ADVANCED ENVIRONMENTAL SCIENCE

Population dynamics

Audience – Biology and environmental science students **Time required – 12 minutes**

Activity	Compare country-age structures to long-term population growth.
Science Standards	**APES: III. B.** Population biology concepts. **APES II.B.1.** Human population dynamics—historical population sizes; distribution; fertility rates; growth rates and doubling times; demographic transition; age-structure diagrams.
Learning Outcomes	• Students will predict total historical population trends from age-structure information. • Students will relate population growth to k (carrying capacity) or r (reproductive factor) selective environmental conditions.

Map URL: http://esriurl.com/enviroGeoInquiry2

Engage

What is growth rate?

→ Click the map URL link above to open the map.
→ Use the search box in the upper-right corner to find the countries listed below.
→ Click each country for growth rates. Hover over graphs to determine a doubling time.
  – New Zealand *[1% growth rate - approximately 75 years to double]*
  – Costa Rica *[2% growth rate - approximately 37 years, but it ranges]*
  – Mozambique *[3% growth rate - approximately 25 years to double]*
  – Qatar *[15% growth rate - approximately 5 years, depending on when measured]*
? What is the product of a country's growth rate and doubling time? *[The product should be close to 75.]*
? How is the doubling time determined from the growth rate? *[75 / Growth Rate = Doubling Time]*

Explore

What can a population pyramid tell you about a country's growth?

→ Click on the dark blue countries to explore their population graphs.
? What is typical of the shape of the population graph in high-growth-rate countries? *[They curve upwards, look like quarter pipes or exponential curves.]*
? How do low-growth-rate population graphs compare? *[Low-growth-rate countries are straight - upward, flat, or downward trending lines.]*
? How long would it take to double Nigeria's population? *[75/4 ~ 18 years (answers range from 15 to 30 if using graph), so it has doubled in most students' lifetime.]*

Explain

What causes such rapid growth in certain countries?

– Countries experience fast growth curves when life expectancies suddenly increase due to improvements in health services. It generally takes a generation to realize large families are not as crucial for family well-being.
→ Follow the Current link in the pop-up of a few fast-growth countries to see their population pyramid.
? What does this pyramid shape imply about the size of the reproductive class of the population? *[It is just about to take off and grow quickly.]*

more ▶

Elaborate

How are shrinking populations distributed?

→ Click Russia's population graph and compare this population pyramid to the fast-growth countries' graphs that you just examined.

? What aspect of the population pyramid hints at why the overall population is changing as the graph suggests? *[There is a diminishing number of young adults.]*

Evaluate

Is the population pyramid shape a good indicator of growth or decline?

? How do pyramid shapes relate to diminishing-growth countries? *[Diminishing-growth countries have top-heavy, V-shaped pyramids.]*

? How do pyramid shapes relate to slow-but-steady-growth countries? *[Slow-growth countries are more straight towers.]*

? How do fast-growth country pyramids compare? *[Fast-growth countries are quite wide at the base.]*

IDENTIFY A MAP FEATURE

- Click any feature on the map, and a pop-up window will open with information.
- Links and images in the window are often clickable.
- An arrow icon in the upper-right of the window indicates that multiple features have been selected. Click the arrow button to scroll through the features.

CHANGE THE DATA STYLE

- Using the Details pane, click the button, Show Contents Of Map.
- Hover over the layer name.
- Under the layer name, select the button, Change Style.
- For Choose An Attribute To Show, select an attribute to map.
- For Select A Drawing Style, select the best symbology for the data.

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to U.S. public, private, and home schools as a part of the White House ConnectED Initiative. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at http://connected.esri.com.

THEN TRY THIS...

- Using an ArcGIS Online organization subscription for schools, add the population density or the human footprint from the Living Atlas collection.
- Change symbols on the Growth Rate layer to show fertility (TFR) and life expectancies (LE).
- Explore the story map, *The Age of Humans: The Anthropocene*, at http://esriurl.com/Geo4201.

TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these texts.

- *Living In the Environment by Thomson Reuters Publishers — Chapters 8, 9*
- *Campbell Biology (9th) by Benjamin Cummings — Chapter 52*
- *Environmental Science for AP by W.H. Freeman — Chapter 7*

Version Q3b 2016. Send feedback: http://esriurl.com/GeoInquiryFeedback