

Measles in Black: Can Measles Wipe Your Immune Memory?

Morgan Gaskill
Boca Raton Community High School
Morgan.gaskill@palmbeachschools.org

Abstract:

This action plan is designed to promote scientific literacy and open the door for conversation about responsible journalism and how scientific research is conveyed to the general public. This activity is designed to supplement an existing unit on infectious diseases and the immune system and does assume some knowledge about the roles of different red blood cells and the mode of action of a viral infection. During this activity, students will read a scientific journal entry suggesting insight about the mode of action of the measles virus in the human body, write a novel abstract of that source article and draw comparisons between the source article and a “news” style article citing that paper to assess if the major points of the source article were conveyed appropriately to the general public.

Rationale:

In this activity, students will be able to further their knowledge about the measles virus as well as the different types of immune cells and the roles they play in coordinating the immune response and establishing immunological memory. As of June 20th 2019, 1,077 individual cases of measles have been confirmed in 28 states so far this year- the highest number of cases in the United States since 1992, despite being declared eliminated in 2000.^[1] One contributing explanation for this increase is a rise in vaccine hesitancy and a general mistrust of science. These are both issues that should be addressed in the classroom.

However, the main objective of this lesson is to start a more general and wider conversation about how science is presented to the general public and how news outlets may generalize or otherwise skew scientific research into forms that are digestible to the general population while also being driven by their own metrics of revenue or generating traffic to their websites. While not always the case, this idea that something that is published may not necessarily be the most accurate representation of scientific research is something that students should be wary of in their day to day life. By promoting scientific literacy and a healthy suspicion of sensationalist journalism, this activity encourages students to do their own research and draw their own conclusions with a healthy dose of skepticism for media presentations.

Description of teaching unit:

This unit is designed to take between 65 and 170 instructional minutes, depending on the needs of students and how much reading is done outside of class.

- **Cambridge CIE 9700 Syllabus (AS Biology) Objectives:**
 - 10.1.b: State the name and type of causative agent of measles (limited to *Morbillivirus*)
 - 10.1.c: Explain the transmission cycle of measles
 - 11.1.b: Explain the role of macrophages and lymphocytes on immune response

- **Learning Outcomes- Students will be able to:**
 - Use active reading techniques to read and understand a scientific journal article
 - Write an abstract for the paper that demonstrates understanding of the most important points described in the paper
 - Compare the article to a secondary news-style article and discuss differences between the two publications

- **These objectives and outcomes will be achieved through the following activities:**
 - **Introduction:** 10-15 minutes; students will receive background information (parts of a scientific journal entry and relevant vocabulary)
 - **Read article 1*:** Approximately 50 minutes (depending on reading level and student ability); students will do a deep read of the journal article and annotate to determine the most important points of the article
 - **Write an abstract*:** Approximately 30 minutes; students will use their notes and annotations of the original article to write their own abstract for the article
 - **Class discussion:** 15-20 minutes; students will compare their abstract with those around them; whole group discussion about the article and the abstracts written
 - **Read article 2*:** 20 minutes; students will read the second article and answer the comparative questions provided
 - **Discussion 2/ Wrap-Up:** 20 minutes; small and large group discussion about the articles and the overall implications of how science is reported in the general media

Note: Any activity marked with an asterisk can be assigned as homework if there are time constraints for in-class reading, although having the teacher on hand to help with any confusion or misconceptions would be helpful.

Materials- Each student should have:

- Pens/pencils
- Highlighter for annotations
- Printed copies of:
 - Background/vocab sheet
 - Article 1 (with abstract removed/blacked out)- Macrophages and Dendritic Cells Are the Predominant Cells Infected in Measles in Humans (2018) can be retrieved from <https://msphere.asm.org/content/3/3/e00570-17/article-info>

- Article 2- Measles erases the immune system's memory- ScienceNews (2019) can be retrieved from <https://www.sciencenews.org/article/measles-immune-system-memory-infection>
- Article 2 questions/reflection sheet

Data Collection/Student Assessments- Student learning will be assessed in the following ways:

- Unit assessments for infectious diseases and immunity (these assessments incorporate other topics, but will include questions on this activity)
- Annotations will be collected and graded (depending on teacher preferences, specific parameters for annotations can be assigned)
- Student abstract
- Article 2 question and reflection sheet
- Participation during class discussions

CATALySES summer institute elements specifically included (UF connections):

- **So, What is an Emerging Pathogen? (June 16th- Dr. Morris):** Emphasis on distrust of science being a major driver for emerging and re-emerging pathogens (vaccine hesitancy)
- **Antimicrobial Stewardship (June 17th- Dr. Venugopalan):** Idea that what you tend to hear (even from medical professionals) may not necessary align with best practices; variation of knowledge even within a field
- **Genetic Engineering in Crops (June 24th- Dr. Barbey):** Continued to emphasize distrust of science based on misconceptions that may be furthered by news media

References Cited:

1. Measles | Cases and Outbreaks | CDC. (n.d.). Retrieved from <https://www.cdc.gov/measles/cases-outbreaks.html> (accessed June 25th, 2019; data is updated every Monday)

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CATALySES 2019 Action Proposal- Lesson Plan

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Key Questions:

- What are the important parts of a scientific research article?
- What cells are primarily affected by the measles virus?
- Does this study provide valid results to support the conclusions stated?
- To what extent (if any) did the news site sensationalize or generalize the information presented in the original source article?



Science Subject: Biology, Anatomy and Physiology (Immune System)

Grade and Ability Level: High School- Cambridge CIE Biology, AP or advanced honors classes. Could be further modified for lower grades or regular level classes.

Overall Time Estimate: Approximately 170 minutes if done entirely in class; can be reduced to approximately 65 minutes if all reading is done as homework

Learning Styles: primarily verbal with some visual, logical and social elements

Lesson Summary: This activity is rooted in the idea of scientific literacy. Students are asked to decipher a technically complicated scientific journal entry and write their own abstract, challenging them to not only read the technical paper but also figure out exactly what the article is trying to say and if there is a solid conclusion that can be drawn. They will then assess an online news article referencing the same journal entry and discuss what elements were changed between the two publications and the implication of those changes.

Student Learning Objectives with Standards: Standards according to the Cambridge CIE 9700 syllabus

- State that measles is caused by *Morbillivirus* and is easily transmitted between humans (10.1.b, 10.1.c)
- Explain the role of macrophages and lymphocytes on the immune response (11.1.b)

Materials: Each student will need a printed copy of each of the articles with the abstract of the journal article removed; highlighters may be provided to help with annotating if needed.

Background Information: This activity requires very little background knowledge. A basic understanding of the measles virus and the cells of the immune system (lymphocytes, macrophages, dendritic cells) will be helpful and may need to be provided, but no in-depth background knowledge is required. Students will receive background information defining important terms and outlining the main components of a research paper.

Advance Preparation: None other than providing printed reading materials.

Procedure and Discussion Questions (with time estimates)

- Days 1-2:
 - Introduction/background: 10-15 minutes
 - Hand out introduction sheets, go over parts of a research paper and relevant vocab words
 - Read/Annotate source article: 50 minutes (in class or as homework)
 - *This time frame is an estimate depending on specific requirements for annotations.
 - Students should read the article independently and try to draw conclusions from this close reading
 - Write an abstract: 30 minutes (also could be done as homework)
 - Students are asked to write an abstract summarizing the paper- this requires them to not only know what an abstract should contain, but also assesses their understanding of the article
- Days 3-4
 - Class discussion: 20-30 minutes
 - Discuss the article itself- **was there anything that jumped out as interesting or odd about the research?** (One example could be the small sample size in this paper- 23) **Would you consider this article accessible as something that someone in the general public could read and understand?**
 - Have students compare abstracts with their neighbor or partners
 - Large group discussion of the abstract- **what are some things that everyone (or most students) included in their abstract? How did they know what was important to the main idea of the article and what was not?**
 - Compare individual abstracts to the original source abstract- **are there things missing that should have been in the abstract? Is any part of the abstract misleading?**
 - Read second article and answer questions: 20-25 minutes (can be assigned as homework)
 - Questions are designed to highlight differences between the two articles- even though the second article does cite additional sources, does it seem to be a fair representation of the information being presented?
- Day 5
 - Discuss second article/ wrap up: 20 minutes
 - **Could this idea be applied to other topics?**
 - **Is it possible that news sources can be irresponsible when reporting on scientific publications? What can be done to combat this?**

Assessment Questions: Can be incorporated into existing content questions about the nature of the measles virus and the immune system. Learning can be best assessed by reading and grading student submitted abstracts and observing class discussion.

Extensions: After this activity, students could also be asked to find their own articles and assess their validity based on source texts. This activity could also be extended to relate to many other topics.

Resources/References:

- Student Background/Vocab Sheet (Attached)
- Source Article: Allen, I. V., Mcquaid, S., Penalva, R., Ludlow, M., Duprex, W. P., & Rima, B. K. (2018). Macrophages and Dendritic Cells Are the Predominant Cells Infected in Measles in Humans. *MSphere*, 3(3). doi:10.1128/msphere.00570-17. Retrieved from <https://msphere.asm.org/content/3/3/e00570-17/article-info>
- Secondary Article: Sanders, L. (2019, June 03). Measles erases the immune system's memory. Retrieved from <https://www.sciencenews.org/article/measles-immune-system-memory-infection>

Student Background: Parts of a Research Paper & Vocabulary List

Parts of a Research Paper

- **Title:** An appropriate title will describe the contents of the paper well enough for the reader to determine if the paper is interesting or relevant to their own purposes.
- **Abstract:** The abstract may be the most important part of a research paper. The purpose of an abstract is to provide an extremely condensed, succinct summary of the research, methods and possibly the conclusions or results of the work being presented. Often the abstract of a paper may be the only part available without a subscription or paying a fee, so it is very important that the abstract accurately summarizes everything the full paper has to offer.
- **Introduction/ Importance:** The introduction of a paper discusses the background of a research topic or justifies the importance of the research. This is also where researchers will present a specific hypothesis that the research will test.
- **Methods:** The method section describes HOW the authors performed their research and exactly how the data was collected.
- **Results:** The results section presents the results of the experiment and will contain the raw data collected during the experiment.
- **Discussion:** This is where the results are analyzed, and conclusions are drawn. This is where authors will discuss the outcome of the experiment, what it means for the original hypothesis and what this may suggest for future research.
- **Acknowledgements:** The authors will often acknowledge individuals or institutions that contributed to the research or provided materials or resources that contributed to the development of the paper.
- **Literature Cited:** The authors will cite any sources used.

Vocabulary

- **Morbillivirus:** the virus that is the causative agent of measles
- **Lymphocytes:** a class of white blood cells that tend to populate lymph nodes and play a major role in the immune response
- **Macrophages:** a type of white cell that plays a role in the immune response; macrophages act by engulfing pathogens as part of the non-specific immune response. They may also play a role in signaling other white blood cells in the event of an infection.
- **Dendritic cells:** a type of white blood cell that digests pathogens and “presents” the pathogenic antigens to lymphocytes to help initiate and coordinate a specific immune response.
- **Prodromal Symptoms:** symptoms that appear early in the course of an infection
- **Cytokeratin:** a filament protein found specifically in epithelial cells that help with mechanical support.
- **In vitro:** experimental work is done OUTSIDE of an organism (such as in a test tube or a culture dish)
- **In vivo:** experimental work takes place within the living organism



“MEASLES IN BLACK” A LESSON IN SCIENTIFIC LITERACY

Morgan Gaskill
CATALySES Summer 2019

OVERVIEW

- Students will read a scientific journal entry- *Macrophages and Dendritic Cells are the Predominant Cells Infected in Measles in Humans* (Allen et al. 2018) but will NOT be given the abstract
 - They will be asked to read and annotate the article and write their own abstract to show that they understood the material and were able to pick out the main points and overlying conclusions of the research being done
- They will then compare it to a news article from ScienceNews that cites the original source- *Measles erases the immune system's memory* and discuss how (AND IF) the news article did a good job of translating the original article into a way that can be read and understood by the general public while still maintaining the major points of the original paper



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ABSTRACT

- Geared towards AP/AICE levels students (could potentially be modified for lower levels with more support)
- Designed as an extension to existing infectious disease/immunity units- Reinforces knowledge of measles and different types of immune cells and immunological memory
- Promote scientific literacy with an activity that ties in to measles as a (re)emerging pathogen
- Read a source journal publication with complex technical terms/data and decipher the “main idea”
- Draw attention to a culture of mistrusting science and how news outlets may not necessarily be the best source to learn about emerging science and discuss how a secondary news article is different from the source material

RATIONALE

- In 2019 (so far) there have been 1,077 individual cases of measles in the United States (according to the CDC as of Monday)
- In the age of social media, it is exceptionally easy for false or misleading information to spread in a way that is very difficult to control.
- Even if we can't control this false information, it is important for students to see that they can't necessarily trust that news sources are presenting scientific research or breakthroughs in a responsible way