



STEP 4 - Use the following resources to answer the focus questions below. You may designate a team member to become an expert on type of disease, but you should come together and share information to produce your final project. Remember, you are responsible for all three diseases.

### **A parasite - Malaria**

Center for Disease Control and Prevention

<http://www.cdc.gov/malaria/biology/humanhost/>

Leiden University Medical Center - Background Info. About Malaria

<http://www.lumc.nl/1040/research/malaria/back.html>

Malaria and People

[http://www.wellcome.ac.uk/en/malaria/MalariaAndPeople/hb\\_imms1.html](http://www.wellcome.ac.uk/en/malaria/MalariaAndPeople/hb_imms1.html)

### **A virus - HIV**

University of Wisconsin Chemistry -HIV & AIDS

<http://www.chem.wisc.edu/~newtrad/CurrRef/AIDStopic/AIDStext/AIDSIntro.html>

The Biology Project

<http://www.biology.arizona.edu/immunology/tutorials/AIDS/HIVimmune.html>

MCB/HHMI Outreach Lectures - Dr. Lue's Lecture on AIDS

<http://outreach.mcb.harvard.edu>

### **A bacteria - Tuberculosis**

Directors of Health Promotion and Education Infectious Facts - Tuberculosis

<http://www.astdhppe.org/infect/tb.html>

University of Wisconsin - Tuberculosis

<http://www.bact.wisc.edu/Bact330/lecturetuberculosis>

FOCUS QUESTIONS - ANSWER SECTIONS A -D FOR HIV, MALARIA , AND TUBERCULOSIS. THEN ANSWER QUESTIONS SPECIFIC TO EACH PATHOGEN.

A. Characterizing the Invader

A1. What is the common name of your disease?

A2. What is the common name of the pathogen that causes this disease?  
What is the scientific name?

A3. What kinds of symptoms are associated with your disease?

B. Epidemiology (Include a graph, chart, or map)

B1. Who is at risk for this disease? Age? Ethnicity? Geographic region?  
Other factors such as genetic predisposition?

B2. Is this disease a current threat or a historical problem?

B3. How many people are affected by this disease annually?

C. Treatment

C1. What is the difference between treatments that affect the function of the pathogen chemically (traditional drugs) and vaccines that help the body fight the pathogen by bolstering the immune response?

C2. What current approaches are being used to combat the spread of this disease? (Drugs? Vaccine? Antiserum?)

C3. What are the risks associated with this treatment?

C4. What are problems associated with the treatment?

## D. Cellular and Molecular Mechanisms

D1. How is the disease transmitted? Where/how does it enter and exit the human body? (Is this connected to the lifecycle of the microbe?)

D2. What kind of host cells (i.e. erythrocytes, liver cells) are targeted by the pathogen?

D3. How does the pathogen proliferate within the human host?

D4. Discuss a cellular mechanism/function that is affected by the pathogen.

D5. Discuss at least one protein that is connected with the pathogen. Try to choose a protein that is or may be the target of treatment.

E. HIV Questions - Create a concept map [\[www.graphic.org/concept.html\]](http://www.graphic.org/concept.html) to show how different cells are involved with HIV -- Which are infected? Which respond?

E1. What are some of the difficulties that scientists face in making a vaccine to combat HIV?

E2. What is the first step in the life cycle of the HIV virus and how can this step be prevented or deterred?

E3. What viral mechanisms can be destroyed without subsequently destroying the host cells mechanisms?

E4. Name and briefly describe the current drugs that target reverse transcriptase. How do these drugs work?

F. Malaria Questions - Create a concept map [\[www.graphic.org/concept.html\]](http://www.graphic.org/concept.html) to show how different cells are involved with Malaria-- Which are infected? Which respond?

F1. Describe the life cycle of plasmodium and the role of both human and mosquito hosts.

F2. How can sickle-cell anemia provide protection against malaria?

F3. Can humans acquire complete immunity to malaria?

F4. Discuss at least one antibody mediated response to malaria.

G. Tuberculosis Questions - Create a concept map

[\[http://www.graphic.org/concept.html\]](http://www.graphic.org/concept.html) to show how different cells are involved with Tuberculosis -- Which are infected? Which respond?

G1. Why is the structure of the M.TB cell wall important?

G2. After M. TB is taken into a macrophage it prevents lysosomes from fusing with the phagosome membrane. Why is this important? How does this disrupt the immune response?

G3. What cell messenger (cytokine) activates macrophages and allows them to destroy M. TB?

G4. Why are antibodies ineffective in combatting M.TB?

STEP 5: Assembling your poster - there should be six major areas

Bacteria  
General info

Parasite  
General info

Virus  
General Info

Concept map of  
Interactions with  
Immune cells

Concept map of  
Interactions with  
Immune cells

Concept map of  
Interactions with  
Immune cells

STEP 6: Presenting your poster - Your team will make a short presentation highlighting three major similarities and three differences you have found between HIV, malaria, and tuberculosis. Your findings should focus on the cellular or molecular differences of how the disease attacks the body or elicits a response from the immune system.

GRADING:

1. ACCURACY OF INFORMATION (30 POINTS) Questions should be accurately answered for all three diseases. Answers may be organized into tables or charts to be displayed on the poster.
2. CONCEPT MAPS (30 POINTS) Connections should be organized for all three diseases. Location, type of cell, pathogen attack, or immune response should be clearly delineated.
3. PRESENTATION/LAYOUT OF POSTER (10 POINTS) Information should be neat and organized. A common layout should be used for each disease. Lettering should be readable from 3 feet away.
4. ANALYSIS OF SIMILARITIES AND DIFFERENCES (30 POINTS) Analysis should demonstrate an understanding of pathogen activity and immune response. Insights into the complexity of interactions should be evident.

## Massachusetts State Standards

### Chemical Structure of Antibodies

1.3 Describe the composition and functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids).

### Bacteria vs. Viruses vs. Parasite

2.2 Differentiate between prokaryotic cells and eukaryotic cells, in terms of their general structures and degrees of complexity.\*

### Toxins as poison/drug function

2.3 Describe how cells function in a narrow range of physical conditions, such as temperature and pH, to perform life functions that help to maintain homeostasis.

3.9 Recognize that while viruses lack cellular structure, they have the genetic material to invade living cells.

5.3 Describe how the taxonomic system classifies living things into domains (eubacteria, archaeobacteria, and eukaryotes) and kingdoms (animals, plants, fungi, etc.)

### Drug interactions and function

3.1 Describe the structure and function of DNA, and distinguish among replication, transcription, and translation.

3.2 Describe the processes of replication, transcription, and translation and how they relate to each other in molecular biology.

- 3.3 Describe the general pathway by which ribosomes synthesize proteins by using tRNAs to translate genetic information encoded in mRNAs.

#### Mutations and resistance to drugs

- 3.4 Explain how mutations in the DNA sequence of a gene may be silent or result in phenotypic change in an organism and in its offspring.
- 5.2 Illustrate how genetic variation is preserved or eliminated from a population through Darwinian natural selection (evolution) resulting in biodiversity.

#### Immune System

- 4.1 Explain how major organ systems in humans (e.g., kidney, muscle, lung) have functional units (e.g., nephron, sarcome, alveoli) with specific anatomy that perform the function of that organ system.
- 4.2 Describe how the function of individual systems within humans are integrated to maintain a homeostatic balance in the body.

#### Humans and Disease

- 6.3 Identify the factors in an ecosystem that influence fluctuations in population size.
- 6.4 Analyze changes in an ecosystem resulting from natural causes, changes in climate, human activity, or introduction of non-native species.
- 6.5 Explain how symbiotic behavior produces interactions within ecosystems.

- Cell functions are regulated. Regulation occurs both through changes in the activity of the functions performed by proteins and through the selective expression of individual genes. This regulation allows cells to respond to their environment and to control and coordinate cell growth and division.
- Cells can differentiate, and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells. In the development of these multicellular organisms, the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism. This differentiation is regulated through the expression of different genes.
- Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuing selection by the environment of those offspring better able to survive and leave offspring.
- The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled every available niche with life forms.
- Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.