Chapter 17 - Immunization

NIMESH PATEL| HLSC 2400

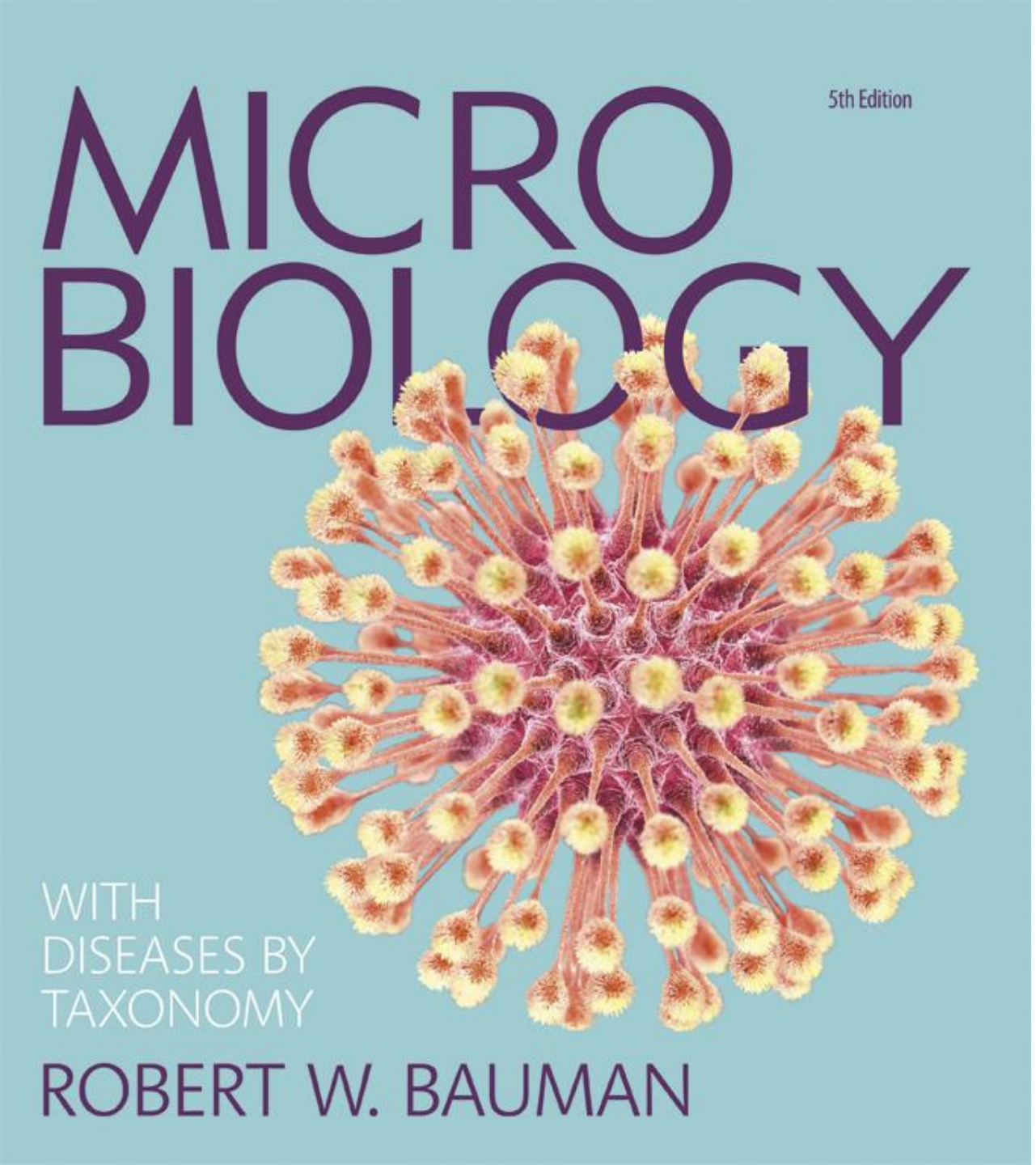
OCTOBER 3, 2017

Reminder: Test # 1

- Test 1: October 3 – October 5, 2017
  - Reattempt: October 6 – October 11, 2017
- Reattempt will be available **ONLY** if you take the first attempt in the mentioned period
- There must be min **48 hours** between the two attempts
- The test will be based on the material presented or discussed in the classroom and textbook chapters that students are required to review independently.
- Check the Moodle for more info on testing center and the exam process

Test # 1

- **Content:** chapter 14 [Infection, infectious disease, and epidemiology], chapter 15 [Innate immunity], and chapter 16 [Adaptive immunity].
- **20** multiple choice questions and/or true-false questions.
- **Duration:** 40 minutes
- **Location:** Testing Centre



PowerPoint® Lecture Presentations prepared by Mindy Miller-Kittrell, North Carolina State University

CHAPTER 17

Immunization and Immune Testing

Types of Acquired Immunity

- Specific immunity acquired during an individual's life
- Two types:
  - **Naturally acquired**
    - Response against antigens encountered in daily life
  - **Artificially acquired**
    - Response to antigens introduced via a vaccine
- Distinguished as either active or passive

TABLE 16.4 A Comparison of the Types of Acquired Immunity

	Active	Passive
Naturally Acquired	 The body responds to antigens that enter naturally, such as during infections.	 Antibodies are transferred from mother to offspring, either across the placenta (IgG) or in breast milk (secretory IgA).
Artificially Acquired	 Health care workers introduce antigens in vaccines; the body responds with antibody or cell-mediated immune responses, including the production of memory cells.	 Health care workers give patients antisera or antitoxins, which are preformed antibodies obtained from immune individuals or animals.

Immunization

- **Two Artificial Methods of Immunity**
  - *Active immunization*
    - Administration of antigens so patient actively mounts an adaptive immune response
  - *Passive immunotherapy*
    - Individual acquires immunity through the transfer of antibodies formed by immune individual or animal

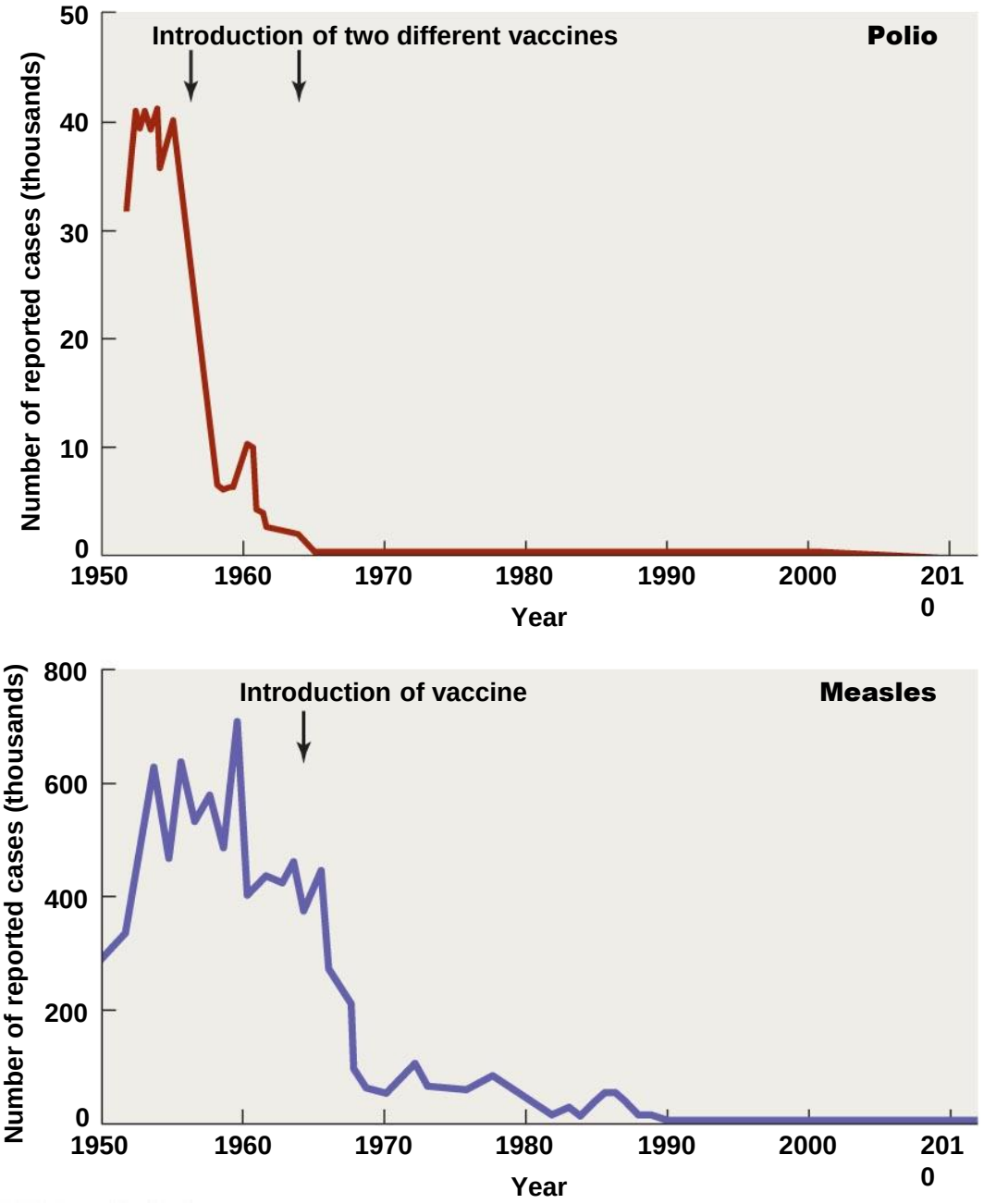
Immunization

- **Brief History of Immunization**
  - Chinese noticed children who recovered from smallpox did not contract the disease again
  - They infected children with material from a smallpox scab to induce immunity
    - This process known as *variolation*
  - Variolation spread to England and America but was stopped due to risk of death

Immunization

- **Brief History of Immunization**
  - 1796 — Edward Jenner discovered process of vaccination
  - 1879 — Louis Pasteur developed a vaccine against *Pasteurella multocida*
  - Antibody transfer developed when it was discovered vaccines protected through the action of antibodies

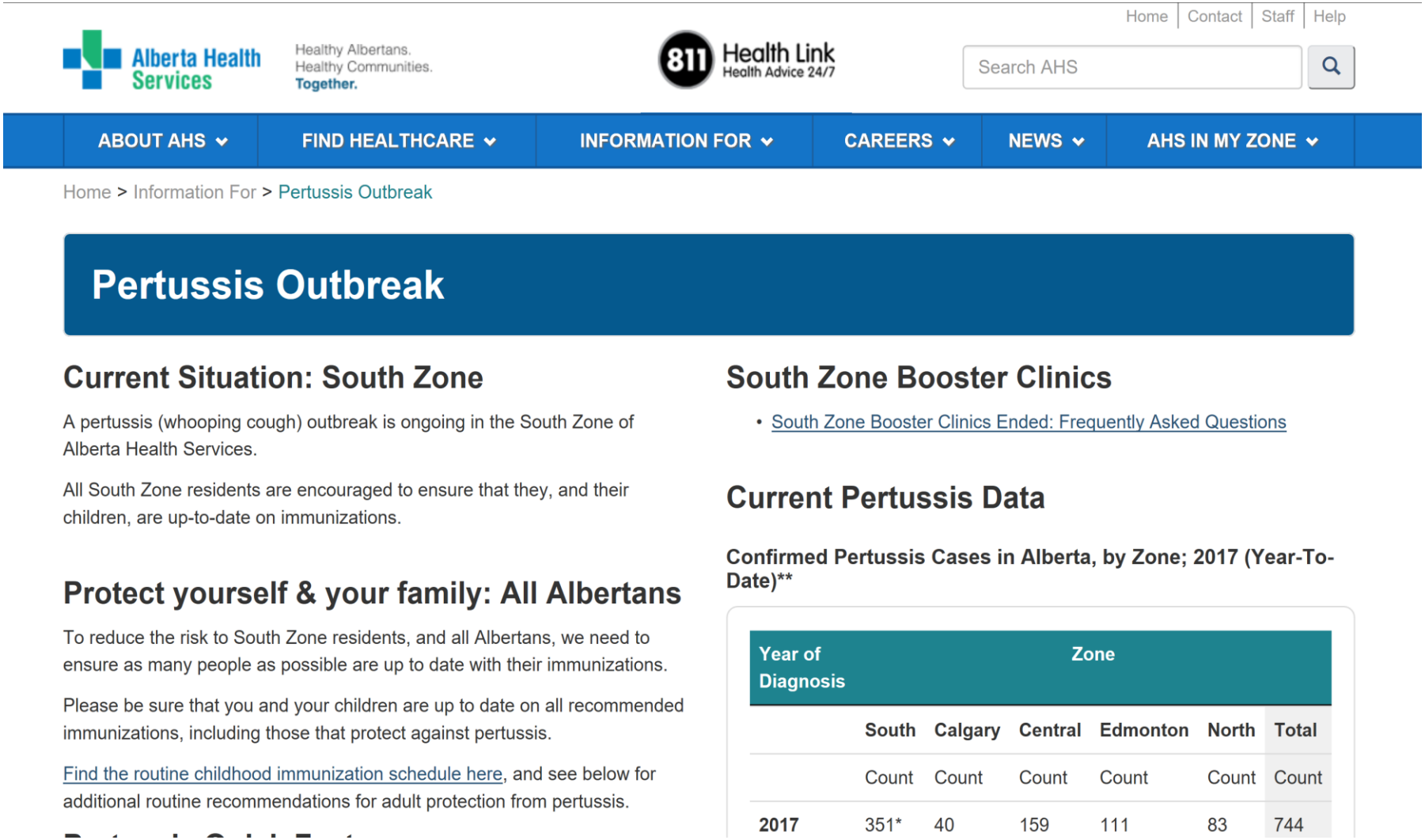
Figure 17.1 The effect of immunization in reducing the prevalence of two infectious diseases in the United States.



Immunization

- **Brief History of Immunization**
  - A variety of political, social, economic, and scientific problems prevent vaccines from reaching all those who need them
  - In developing nations, **over 3 million children still die** each year from vaccine-preventable infectious diseases, primarily because of political obstacles.
  - Effective vaccines not developed for some pathogens
    - E.g., malaria, HIV
  - Vaccine-associated risks discourage investment in developing new vaccines
    - Medical risks (low) and financial risks

Whooping Cough Outbreak: Southern Alberta



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Pertussis Outbreak

Current Situation: South Zone

A pertussis (whooping cough) outbreak is ongoing in the South Zone of Alberta Health Services.

All South Zone residents are encouraged to ensure that they, and their children, are up-to-date on immunizations.

Protect yourself & your family: All Albertans

To reduce the risk to South Zone residents, and all Albertans, we need to ensure as many people as possible are up to date with their immunizations.

Please be sure that you and your children are up to date on all recommended immunizations, including those that protect against pertussis.

Find the routine childhood immunization schedule here, and see below for additional routine recommendations for adult protection from pertussis.

South Zone Booster Clinics

- South Zone Booster Clinics Ended: Frequently Asked Questions

Current Pertussis Data

Confirmed Pertussis Cases in Alberta, by Zone; 2017 (Year-To-Date)**

Year of Diagnosis	Zone					
	South	Calgary	Central	Edmonton	North	Total
	Count	Count	Count	Count	Count	Count
2017	351*	40	159	111	83	744

Whooping Cough Outbreak: Southern Alberta

https://globalnews.ca/news/3566304/alberta-whooping-cough-cases-surge-to-266-as-outbreak-continues-to-spread/

Whooping Cough Outbreak: Southern Alberta

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Low immunization rate blamed for exponential growth of whooping cough outbreak near Lethbridge

Immunization rates in southern Alberta can vary significantly, some say due in part to religion

By David Bell, CBC News Posted: Jun 17, 2017 1:00 PM MT | Last Updated: Jun 19, 2017 9:54 AM MT

A whooping cough outbreak in southern Alberta has health officials pleading for greater acceptance of immunization science. (Ted S. Warren/File Photo/The Associated Press)

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Southern Alberta is seeing a surge of cases of pertussis, or whooping cough, and a health official says it's directly related to low immunization rates in some areas.

As of Thursday morning, 38 cases in the Lethbridge area have been linked.

"We are getting multiple lab reports a day and we are definitely seeing this

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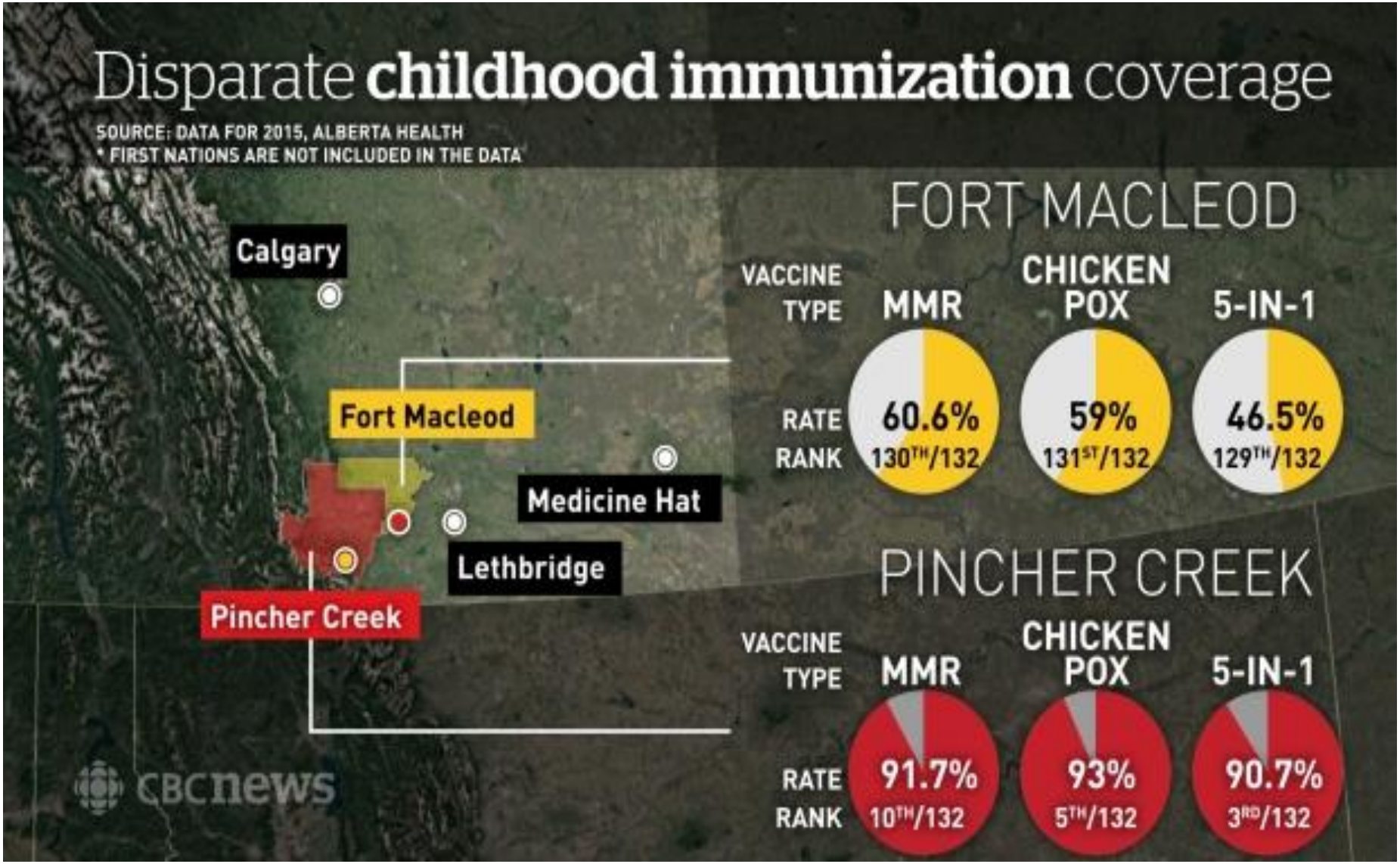

http://www.cbc.ca/news/canada/calgary/pincher-creek-fort-macleod-vaccination-rates-1.3987887

Measles Outbreak in BC

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Canada BC

Measles outbreak provokes huge demand for vaccine in B.C.

Disneyland outbreak prompts concern in run up to Spring Break

CBC News Posted: Feb 13, 2015 12:13 PM PT | Last Updated: Feb 13, 2015 12:13 PM PT

Clinics in the Lower Mainland are experiencing huge demand for measles vaccinations in the run up to Spring Break. THE CANADIAN PRESS/AP-The Fort Collins Coloradoan, Dawn Madura (Associated Press)

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A measles outbreak in Disneyland has prompted a huge run on the vaccine in the Lower Mainland as families prepare for Spring Break vacations.

More than 70 people across the U.S. (including six Disneyland employees), Mexico and Canada have been affected by the outbreak.

- **Pickering mom slams 'anti-vaxxers' after baby possibly exposed to measles**

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Latest British Columbia News

- Insurance licensor suspends 21 Surrey agents over alleged cheating on exams
- 21-year-old Victoria man recovering in Vegas ICU following deadly shooting
- 3 Canadians among dozens killed in Las Vegas mass shooting

Let’s get back to science

- *“The science behind the effectiveness and benefits of vaccination is well documented, and we are seeing the sad consequences of parents opting out of these benefits. But do you remember the origins of the rumors attempting to connect the MMR vaccine with autism? It began with a research paper-later retracted-from investigators at a London medical school, but soon spread fear, guilt, and now the resurgence of a* ***nearly eradicated*** *infectious disease across the globe.*
- *In 2011, The BMJ published an in-depth, three-part investigation that described the problems with data corruption and bias in the original paper:*

  How the case against the MMR vaccine was fixed
  <http://emails.bmj.com/c/1LsiM5ARf3eBrbw9zbtpRtLEl>

  How the vaccine crisis was meant to make money
  <http://emails.bmj.com/c/1LsiQ4WcFMA6paglqKRLAsnJW>

  The Lancet's two days to bury badnews
  <http://emails.bmj.com/c/1LsiU4hy6vVBn90xikg7jqZPx>

Let’s get back to science

- *As we move forward, and encourage parents to vaccinate their children, I think it's important to revisit this history and remember the detrimental effects that fraudulent data can have on the health of the global population, and the importance of championing transparency, integrity, and scientific literacy.”* - Carolyn Wong Simpkins, MD, PhD, BMJ Clinical Director, North America

659 elementary school students in Windsor area suspended for incomplete immunization records

Students born between 2008-2011 with incomplete records received notice in the spring

CBC News Posted: Sep 28, 2017 9:08 AM ET | Last Updated: Sep 28, 2017 1:05 PM ET

File photo. (CBC)

The Windsor-Essex County Health Unit has suspended 659 elementary school students in the Windsor, Ont., area after determining their immunization records weren't up to date.

The health unit reviewed the immunization records of all children registered with boards in the area born between 2008-2011, meaning they're in Grades 1 to 4. The exact schools involved weren't immediately available.

Immunization: A Success Story

India completes 5 polio-free years; last case reported on Jan 2011

India on Wednesday completed five years of being polio-free. Polio is a highly infectious viral disease that leads to irreversible paralysis and used to cripple more than 50,000 children in the country each year in the early 90s.

HEALTH AND FITNESS Updated: Jan 13, 2016 20:46 IST

HT Correspondent
Hindustan Times

BBC on India's success against Polio

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How India managed to defeat polio

13 January 2014 | India

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India's polio immunisation programme is among the most extensive in the world

It is three years since India last reported a case of polio. Patralekha Chatterjee reports on how the country appears to have finally managed to beat the disease.

Despite a healthcare system beset by severe problems, India has ushered in the new year with an achievement to be proud of.

Immunization

- **Active Immunization**
  - Vaccine Types
    - Attenuated (modified live) vaccines
      - Use pathogens with reduced virulence
      - Process of reducing virulence called **attenuation**
      - Can result in mild infections
      - Active microbes stimulate a strong immune response
      - Can provide contact immunity
      - Modified microbes may retain enough residual virulence to cause disease in susceptible individuals

Immunization

- **Active Immunization**
  - Vaccine Types
    - Inactivated (killed) vaccines
      - Safer than live vaccines
      - Whole agent vaccines
        - Inactivate but whole microbes
      - Subunit vaccines
        - Antigenic fragments of microbes
      - Often require multiple doses to achieve full immunity
      - Does not stimulate contact immunity
      - Often contain adjuvants
        - Chemicals added to increase effective antigenicity

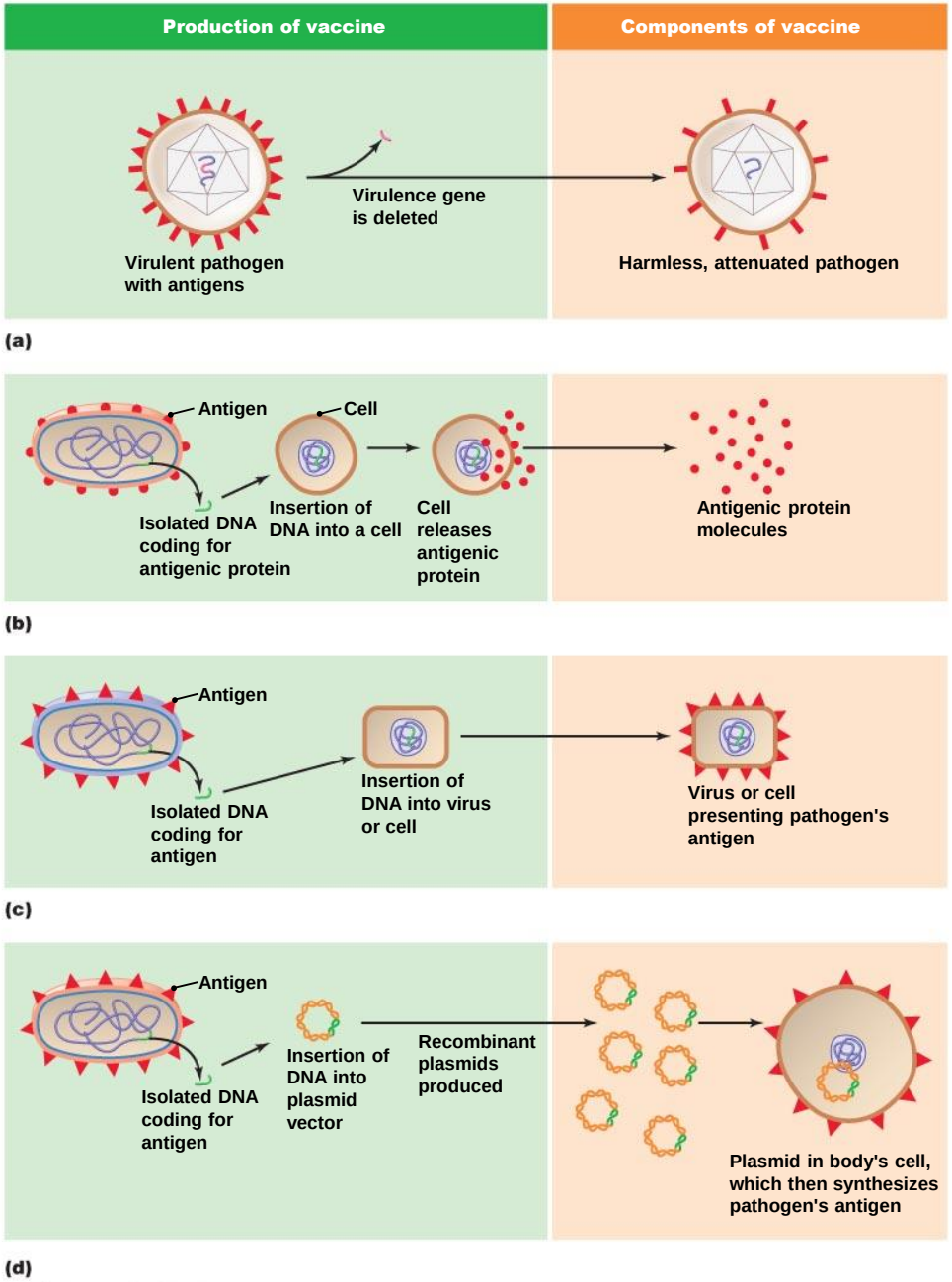
Immunization

- **Active Immunization**
  - Vaccine Types
    - Toxoid vaccines
      - Chemically or thermally modified toxins used to stimulate active immunity
      - Useful for some bacterial diseases (e.g., tetanus, diphtheria)
      - Stimulate antibody-mediated immunity
      - Require multiple doses as well as reinoculations every 10 years because toxoids possess few antigenic determinants

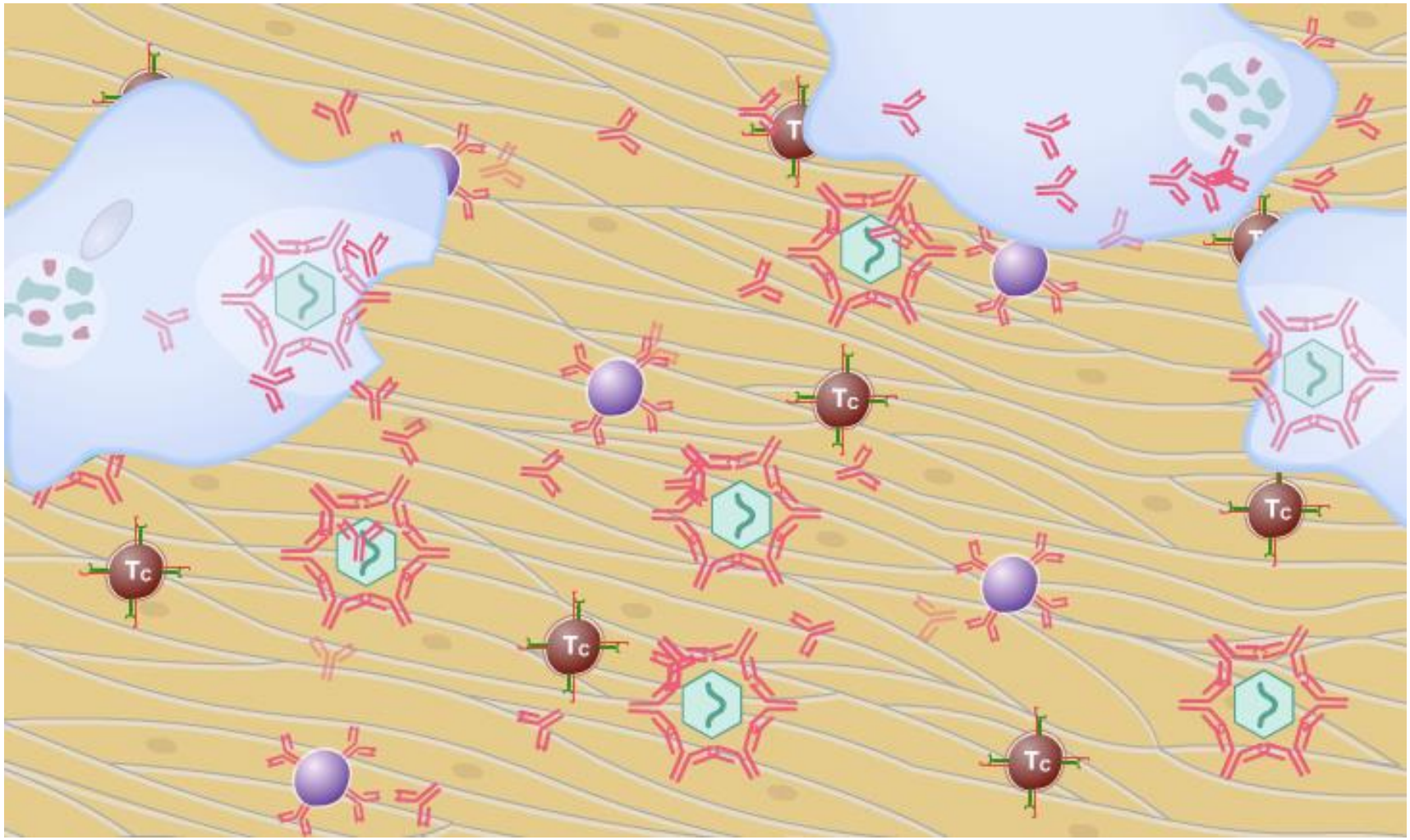
Immunization

- **Active Immunization**
  - Vaccine Types
    - Combination vaccines
      - Simultaneous administration of antigens from several pathogens
    - Vaccines using recombinant gene technology
      - Research attempts to make vaccines more effective, cheaper, and safer
      - Recombinant DNA techniques used to improve vaccines

Figure 17.2 Some uses of recombinant DNA technology for making improved vaccines.

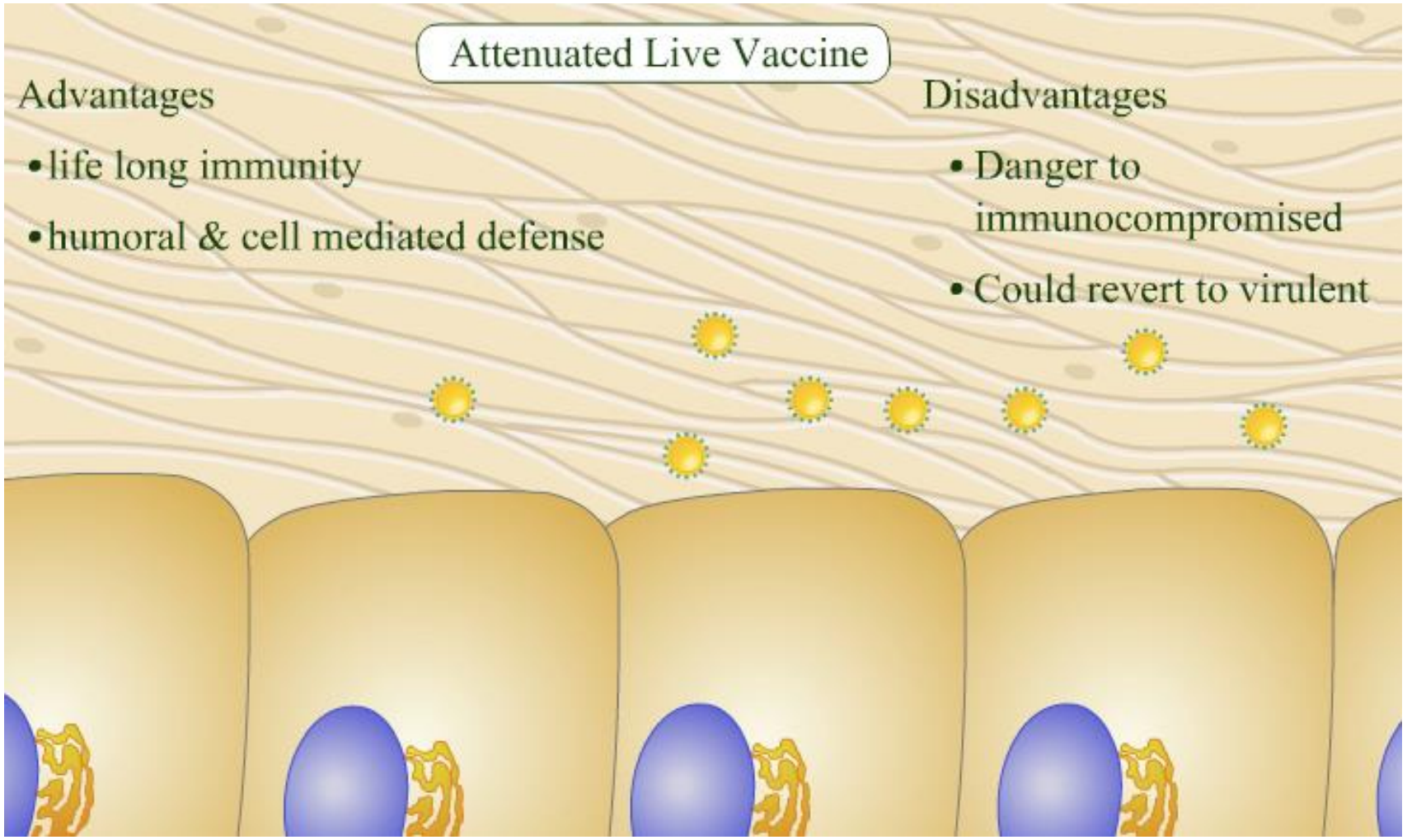


Vaccines: Function



PLAY **Vaccines: Function**

Vaccines: Types

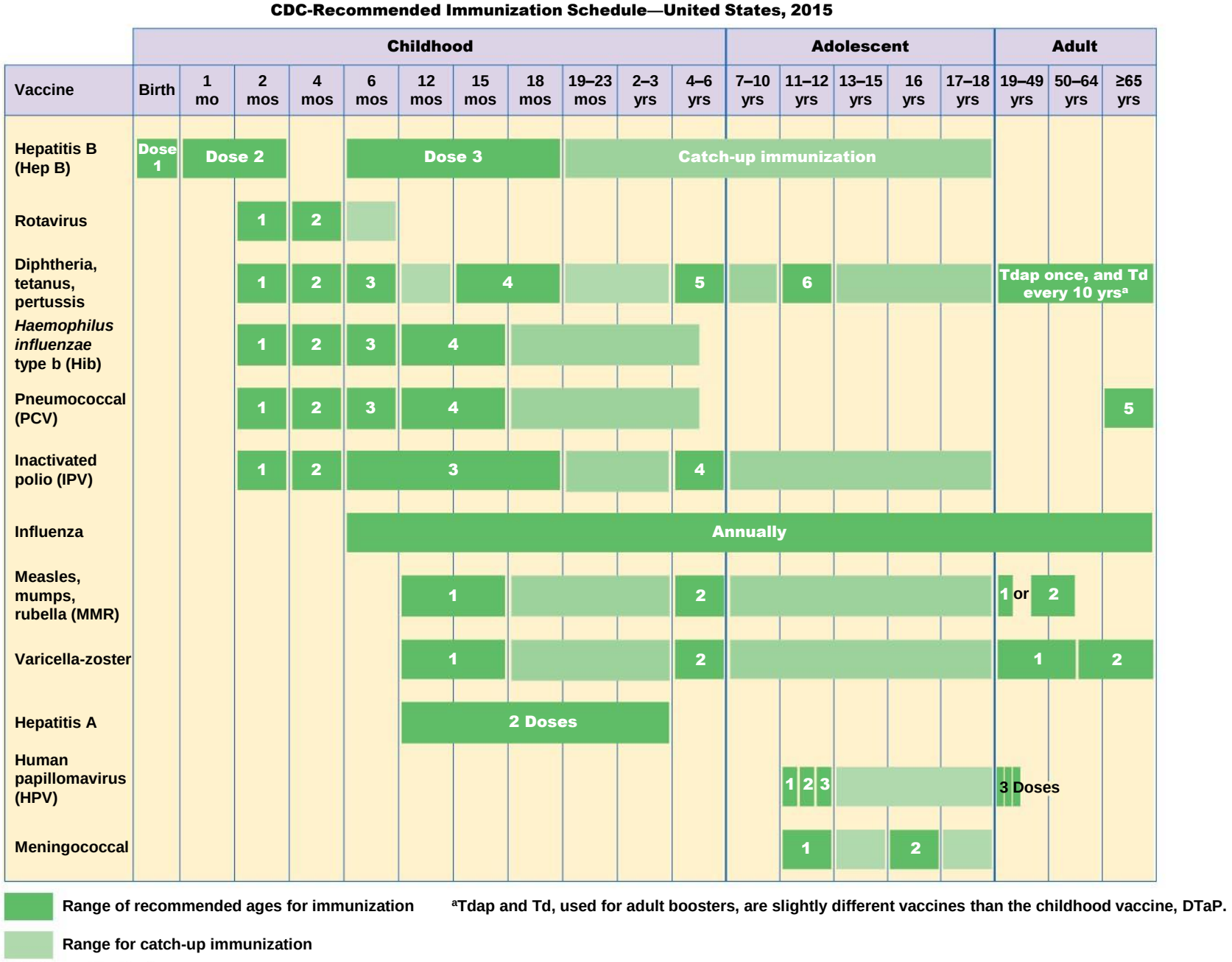


PLAY **Vaccines: Types**

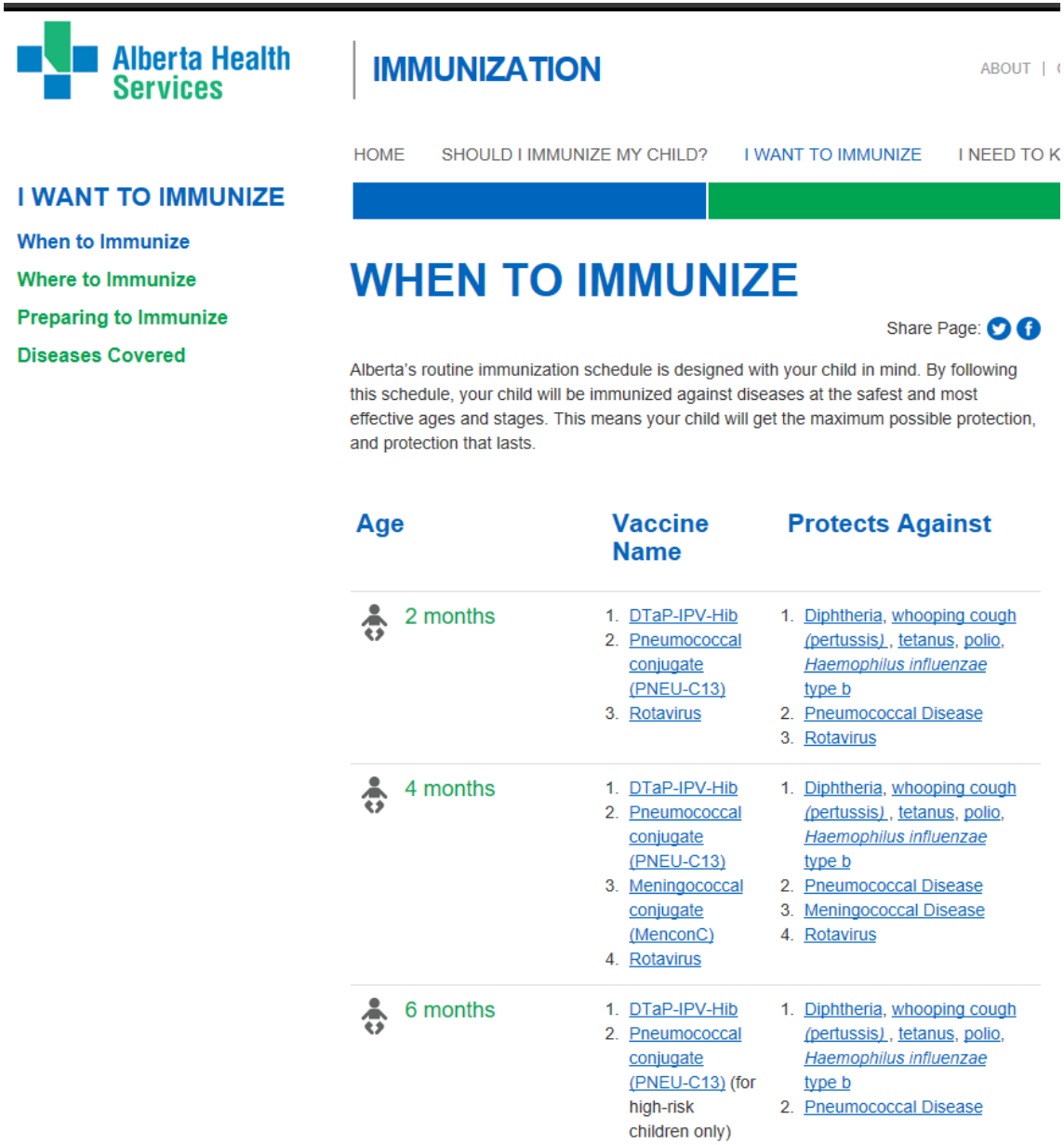
Immunization

- **Active Immunization**
  - Vaccine Manufacture
    - Mass-produce many vaccines by growing microbes in culture vessels
    - Viruses are cultured inside chicken eggs
    - Individuals with egg allergies must avoid some vaccines

Figure 17.3 The CDC's recommended immunization schedule for the general population.



AHS Immunization Schedule



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Alberta's routine immunization schedule is designed with your child in mind. By following this schedule, your child will be immunized against diseases at the safest and most effective ages and stages. This means your child will get the maximum possible protection, and protection that lasts.

Age	Vaccine Name	Protects Against
2 months	1. DTaP-IPV-Hib 2. Pneumococcal conjugate (PNEU-C13) 3. Rotavirus	1. Diphtheria, whooping cough (pertussis), tetanus, polio, *Haemophilus influenzae* type b 2. Pneumococcal Disease 3. Rotavirus
4 months	1. DTaP-IPV-Hib 2. Pneumococcal conjugate (PNEU-C13) 3. Meningococcal conjugate (MenconC) 4. Rotavirus	1. Diphtheria, whooping cough (pertussis), tetanus, polio, *Haemophilus influenzae* type b 2. Pneumococcal Disease 3. Meningococcal Disease 4. Rotavirus
6 months	1. DTaP-IPV-Hib 2. Pneumococcal conjugate (PNEU-C13) (for high-risk children only)	1. Diphtheria, whooping cough (pertussis), tetanus, polio, *Haemophilus influenzae* type b 2. Pneumococcal Disease

TABLE 17.1 Principal Vaccines to Prevent Human Diseases

Vaccine	Disease Agent	Disease	Vaccine Type	Method of Administration
Recommended by the CDC				
Hepatitis B	Hepatitis B virus	Hepatitis B	Inactive subunit from recombinant yeast	Intramuscular
Rotavirus	*Rotavirus*	Gastroenteritis	Attenuated, recombinant	Oral
Diphtheria/tetanus/ acellular pertussis (DTaP)	Diphtheria toxin Tetanus toxin *Bordetella pertussis*	Diphtheria Tetanus Whooping cough	Toxoid Toxoid Inactivated subunit (inactivated whole also available)	Intramuscular
Haemophilus influenzae type b (Hib)	*Haemophilus influenzae*	Meningitis, pneumonia, epiglottitis	Inactivated subunit	Intramuscular
Pneumococcal (PCV)	*Streptococcus pneumoniae*	Pneumonia	Inactivated subunit	Intramuscular
Polio	Poliovirus	Poliomyelitis	Inactivated (attenuated also available)	Subcutaneous or intramuscular (attenuated: oral)
Influenza	Influenzaviruses	Flu	Inactivated subunit	Intramuscular or oral
Measles/mumps/rubella (MMR)	Measles virus Mumps virus Rubella virus	Measles Mumps Rubella (German measles)	Attenuated Attenuated Attenuated	Subcutaneous
Varicella-zoster	Chicken pox virus	Chicken pox, shingles	Attenuated	Subcutaneous
Hepatitis A	Hepatitis A virus	Hepatitis A	Inactivated whole	Intramuscular
Human papillomavirus (HPV)	Human papillomaviruses	Genital warts, cervical cancer	Inactive recombinant	Intramuscular
Meningococcal	*Neisseria meningiditis*	Meningitis	Inactive	Subcutaneous or intramuscular

TABLE **17.1** Principal Vaccines to Prevent Human Diseases *(Continued)*

Vaccine	Disease Agent	Disease	Vaccine Type	Method of Administration
Available but Not Recommended for General Population in the United States				
Anthrax	*Bacillus anthracis*	Anthrax	Inactivated whole	Subcutaneous
BCG (bacillus of Calmette and Guérin)	*Mycobacterium tuberculosis, M. leprae*	Tuberculosis, leprosy	Attenuated	Intradermal
Japanese encephalitis vaccine	Japanese encephalitis virus	Encephalitis	Inactive	Subcutaneous
Rabies	Rabies virus	Rabies	Inactivated whole	Intramuscular or intradermal
Typhoid fever vaccine	*Salmonella enterica*	Typhoid fever	Attenuated (inactive also available)	Oral (inactive: subcutaneous or intramuscular)
Vaccinia (cowpox)	Smallpox virus, monkeypox virus	Smallpox, monkey pox	Attenuated	Subcutaneous
Yellow fever	Yellow fever virus	Yellow fever	Attenuated	Subcutaneous

Immunization

- **Active Immunization**
  - Vaccine Safety
    - Problems associated with immunization
      - Mild toxicity
        - Pain at the injection site, malaise, fever
      - Risk of anaphylactic shock
      - Residual virulence from attenuated viruses
      - Allegations certain vaccines cause autism, diabetes, and asthma
        - **Research has not substantiated these allegations**

Immunization

- **Passive Immunotherapy**
  - Administration of antiserum that contains preformed antibodies
  - Provides immediate protection against a recent infection or ongoing disease
  - Antisera have several limitations:
    - Can trigger allergic reactions called serum sickness
    - Antibodies of antisera are degraded relatively quickly
    - Individual not protected from subsequent infections
  - Limitations are overcome through development of hybridomas

Figure 17.4 The production of hybridomas.

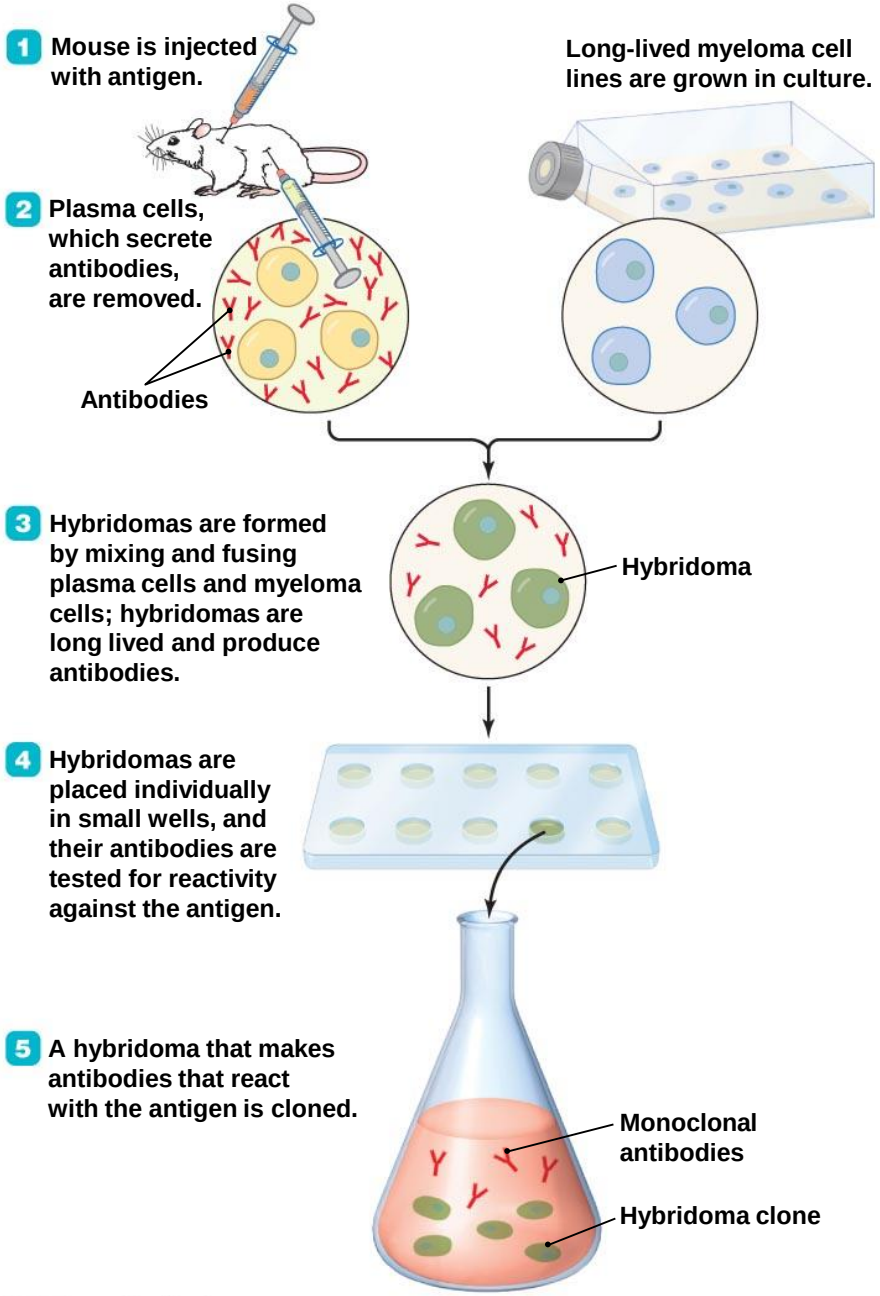
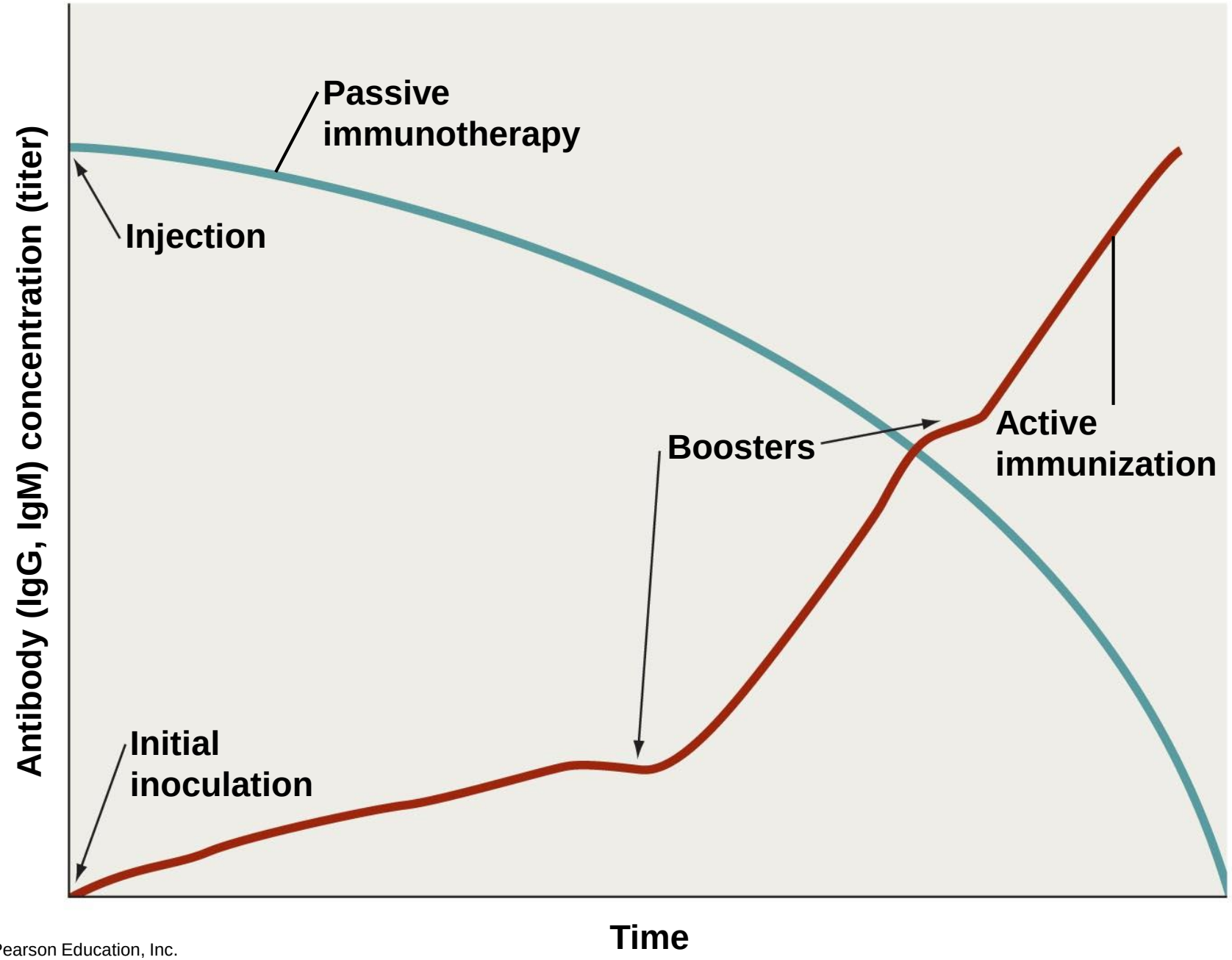


Figure 17.5 The characteristics of immunity produced by active immunization (red) and passive immunotherapy (green).



Serological Tests That Use Antigens and Corresponding Antibodies

- Serology is the determination of the presence of specific antigens or antibodies in blood serum
- Serological tests available to identify a variety of antigens and antibodies in serum
- Serological tests have several uses:
  - Monitor the spread of infection within a population
  - Establish diagnosis of disease

TABLE 17.2 Antibody-Antigen Immunological Tests and Some of Their Uses

Test	Use
Immunodiffusion (precipitation)	Diagnosis of syphilis, pneumococcal pneumonia
Agglutination	Blood typing; pregnancy testing; diagnosis of salmonellosis, brucellosis, gonorrhea, rickettsial infection, mycoplasma infection, yeast infection, typhoid fever, meningitis caused by *Haemophilus*
Viral neutralization	Diagnosis of infections by specific strains of viruses
Viral hemagglutination inhibition	Diagnosis of viral infections including influenza, measles, mumps, rubella, mononucleosis
Complement fixation	In the past, diagnosis of measles, influenza A, syphilis, rubella, rickettsial infections, scarlet fever, rheumatic fever, infections of respiratory syncytial virus and *Coxiella*
Direct fluorescent antibody	Diagnosis of rabies, infections of group A *Streptococcus*, identification of lymphocyte subsets
Indirect fluorescent antibody	Diagnosis of syphilis, mononucleosis
ELISA	Pregnancy testing; presence of drugs in urine; diagnosis of hepatitis A, hepatitis B, rubella; initial diagnosis of HIV infection
Immunoblot (western blot)	Confirmation of infection with HIV; diagnosis of Lyme disease