Teacher Notes

Malaria in Africa

Adapted from ARGWorld Activity O – Association of American Geographers

Overview

Students match a map that shows the geographic extent of malaria with maps of the geographic ranges of several insects and arachnids. These map comparisons allow students to make generalizations about relationships between features and to reject some otherwise plausible hypotheses about causes and effects.

Learner outcomes, standards, and curricular links

After doing this Activity, a student should be able to:

1) compare maps, make generalizations about the similarity of patterns, and identify areas that are exceptions to the generalization (Standard 4: physical and human characteristics of places; Standard 5: creating regions to simplify and thus help interpret the earth's complexity)

2) explain relationships between environment, malaria, sickle-cell trait, and human population (Standard 9: characteristics, distribution, and migration of human population; Standard 8: characteristics and spatial distribution of ecosystems)

3) optional: construct an isoline map from a set of point observations (Standard 1: how to use maps and other graphic representations);

This Activity can fit a geography unit on population or environment in Africa, a unit on African history, or an economics unit on regional differences.

Resources

Time: 10-40 minutes, depending on whether the students just do the worksheet or view multimedia units

CD units on Malaria, Isoline Maps (how to make them), Seasonal Precipitation (reason for rainy and dry seasons), Regions in Africa, and perhaps Subsistence Farming, Seasonal Grazing, and Urban Gardens (images and descriptions of life in different environments).

Classroom procedures

1) Ask questions about malaria, mosquitoes, sickle-cell trait, or map patterns.

2) Optional, if students need a review: have students read about isoline maps (or study the CD unit on Isoline Maps) and finish the optional Response Sheet O3 on Isoline Maps.

3) Have students do the Response Sheets

Setting up the activity

Distribute and have students read the background on malaria, and/or show Part 1 of the CD unit on malaria. Do Response Sheet 1, and/or continue the CD unit until the "cause" of malaria has been identified. Then ask both of these questions, in whatever order seems appropriate:

? Where are mosquitoes the biggest problem? Answers may vary, depending on what scale they happen to think of first - continents, states or neighborhoods or parts of a backyard. Direct the discussion so that it includes at least a passing reference to each scale of observation.

? When are mosquitoes the biggest problem? Again, answers may vary, with some people thinking about seasonal differences and others thinking about weekly weather patterns or time of day. Again, direct discussion so that students are aware of the importance of different time scales.

Alternative introductions

Ask students if they have heard of a genetic disorder called sickle-cell trait. If so, have them describe the condition and some consequences. Tell them scientists think this disease might have been good for a human population. If they express surprise at this possibility, say that this Activity will examine some maps that led scientists to decide that sickle-cell trait might have been helpful for people in some parts of the world. But to understand why, we have to see what causes malaria.

Evaluation

1 – C, E, F The map patterns of these organisms do not match malaria.
2 – B
It is important to emphasize that these comparisons cannot be definitive. All of these organisms do cause disease, and malaria is transmitted by several different kinds of mosquitoes. The map comparisons range from likely, possible, not likely, and impossible.

Concluding the activity

1) Isolines and regions are simply conventional ways of organizing a lot of point observations into a graphic display that can make the general geographic pattern easier to see.

2) Map comparison is a powerful tool, but it has limitations. It can help us reject some otherwise plausible hypotheses about the relationship between features. But it cannot prove that a given hypothesis is true – other scientific tests are always needed to confirm relationships that a map comparison might suggest as possibly true.

Extension and enrichment

Students could look at malaria on other continents, to see if the relationships that they observed in Africa also apply in other parts of the world. (Do an image search with keywords "malaria map."

Students could examine the map patterns of other diseases, to see if there are environmental conditions that may limit the occurrence of the diseases. Enter the name of a disease, the word "map," and either the Centers for Disease Control or the World Health Organization into an Internet search engine.

Students could role-play one of the knottier issues in geography: should people be required to report their home addresses when they are diagnosed with particular diseases, or is that an infringement on the right to privacy? This issue becomes acute when the disease is highly communicable and/or difficult to cure, such as drug-resistant tuberculosis. And how about genetic conditions such as sickle-cell?

Frequently asked questions

On the CD, they turned a dot map of malaria observations into an area map by just drawing lines around the dots and shading the area in with a color. How did they know where to draw the line?

They really didn't – they just made a reasonable assumption that the places in between the dots might also have malaria, except it just wasn't recorded during the survey. This is a standard way of turning point observations into a map that shows the geographic range of something. The CD unit on Regions in Africa has an animated explanation of this process, and it also provides useful background about the continent.

Do they use this technique for other diseases?

All the time! At the Centers for Disease Control and other labs, one of the first steps in any epidemiological investigation of a new outbreak of disease is to plot the occurrences of the disease on a map in order to see if the geographic pattern might be related to anything else – nighttime temperature, for example, or population density, age of buildings, air pollution, proximity to a landfill, whatever.

Why is malaria still such a problem if scientists have known about the cause for such a long time?

One reason is that there are a number of strains of the disease and a number of different mosquito species that can transmit it, and all of them have different ranges, environmental preferences, and life cycles. Moreover, the malaria "germ" has the ability to develop resistance to new drugs within a few years, especially in poor regions where people often fail to finish the full course of a drug treatment. There are several good web sites that you can consult for up-to-date information.

Is there any hope?

Yes – because of its economic and social importance, the malaria organism was one of the first to have its entire genome (genetic code) mapped, and this information might provide new ideas for treatment and even a preventive vaccine.

Student doing the isoline-map activity 4U: I got my line to go between the 57 and the 61 on the isoline map here, but then I don't see where it should go.

(Mistaken response: "Well, you probably should go here between the 57 and the 72." That answer just postpones the dilemma that led to the question in the first place, which is how to make a line end properly.)

Redirection: Well, how did the line start?

Student: They just started it at the coast.

Teacher: Right. So it could end somewhere else on the coast. Let's look along the coast to see if there is any other place where a 60-line would reach the ocean. In fact, there may be several places where that would happen, because there may be several 60-lines on the map.

Student: Somewhere around here (pointing to a West Africa) ?

Teacher: OK! Now, a 60-line line can't go to the coast between the 72 and the 99, so where should it go?

Malaria in Africa
Glossary of key terms

anopheles mosquito: a type of mosquito that is largely responsible for the transmission of malaria (as well as some other diseases)

area map: a map that shows the area or extent of something

carrier: a person who "carries" a disease or condition; it is possible to be a carrier of a disease and not experience any of its symptoms

chronic: a term that refers to diseases whose symptoms last months or years

disease strain: a "version" of a disease; when a medicine is in widespread use, often resistant strains develop

epidemiology: the study of human disease and how it is passed

hypothesis: an educated guess about a scientific fact; often causal relationships are hypothesized, that is, it is common to make a hypothesis that one thing causes another

immunity (*adj., immune*): a condition of not being susceptible to a disease; people who have the sickle-cell trait may be partially immune to malaria, even if they are bitten by an infected mosquito

isoline map: a map with lines that connect points of equal value (see CD unit on Isoline Maps)

latitude: distance north or south of the Equator, defined by the angle from the equator (see the CD unit on Solar Energy)

malaria: a blood-borne disease that is passed through mosquitoes; malaria literally means "bad air" because when the disease was first recognized the disease it seemed to happen to people in swampy areas with "bad air"

map vocabulary: the "language of maps"; the tools that a mapmaker uses to communicate information in a map, such as lines, symbols, color, and area (see the CD unit on Choosing Map Symbols)

point symbol: circle, square or other small diagram or picture that represents something at specified point on a map (see the CD unit on Megacities)

population density: a measure of how crowded an area is; population density is calculated by dividing the population of a place by its area (see the CD unit on Urban Gardens)

range: when referring to animals, the range is the area over which that animal lives

recurrence: the return of the symptoms of a disease; often a recurrence produces symptoms that are worse than the initial symptoms

resistance: what happens when a disease evolves to resist to medication; when a disease become resistant, medicine is not as effective as it once was

sickle-cell trait: a genetic trait that results in blood cells that do not hold their form; people with sickle-cell are easily fatigued and often experience serious health problems; the trait is most common in African populations and people descended from Africans.

stagnant water: water that is still, unmoving