

# Populations

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# Population

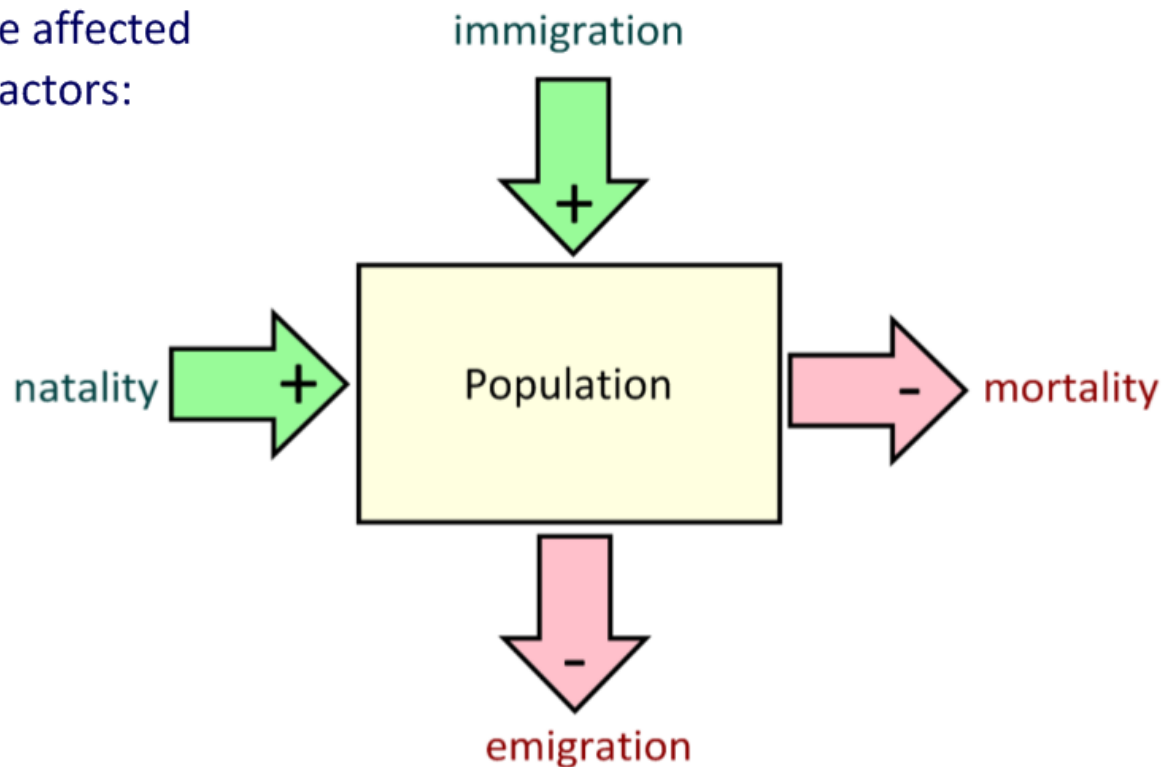
the total number of individuals of a species in a given area

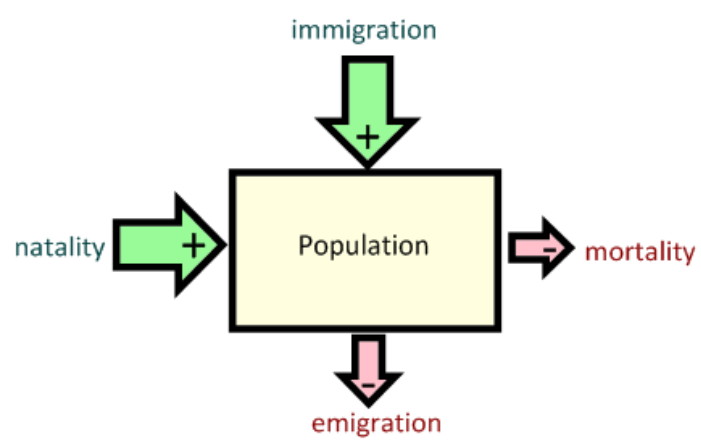
## Why study populations?

- Monitoring endangered species
- Monitoring environmental health
- Monitoring change in an area over time
- Making sensible policy decisions
- Estimating demand for natural resources

The driving force behind anthropogenic environmental damage is the **increasing demand** placed on the environment by the **growing human population**.

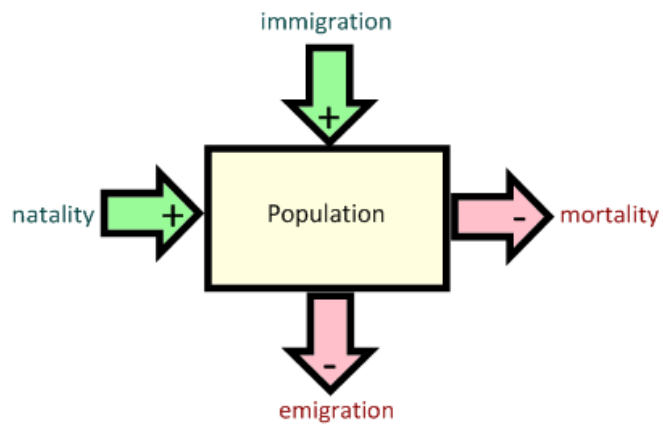
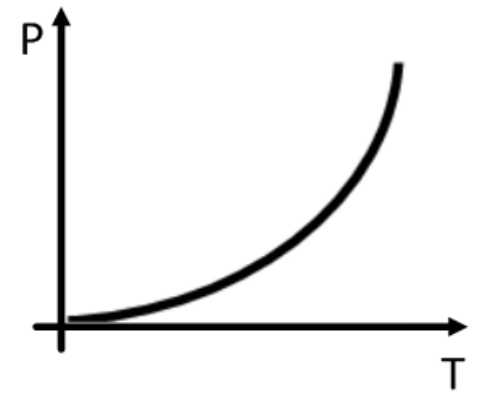
Populations are affected by four main factors:





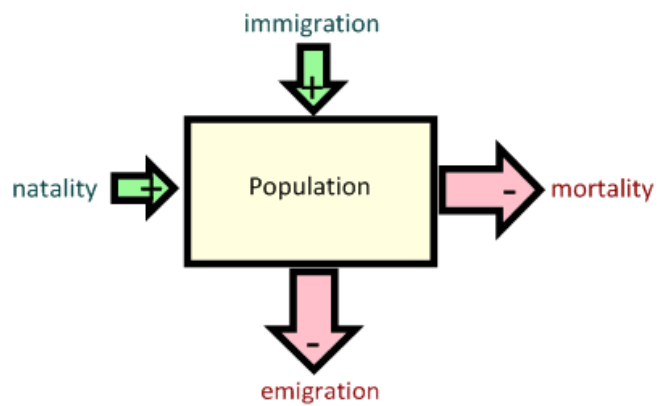
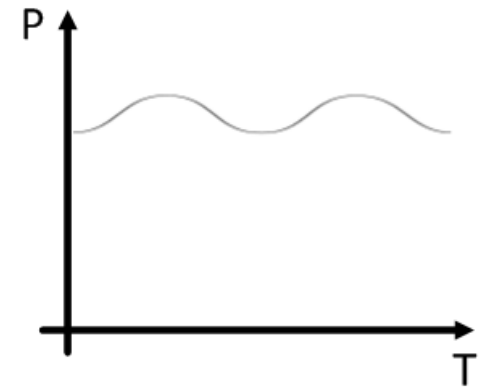
Population Growth:

$$I + N > E + M$$



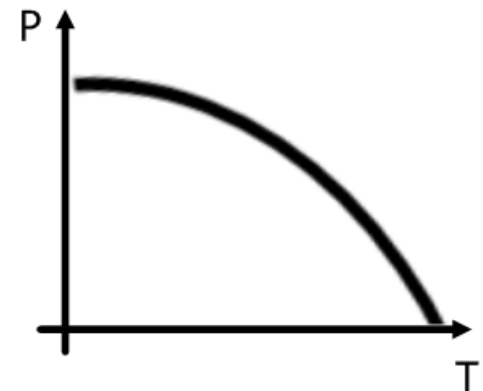
Population Stability:

$$I + N = E + M$$



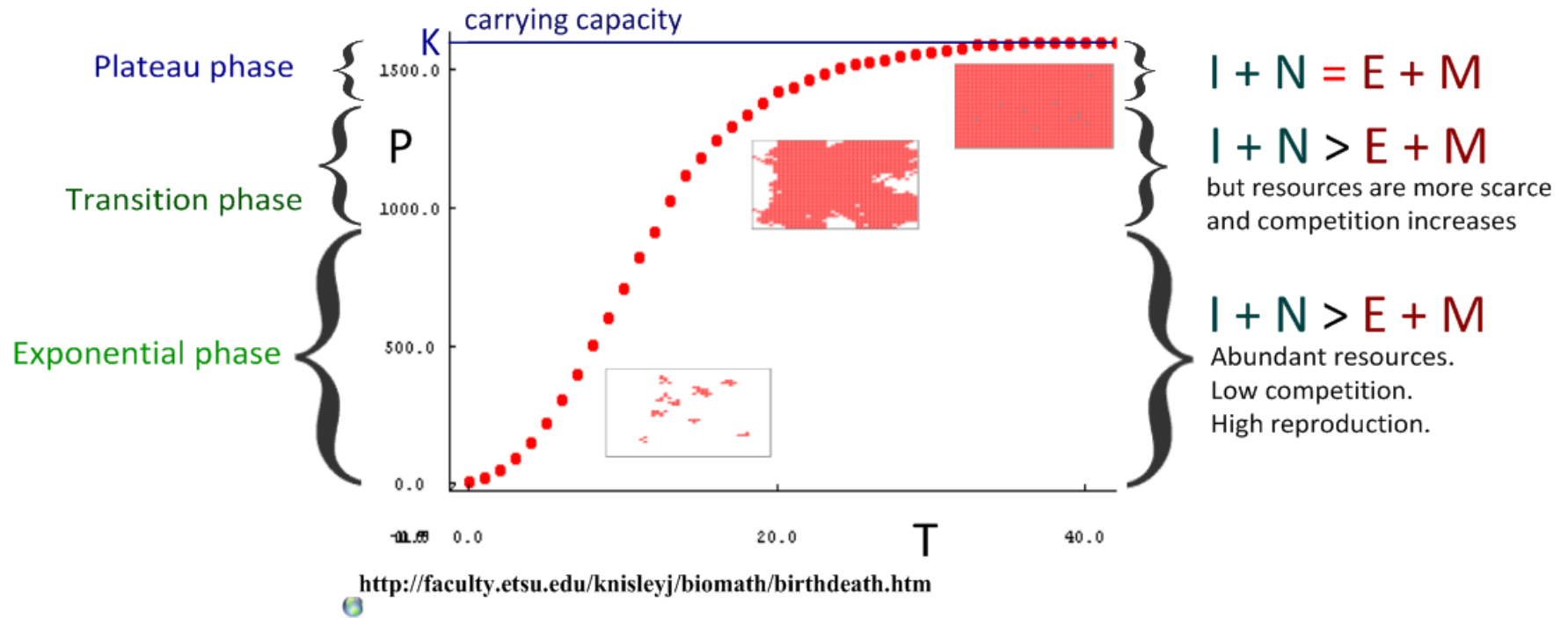
Population Decline:

$$I + N < E + M$$



# Population growth follows a sigmoidal curve:

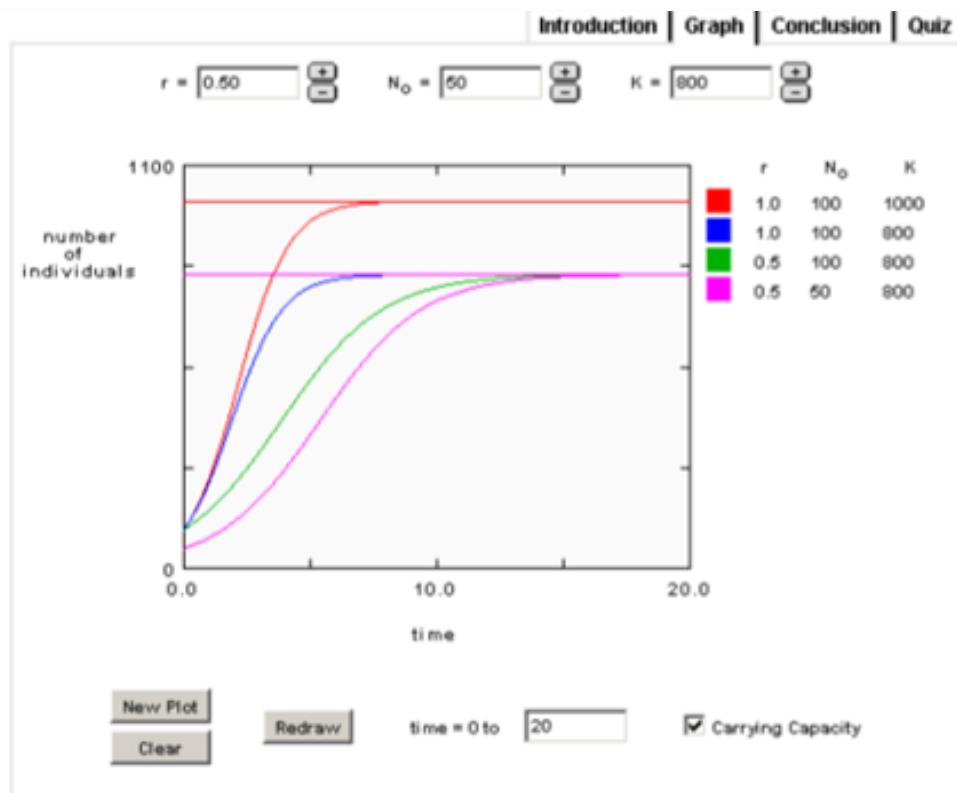
Population growth follows three stages: Exponential, Transition, Plateau



In the exponential phase, rate of **population growth is rapid** as **resources are abundant** and **competition and mortality are low**. As resources become more scarce, competition and mortality increase. The rate of growth slows, though the population continues to grow - the transition phase. When a population reaches its **carrying capacity (K)**, the **population remains stable** as resources are scarce and competition is high: plateau phase.

# What factors affect the rate of growth of a population?

Use the tutorial to manipulate the variables associated with population growth and plot the curves. Can you explain the differences?



$K$  = carrying capacity of environment

$r$  = rate of reproduction

$N_0$  = starting population

Higher  $K$  = higher population

Higher  $r$  = more rapid growth

Higher  $N_0$  = less space for growth  
(reaches  $K$  more quickly)

<http://bcs.whfreeman.com/thelifewire/content/chp54/5402002.html>

Higher level students read ahead:

What is the difference between a **r-strategist** and an **K-strategist** in terms of *reproductive strategies*?

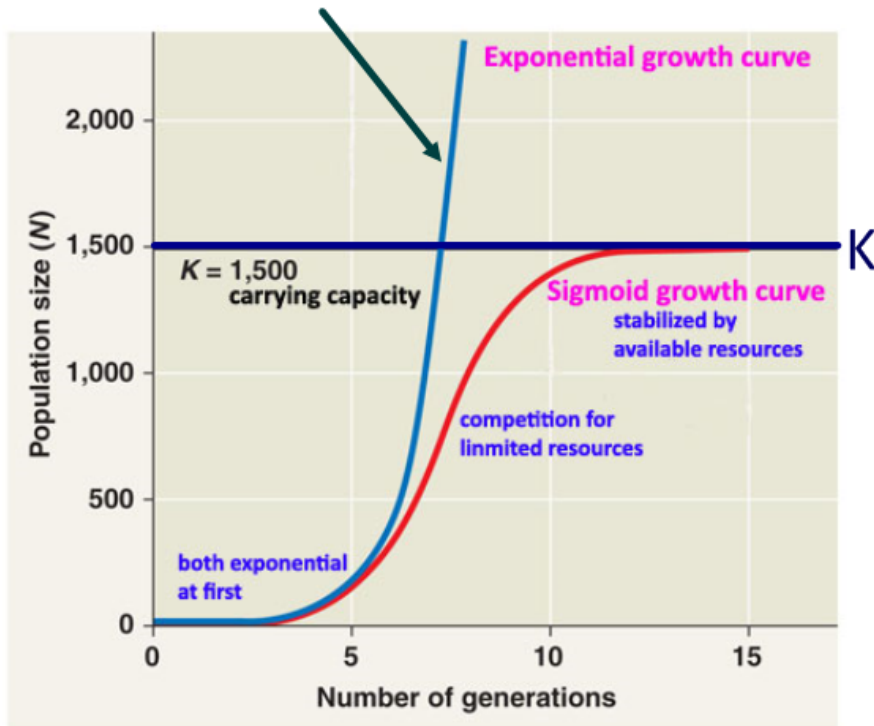
(Topic G5: Population Ecology)

# Which factors limit the population growth of a species?

All environments have a finite carrying capacity ( $K$ ).

Beyond this limit, the population can no longer increase overall:  $I + N = E + M$

growth without limitation



Limiting factors that contribute to  $K$ :

- food & water availability
- space for territories & nesting
- availability of mates
- disease
- predation
- environmental change

<http://www.bio.miami.edu/~cmallery/150/handouts/c8.53x12.sigmoid.jpg>



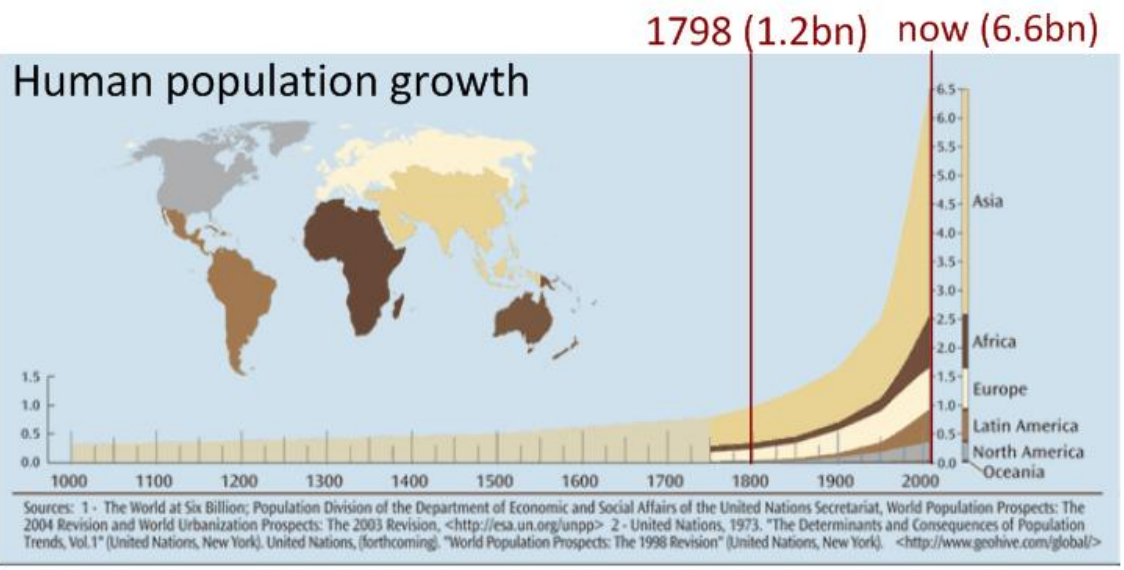
# Malthus predicted the human population disaster:

"The power of population is so superior to the power of the earth to produce subsistence for man, that premature death must in some shape or other visit the human race. The vices of mankind are active and able ministers of depopulation. They are the precursors in the great army of destruction, and often finish the dreadful work themselves. But should they fail in this war of extermination, sickly seasons, epidemics, pestilence, and plague advance in terrific array, and sweep off their thousands and tens of thousands. Should success be still incomplete, gigantic inevitable famine stalks in the rear, and with one mighty blow levels the population with the food of the world."



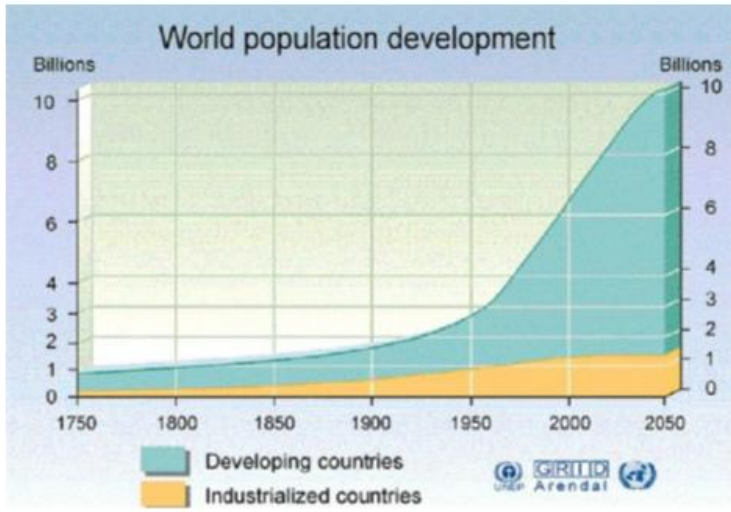
[http://en.wikipedia.org/wiki/Thomas\\_Robert\\_Malthus](http://en.wikipedia.org/wiki/Thomas_Robert_Malthus)

From Thomas Malthus's 1798  
"An Essay on the Principles of Population"



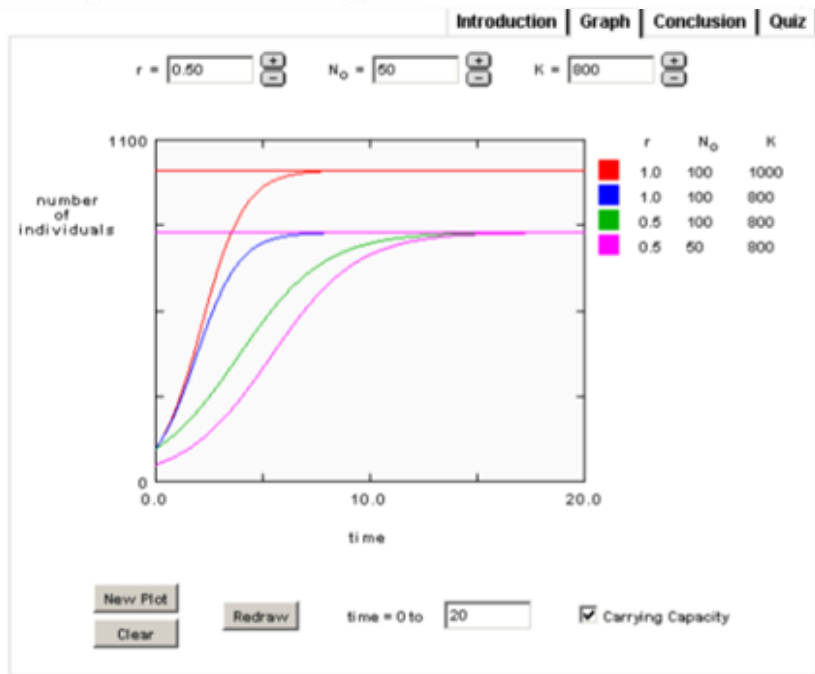
Sources: 1 - The World at Six Billion; Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2004 Revision and World Urbanization Prospects: The 2003 Revision, <<http://esa.un.org/unpp>> 2 - United Nations, 1973, "The Determinants and Consequences of Population Trends, Vol. 1" (United Nations, New York), United Nations, (forthcoming), "World Population Prospects: The 1998 Revision" (United Nations, New York), <<http://www.geohive.com/global/>>

<http://blogs.mcgill.ca/circumference/2009/09/28/population-shrinkage/>



<http://www.sustainableScale.org/AreasofConcern/Population/PopulationandScale/QuickFacts.aspx>

# Population growth tutorials:



<http://bes.whfreeman.com/thelifewire/content/chp54/5402002.html>

*the big picture*

## 39 POPULATION ECOLOGY

Describing a Population  
How Populations Grow  
Life Histories  
Human Populations

*the big picture*

Pause Animation    Replay Segment    Reset Animation

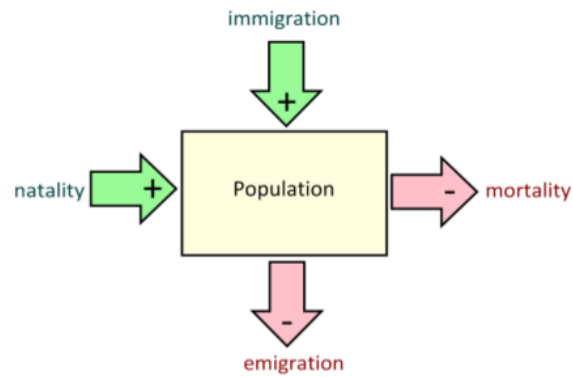
(Click to View Caption)

[http://www.wadsworthmedia.com/biology/0495119814\\_starr/big\\_picture/ch39\\_bp.html](http://www.wadsworthmedia.com/biology/0495119814_starr/big_picture/ch39_bp.html)

[http://webhelp.esri.com/arcgisdesktop/9.2/dhtml/Population\\_change\\_over\\_time.htm?CFID=20801198&CFTOKEN=20090335&jsessionid=b330dd515c6511194319](http://webhelp.esri.com/arcgisdesktop/9.2/dhtml/Population_change_over_time.htm?CFID=20801198&CFTOKEN=20090335&jsessionid=b330dd515c6511194319)







For more IB Biology resources:

<http://sciencevideos.wordpress.com>