Of Mice and Men: Engaging High School Students in Biomedical Science

Charlotte A. Moser
Vaccine Education Center at Children’s Hospital of Philadelphia
Today’s presentation:

• Understanding of vaccines among adults

• Preview of high school materials
  • Progression of content, including key questions
  • Previews of activities and resources, including sampling of animations and videos
  • Review of study findings related to outcomes of student online research

• NSTA 2018 – Additional opportunities
For MANY students . . .

your science class will be one of their last experiences with formal science education.
Yet, as adults, every one of them will... 

Make decisions that require an understanding of science. 

Be affected by biomedical science.
When it comes to vaccines . . .

<table>
<thead>
<tr>
<th>Preventive health benefits</th>
<th>Risk of side effects</th>
<th>Overall rating THE BENEFITS OUTWEIGHT THE RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U.S. adults</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HIGH</strong></td>
<td>73</td>
<td></td>
</tr>
<tr>
<td><strong>MEDIUM</strong></td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td><strong>LOW</strong></td>
<td>66</td>
<td></td>
</tr>
<tr>
<td><strong>AMONG THOSE WITH SCIENCE KNOWLEDGE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td>91</td>
<td></td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>76</td>
<td></td>
</tr>
<tr>
<td><strong>Low</strong></td>
<td>55</td>
<td></td>
</tr>
<tr>
<td><strong>EDUCATION</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Postgrad degree</strong></td>
<td>87</td>
<td></td>
</tr>
<tr>
<td><strong>College degree</strong></td>
<td>89</td>
<td></td>
</tr>
<tr>
<td><strong>Some college</strong></td>
<td>72</td>
<td></td>
</tr>
<tr>
<td><strong>H.S. or less</strong></td>
<td>61</td>
<td></td>
</tr>
<tr>
<td><strong>FAMILY INCOME</strong></td>
<td></td>
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<tr>
<td><strong>$100,000+</strong></td>
<td>86</td>
<td></td>
</tr>
<tr>
<td><strong>$75K-$99,999</strong></td>
<td>92</td>
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<td><strong>$50K-$74,999</strong></td>
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<tr>
<td><strong>$30K-$49,999</strong></td>
<td>70</td>
<td></td>
</tr>
<tr>
<td><strong>&lt; $30,000</strong></td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

Note: Respondents who gave other responses or who did not give an answer are not shown.
Source: Survey conducted May 10-June 6, 2016. "Vast Majority of Americans Say Benefits of Childhood Vaccines Outweigh Risks" PEW RESEARCH CENTER
• Focus on the immune system, disease, vaccination and the scientific process
• Free lessons and resources
• Standards aligned (NGSS and CCSS)
• Elementary through high school/college
Units for High School Students

The Human Immune System

Diseases and Vaccination

INFLUENZA VIRUS
Biomedical Research and Animals

Collaborating in Science Partner

Pennsylvania Society for Biomedical Research
Unit 1: The Human Immune System

Lesson 1: The organs & tissues of the immune system
Lesson 2: The innate immune system
Lesson 3: The adaptive immune system
Lesson 2: The Innate Immune System

- What are the key features and processes of the innate immune system?
- How can the innate immune system be modeled?
Herstmonceux Castle, near Wartling, East Sussex, Great Britain. (Courtesy of Geograph.org)
# Student Activity

**Materials:**
- shoebox without lid
- craft knife or scissors
- 10 ping pong balls
- 10 marbles
- 10 1½” foam balls
- masking tape

## Table with Percentages

<table>
<thead>
<tr>
<th></th>
<th>% Moat</th>
<th>% Walls</th>
<th>% Castle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial #1 (ping pong balls)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial #2 (foam balls)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Trial #3 (marbles)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Total number of items</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Innate Immune System

Lesson 2 classroom resource
Novel animation
1:57 length
Lesson 3: The Adaptive Immune System

- What are the key features and processes of the adaptive immune system?
- How does the adaptive immune system differ from the innate immune system?
Other cells of the adaptive immune system

- Macrophage
- Dendritic Cell
- T cell
The Adaptive Immune System

Lesson 3 classroom resource
Novel animation
1:18 length
How do antibodies work?

Lesson 3 classroom resource
Novel animation
2:13 length
Unit 2: Diseases and Vaccination

• Lesson 1: Development of disease and infection
• Lesson 2: Case studies: Influenza and HIV
• Lesson 3: The discovery & development of vaccines
• Lesson 4: Vaccine History & Research
• Lesson 5: Vaccine Safety
Pathogens and the Immune System
Lesson 1: Development of disease and infection

- How do antigens and the immune system affect each other’s evolution?
- What are key steps in the process of the development of infection and disease?
Lesson 1: Development of disease and infection

• How do antigens and the immune system affect each other’s evolution?

• What are key steps in the process of the development of infection and disease?
Influenza relies on antigenic variation
Lesson 3: The discovery and development of vaccines

- What is the purpose of a vaccine?
- What are the different ways in which vaccines are made?
- How do vaccines protect populations of people?
Lesson 3: The discovery and development of vaccines

Types of vaccines

- Inactivated (killed virus) vaccine
- Live, weakened vaccine
- Recombinant vaccine
- Toxoid vaccine
- Conjugate vaccine
Lesson 4: The History of Vaccine Research

• What are the key discoveries in the history of vaccine research?

• Who are the leading scientists in the history of vaccine research?

• What are the main ethical considerations of vaccine research?
Vaccinated: One Man’s Quest to Defeat the World’s Deadliest Diseases

Student readings from this book:
• “Eight Doors” chapter
• “Blood” chapter

Book by Paul A Offit, MD
Director, Vaccine Education Center at Children’s Hospital of Philadelphia
Understanding scientific progress develops over time

Lesson 4 classroom resource

Hilleman: A Perilous Quest to Save the World’s Children film clip - mumps

3:05 length
Understanding scientific progress develops over time

Lesson 4 classroom resource

Hilleman: A Perilous Quest to Save the World’s Children film clip – hepatitis B

10:50 length
Lesson 5: Vaccine Safety

• What are the main issues regarding vaccine safety?

• What is the scientific basis for issues regarding vaccine safety?
World Health Organization

Lesson 5 classroom resource

Vaccine Safety Net program provides criteria for evaluating web sites for credibility and content quality.

www.vaccinesafetynet.org
Why is this lesson important?

• 2008 study by Philip Kortum and colleagues at the University of Texas School of Medicine

• Subjects: 34 students from a science magnet HS

• Objective: To determine effectiveness of students’ assessment of the accuracy of Internet-based information related to a controversial medical topic (vaccines) using keyword searches.
What did Kortum and Colleagues find?

55% of Links were not accurate

- Inaccurate links: 55%
- Accurate links: 45%

59% of students thought links were accurate

- No to accuracy: 41%
- Yes to accuracy: 59%
In addition...

59% of the “facts” they reported were wrong.

53% of students left the exercise with inaccurate information
Vaccines: Separating Fact from Fear

*This video was produced by the Vaccine Education Center at the Children’s Hospital of Philadelphia, but did not participate in conducting the study.

4% of the “facts” they reported were wrong.

5% of students left the exercise with inaccurate information.

Correct facts 96%

Incorrect facts 4%

Reported inaccuracies 5%

Did not report inaccuracies 95%
Study Conclusions

The authors stated:

• Students may leave Internet research exercises with incorrect information.
• It is important to follow-up conflicting information with a solid unambiguous message.

_I would add…_

_The ability to evaluate information is a necessary life skill._
Biomedical Research and Animals

Lesson 1: Learning from Animals

• What are the benefits of studying and understanding other species?

• How has animal research improved our understanding of disease?

Lesson 2: Animal Research and Vaccines

• What role does animal research play in vaccine development?

• What are some limitations of animal research?
How are animals essential to research?

Lesson 1 classroom resource

Dr. Paul Offit discusses working with animals in research.

1:45 length
Additional opportunities at NSTA 2018

The Science of Vaccines: Your Questions Answered

Dr. Paul Offit
Scientist, Inventor, Pediatrician, Author

Friday, March 16 10 – 11:30am
GA WCC - B407 (this room)
Additional opportunities at NSTA 2018

• Inspiring Individuals and Changing Conversations: Consider Hosting a Film Screening
  Friday 3/16 - 8am to 10am

• Famous Relationships – Science is Full of Them: Engaging MS Students
  Saturday 3/17 – 8am to 9:30am
Additional opportunities at NSTA 2018

Booth: 343

- Classroom materials
- Vaccine information
- Giveaways
- Meet our team
Thank you!

Exhibit Hall Booth: 343

Charlotte A. Moser
moser@email.chop.edu

Websites:
VaccineMakers.org – classroom materials
HillemanFilm.com – film information
vaccine.chop.edu – vaccine information