



## **PROBLEM SOLVING ACTIVITY: CLIMATE CHANGE AND DISEASE**

### **ACTIVITY #1: UNDER THE WEATHER**

**OBJECTIVES:** Students will:

- Compute and analyze data regarding the possible growth of infectious diseases as a result of global warming.
- Design information sheets on various vector-borne diseases for public use.

**MATERIALS:** Paper/pencil/pen, colored pencils, calculator and blank world map and/or access to a computer;

**PROCEDURE:**

1. Read over the **BACKGROUND INFORMATION** and the following hypothetical invitation with the students and discuss in detail.
2. Explain to students that they will be relying upon this information as well as the information in the **DATA TABLE: INCIDENCE AND LOCATIONS OF INFECTIOUS DISEASES (1994-2050)**, to complete their task.

**TASK:** You have been hired as an educational consultant for the **World Health Organization (WHO)**, a branch of the United Nations. Your job is to produce a map and a small pamphlet about one of the diseases listed below. This pamphlet will be used by UN volunteers to educate people in developing nations about the threat of these diseases and what they can do to protect themselves. Be sure to include the following information:

- Organism that causes the disease
- Method of infection
- Symptoms
- Treatment
- Preventative measures

## Teacher Sheet 2

1. You may choose to report on any one of the diseases listed below:

- ✓ Malaria
- ✓ Schistosomiasis
- ✓ Guinea worm
- ✓ River blindness
- ✓ Sleeping sickness
- ✓ Filariasis
- ✓ Equine encephalitis
- ✓ Dengue fever
- ✓ Yellow fever
- ✓ Typhus
- ✓ Lyme disease or Rocky Mountain Spotted Fever



2. Pamphlets should be made from a single sheet of 8.5 x 11 (standard letter size) paper or light cardboard and folded in three sections horizontally.

- ✓ The name of the disease and a map showing the geographic location of the disease should appear on the front cover.
- ✓ Any references used to research information should be noted on the last page.

3. Students will also create a map indicating the present ranges of the 10 diseases listed in the data table.

- ✓ Create a code for each disease (either a color or symbol).
- ✓ Include a key on the map explaining the code.

4. Compute the numbers for columns 7 and 8 on the data table using a calculator.

- ✓ Use the following formulas:

**Column 7:**  $\text{New cases each year} \times \% \text{ increase} = \text{New cases yearly in 2050}$

**Column 8:**  $\text{Population at risk} \times \% \text{ increase} = \text{Population at risk in 2050}$

5. Transcribe the new data onto the **DATA TABLE**.

6. Respond to the related questions in the **ANALYSIS** section.



## ACTIVITY 2: THE PESTS HAVE IT!

### OBJECTIVES: Students will:

1. Explain how vector-borne diseases are transmitted;
2. Describe how climate affects the life cycle of vectors;
3. Explore how social factors affect the incidence and spread of disease.
4. Create a map indicating the present ranges of the diseases listed on the data table.

### MATERIALS

- Access to the Internet, or school and public library for research.
- Maps of disease distribution (See [Suggested Resources](#).)

### PROCEDURE:

#### PART I: COMPARING

1. Have students look over maps of the present-day distribution of malaria in order to characterize the countries where malaria occurs.
  - ✓ They should especially consider the climate of the country, such as average annual temperatures, average nighttime (low) temperatures, and precipitation, and whether it is a developing or developed nation.
2. Ask students to write a short essay comparing countries with malaria to those without malaria, and suggesting possible reasons for the differences between the groups.
3. Write the names of different vector-borne diseases, along with the name of the vector, onto 3 x 5 index cards (see list of diseases below).

## Teacher Sheet 4

4. Group students into pairs and have each pair pull an index card out of a box.
    - One student in the pair should do some research to find out how the disease spreads from one human to another.
    - The other student in the pair should research the life cycle of the vector.
  5. Have students create a poster or diorama that illustrates the relationships between the host, parasite, and vector, and how the disease can be transmitted from one human to another. The students should present their findings orally to the class.
  6. Bring the class together as a group and ask them to use what they have learned from the oral presentations to brainstorm about how climate might influence the spread of the diseases discussed. Guide the discussion by having students consider the question from three perspectives:
    - a. How does climate impact the vector directly?
    - b. How does climate impact the vector's (or go-between host's) habitat?
    - c. How does climate impact the parasite?
- \*\*NOTE:[Students should consider the role of climatic factors such as temperature, rainfall/snow, presence of surface water, humidity, wind, soil moisture, and frequency of storms or droughts.]**
7. Record ideas at the front of the room, and provide a summary sheet for the students to use as references.
  8. Divide students into new groups of four to explore the impact on climate on vectors in more detail.
    - Assign each group a specific vector: tick, rodent, mosquito, snail, bird.
    - Ask the students to fill out a chart highlighting how projected climate changes due to an enhanced greenhouse effect might impact their vector.

**\*\*[Note: This can be done as an in-class group activity, with students drawing on the ideas and examples from the previous exercises. Students can also research the vector in more depth individually as a take-home assignment, and then complete the chart as a group during the next class period.]**

**\*\*[Note: If interested, students can research climate changes for their region of the country by reading the U.S. National Assessment Reports at:**

<http://www.usgcrp.gov/usgcrp/nacc/default.htm>

**\*\*[Note: Students may not be able to fill in all of the spaces in their chart for their vector, but they should try to fill in as many as possible.]**

9. Student will now write a reflective essay in which they comment on the group's predictions of the potential effects of climate change on the spread of the disease. Questions to consider include:

- How easy/difficult was it to evaluate the impacts on the vector and vector habitat?
- How easy/difficult was it to evaluate the impacts on disease transmission?
- What, if anything, made the evaluation difficult?
- How accurate does the group think their predictions are?
- What additional information would the group like to have to complete the chart?

**\*\*[Note: If possible, the teacher should follow up this activity with a discussion on the use of models to predict the impact of climate change on disease. A color map showing model projections of changes in malaria distribution with a warming climate can be found in the August 2000 *Scientific American* article at:**

## SUGGESTED RESOURCES

### MALARIA MAPS:

- The Center for Disease Control's "Yellow Book," entitled *Health Information for International Travel, 1999-2000*, can be downloaded for free at <http://www.cdc.gov/travel/reference.htm>. This resource includes a section on malaria and a map showing countries in which malaria is endemic. A separate listing at the front of the book shows disease risk for specific countries.
- A world map showing countries in which malaria is endemic can also be found at the Malaria Database, "Introduction" section at:  
<http://www.wehi.edu.au/MalDB-www/intro.html>

### GENERAL INFORMATION ON VECTOR-BORNE DISEASES:

- **Division of Vector-Borne Infectious Diseases, Centers for Disease Control and Prevention at:**  
<http://www.cdc.gov/ncidod/dvbid/index.html>  
This site provides fact sheets, images, and world maps showing the distribution of several types of vector-borne diseases. It is a good resource for student research.
- **Malaria Foundation International:** <http://www.malaria.org/> This site provides basic information about malaria, including answers to frequently asked questions, a comprehensive glossary of terms, and links to other sites with information about malaria.
- **West Nile Virus Information:**  
<http://www.globalchange.org/impactal/westnile.html>

### VECTOR LIFE CYCLES:

- **"What's All the Buzz about Mosquitoes?"**  
<http://www.nysipm.cornell.edu/publications/mosquitobro/index.html>
- **Mosquito Bytes:** <http://whyfiles.org/016skeeter/index.html>
- **Climate Change and Human Health:** Epstein, P.R., 2000. Is global warming harmful to health? *Scientific American* (August 2000):  
<http://www.sciam.com/2000/0800issue/0800epstein.htm>