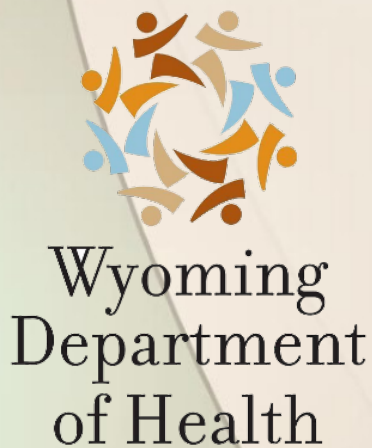


The Big, Wonderful Immune System

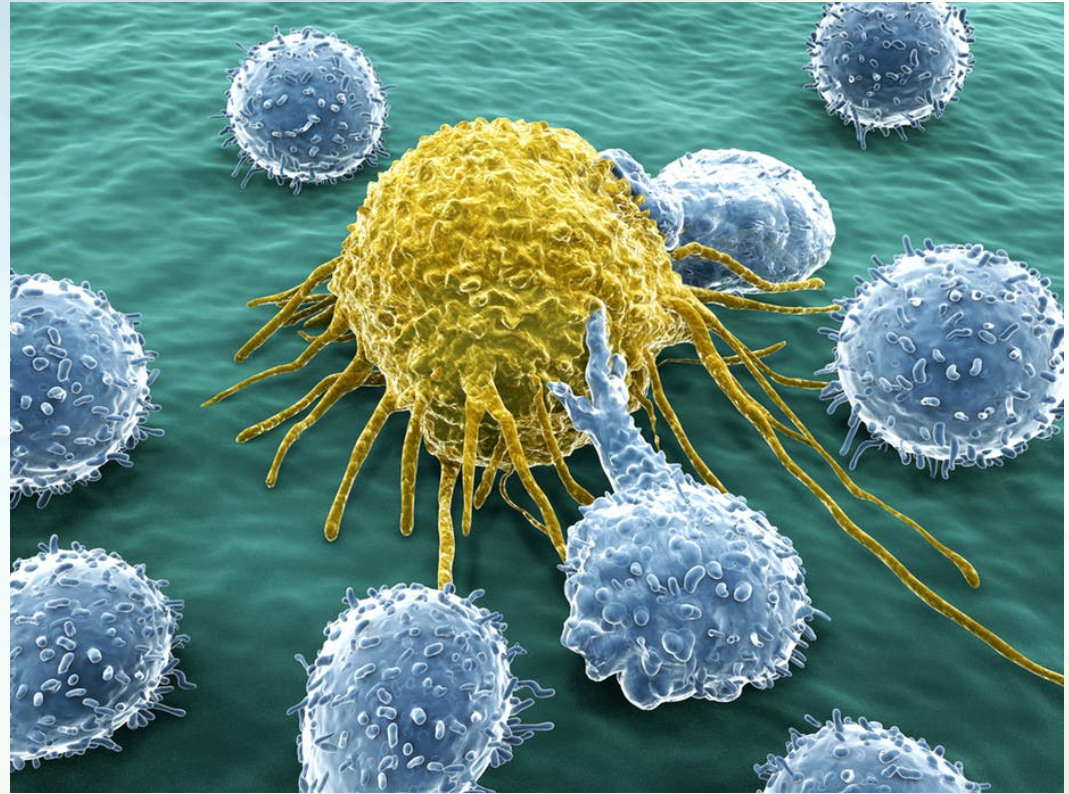
Heidi Gurov, RN BSN CMSRN ONC
Clinical Consultant & Quality Improvement Specialist
Wyoming Department of Health Immunization Unit

Wyoming Immunization Conference
May 13, 2020



Today we'll learn...

- General anatomy and function of the human immune system
- Types of immunity
- Types of vaccines and how they differ
- Breakthrough disease & vaccine failure
- Herd immunity



The Immune System

What is the immune system?

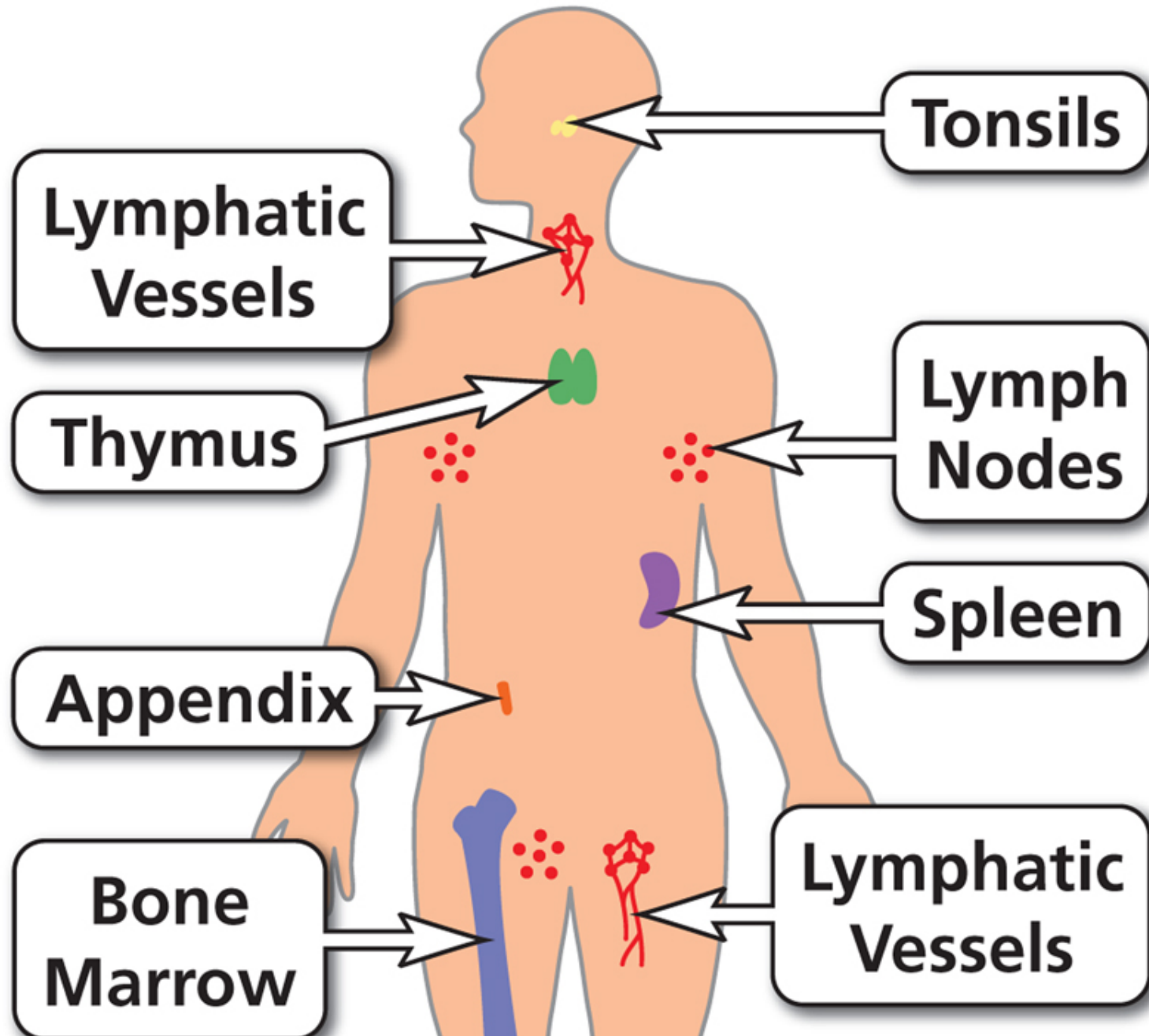
- A complex system of interacting cells that identifies foreign substances and develops a defense against these substances
- Two key principles:
 - Specificity
 - Memory

Antigen

- Substance capable of producing an immune response
- Recognized as “non-self,” or foreign
- Two types:
 - Exogenous
 - Endogenous

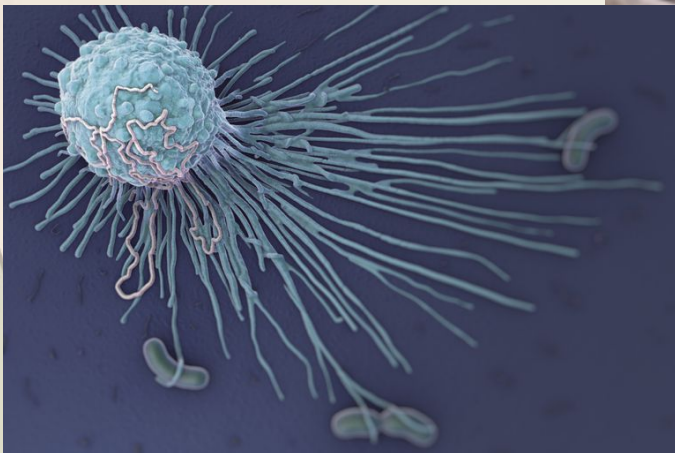
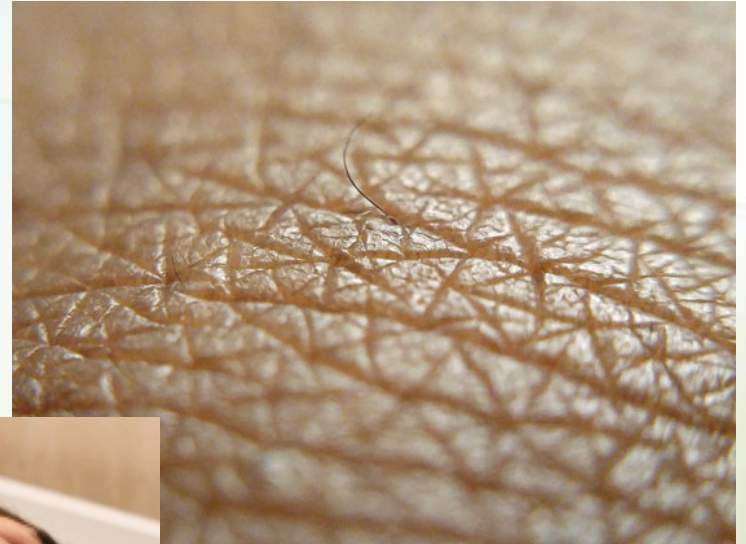


Immune System



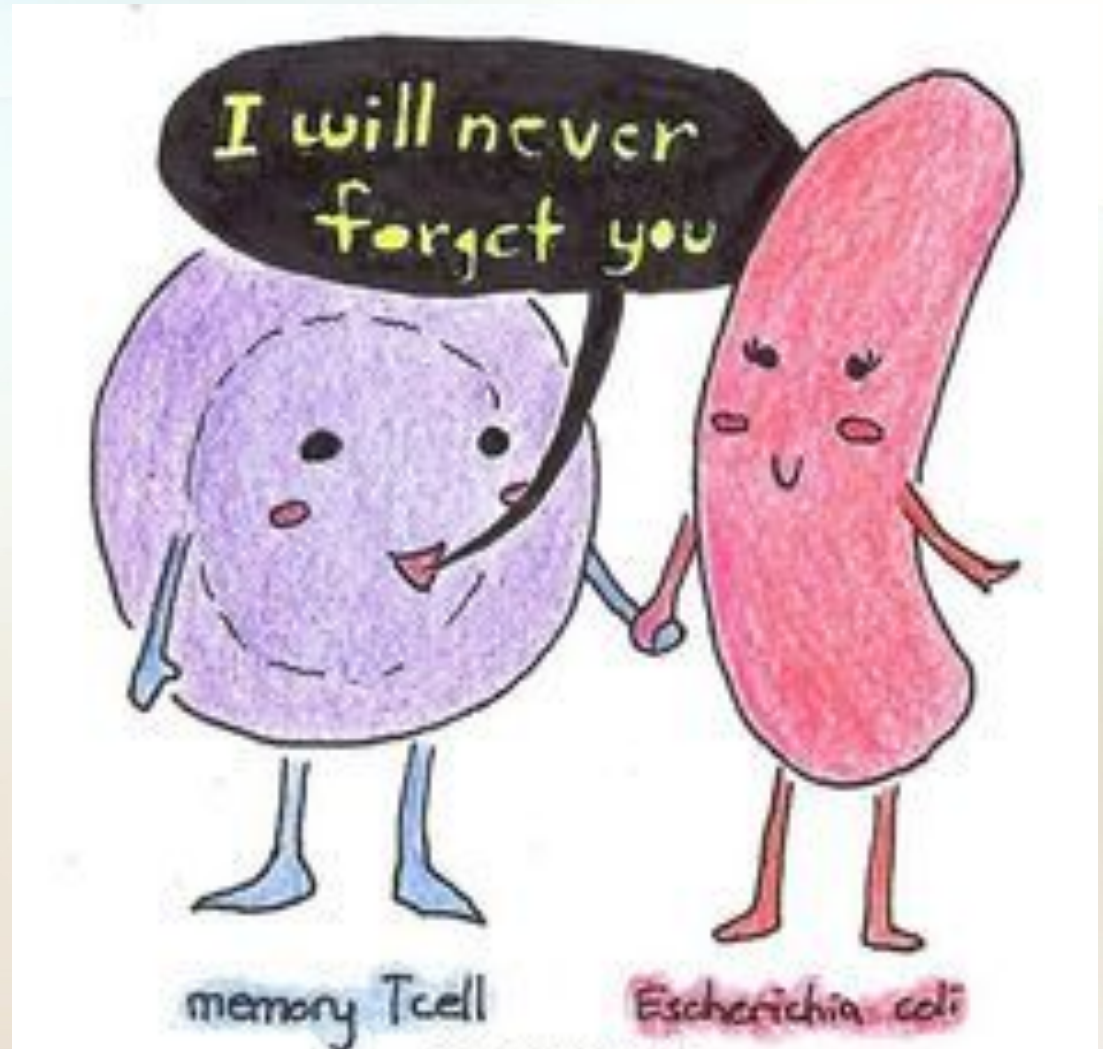
Innate Immunity

- Anatomical barriers
- Cellular response
- Soluble proteins

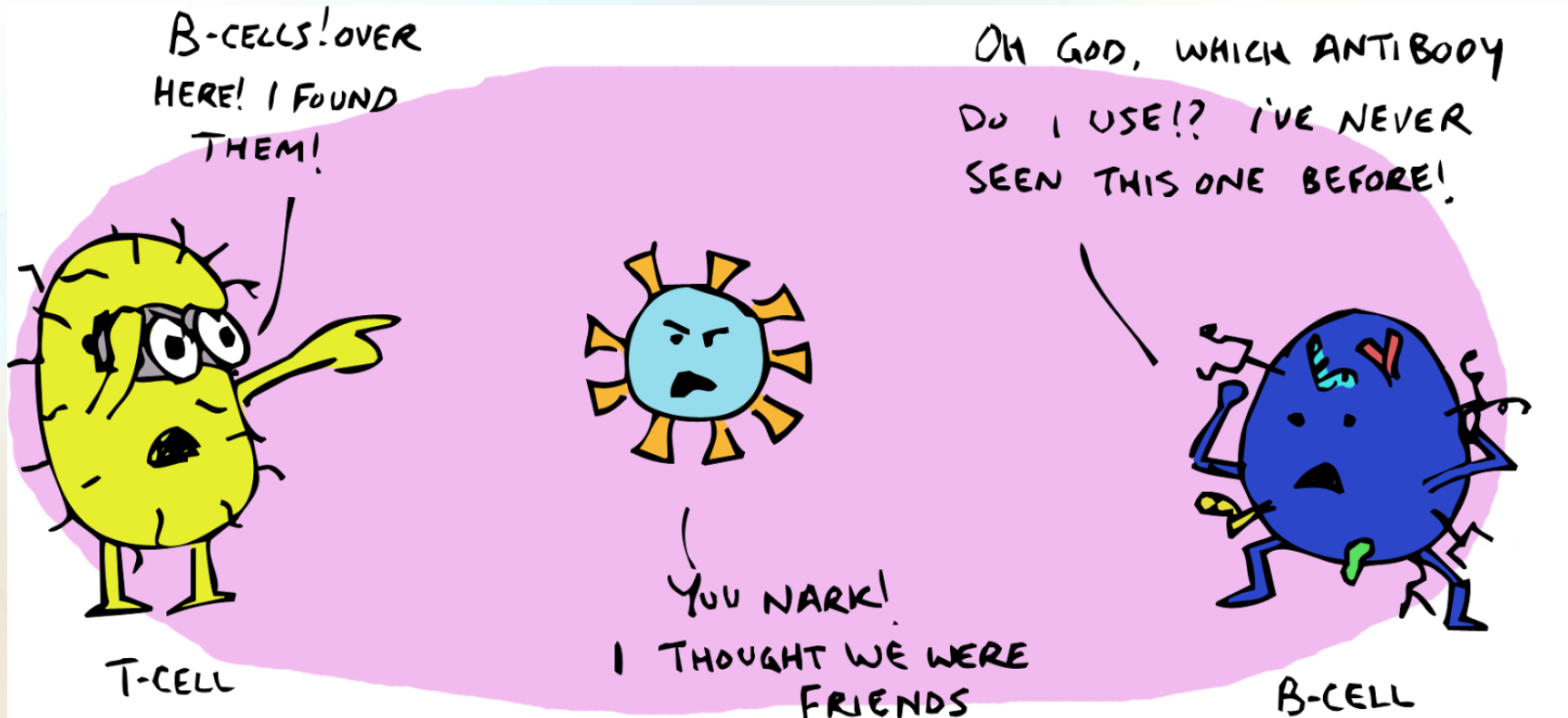


Adaptive Immunity

- Humoral vs. Cell-Mediated
- Active vs. Passive



Humoral Immunity

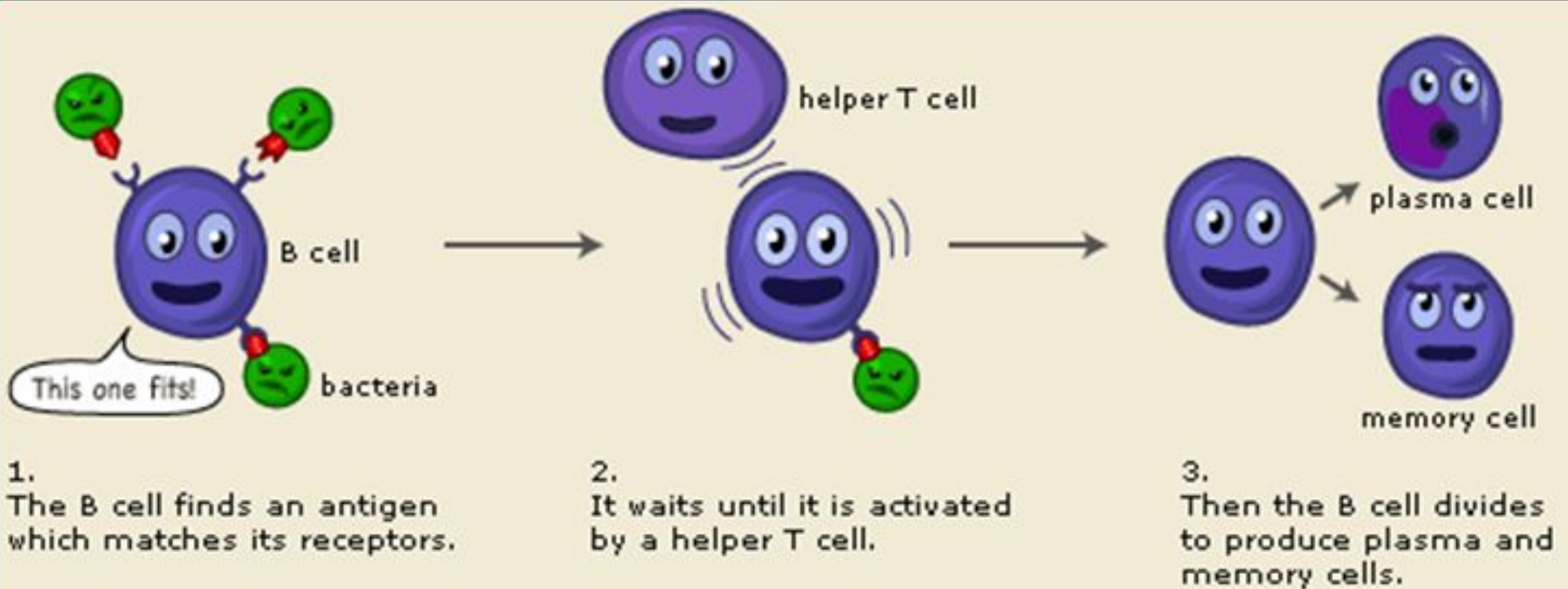


- B Lymphocytes

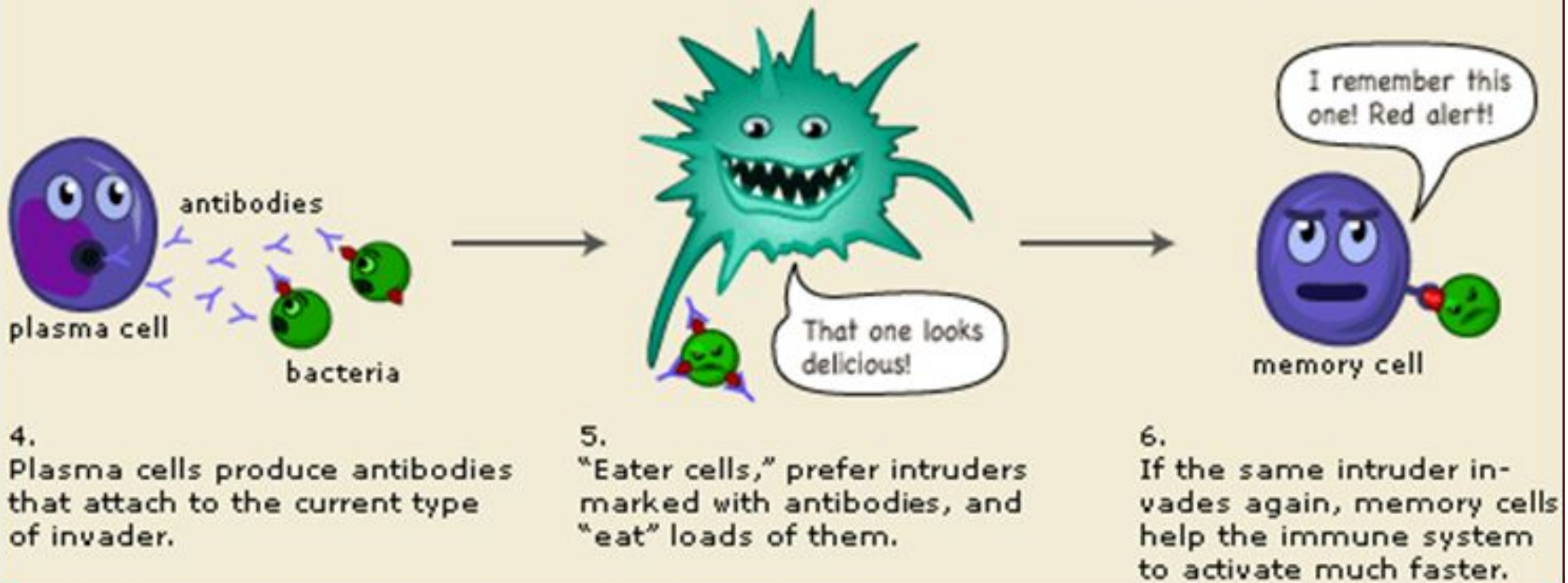
- Mature in the bone marrow
- Memory B cells
 - Long life span
 - Membrane bound antibodies

- Plasma cells (effector B cells)
 - Antibodies in secretory form
 - Live only a few days
- Antibodies
 - 5 types

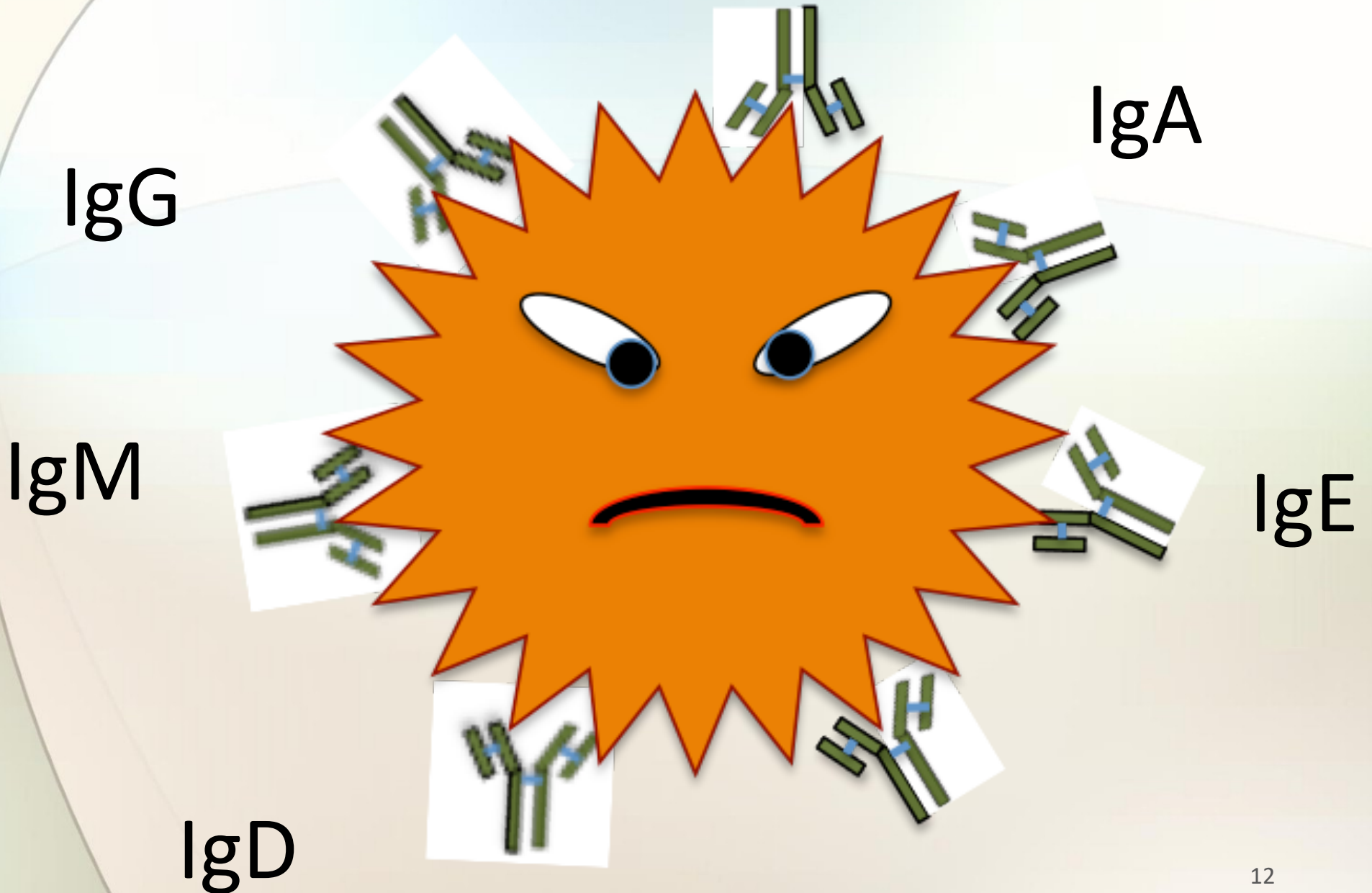
Humoral Response: Part 1



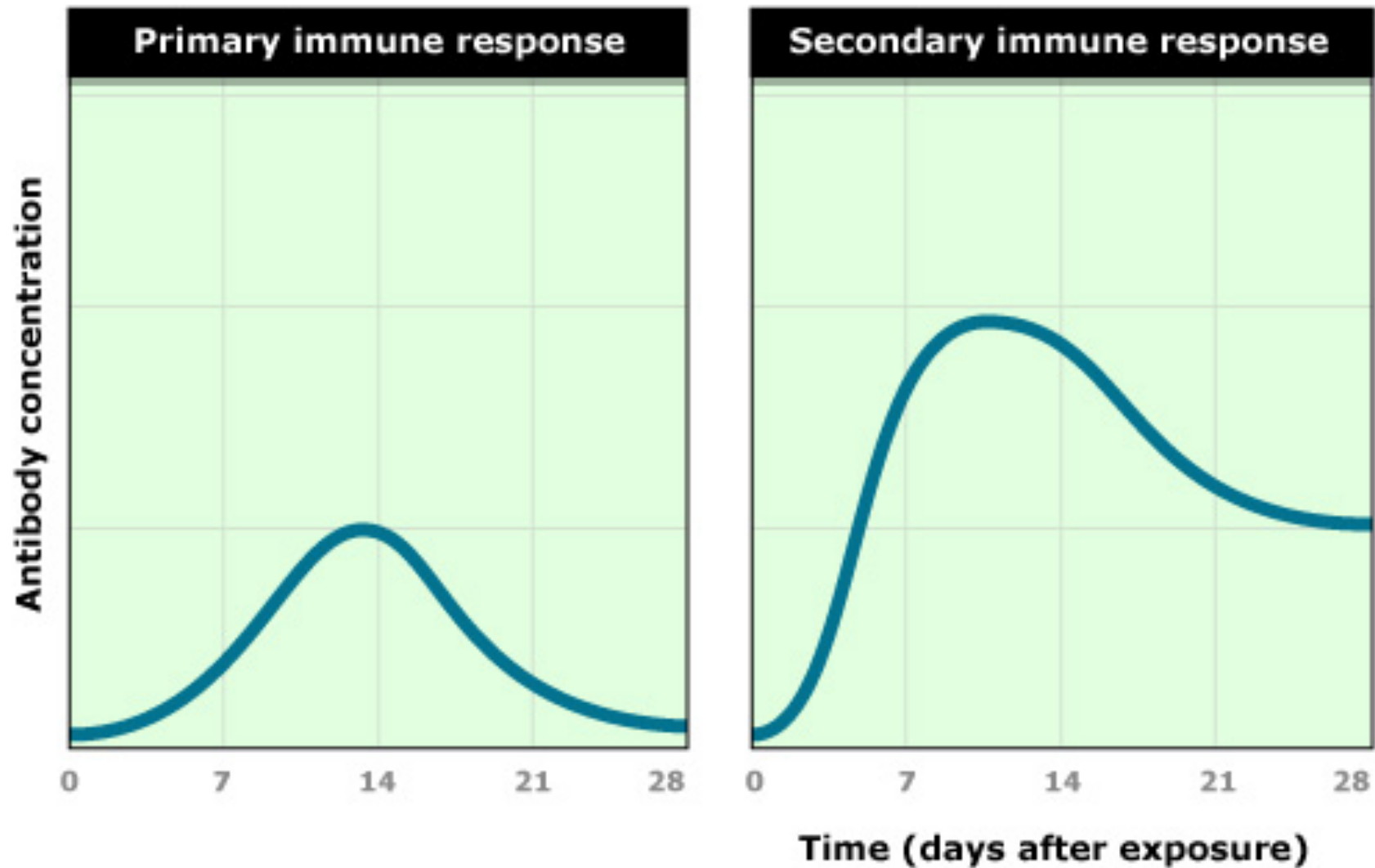
Humoral Response: Part 2



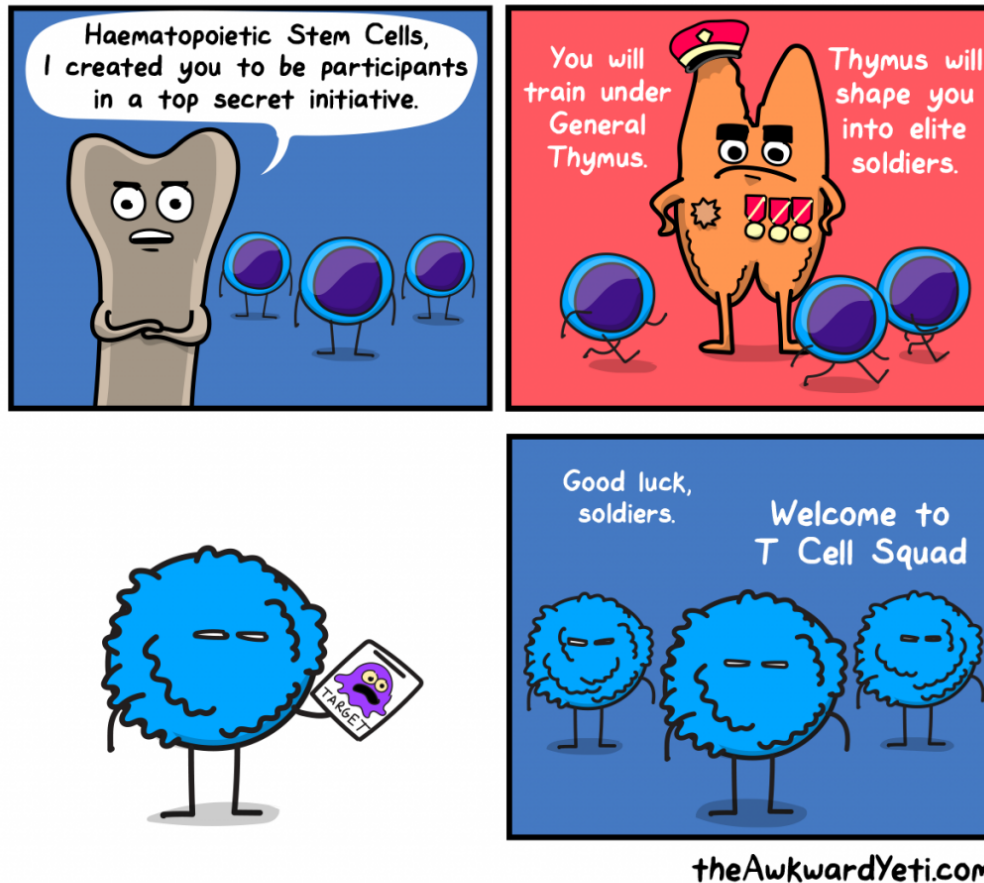
Antibodies



Primary vs. Secondary Response



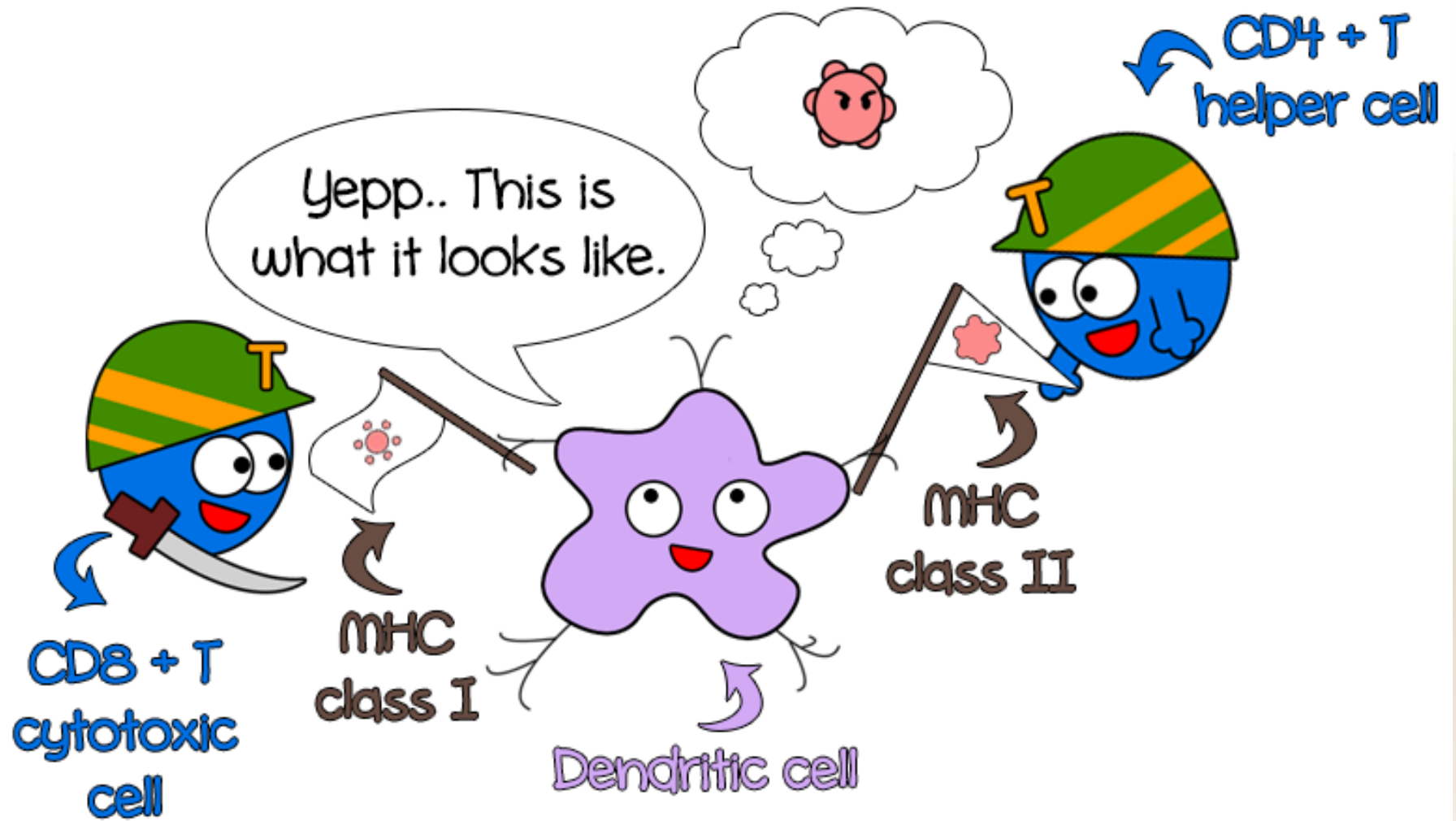
Cell-Mediated Immunity



- T-lymphocytes

- Arise in bone marrow but mature in thymus
- T-helper CD4 cells
 - Recognizes and interacts with antigen-molecule complex
 - Becomes activated, secretes cytokines
- T-cytotoxic CD8 cells
 - Exhibits cell killing activity once activated

The Cell-Mediated Response



Passive vs. Active Immunity

- Passive Immunity
 - Protection by products produced by an animal or human and that are transferred to another human



Passive vs. Active Immunity

- Active Immunity
 - Protection produced by a human's own immune system





theAwkwardYeti.com

Questions??

heidi.gurov@wyo.gov or 307-777-8981



Vaccines

Vaccination

- Active immunity
- Two types:
 - Inactivated
 - Live, attenuated
- General rule: The more similar a vaccine is to the disease-causing form of the pathogen, the better the immune response is to the vaccine

Inactivated Vaccines

- Cannot cause any form of disease
- Less affected by circulating antibody
- Always require multiple doses
- Mostly a humoral response
- Antibody titers will diminish with time

Inactivated Vaccine Types

- Whole Cell
 - Polio, hepatitis A, rabies
- Fractional
 - Toxoid
 - Diphtheria, tetanus
 - Subunit
 - Hepatitis B, influenza, acellular pertussis, anthrax

Inactivated Vaccine Types

- Fractional – continued:
 - Pure polysaccharide based
 - Pneumococcal, typhoid
 - Conjugate
 - Hib, pneumococcal, meningococcal
 - Recombinant
 - Hepatitis B, HPV, influenza

Live, Attenuated Vaccines

- Weakened in laboratory
- Fragile
- Humoral and cell-mediated response
- Usually produce immunity with one dose
- Interference from circulating antibody
- Cannot be used in immunocompromised persons

Live, Attenuated Vaccines

- Measles, mumps, rubella (MMR)
- Varicella
- Zoster
- Rotavirus
- Intranasal influenza
- Yellow fever
- Oral typhoid
- Vaccinia (smallpox)

Vaccine Components

- Antigen
 - Stimulates immune response
- Stabilizers
 - Maintain effectiveness in storage
 - MgCl₂, MgSO₄, lactose-sorbitol
- Gelatin
 - All religious groups have approved the use of gelatin contain vaccines for their followers
 - Vegans may refuse products with gelatin

Vaccine Components

- Antibiotics
 - Help prevent bacterial contamination of tissue cultures during manufacturing process
 - Neomycin, streptomycin, polymyxin B, chlorotetracycline, amphotericin B
 - Rarely cause human allergies

Vaccine Components

- Adjuvants
 - Help stimulate the production of antibodies against the antigen
 - Makes vaccines more effective by enhancing, accelerating, and prolonging the immune response
 - Important in inactivated vaccines
 - Several hundred different types

Aluminum

- Used as adjuvant since 1930s
- Natural element that is present in our environment
- Quantity found in vaccines is small
 - In the first 6 months of life, babies...
 - Receive 4mg if they get all recommended doses of vaccines
 - Ingest 10mg if they are breastfed
 - Ingest 40mg if they are fed regular formula
 - Ingest 120mg if they are fed soy-based formula
- Processed the same in body whether ingested or injected

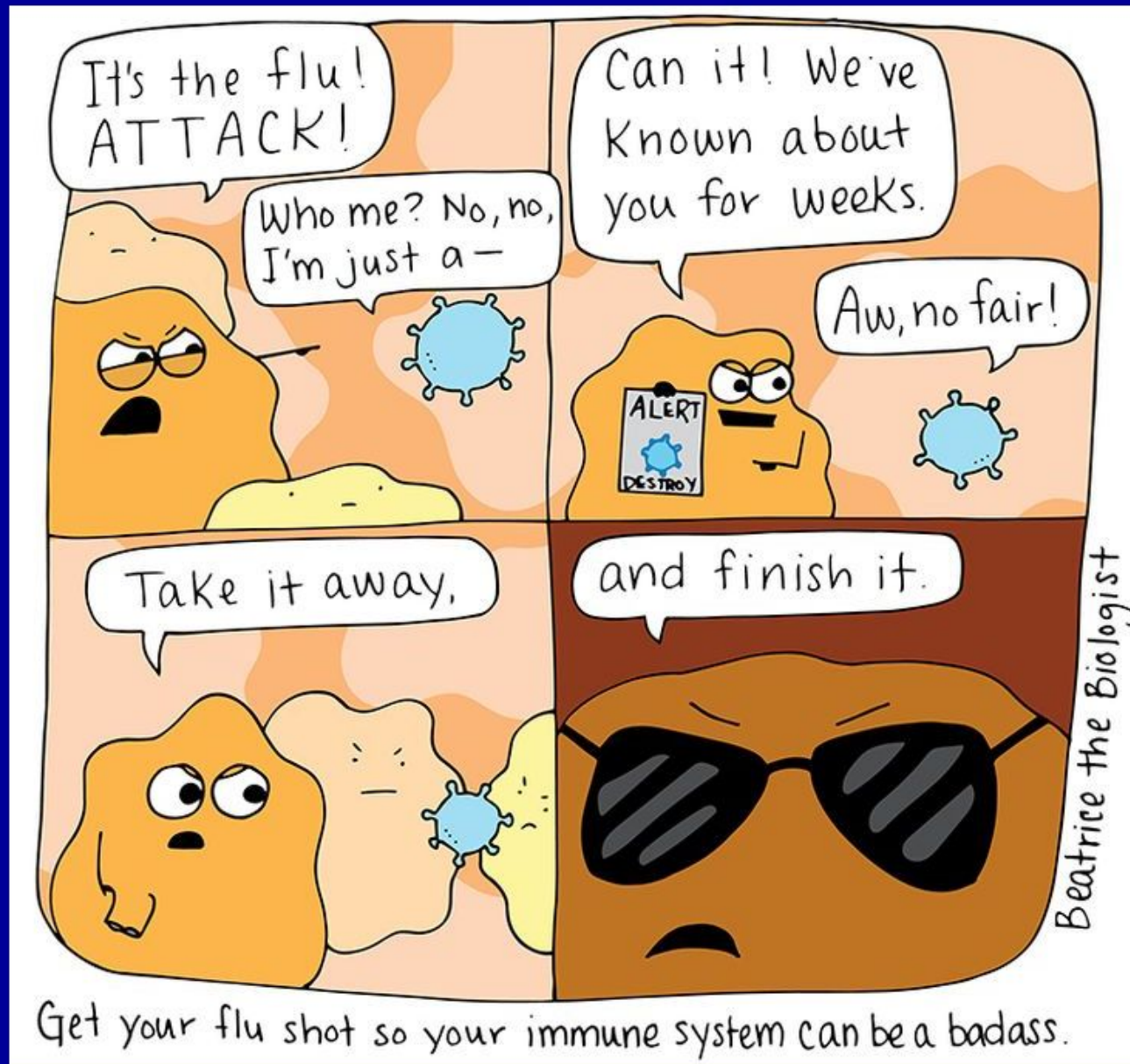
Vaccine Components

- **Preservatives**
 - Added to multi-dose vials to prevent bacterial or fungal growth
 - **Thimerosal**
 - Ethyl-mercury compound
 - Naturally occurring element found in the environment
 - Pulled from all routine childhood vaccines in the late 1990s
 - **Formaldehyde**
 - Used to inactivate viruses and detoxify bacterial toxins
 - A by-product of protein and DNA synthesis, so it is commonly found in the bloodstream
 - The quantity found in the blood is 10 times greater than that found in any vaccine

Fetal Cells

- Fetal cell lines
 - Used to make rubella, varicella, hepatitis A, shingles, and rabies vaccines
 - Cells were obtained from two elective abortions performed in the early 1960s
 - Does not require ongoing abortions
 - National Catholic Bioethics Center determined the use of vaccines grown in fetal cells isolated from historic abortions was morally acceptable





Questions??

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Breakthrough Disease

- Varicella
- Pertussis
- Polio

- Usually significantly milder than natural disease
- Can result from several factors



Do You Know What Breakthrough Varicella (Chickenpox) Looks Like?

What is breakthrough varicella?

Breakthrough varicella is an infection with wild-type varicella zoster virus that occurs in a varicella vaccinated person more than 42 days after vaccination.

Varicella in an Unvaccinated Person



- 250–500 lesions
- Mostly vesicular
- Fever
- Illness for 5–7 days

Breakthrough Varicella



- <50 lesions
- Few or no vesicles
- No or low fever
- Shorter duration of illness

How is breakthrough varicella confirmed?

The best method to confirm breakthrough varicella is laboratory PCR testing of skin lesion specimens—scabs, vesicular fluid, or scrapings of maculopapular lesions.

www.cdc.gov/chickenpox/lab-testing/



Centers for Disease Control and Prevention
National Center for Immunization and Respiratory Diseases

Why is breakthrough varicella hard to diagnose?

The rash caused by breakthrough varicella looks similar to other rashes, so it is often difficult to diagnose clinically.

Breakthrough Varicella



Insect Bites



Poison Ivy




Ringworm





Vaccine Failure

- Primary
- Secondary



 = not immunized,
but still healthy

 = immunized
and healthy

 = not immunized,
sick, and contagious



No one
is immunized.



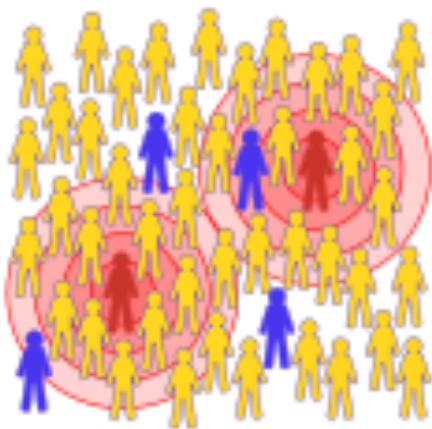
Contagious
disease spreads
through the
population.



Some of the
population gets
immunized.



Contagious
disease spreads
through some
of the population



Most of the
population gets
immunized.



Spread of
contagious
disease is
contained.

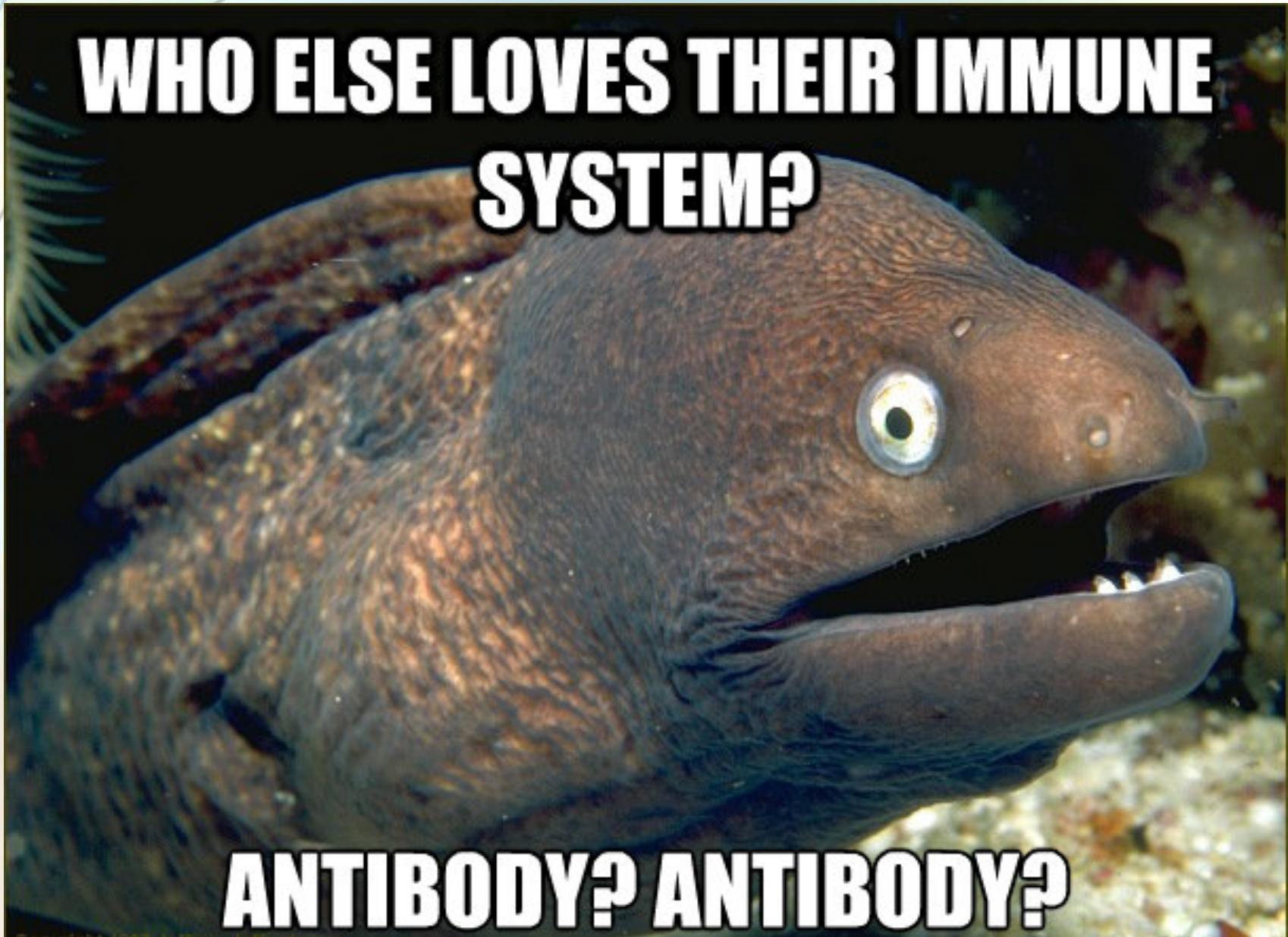


Herd Immunity



**The
immune
system is
awesome!!**

**WHO ELSE LOVES THEIR IMMUNE
SYSTEM?**



ANTIBODY? ANTIBODY?

Questions??

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Wyoming
Department
of Health



Thank you!!

Heidi Gurov, RN BSN CMSRN ONC
Clinical Consultant & Quality Improvement Specialist
Wyoming Department of Health
Immunization Unit

307-777-8981

Heidi.gurov@wyo.gov

www.immunizewyoming.com