

The Immune System and The Science Behind Vaccines



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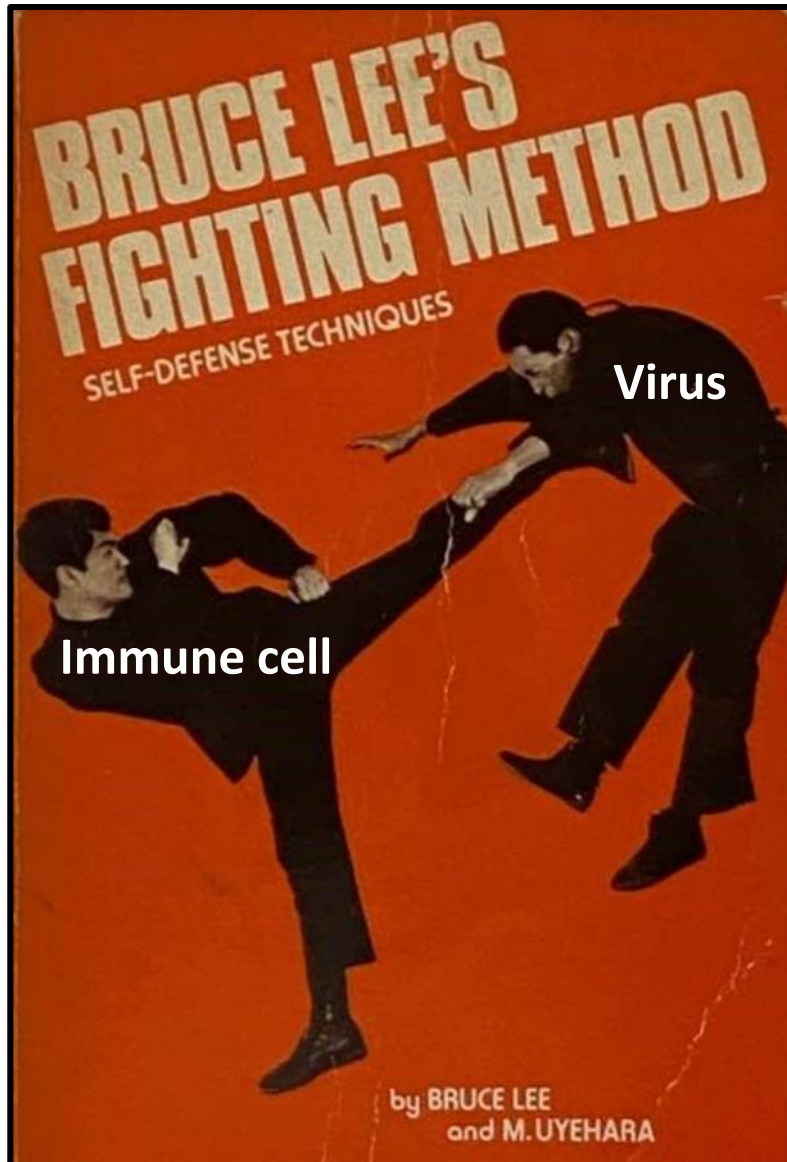
Director | CU Anschutz Medical Campus Foundational Sciences Science Communication Program

Co-Director | Colorado Clinical and Translational Sciences Institute (CCTSI) 'Communicating Your Science' Program

QUESTIONS

- What is the immune system?
- How does the immune system work?
- What is a vaccine?
- How do vaccines work?
- Why are there so many different types of vaccines?
- Why should I get vaccinated?

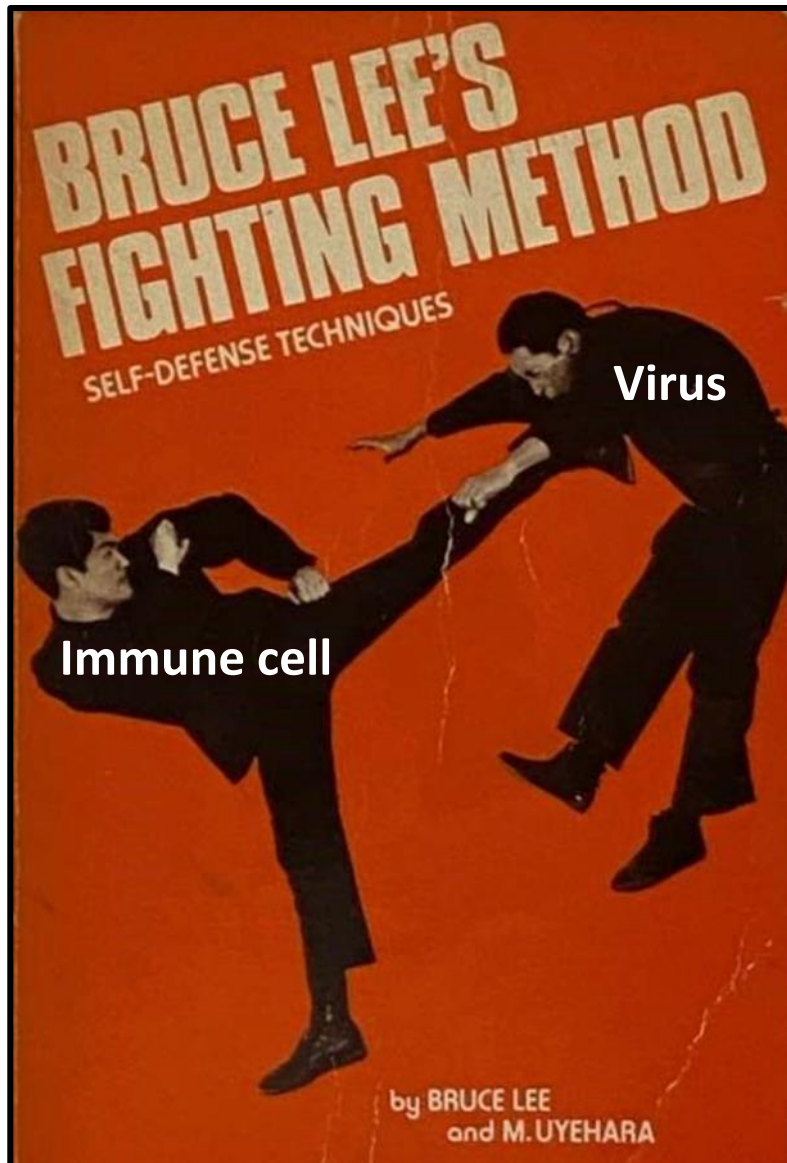
IMMUNE CELLS ARE LIKE MARTIAL ARTISTS



Immune cells

- Train in self-defense
- Study their enemy
- Remember their enemy

IMMUNE CELLS ARE LIKE MARTIAL ARTISTS

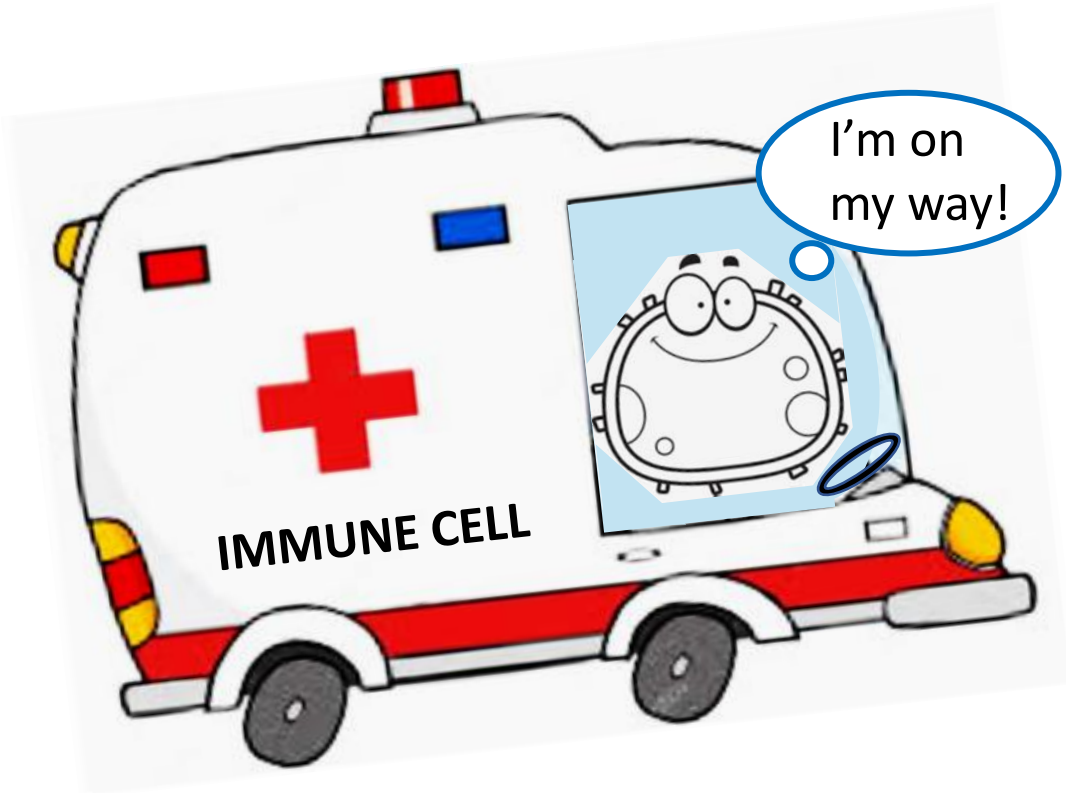


Immune cells respond to every encounter with a **pathogen** to protect our body and defeat the enemy

Pathogens are microscopic organisms (germs) that invade our bodies and want to make it their home, like viruses and bacteria



THE CELLS OF THE IMMUNE SYSTEM ARE MOBILE



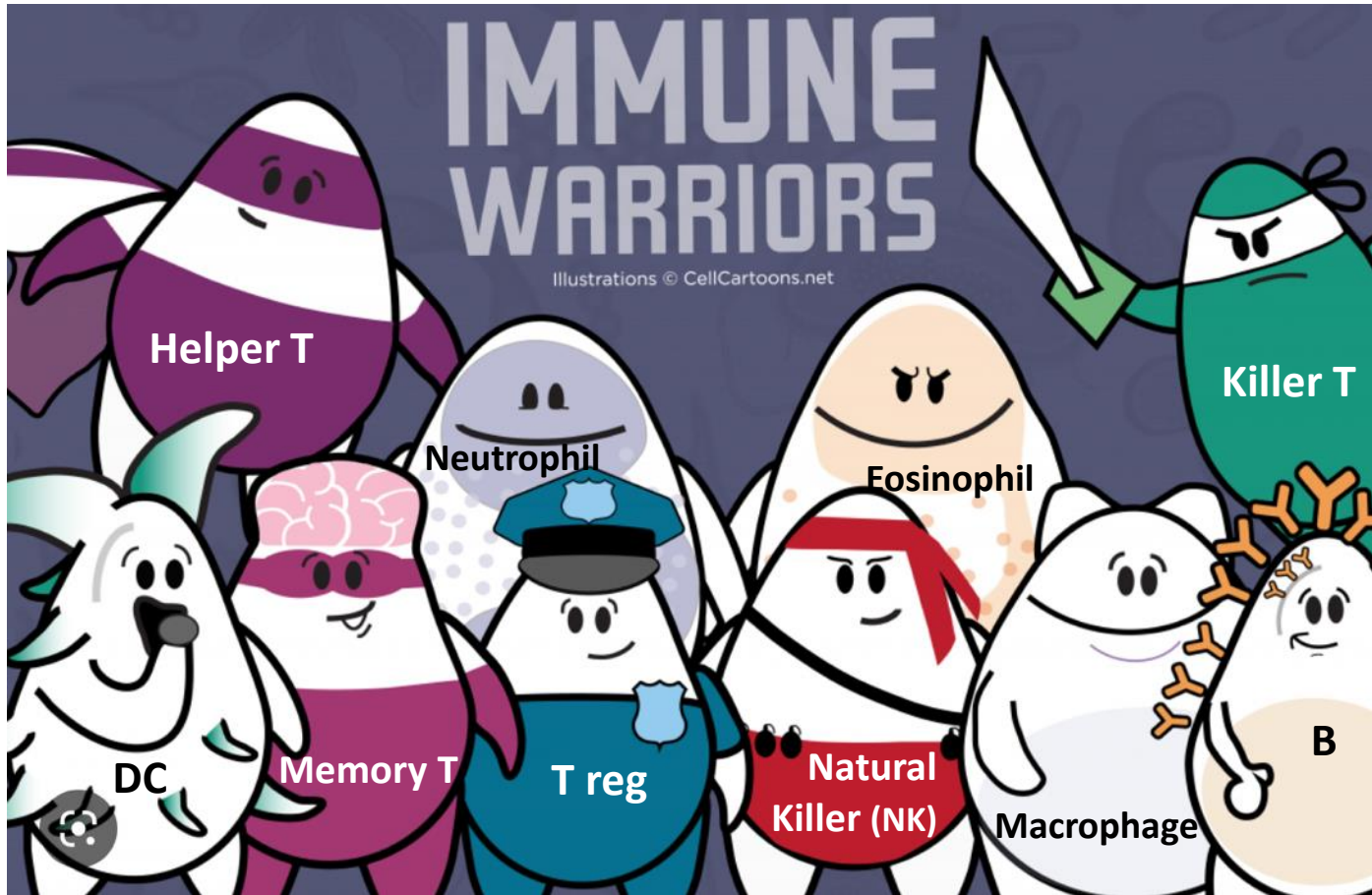
Our immune system is a **mobile defense system** made up of lots of different types of cells that travel to the site of an injury when needed

Inflammation?!

Immune function relies on getting the right cells to the right place at the right time



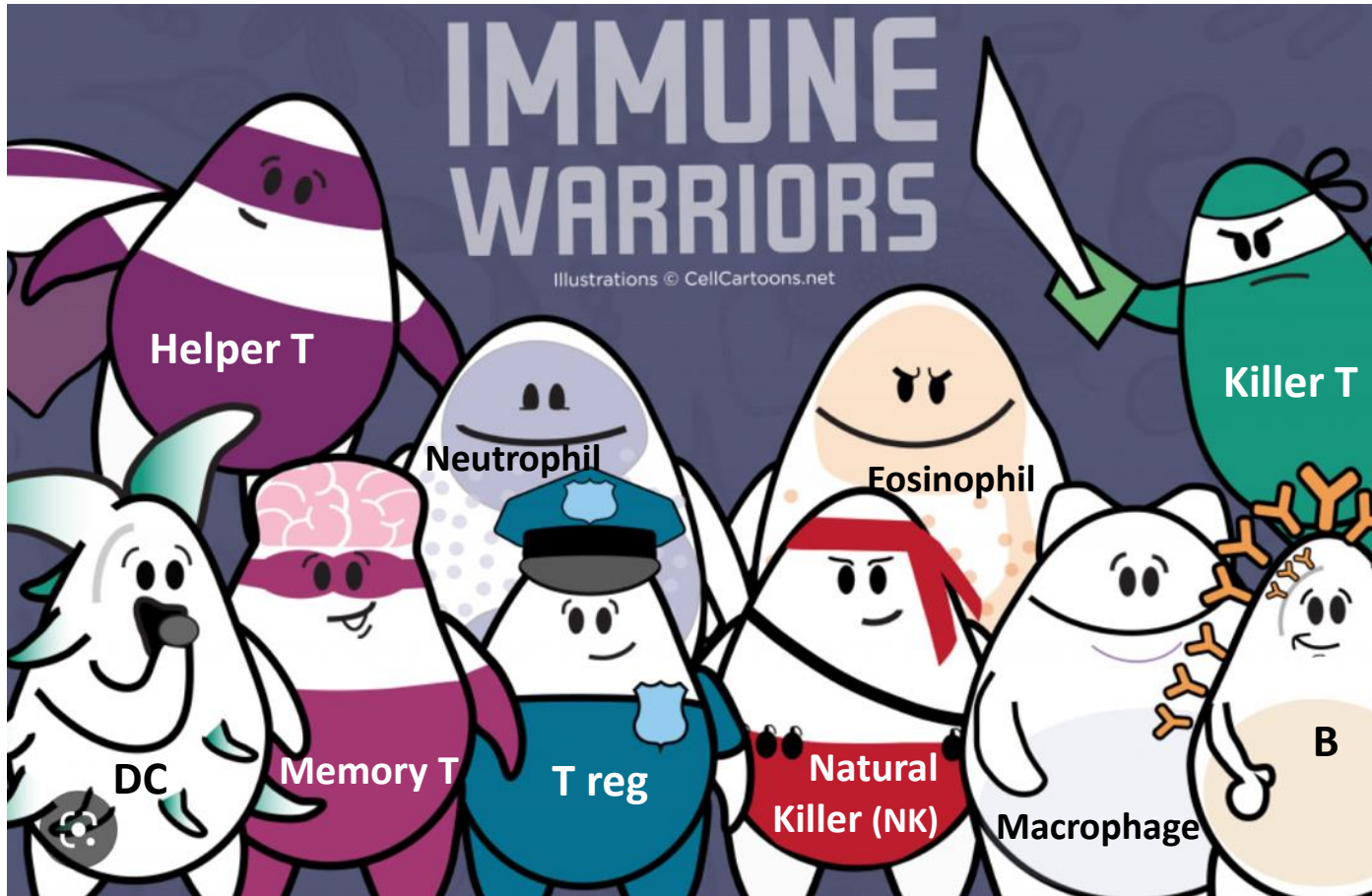
MANY TYPES OF IMMUNE CELLS IN OUR BODIES



There are multiple types of immune cells in our body that have slightly different 'jobs'

All of them work together to defend us against pathogens

IMMUNE CELLS - NON-SPECIFIC and SPECIFIC



Immune cells work together to defend us against pathogens

Some immune cells are **non-specific** (aka 'innate')

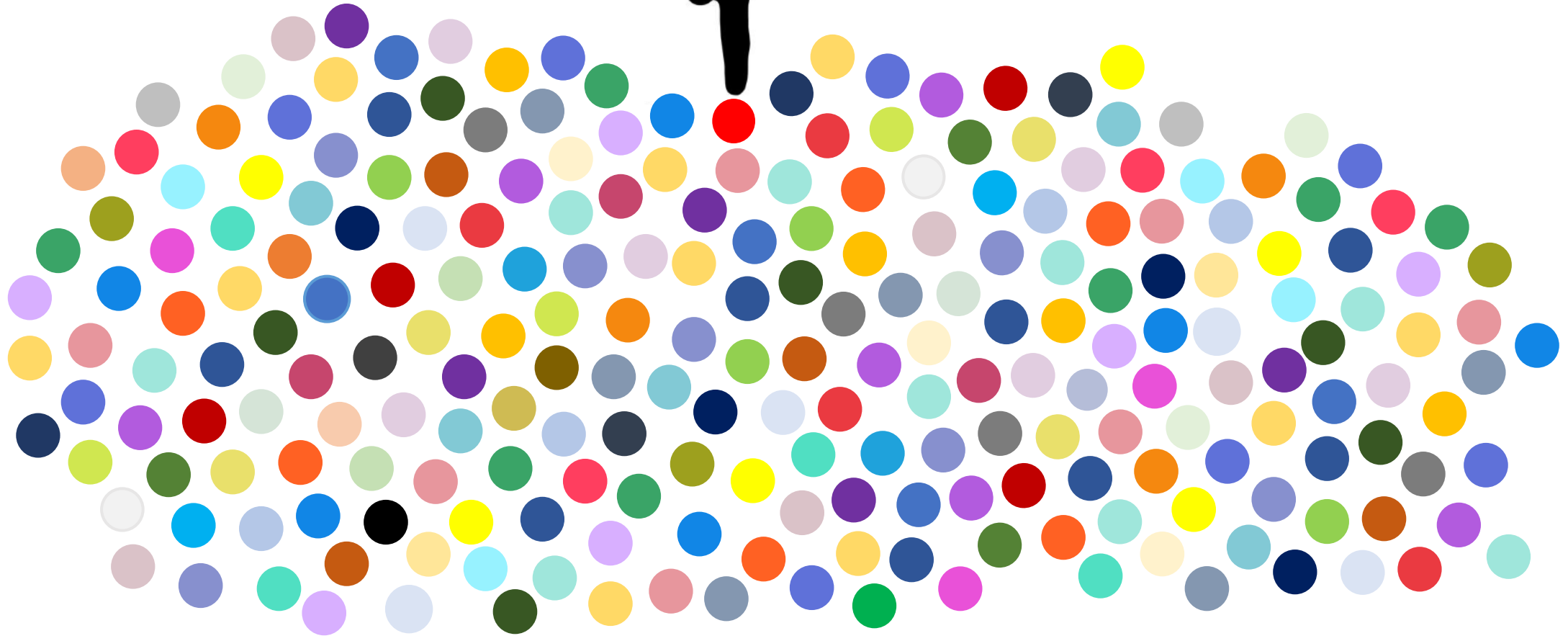
Some immune cells are **specific** (aka 'adaptive')

B and T CELLS ARE SPECIFIC for 1 THING

Each B cell and each T cell has unique specificity



Every time we encounter a pathogen (in the wild or in a vaccine) only a few B and T cells respond!



VACCINES TRAIN THE IMMUNE SYSTEM

Vaccines work *with* our immune system to provide long-lasting protection

Vaccines contain harmless forms of pathogen (aka 'the enemy') that stimulate an immune response

Vaccines provide a 'practice' version of the pathogen to train the immune system – get it ready for the fight!

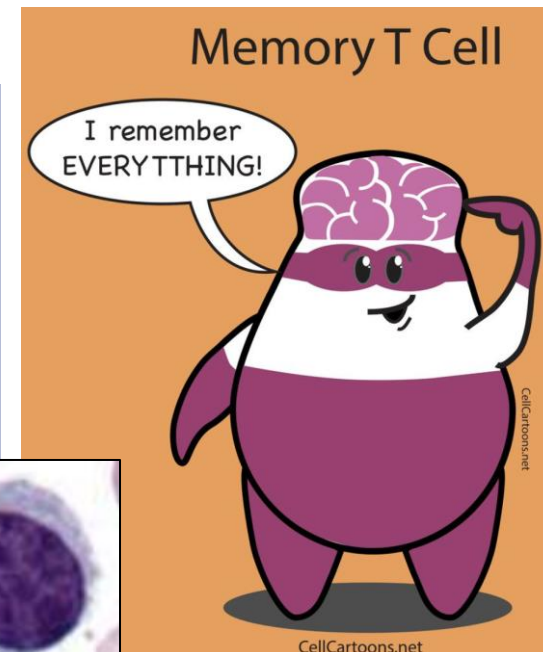
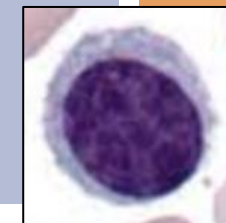
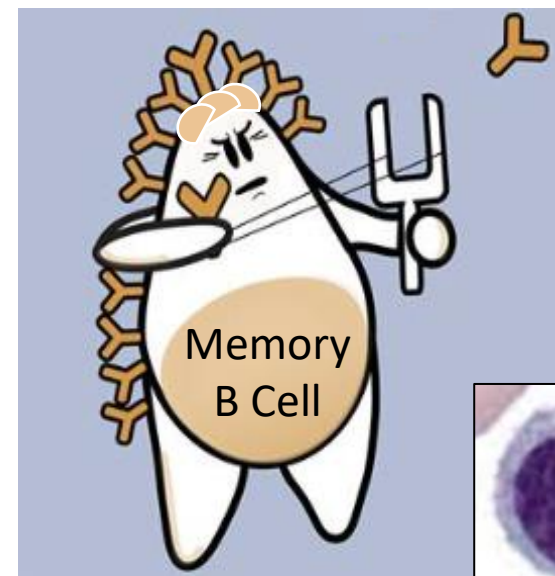


VACCINES TRAIN THE IMMUNE SYSTEM

Vaccines work *with* our immune system to provide long-lasting protection to train immune **memory cells**

These **memory cells** will be ready to attack when the real, harmful pathogen enters the body

The **ultimate goal of a vaccine** is to create **memory cells** and provide **long-lasting protection**



QUICK REVIEW of CORE IDEAS

- 1. The immune system is a mobile defense system composed of a variety of specialized cells**
- 2. The cells of the immune system work together to detect and defend us from pathogens and disease**
- 3. Vaccines are harmless forms of a pathogen that stimulate the immune system**
- 4. Vaccines train the immune system to make memory cells for long-lasting protection**

QUESTIONS

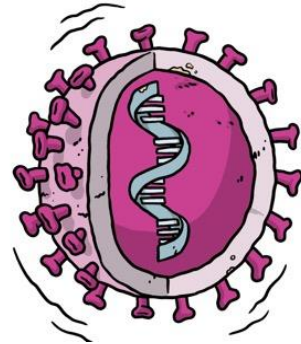
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DIFFERENT TYPES OF VACCINES...

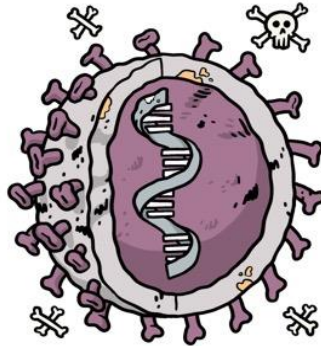
WHOLE PATHOGEN



intact virus for comparison

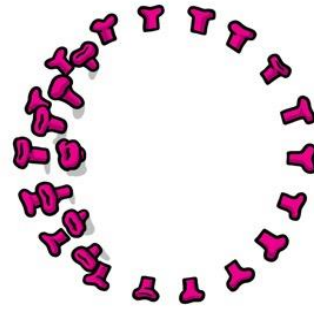


Live, attenuated
(weakened)

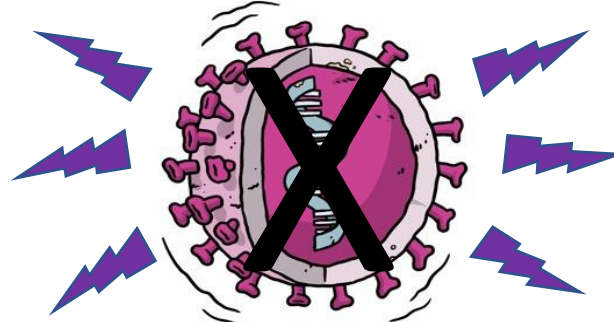


Killed

PARTS of PATHOGEN



Subunit
(small pieces of the virus)

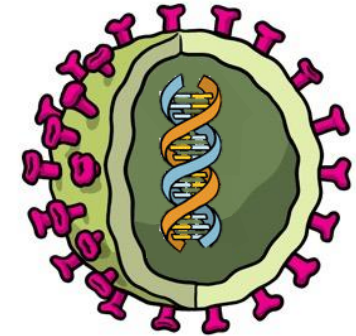


Toxoid
(inactivated toxins)

NUCLEIC ACID-BASED



mRNA
in a lipid (fat) shell



DNA in a vector

FUN FACT.

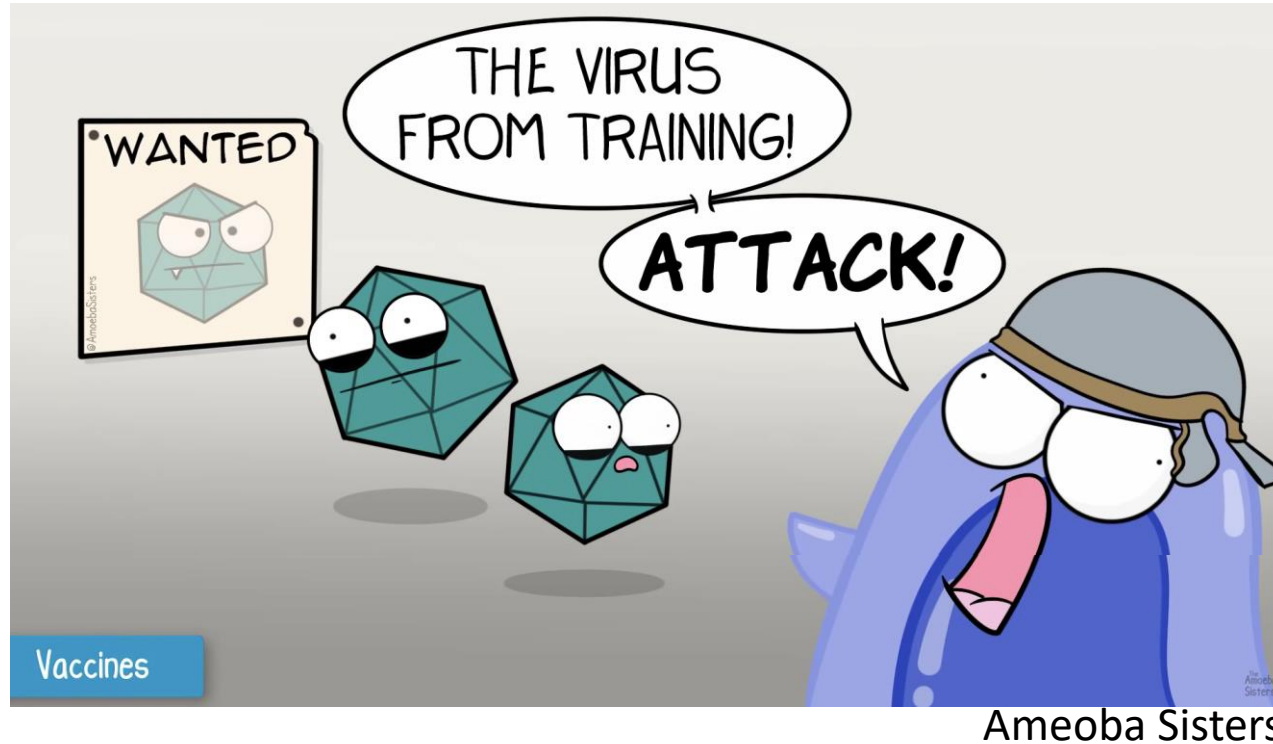
Scientists pick the best type of vaccine for each unique pathogen!

Adapted from WHO

<https://www.who.int/news-room/feature-stories/detail/the-race-for-a-covid-19-vaccine-explained>

to respond to so many different types of pathogens!

GET VACCINATED TO PROTECT YOURSELF

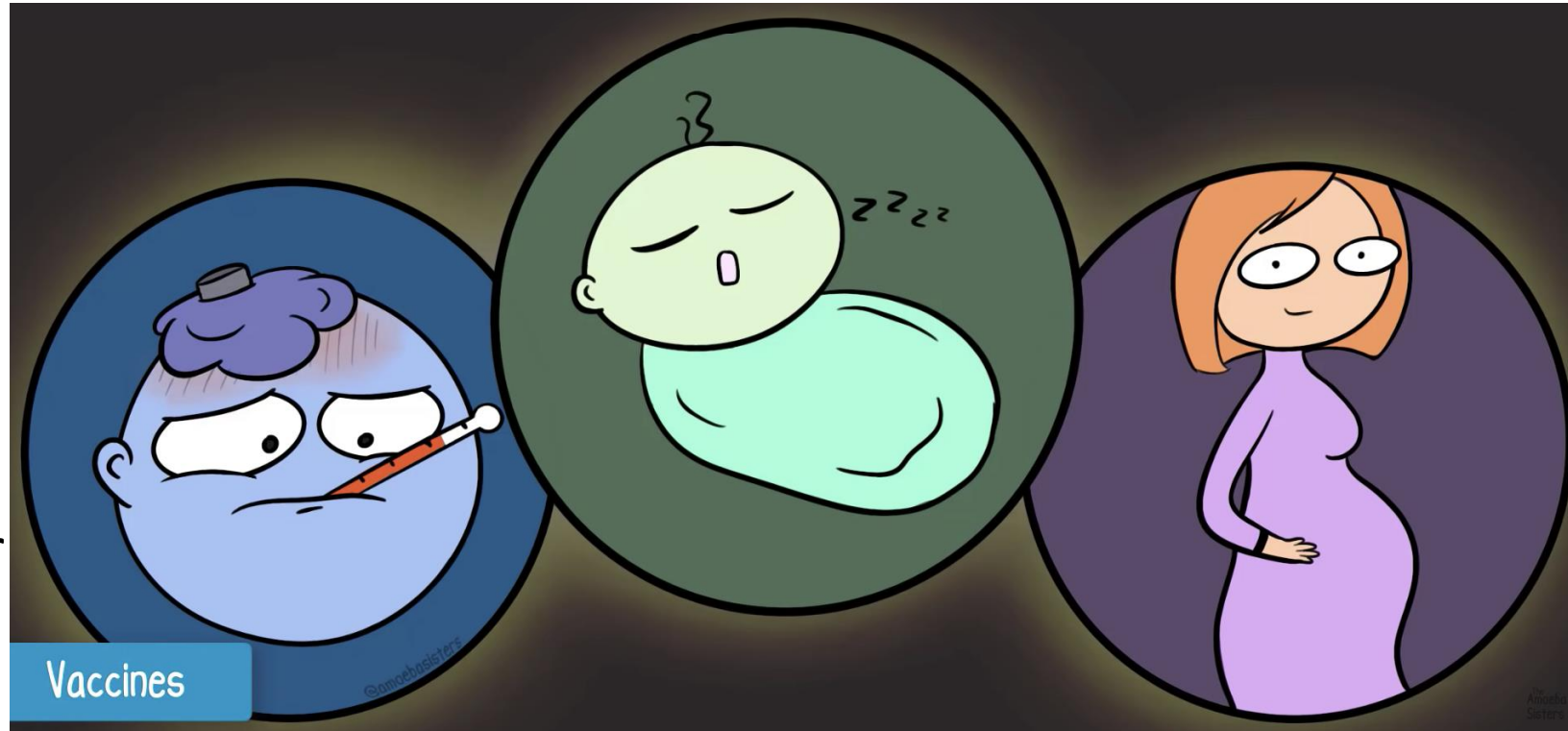


Vaccines train immune cells to create memory and provide long-lasting protection

Vaccines help us to protect ourselves from becoming sick

GET VACCINATED TO PROTECT OTHERS

Infants too young
for some vaccines



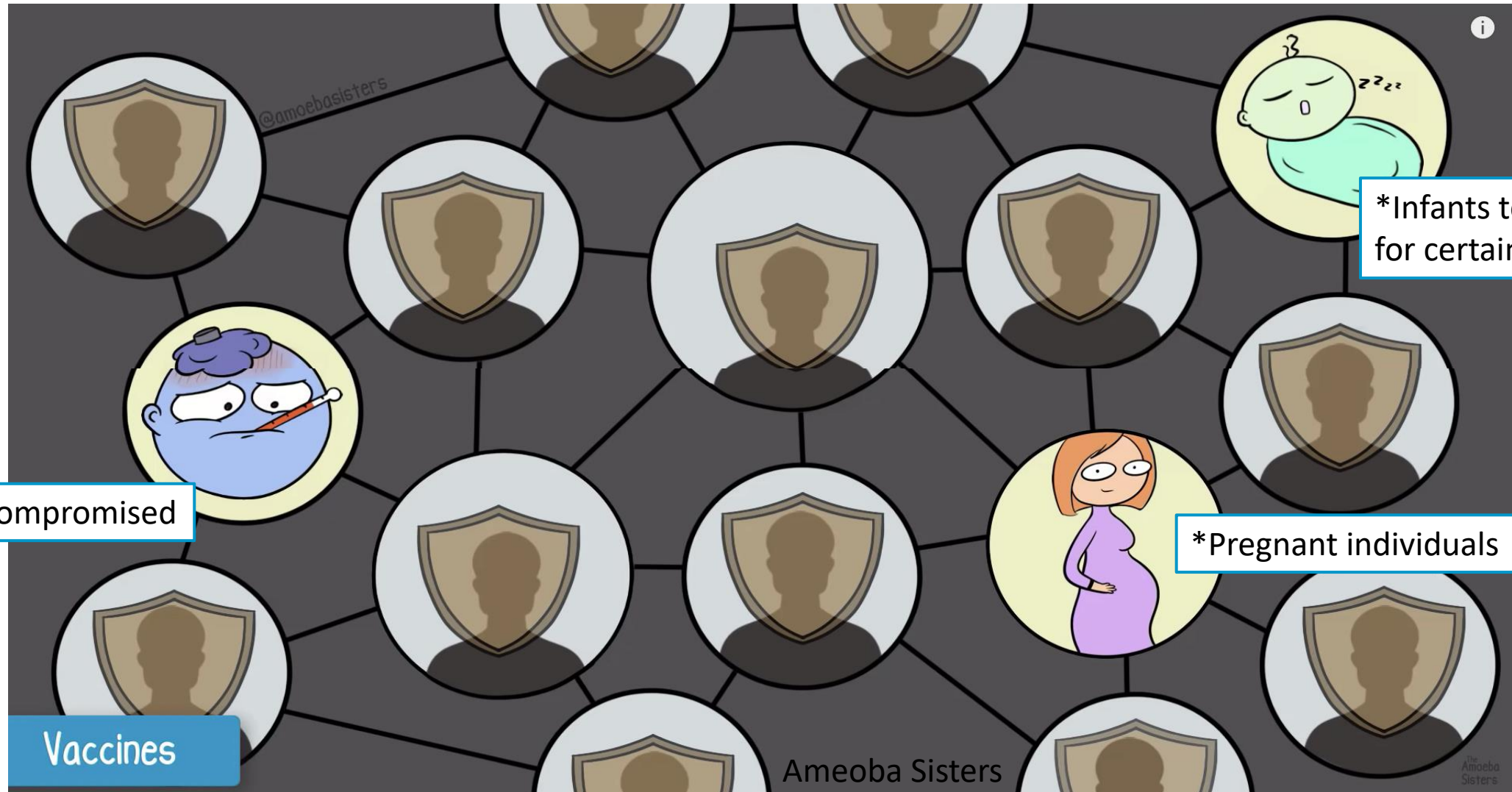
People who have
weakened immune
systems or
cancer or
on chemotherapy or
had a transplant

People who
are pregnant

Ameoba Sisters

**There are some people who can't be immunized
due to health issues or status of immune system**

GET VACCINATED TO PROTECT OTHERS



HERD IMMUNITY

Those who are vaccinated protect or 'shield' those who are not vaccinated by decreasing the spread of disease

QUICK REVIEW of CORE IDEAS

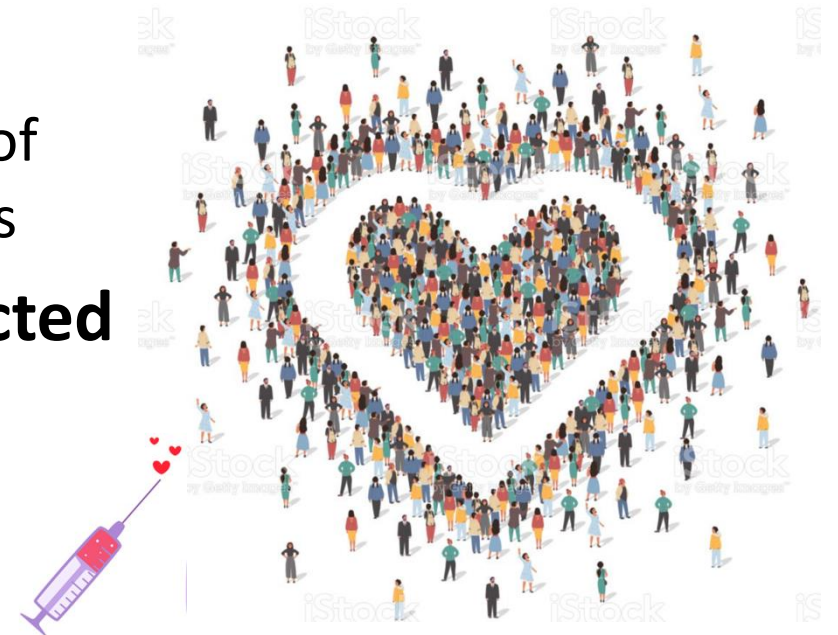
1. The immune system is a mobile defense system composed of a variety of specialized cells
2. The cells of the immune system work together to detect and defend us from pathogens and disease
3. Vaccines are harmless forms of a pathogen that stimulate the immune system
4. Vaccines train the immune system to make memory cells for long-lasting protection
- 5. Multiple types of vaccines exist because there are multiple types of pathogens – the best and most effective is selected**
- 6. We get vaccinated to protect ourselves from disease and to shield our community from the spread of disease**

QUESTIONS that have been answered 😊

- What is the immune system?
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SUMMARY

- The immune system is a mobile defense system that continually patrols and deploys cells as needed across the body
- Vaccines are harmless forms of pathogen that work *with* the immune system to train our B and T cells (adaptive) to provide long-lasting protection
- The B and T cells of our adaptive immune system are individually highly specific and when combined incredibly diverse
- Due to the exquisite specificity built into our B and T cells, our immune systems can't be overwhelmed by antigen or immunization
- Preventive vaccines have led to the control or elimination of many infectious diseases that once claimed millions of lives
- **We need to view our communities as interconnected humans who take care of each other and provide protection for those who can't be vaccinated**



THANK YOU!



QUESTIONS?

Ask now or email later

Aimee.Bernard@cuanschutz.edu



Immunize for Good. Respect the Facts. Protect Your Child. Immunize for Good.

RESOURCES



Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

Vaccines & Immunizations

<https://www.cdc.gov/vaccines/index.html>



credible vaccine information for
families, from families ❤️

<https://www.voicesforvaccines.org>



<https://www.immunizecolorado.org/>



healthy children.org

Powered by pediatricians. Trusted by parents.
from the American Academy of Pediatrics

<https://www.healthychildren.org/>



Immunize.org

<https://www.immunize.org/vaccines/>

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SOCIAL MEDIA



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BLOGS

Team Vaccine
Immunology 101 Series



PODCASTS



MAKE IT MAKE SENSE
WITH DR. TONI AND DR. AIMEE

Help! Make It Make Sense
with Dr. Toni & Dr. Aimee

THE CONVERSATION

Academic rigor, journalistic flair

Arts + Culture Economy Education Environment + Energy Ethics + Religion **Health** Politics + Society Science + Tech Podcasts



Immune health is all about balance – an immunologist explains why both too strong and too weak an immune response can lead to illness

Published: November 20, 2023 8:18am EST



Aimee Pugh Bernard
Feb 19 · 8 min read · Listen



Medium
<https://medium.com>

An Immunologist Offers Tips for Assessing Science and Health Info on the Internet



Un inmunólogo ofrece consejos para evaluar información científica y sanitaria en Internet-

THE IMMUNOLOGY
PODCAST™

featuring Drs. Akiko Iwasaki
& Aimee Bernard

January 2024

Ep. 70: "Public Outreach" Featuring Drs. Akiko Iwasaki and Aimee Bernard
- The Immunology Podcast

THE DENVER POST

OPINION > OPINION COLUMNISTS

Guest Commentary: The death of Colorado's reasonable vaccine bill should be a call to action

By LINDSAY DIAMOND and AIMEE BERNARD
May 7, 2019 at 11:05 a.m.



The immune system is your personal Transportation Security Administration (TSA)

- Detect patterns of danger - alert



- Detect patterns of self - tolerate

