the 2010 population were people counted who were 0 – 4 years at the start of 1980?
People in the 30 – 34 years old age group in 2010 were counted in the 0 – 4 years old age group in 1980.
 - d. What percent of the people in Kenya belonged to the age group you identified in (c)?
(3.00 millions of people /40.84 millions of people) x 100 is approximately 7.3% of the country's population.
5. Summarize the change in the count and percent of the people who were 0 – 4 years old at the start of 1980 to the count and percent of people 35 – 39 years old in 2015.
The count of people 0 – 4 years old decreased in count for each of the next age groups that counted them. The decrease is primarily explained that as people grew older, they died.
6. Although a decrease in both the count and the percent of people were noted in the 0 – 4 years old age group to the 35 – 39 years old age group, there are other summaries that indicate changes in the population of Kenya from 1980 to 2015.
 - a. Complete the following table by calculating the percent of the population in the given year who were 35 – 39 years old. (The calculation for 1980 has been completed as an example. Calculate your answer to the nearest tenth of a percent.)

Year	Count in age group 35 – 39 years old (millions of people)	Count in total population (millions of people)	Percent of 35 – 39 years old in the total population
1980	0.66	16.33	4.0%
1990	1.05	23.36	4.5%
2000	1.56	30.62	5.1%
2010	2.10	40.83	5.1%
2015	2.89	45.93	6.3%

- b. Based on the above changes in this age group, and similar changes in several older age groups, describe a change in the median age of people in Kenya from 1980 to 2015.

Older age group represent more of the population in 2015 than in 1980. This greater percent indicates that although people died due to age, the percent of the people who died was less.

- c. Why was the change in the median age an encouraging summary for the population of Kenya?

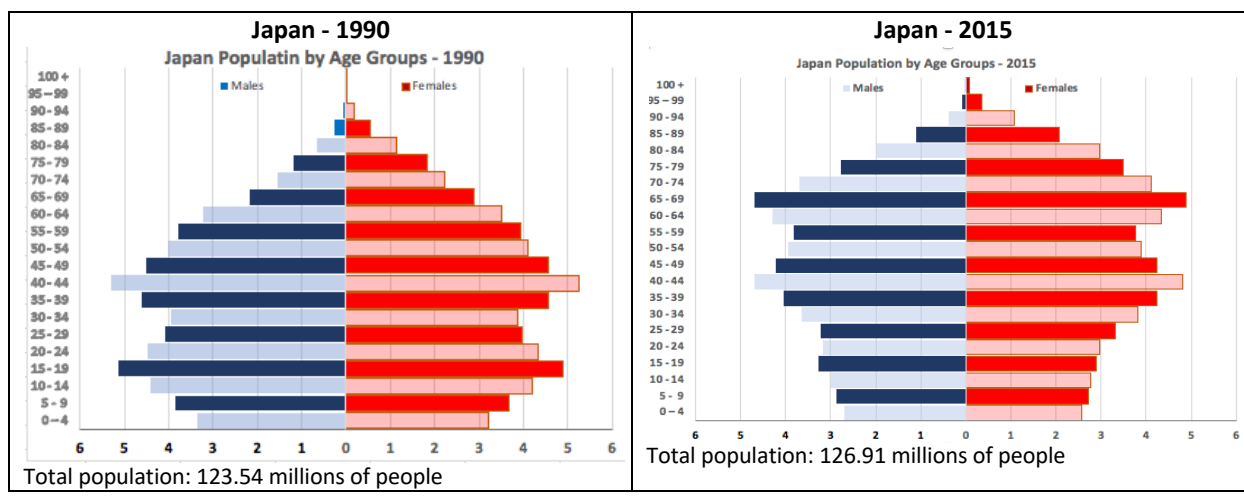
As indicated, more people were living longer and making up a greater percent of the country's population. The changes in Kenya will be picked up in Units 3 and 4 as the impact of these changes are significant.

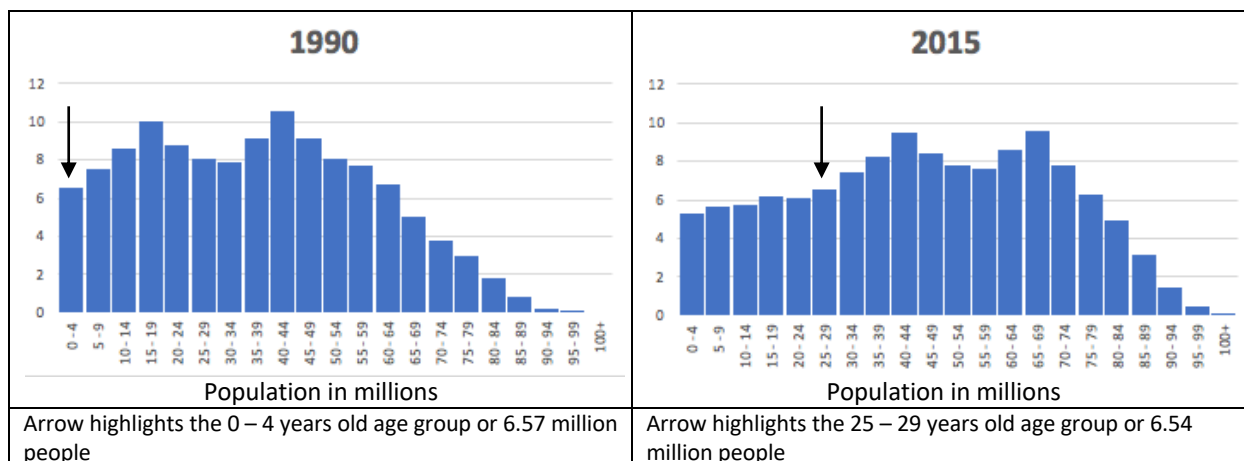
7. In what way do you think the mean ages has also changed from 1980 to 2015 in Kenya? Explain your answer.

Similar to the change in the median age, the mean age is also greater. The reasons for the change are again that more people in the older age groups are living longer, and the percent (or weight) of the older age groups is more significant in 2015. The calculation of the mean is more impacted by those changes. It is not intended, however, that students would carry out the details of estimating the mean ages as outlined in Lesson 4. A description and a discussion of the mean as a balance point is the focus of the answer to this question.

Japan

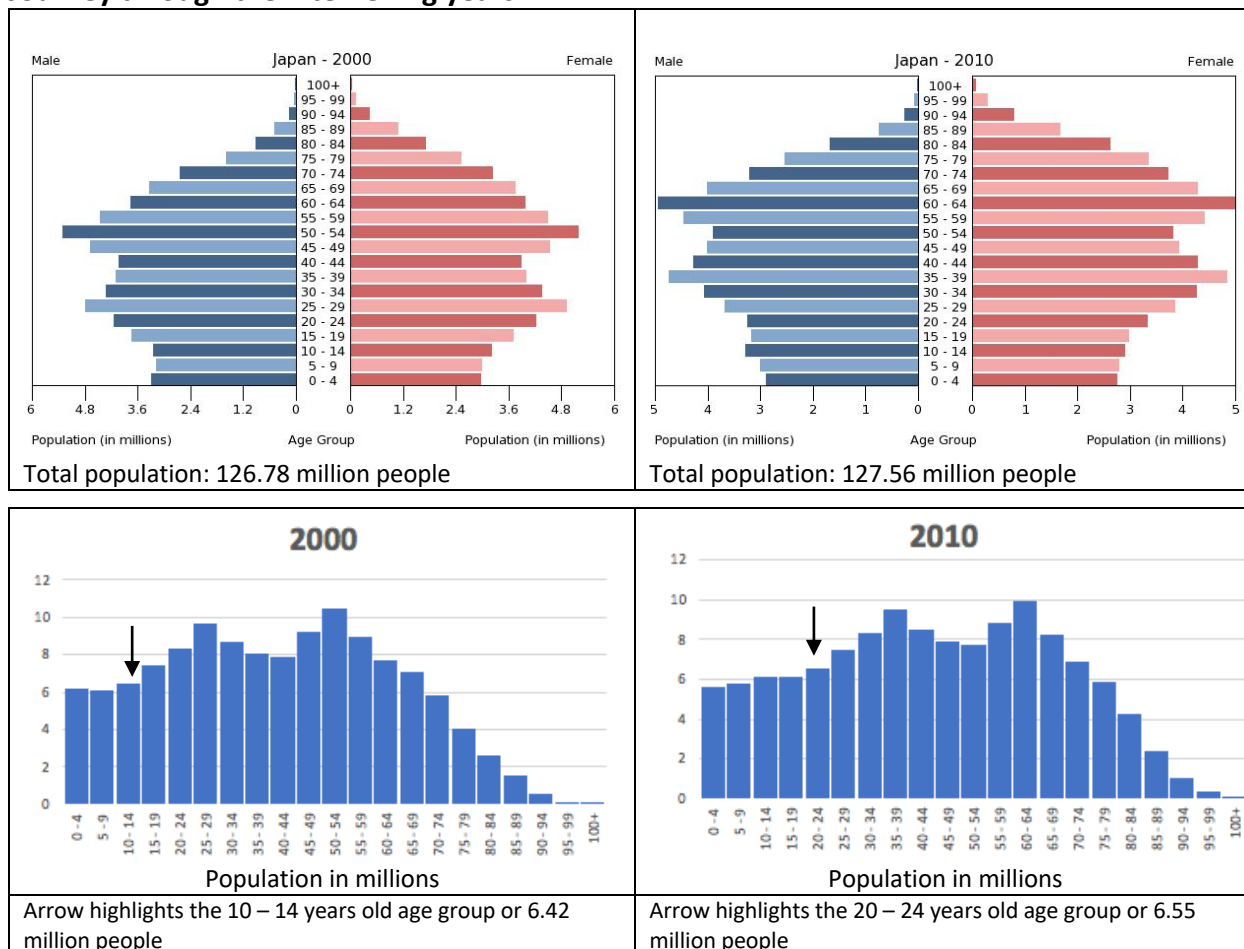
The 1980 population and the 2015 population are summarized by the following population pyramid graphs and histograms.





The population pyramid graphs and histograms of the intervening years of 2000 and 2010 are also provided. Note the changes in the shape of the population pyramid graphs and histograms.

Journey through the intervening years:



8. What do the graphs tell us about the changes in the population of Japan from 1990 to 2015? Identify at least 2 changes highlighted by the graphs.
*The graphs indicate a slight increase in the areas that indicate an increase in the population of the country **except for the 2010 to 2015 graphs**. The age groups that have the greatest count of people are also clearly aging over the time analyzed in this lesson. Students may see Japan's population similar to the summaries of the United States, specifically related to the Baby Boom and Millennial Generations.*
9. Use the 1990 and 2015 population pyramid graphs or histograms to answer the following questions.
 - a. What is the count of people 0 – 4 years old in 1990?
6.57 million people
 - b. What is the percent of people 0 – 4 years old in 1990?
 $6.57 / 123.54$ is approximately 0.053, or 5.3%.
 - c. What is the count of people 25 – 29 years old in 2015?
6.54 million people
 - d. What is the percent of people 25 – 29 years old in 2015?
 $6.54 / 126.91$ is approximately 0.052, or 5.2%.
10. Use the 2000 and 2010 population pyramid graphs or histograms to answer the following questions?
 - a. What is the count of people 10 – 14 years old in 2000?
6.42 million people
 - b. What is the percent of people 10 – 14 years old in 2000?
 $6.42 / 126.78$ is approximately 0.051, or 5.1%.
 - c. What is the count of people 20 – 24 years old in 2010?
6.55 million people
 - d. What is the percent of people 20 – 24 years old in 2010?
 $6.55 / 127.56$ is approximately 0.051, or 5.1%.
11. Based on the counts and percent derived in questions (9.) and (10.), what happened to the people and the country of Japan who were 0 – 4 years old at the start of 1990 that changed the counts and the percent from 1990 to 2015?
The counts and percent are interesting for Japan, and different than the United States and Kenya. The counts show a slight increase in the counts except from 2010 to 2015. The percent were slightly less or the same. The total population had slight increases, except from 2010 to 2015, in which the total population actually decreased. The aging of the people in Japan results in deaths that resulted in the slightly decreasing counts as people aged. The slight changes in percent, however, indicate that these changes are not major as was the case with Kenya.

12. In what way do you think the median ages changed from 1990 to 2015 in Japan?

Explain your answer.

The median ages are increasing over the time highlighted by the histograms. If students add up the age group totals to estimate the age group that captures approximately half of the population, 50% of the population is captured in the 35 – 39 years old age group for 1990, 50% is captured in the 40 – 44 years old age group for 2000 and 2010, and 50% is captured in the 45 – 49 years old age group for 2015. This increase in the median age is a major indicator of the aging population of Japan.

13. In what way do you think the mean ages changed from 1990 to 2015 in Japan? Explain your answer

The mean ages are also increasing. Again, the general shift of the balance point to the older age groups is the main focus of the change in the mean ages.

14. If you knew a person from Japan who was well aware of the history of Japan, what questions would you ask this person based on the above pyramid graphs or histograms?

Questions that would ask what happened just before and after the age groups have the greatest count of people (specifically 15 – 19 years old and 40 – 44 years old in the 1990 graphs). Are the counts connected in the same way to the Baby Boom and Millennial Generations discussed in a summary of the United States population? What events might have caused the decrease in the population in the set of histograms? What challenges are faced in this country with a growing aging population?

15. Complete the following summary table of the United States, Kenya, and Japan:

This problem represents a key summary of the work in this lesson and Lesson 6. Use students' responses as an indication of their understanding of the changes in population due to death, immigration, aging, and increased birth rates. These descriptions will be a major part of the recursive model developed in Unit 3.

Country	Explain the changes of the counts of the age groups over time that were highlighted in this lesson.	Summarize the changes in the overall population count and shape of the countries during the years highlighted in the lesson.
United States	<i>The counts of the people in the age groups cited increased over the years highlighted by the graphs that are explained by immigration.</i>	<i>The country's total population increased over the years highlighted. The increase is again primarily explained by immigration. Also, the mean and the median ages appear to increase, thus slightly changing the shape of the country to reflect an aging population.</i>
Kenya	<i>The counts of the people in the age groups cited decrease in both counts and percent. The explanation is</i>	<i>The total population of the country increases over the years highlighted. The primary explanation is the high</i>

	<i>related to the decrease counts from death. The crease in the counts and the increase in the total population of the country (growth due to high birth rates) explains the decrease in the percent of the age groups cited.</i>	<i>birth rate that impacts the count of people 0 – 4 years old. This increased count is even more important in explaining the increase in the population as the count of older age groups decrease.</i>
Japan	<i>The counts and the percent of the people in the age groups cited slightly increased over time except as Japan moved from 2010 to 2015. The decrease in the count of people from 2010 to 2015 is a major description of Japan’s aging population.</i>	<i>The population slightly increased over the time periods highlighted in the lesson, except for the time period from 2010 to 2015, where the total population of the country slightly decreased. This decrease is a major factor of the unusual population changes for Japan.</i>

Use the population totals for 2010 and 2015 as the anchor years in observing changes over time. If this module is done when the actual values of the population are known for years 2020 or beyond, consider adjusting the anchor years. Also add 2015 population estimates for the country you envisioned in Lesson 5, or My Country.
(Population expressed in millions of people.)

The following table for Kenya and Japan will be referenced in the lessons that continue analyzing the counts of Kenya, Japan, and the United States. The My Country data are provided as a follow-up for the country designed in Lesson 5. The population for 2010 and the population for 2015 will also be used in the modeling lessons that follow as an example of a top-layered country and possible changes over time a country with that shape might face. You do not have to share data the My Country data with students unless a complement to the other countries would improve the investigations.

Kenya			Japan		My Country	
Age Group	2010	2015	2010	2015	2010	2015
0 – 4	6.87	6.38	5.63	5.27	6.20	5.10
5 – 9	6.01	6.76	5.76	5.61	6.40	6.10
10 - 14	4.55	5.95	6.16	5.75	6.20	6.35
15 - 19	4.13	4.49	6.13	6.15	7.00	6.00
20 - 24	3.99	4.08	6.55	6.13	6.00	6.50
25 - 29	3.70	3.92	7.50	6.54	7.20	6.40
30 - 34	3.00	3.6	8.30	7.47	7.15	7.00
35 - 39	2.10	2.89	9.55	8.27	7.60	7.10
40 - 44	1.63	2.01	8.52	9.50	7.05	7.50
45 - 49	1.32	1.55	7.91	8.46	7.60	7.00
50 - 54	1.04	1.25	7.69	7.82	8.00	7.50
55 - 59	0.81	0.98	8.84	7.57	8.10	7.80
60 - 64	0.59	0.75	9.92	8.62	8.50	8.00
65 - 69	0.43	0.53	8.27	9.57	9.00	8.40
70 - 74	0.31	0.36	6.89	7.82	9.34	8.80
75 - 79	0.20	0.23	5.86	6.26	10.20	9.00
80 - 84	0.10	0.12	4.27	4.95	15.00	10.00
85 - 89	0.04	0.05	2.40	3.17	14.00	12.00
90 - 94	0.01	0.01	1.03	1.45	7.00	11.00
95 - 99	0.01	0.01	0.33	0.44	3.50	6.00
100+	0.00	0.01	0.05	0.09	1.50	3.00
Totals	40.84	45.93	127.56	126.91	163.34	156.55

Assessment Ideas:

Assessment Task:

Consider the following assessment task to determine a student’s understanding of the lesson.

Adeline created a country she named Awesome. She generated counts for a 2010 population distribution and a 2015 population distribution for ages 0 – 100+ years old. When estimating the mean and median ages of Awesome, she found that from 2010 to 2015 the mean age got younger but the median age stayed the same.

- a. Is the above possible, or do you think that Adeline made an error in her calculation of the mean and median ages? Explain your answer
- b. Develop sketches of a 2010 histogram and a 2015 histogram that Adeline might have developed.

Comments on the Assessment Task:

There are several possible explanations and sketches that would result in the mean age decreasing and the median age staying the same. To help students provide an explanation of their thinking, direct them to mark on their sketches the location of the median age on both the 2010 and 2015 histograms. The most straight forward explanation would be to add people in the 0 – 4 years old age group of the 2015 histogram (each new person a result of additional births). Then students would also add **the same number of people** to older age groups (counts added by immigration) but the new people would be added to the age groups in the lowest range of the upper 50% of the distribution (need to make sure that the people added result in a younger mean age). The assumption of this approach is that no one has died or left the country during that time. If students add death and immigration to the mix, then a little more adding and subtracting of people and their ages would need to be analyzed.

Additional Assessment Ideas:

Question 14 adds insights into students understanding by assessing what **questions** they would raise about the unusual shape of Japan’s pyramid graphs to someone who could answer questions about Japan’s past. What events happened to explain the large count of people in age groups 40 – 44 years old and 65 – 69 years old in the 2015 graph? Why does Japan’s population seem to be decreasing since 2010? Students who understand the objectives of this lesson will probably not be able to answer what specifically happened in the past, but they will be able to suggest ideas that would result in a decline of the population of Japan.

Question 15 provides a good indication of a student’s understanding of the lesson as its summaries the focus of this lesson and the previous lessons.