**Epidemiological Case Study:** *An investigation of disease, anatomy, physiology, and cell biology*



The *Vibreo cholera* outbreak of 1854 is just one of many epidemics that have had devastating effects on the human population. Understanding the nature of a disease, it’s causes and effects, and how it is transmitted and spread through a population have long been the focus and concern of scientists, demographers, and the general public.

In this long-term study, you will investigate a specific epidemic, becoming an expert on the pathogen’s biology as well as the way the pathogen interacts with a host’s cells, anatomy, and physiology. You will document and share your findings in a health symposium in an engaging, informational format of your choosing (pending teacher approval).

**Epidemics of Concern:**

* Botulism
* Cholera
* *Escherichia coli*
* Ebola virus disease
* Giardiasis
* Human immunodeficiency virus/Acquired immunodeficiency virus (HIV/AIDS)
* Influenza
* Legionella
* Leprosy
* Lyme disease
* Malaria
* Measles
* Meningitis – *bacterial, fungal, amebic, parasitic, viral*
* Plague
* Polio
* Salmonella
* Severe Acute Respiratory Syndrome (SARS)
* Smallpox
* Tuberculosis
* Typhus
* Yellow Fever
* Zika virus disease
* Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Research Roles & Descriptions:**

|  |  |
| --- | --- |
| **Epidemiologist**  Investigate the transmission, causes, and risk factors associated with the spread of the disease.  *Lead Student \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* | **Anatomist**  Studies the organ structures affected by the disease as well as those that respond to the pathogen.  *Lead Student \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* |
| **Cell biologist**  Studies that cellular structures affected by the disease as well as those that respond to the pathogen.  *Lead Student \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* | **Physiologist**  Studies the biological processes affected by the disease as well as those that respond to the pathogen.  *Lead Student \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* |
| **Pathologist**  Investigates the classification, life cycle, structure, and notable physiological activities of a disease-causing agent.  *Lead Student \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* | **Public Health Specialist**  Share information to the general public regarding the epidemic, including information of the transmission, causes, and effects of the disease.  *Lead Student \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* |

**Project Outline & Timeline**:

* About the disease – **DUE January 14**
  + History of notable outbreaks, epidemics, and/or pandemics for the specific disease.
  + Geographic distribution of outbreaks and spread of disease.
  + Affected populations
  + Environmental factors contributing to transmission
  + Notable scientists contributing to understanding of the disease.
* Pathogen biology – **DUE February 8**
  + Taxonomy
  + Cell structure
  + Life cycle
  + Notable physiology
* Host biology
  + Anatomical perspective - **DUE January 18**
    - Anatomical structures affected by pathogen
    - Anatomical structures’ response to pathogen
  + Physiological perspective - **DUE January 25**
    - Biological processes affected by pathogen
    - Symptoms occurring in response to pathogen
    - Biological processes that respond to pathogen
    - Interaction of treatment(s) on physiology
  + Cellular perspective – **DUE February 1**
    - Cells affected by pathogen
    - Cells responding to pathogen
* Health Symposium – **DUE February \_\_\_\_\_\_**

**Product Rubric Parameters**

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| --- | --- |
| Score | Qualifications |
| 5 | * All aspects of the project component are addressed completely and accurately. * Each component is explained in a clear, concise, understandable, engaging manner. * Relevant graphics are included. * All sources are cited. |
| 4 | * Most aspects of the project component are addressed completely and accurately. * Most components are explained in a clear, concise, understandable, engaging manner. * Many relevant graphics are included. * Most sources are cited. |
| 2 | * Some aspects of the project component are addressed completely and accurately. * Some components are explained in a clear, concise, understandable, engaging manner. * Some relevant graphics are included. * All sources are cited. |
| 0 | * Components not attempted |

**Process Rubric Parameters**

|  |  |
| --- | --- |
| Score | Qualifications |
| 5 | Student is consistently   * present, engaged, and on-task throughout project work time. * responsible for completing an equitable share of the project. * supporting other students’ work in a kind, respectful way. * appropriately caring for and utilizing classroom resources (e.g., texts, computers) |
| 4 | Student is usually   * present, engaged, and on-task throughout project work time. * responsible for completing an equitable share of the project. * supporting other students’ work in a kind, respectful way. * appropriately caring for and utilizing classroom resources (e.g., texts, computers) |
| 2 | Student is occasionally   * present, engaged, and on-task throughout project work time. * responsible for completing an equitable share of the project. * supporting other students’ work in a kind, respectful way. * appropriately caring for and utilizing classroom resources (e.g., texts, computers) |
| 0 | Student is rarely   * present, engaged, and on-task throughout project work time. * responsible for completing an equitable share of the project. * supporting other students’ work in a kind, respectful way. * appropriately caring for and utilizing classroom resources (e.g., texts, computers) |

**Part 1, About the Disease - *Rubric***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Project Components** | **Student Researcher** | **Completed**  **(Y//N)** | **Points Earned** | | | | **Comments** |
| **5** | **4** | **2** | **0** |
| History of the disease, notable outbreaks, important scientific discoveries |  |  |  |  |  |  |  |
| Scientific discoveries and advancements; Important scientists associated with findings |  |  |  |  |  |  |  |
| Geographic distribution and spread; includes relevant maps |  |  |  |  |  |  |  |
| Affected populations and relevant statistics; includes relevant graphs & tables |  |  |  |  |  |  |  |
| Environmental factors & other risk factors contributing to disease contraction; includes relevant graphics |  |  |  |  |  |  |  |
| Student engagement and contribution of the learning process **(x2)** |  |  |  |  |  |  |  |

**TOTAL \_\_\_\_\_\_\_\_\_/35**

**Part 1, About the Disease – *Guiding Questions & Prompts***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* What is the history of the disease? When was it first reported? Is it still currently a health concern?
* What are some notable outbreaks?
* Are there maps or other images that are important to include to describe historical spread of the disease?
* What important scientific discoverieshave occurred in association with this disease? When did the discoveries occur? Who are the scientists involved with these discoveries?
* What is the geographic distribution of this disease?
* What human populations have been/are most likely to be affected?
* What statistics can be included about the impact of this disease, presently and historically? Why are these statistics relevant?
* Are there graphs & tables that could be included to effectively show the impacts of this disease?
* What environmental factors contribute to the transmission of the disease?

* What other risk factors contributing to disease transmission?

**Part 2, Anatomical Perspective - *Rubric***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Project Components** | **Student Researcher** | **Completed**  **(Y//N)** | **Points Earned** | | | | **Comments** |
| **5** | **4** | **2** | **0** |
| Affected anatomical structures: (x2)   * Structures and locations are identified. * Connections to disease are explained. * Includes all relevant graphics. |  |  |  |  |  |  |  |
| Responding anatomical structures: (x2)   * Structures and locations are identified. * Connections to disease are explained. * Includes all relevant graphics. |  |  |  |  |  |  |  |
| Student engagement and contribution of the learning process (x2) |  |  |  |  |  |  |  |

**TOTAL \_\_\_\_\_\_\_\_\_/30**

**Part 2, Anatomical Perspective – *Guiding Questions & Prompts***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* What anatomical structures are affected by the disease?
* Where are these structures located?
* What diagrams can be included to effectively illustrate the structures and locations of these organs?
* How does the disease affect these structures?
* Is there a graphic that supports the explanation of how the disease affects the human anatomy (e.g., flow chart, diagram)?
* What anatomical structures respond to the disease?
* Where are these structures located?
* What diagrams can be included to effectively illustrate the structures and locations of these organs?
* Why do these structures interact to / respond to the disease?
* Is there a graphic that supports the explanation of how the human anatomy responds to the disease (e.g., flow chart, diagram)?

**Part 3, Physiological Perspective – *Rubric***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Project Components** | **Student Researcher** | **Completed**  **(Y//N)** | **Points Earned** | | | | **Comments** |
| **5** | **4** | **2** | **0** |
| Affected biological processes: (x2)   * Processes are explained. * Connection to structures & locations identified. * Connections to disease are explained. * Includes all relevant graphics. |  |  |  |  |  |  |  |
| Responding biological processes(x2)   * Processes are explained. * Connection to structures & locations identified. * Connections to disease are explained. * Includes all relevant graphics. |  |  |  |  |  |  |  |
| Physiological symptoms are described |  |  |  |  |  |  |  |
| Medical treatments are identified and their connection to physiological processes are described. (x2) |  |  |  |  |  |  |  |
| Student engagement and contribution of the learning process (x2) |  |  |  |  |  |  |  |

**TOTAL \_\_\_\_\_\_\_\_\_/45**

**Part 3, Physiological Perspective – *Guiding Questions & Prompts***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* What physiological processes are affected by the disease?
* How are each of these physiological processes carried out under healthy, non-diseased circumstances?
* How are each of these physiological processes affected by the disease?
* Which structures (*likely identified in part 2*) are used in each of these processes?
* Is there a graphic(s) that supports the explanation of how the disease affects these physiological processes (e.g., flow chart, diagram)?
* What physiological processes respond to the disease?
* How do each of these physiological processes respond to the disease?
* Which structures (*likely identified in part 2*) are used in each of these processes?
* Is there a graphic(s) that supports the explanation of how these physiological processes respond to the disease (e.g., flow chart, diagram)?
* What symptoms occur in response to the disease?
* What medical treatments exist to eliminate the disease and/or alleviate symptoms?
* How do each of these treatments interact with the physiological processes to treat the disease/symptoms?

**Part 4, Cellular Perspective - *Rubric***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Project Components** | **Student Researcher** | **Completed**  **(Y//N)** | **Points Earned** | | | | **Comments** |
| **5** | **4** | **2** | **0** |
| Affected cell type(s) |  |  |  |  |  |  |  |
| Affected cellular structures: (x2)   * Structures and locations are identified. * Normal and impaired functions described. * Connections to disease are explained.   Includes all relevant graphics. |  |  |  |  |  |  |  |
| Responding cell type(s) |  |  |  |  |  |  |  |
| Responding cellular structures: (x2)   * Structures and locations are identified. * Functions described. * Connections to disease are explained.   Includes all relevant graphics. |  |  |  |  |  |  |  |
| Student engagement and contribution of the learning process (x2) |  |  |  |  |  |  |  |

**TOTAL \_\_\_\_\_\_\_\_\_/40**

**Part 4, Cellular Perspective – *Guiding Questions & Prompts***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* What cell types (e.g., nerve cells, muscle cells) are affected by the disease?
* Is there a graphic illustrating these cell types that could be included?
* What organelles are affected by the disease for each of these cell types?
* Where are these organelles located within the cell?
* Are there diagrams that can be included to effectively illustrate the organelles’ structures and locations?
* How does the disease affect these organelles for each cell type?
* Is there a graphic that supports the explanation of how the disease affects the cell (e.g., flow chart, diagram)?
* What cell types respond to the disease?
* Is there a graphic illustrating these cell types that could be included?
* What organelles respond to the disease?
* Where are these organelles located within the cell?
* What are the functions of these organelles?
* What diagrams can be included to effectively illustrate the structures and locations of these organelles?
* How do these organelles interact to / respond to the disease?
* Is there a graphic that supports the explanation of how the human anatomy responds to the disease (e.g., flow chart, diagram)?

**Part 5, Pathogen Biology – *Rubric***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Project Components** | **Student Researcher** | **Completed**  **(Y//N)** | **Points Earned** | | | | **Comments** |
| **5** | **4** | **2** | **0** |
| Identification of pathogen taxonomy; use of scientific nomenclature |  |  |  |  |  |  |  |
| Description of cellular structure (x2)   * Structures and locations are identified. * Functions of structures described. * Connections to disease transmission are explained. * Includes all relevant graphics. |  |  |  |  |  |  |  |
| Description of pathogen life cycle.   * Includes all notable stages * Connection to transmission explained * Includes all relevant graphics |  |  |  |  |  |  |  |
| Description of pathogen physiology (x2)   * Processes explained. * Connection to structures & locations identified. * Connections to host explained. * Includes all relevant graphics. |  |  |  |  |  |  |  |
| Effect of medical treatments on pathogen physiology |  |  |  |  |  |  |  |
| Student engagement and contribution of the learning process (x2) |  |  |  |  |  |  |  |

**TOTAL \_\_\_\_\_\_\_\_\_/40**

**Part 5, Pathogen Biology – *Guiding Questions & Prompts***

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* How is the pathogen classified?
* What is the pathogen’s scientific name and common name(s)?
* What is the pathogen’s cellular classification (e.g, multicellular, unicellular, prokaryote, eukaryote, plant cell, animal cell)?
* What are some notable organelles of the pathogen?
* What are the functions of each of these organelles?
* How does the pathogen’s structure enable it to affect a host and spread within a population?
* Is there a diagram that illustrates the pathogen’s cellular structure?
* What are some important physiological processes carried out by the pathogen?
* What structures are involved in carrying out these processes?
* How are these processes carried out and how do they affect the host?
* How is the physiology of the pathogen affected by medical intervention(s)?
* Are there diagrams that effectively illustrate how these processes work and how they affect a host?

**Part 6, Health Symposium**

DUE DATE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ STUDENT LEADER \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Project Components** | **Student Researcher** | **Completed**  **(Y//N)** | **Points Earned** | | | | **Comments** |
| **5** | **4** | **2** | **0** |
| All project components are included |  |  |  |  |  |  |  |
| Accurate, relevant information is shared (x2) |  |  |  |  |  |  |  |
| Information is communicated clearly and is engaging to audience |  |  |  |  |  |  |  |
| Presentation format is creative |  |  |  |  |  |  |  |
| Final project is free of grammatical & spelling errors |  |  |  |  |  |  |  |
| Literature cited includes 5+ properly cited sources |  |  |  |  |  |  |  |
| Student engagement and contribution of the learning process |  |  |  |  |  |  |  |

**TOTAL \_\_\_\_\_\_\_\_/40**