

Slowing malaria

from the Esri GeoInquiries™ collection for Environmental Science

Audience – Advanced environmental science

Time required – 15 minutes

Activity	Investigate the causes of disease and ways to control malaria.
Science Standards	APES: IIIB.3. Impacts of Population Growth: disease APES: VIB.1. Hazards to Human Health: environmental risk analysis NGSS HS-Life Science 4-4. Biological Evolution: Unity and Diversity; construct an explanation based on evidence for how natural selection leads to adaptation of populations.
Learning Outcomes	<ul style="list-style-type: none">• Students will investigate the spatial patterns of malaria risks.• Students will analyze environmental factors related to malaria control in Africa.

Map URL: <http://esriurl.com/enviroGeoInquiry3>



Engage

Who is at risk for malaria?

- Click the map URL link above to open the map.
- Shaded regions show where over 41 species of mosquitoes can survive and spread malaria.
- ? What countries or regions have environments that will not support the Anopheles mosquito?
[Canada, the lower half of South America, parts of the United States such as Alaska, and some of Russia]
- Over 3.2 billion people live in areas where these mosquitoes could survive.
- ? With over 7.1 billion people on the earth, what percentage of the world is at risk? *[45%]*



Explore

Where is the highest risk for death by malaria?

- On the Details pane, click the button, Show Contents Of Map.
- Clear the checkbox for the layer, Dominant Mosquito Vector Worldwide.
- Click the checkbox for the layer, P. falciparum Distribution.
- Plasmodium falciparum is the most deadly parasite that causes malaria.
- ? What environmental factors enable this parasite to survive in this region? *[30°S to 30°N; warm ambient temperatures and adequate rainfall]*
- ? Which region has the highest endemicity (disease intensity)? *[Sub-Saharan Africa]*
- Zoom in to Kenya.
- ? Why are some areas malaria-free (gray)? *[Higher altitudes prevent mosquito and plasmodium survival.]*



Explain

What progress has been made to reduce malaria in Africa?

- Turn off the map layer, P. falciparum Distribution.
- Click the checkbox to the left of the layer name, Endemic African Countries.
- Zoom out to view Africa. Turn on and off the Endemic African Countries layers for years 2000 & 2015.
- ? What progress was made from 2000 to 2015? Use the legend to better understand the map symbology. *[Malaria incidents have decreased significantly by 40 percent.]*
- ? Brainstorm about the ecology of anopheles mosquitoes. What are some possible controls? *[Pesticides, like DDT; personal sprays, like DEET; and insecticide-treated bed nets (ITNs)]*
- The use of ITNs is the most important factor in children. With layers on, Endemic Africa: P. falc. Incidence for 2000 or 2015, click several countries to compare the relationship between use and malaria decrease.

Elaborate

What other factors affect malaria?

- ? How will climate change affect endemicity? [*Higher altitudes will be vulnerable; some areas may become too dry for malaria; and an increase extent of anopheles mosquito distribution may occur.*]
- Turn off the Endemic Africa layer and turn on the Sickle Cell layer.
- Pan the countries and brainstorm about why the sickle cell allele persists in certain regions. [*Increased malarial resistance*]

Evaluate

Does endemicity affect the control of malaria?

- Turn off the layer, Sickle Cell.
- Turn on and off the layers, Endemic Africa: P. falc.incidence (2000 and 2015).
- Using the search field above the map, search for the country Ghana. (The map will zoom to it.)
- ? Click the country; what is the percent of change in incidence from 2000 to 2015. [*A 42% decrease*]
- Models predict that countries with an endemicity (sustained without external sources of infection) of less than 40% can control malaria with extensive use of ITNs.
- Click several countries to predict whether they will need additional control measures.

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 button to scroll through the features.

USE THE TIME SLIDER

- A time-enabled map layer must be visible.
- Click the lower slider button and stretch it to the end time period that you wish to view.
- Click the Play button (right arrow).

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...

- In an ArcGIS Online organizational subscription for schools, use the Hot Spot Analysis function to identify statistically significant relationships among countries by ITN use and malaria incidence reduction in children aged 2 to 10 years old.
- Explore the USAID Deliver Project's anti-malaria supply chain story map at <http://esriurl.com/Geo4191>.

TEXT REFERENCES

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

- *Environmental Science for AP* by W.H. Freeman and Company/BFW — Chapter 17
- *Living in the Environment (16th)* by Brooks/Cole, Cengage Learning — Chapter 17
- *Campbell Biology (9th)* by Benjamin Cummings — Chapter 23