

# Population dynamics

from the Esri GeoInquiries™ collection for Environmental Science

Audience – Advanced environmental science

Time required – 12 minutes

<b>Activity</b>	Compare country-age structures to long-term population growth.
<b>Science Standards</b>	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.
<b>Learning Outcomes</b>	<ul style="list-style-type: none"> <li>Students will predict total historical population trends from age-structure information.</li> <li>Students will relate population growth to k (carrying capacity) or r (reproductive factor) selective environmental conditions.</li> </ul>

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? [ $75 / \text{Growth Rate} = \text{Doubling Time}$ ]



## 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? [ $75/4 \sim 18$  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.]

## 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 public, private, and home schools. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at <http://www.esri.com/schools>.

### 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 (9<sup>th</sup>)* by Benjamin Cummings — Chapter 52
- *Environmental Science for AP* by W.H. Freeman — Chapter 7