PARASITIC INFECTIOUS DISEASES: River Blindness

WebQuest Description:
Content Standard(s) Standard BIO.5 a, b, c.5 d, e
The student will investigate and understand life functions of parasite archaebacteria, monerans (eubacteria), protists, fungi, plants, and animals including humans. The student will investigate and understand life functions of archaebacteria, monerans (eubacteria), protists, fungi, plants, and animals including humans.
Key concepts include
a) How their structures and function vary between and within the kingdoms;
b) Comparison of their metabolic activities; and
c) Analyses of their responses to the environment.
d) Maintenance of homeostasis; and
e) Human health issues, human anatomy, body systems, and life functions.

Grade Level: 9-12
Curriculum: Science
Keywords: Content Standard(s) Standard BIO.5 a, b, c.5 d, e

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Introduction

The students are going to embark on a guided exploration of the onchocerciasis or river blindness to investigate the species, insect reproduction, and human health. The students will investigate an epidemic scenario in a rural farming community. The student must take advantage of virtual field work, research data, and patient’s records in order to provide persuasive advice to the public health commission through delivery of a written report. The activity builds upon understanding of basic biology and highlights the impact that one microbe might have on the health of a community. In this WebQuest; you will research the biology of the parasitic worm Onchocerca volvulus. This Onchocerca volvulus is transmitted through repeated bites by blackflies of the genus Simulium. This disease is called River Blindness because the blackfly that transmits the infection lives and breeds near fast-flowing streams and rivers and the infection can result in blindness. In addition, to visual impairment or blindness, onchocerciasis causes skin disease, including nodules under the skin or debilitating itching. The current research is revealing many clues in the fight against infectious diseases. The fundamental biology of symbiosis and host-microbe relationships is preventing the spread of river blindness.

Tasks

In a sub-Sahara desert, in a community of nomadic population who farm around body of water and raising livestock. A 60-year-old grandmother in the village of Bambini, Tanzania, was suffering from uncontrollable itching and had developed skin lesions, clear signs of the progression of unknown diseases to prevent the disease from reaching its mature stage, when irreversible unknown sickness progresses significantly. This is a bizarre illness has been recently identified in an isolated village of Bambini, in Tanzania; the initial parasitic epidemic reports claim that the disease is most likely transmitted by a newly discovered species of blackflies. This is an parasitic epidemic reports have encountered much skepticism within the scientific community as they also suggest that newly born males of this particular species are often killed by a bacterial infection and the population is over 90% female while the illness is currently confined to the small village, could easily spread to the mainland and cause a major pandemic. You are a group of experts selected to serve as a specialized task force to investigate this parasitic epidemic is namely, reproduction specialist, microbiologist, epidemiologist and public health/medical specialist. You are in a group of four students will be led by a reproductive specialist, virologist, and epidemiologist and public health specialist to research the aspects of this parasitic epidemic.

1. How the blackflies transmits the parasite bite during the day. What is the impact of the Female blackflies needed to ingest blood for ovulation, so they feed on humans? 2. If a blackfly bites an infected person, onchocerciasis larvae can be ingested by the blackfly after which they migrate to the flight muscles. The larvae develop inside the blackfly and become infective for humans in about 10 to 12 days. 3. How to assist the community to control and prevent the spread of Humans become infected when blackflies deposit Onchocerca infective larvae into the skin when biting to extract blood. 4. Once inside the human body, the larvae mature into adults in around 3 months to 1 year in this community.

This group will explore the validity of the parasitic epidemic reports about a spread of blackflies as well as provide recommendations for moving forward. These groups are advice to use the expertise in the areas of Reproduction, Biology, Disease, Diagnosis, Treatment, Prevention and Virus Control and deliver a comprehensive report to the Public Health Commission.
Process

Objectives:
This WebQuest is designed to identify and analyze how students should be able to:
- Categorize the impact of river blindness, its affect on its communities, human, and the impact it has on that country's economy.
- Explore its impact on the reproduction, evolution and pathogenicity of its host, and evaluate its use in pest control and disease management.

Synthesize and collaborate with classmates to serve on a specialized task force to address the implications this research could have on preventing the next great epidemic.

This is a WebQuest design for groups of four students; each has an essential role to investigate of the river blindness as a team. Each student will tackle two of the eight major themes. Once you have decided on the teams and assign roles and responsibilities, you will each identify your particular role within the group. If you are working in a team of four, select one of the following roles. Each student assumes the role of as reproduction specialist, microbiologist, epidemiologist and public health/medical specialist.

Reproductive Specialist
Microbiologist
Epidemiologist
Public Health/Medical Specialist

Each student will play the role of a specialist defined in the process to investigate the six major themes, namely the reproduction, epidemiology, biology, disease, diagnosis, treatment, prevention, and virus control as the river blindness investigation team.

Each student will tackle two of the eight major themes. Based on the eight theme investigate this parasitic infectious diseases spreading in the community. You are responsible for developing a comprehensive report and each specialist will use the guiding questions to prepare the following PowerPoint Presentation, Public Awareness Campaign, and Informative Pamphlet for this project assignment. You have been provided multimedia resources, educational and scientific informational online, and River blindness websites as a guiding resources for this project. Finally, you have rubrics to help prepare effective reports on the topic parasitic infectious diseases: River Blindness.

Multimedia: YouTube
Schistosomiasis Ending the Anguish of a Silent Disease View Video (3:27) Ending the Anguish of a Silent Disease View Video (3:57) 
Envisioning A Future Free From Blindness View Video (3:57)
River Blindness: Preserving Vision for Future Generations View Video (3:10)
River Blindness Prevention Watch Video

Reproductive Specialist
Why would induce asexual reproduction in its host? How can we "cure" the host of asexual reproduction? How do pathogenic filarial parasites affect the lives of humans? Describe the threat of filarial nematode Filarial worms of the genus Onchocerca species. Describe how Filarial worms cause blindness in human host? What happen when Filarial nematodes enter the human body at their third larval stage? How to stall the reproduction of Onchocerciasis that is caused by nematodes (roundworms) that inhabit subcutaneous tissues?

Epidemiologist
What is onchocerciasis? In what parts of the world am I more likely to get onchocerciasis? How is onchocerciasis spread? Who is most at risk for onchocerciasis? What is the impact of onchocerciasis? What are the clinical manifestations of onchocerciasis? How soon after infection the symptoms of onchocerciasis progress? What should the community do prevent onchocerciasis? What is the treatment for onchocerciasis? How can the community control and prevent the black fly that causes the onchocerciasis? Microbiologist

What are the presenting symptoms of this disease?

Are any of these symptoms particularly characteristic of this disease? Is this disease chronic or acute? Lethal or non-lethal? What is the infectious agent? Is this agent a virus or bacteria? Describe the agent in DETAIL. What is its classification? What other organisms is it related? What is known about its structure of this parasite? How does the infectious agent interact with the body to produce the symptoms of the disease? What cells or tissues does it infect and how does it damage those cells or tissues? What method is used to manage the vector control in the identified area? What new strategies are being employed to manage the vector control infecting the human host population in the area?

Public Health Specialist
What medication is use to prevent onchocerciasis in this community? Where did this disease first emerge? Is it endemic to a particular area, or pandemic? Has it erupted in periodic epidemic outbreaks? Describe the spread of this disease through a population or around the country, if applicable. What human actions are related to the spread of this disease? Be specific. How is this disease transmitted from host to host? If there is a vector involved, describe the interaction between pathogen, host and vector in DETAIL. How is this disease treated? If a vaccine is available, Describe the components of the vaccine and discuss its effectiveness. If antibiotics are used, discuss the effectiveness of this treatment. What problems currently exist with treatment strategies?

Websites Resources
http://www.cdc.gov
http://www.who.int/en
http://medlineplus.gov
http://www.mayoclinic.com
http://www.infectiousdiseasenews.com
http://www.medscape.com/infectiousdiseases
http://www.immunofacts.com
http://www.cdc.gov
http://www.nfido.org
http://www.metrokc.gov/health/prevcont
http://www.astdhpphe.org/infect
http://www.who.int

Evaluation
The above story is reprinted (with editorial changes) from Science Daily (Oct. 6, 2010). The New Diagnostic Tool: A sensitive and screening method that rapidly identifies individuals with active river blindness, a parasitic disease that afflicts an estimated 37 million people. The test could change the current strategy of mass treatment in areas where river blindness, also known as onchocerciasis, is suspected. The study was published online on October 5, 2010, by the journal PLOS Neglected Tropical Diseases. "A sensitive and reproducible diagnostic test for this disease is crucial for the success of worldwide control and elimination programs," said Kim Janda, Ph.D., a professor in the Departments of Chemistry and Immunology and Microbial Science, member of The Skaggs Institute for Chemical Biology, and director of The Worm Institute for Research and Medicine (WIRM) at Scripps Research. "This diagnostic tool could be a game-changer for how the disease will be treated in the future." The New Diagnostic Tool: To develop the test, the Scripps Research scientists used a highly sophisticated process known as metabolomics, the systematic study of the unique chemical fingerprints that specific cellular processes leave behind, in other words of their small-molecule metabolite profiles. Metabolic profiling can give a quick snapshot of the physiology of an organism. The use of metabolomics on an African sample set comprised of 73 serum and plasma samples revealed 14 biomarkers that showed excellent discrimination between O. volvulus-positive and negative individuals. Application of these biomarkers to an additional sample set from onchocerciasis endemic areas where long-term ivermectin treatment has been successful revealed that the biomarkers could distinguish individuals with worms of compromised viability from those with active infection. Story Source: The above story is reprinted (with editorial changes) from Science Daily (Oct. 6, 2010).

Teacher’s Overview/ Annotation
National Science Standards: This is an attempt to integrate Virtual Field studies inquiry based project that is aligned with the national standards and science and technology and content objectives:

BIO.4 The student will investigate and understand relationships between cell structure and function. Key concepts include:
(a) characteristics of prokaryotic and eukaryotic cells;
(b) exploring the diversity and variation of eukaryotes;
(c) similarities between the activities of a single cell and a whole organism; and
(d) the cell membrane model (diffusion, osmosis, and active transport).

BIO.5 The student will investigate and understand life functions of archaeabacteria, monerans (eubacteria), protists, fungi, plants, and animals including humans. Key concepts include:
(a) how their structures and functions vary between and within the kingdoms;
(b) comparison of their metabolic activities;
(c) analyses of their responses to the environment;
(d) maintenance of homeostasis;
(e) human health issues, human anatomy, body systems, and life functions; and
(f) how viruses compare with organisms.

Contents Standard BIO.5 a, b, c The student will investigate and understand life functions of archaeabacteria, monerans (eubacteria), protists, fungi, plants, and animals including humans. Key concepts include:
(a) how their structures and function vary between and within the kingdoms;
(b) comparison of their metabolic activities; and
(c) analyses of their responses to the environment. Essential Knowledge and Skills:

Skills
- Differentiate and give examples of the following from local ecosystems:
  - autotrophs and heterotrophs (producers, consumers, and decomposers)
  - multicellular and unicellular organisms
  - motile and non-motile organisms
  - organisms with and without cell walls
  - sexually and asexually reproducing organisms
  - aquatic and terrestrial organisms
- Behavioral responses to the environment.

NS.9-12.1 SCIENCE AS INQUIRY As a result of activities in grades 9-12, all students should develop Abilities necessary to do scientific inquiry
Understandings about scientific inquiry

NS.9-12.3 LIFE SCIENCE As a result of their activities in grades 9-12, all students should develop understanding of the cell
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems

Behavior of organisms

NS.9-12.5 SCIENCE AND TECHNOLOGY As a result of activities in grades 9-12, all students should develop Abilities of technological design
- Understandings about science and technology

In my quest to complete this project, I retrieved information on March 1, 2, and 6 from the following websites that was extremely helpful in developing this webquest project lesson:

plan: http://serc.carleton.edu/microbelife/index.html
http://www.cdc.gov/parasites/onchocerciasis
http://www.sightsavers.org/learn_more/causes_of_blindness/river_blindness
http://webquest.sdsu.edu/designsteps/index.html
http://webquest.sdsu.edu/designpatterns/all.htm

Standards

Credits

Other