Vaccines and the Immune System

High School Students

Includes:

- 10 Videos
- 4 Assignment/Activity Suggestions
- 4 Next Generation Science Standards
- 9 WHST 11-12th Grade Common Core Standards

Overview

It seems that with more information, there's more confusion as to what is science fact and what is science fiction. This package gives teachers the tools to teach students about the immune system and the importance of vaccines. The videos talk about some new innovations in science that use our own immune system to fight diseases and it also investigates the "vaccines cause autism" myth. Teachers can tie the immune system to evolution, DNA and protein synthesis, genetic diversity, survival and fitness of a species, and natural selection.

The following instructional videos are not meant to take the place of a lecture, but it can be used as a resource for teachers who may have students who are absent, need to review content, or simply want some extra resources.

Instructional Clip: *Immune System Part 1*
Instructional Clip: "*Immune System Part 2*
Instructional Clip: "*Immune System Part 3*
Instructional Clip: "*Investigating the Immune System: the Immune System*"

Suggested Activities

1. **The Innate Immune System**
   The innate immune system is non-specific and will be able to recognize any non-self PAMPs (pathogen associated molecular patterns). Students may already be familiar with inflammation such as swelling and redness around a

wound. The following video talks about inflammation in the gut and how the innate immune system works works with the adaptive immune system.

After watching this video, teachers could have students research FMT (fecal matter transplants). This is a new method through which healthy fecal matter is transplanted into the colon of someone with inflammatory bowel issues. There have been a number of studies done on this procedure and teachers could direct students to read, analyze, summarize, and present one study. This could be done individually or students could pair up/work in groups.

Clip: "*Ulcerative colitis: Fresh approaches to taming inflammation*"

2. **The Adaptive Immune System**

Students should understand that the innate and adaptive immune system work together. Different chemical signals and antigen presenting cells create chemical cascades and chain reactions that increase inflammation and elicit an immune response. The video below talks about how we are able to create antibody diversity from a limited number of genes. From here, teachers can tie this diversity back to evolution, fitness, and mate selection. Some questions for a discussion activity include:

- What happens when there isn't enough genetic diversity?
- What did children die of before the invention and discovery of antibiotics and medicine?
- How old were these children?
- Why was child mortality rate so high?
- How is this an example of natural selection in humans?

Clip: "*Immunology Wars: A billion antibodies*"

3. **Fighting Cancer with Antibodies**

Usually, if a cell becomes cancerous, your immune system recognizes it and destroys. Tumor cells that grow out of control have learned to evade the immune system. The video below talks about a new type of cancer treatment that uses the patients' own antibodies to tag and kill tumors.

From here, teachers can introduce students to biomedical tests that also use antibodies as tags, such as a Western blot or an ELISA. This should be an easily relatable topic because many popular tests, such as pregnancy and rapid HIV tests are Western blots and ELISAs.

Teachers could easily turn this into a lab if they have access to Western blots or ELISAs in their classroom. Along with reporting their results, students could also research some of the issues with false positives that can happen with Western blots and ELISAs.

Clip: "*Immunology Wars: Monoclonal antibodies*"

4. **The word "vaccine" comes from the Latin word for "cow"**
   Given the numerous outbreaks of measles and other almost-eradicated diseases around the world, it's becoming more and more important for students to understand the importance of vaccines. The videos below are good introductory videos to the history of vaccines and how vaccines work. It may be difficult for students to understand what the world was like when smallpox was still rampant and unpreventable, but the second video (*TED-Ed: How we conquered the deadly smallpox virus - Simona Zompi*) puts smallpox into perspective.

   This topic is a good way for history and science classes to collaborate on. Students could research and present on the science behind smallpox and other diseases. At the same time, they could also look at what the world was like back then as far as migration and transportation. How did these two things help the spread of diseases? Another interesting take on these diseases and migration is for teachers to have students look at how smallpox aided Europeans as they crossed the Atlantic into the Americas.

   Other myths about vaccines that teachers could address include:
   - The difference between methylmercury and ethylmercury
   - Causation versus correlation
   - The fabricated scientific study (that has since been retracted) linking vaccines to autism
   - Vaccines don't contain pig or fetal cells, the viruses simply need cells to grow in

   Clip: "*Why Vaccines Work*"
   Clip: "*TED-Ed: How we conquered the deadly smallpox virus - Simona Zompi*"
   Clip: "*How Risky Are Vaccines*"

Clips:

1. Immune System Part 1
2. Immune System Part 2
3. Immune System Part 3
4. Investigating the Immune System: the Immune System
5. Ulcerative colitis: Fresh approaches to taming inflammation
6. Immunology Wars: A billion antibodies
7. Immunology Wars: Monoclonal antibodies
8. Why Vaccines Work
9. TED-Ed: How we conquered the deadly smallpox virus - Simona Zompi
10. How Risky Are Vaccines

NGSS Applicable to this Package:

CATEGORY: Structure and Function: DNA TO PROTEINS (HS) HS-LS1-1
CATEGORY: Structure and Function: BODY SYSTEMS (HS) HS-LS1-2
CATEGORY: Interdependent Relationships in Ecosystems: SURVIVAL (HS) HS-LS2-8
CATEGORY: Natural Selection and Evolution: TRAIT SELECTION (HS) HS-LS4-3

Common Core Standards Applicable to this Package:

CCSS.ELA-LITERACY.WHST.11-12.1
CCSS.ELA-LITERACY.WHST.11-12.2
CCSS.ELA-LITERACY.WHST.11-12.4
CCSS.ELA-LITERACY.WHST.11-12.5
CCSS.ELA-LITERACY.WHST.11-12.6
CCSS.ELA-LITERACY.WHST.11-12.7
CCSS.ELA-LITERACY.WHST.11-12.8
CCSS.ELA-LITERACY.WHST.11-12.9
CCSS.ELA-LITERACY.WHST.11-12.10