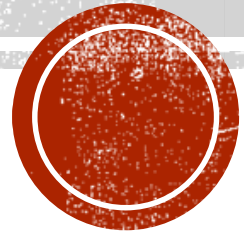
IMMUNIZATION

CCV

Microbiology



IMMUNIZATION

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

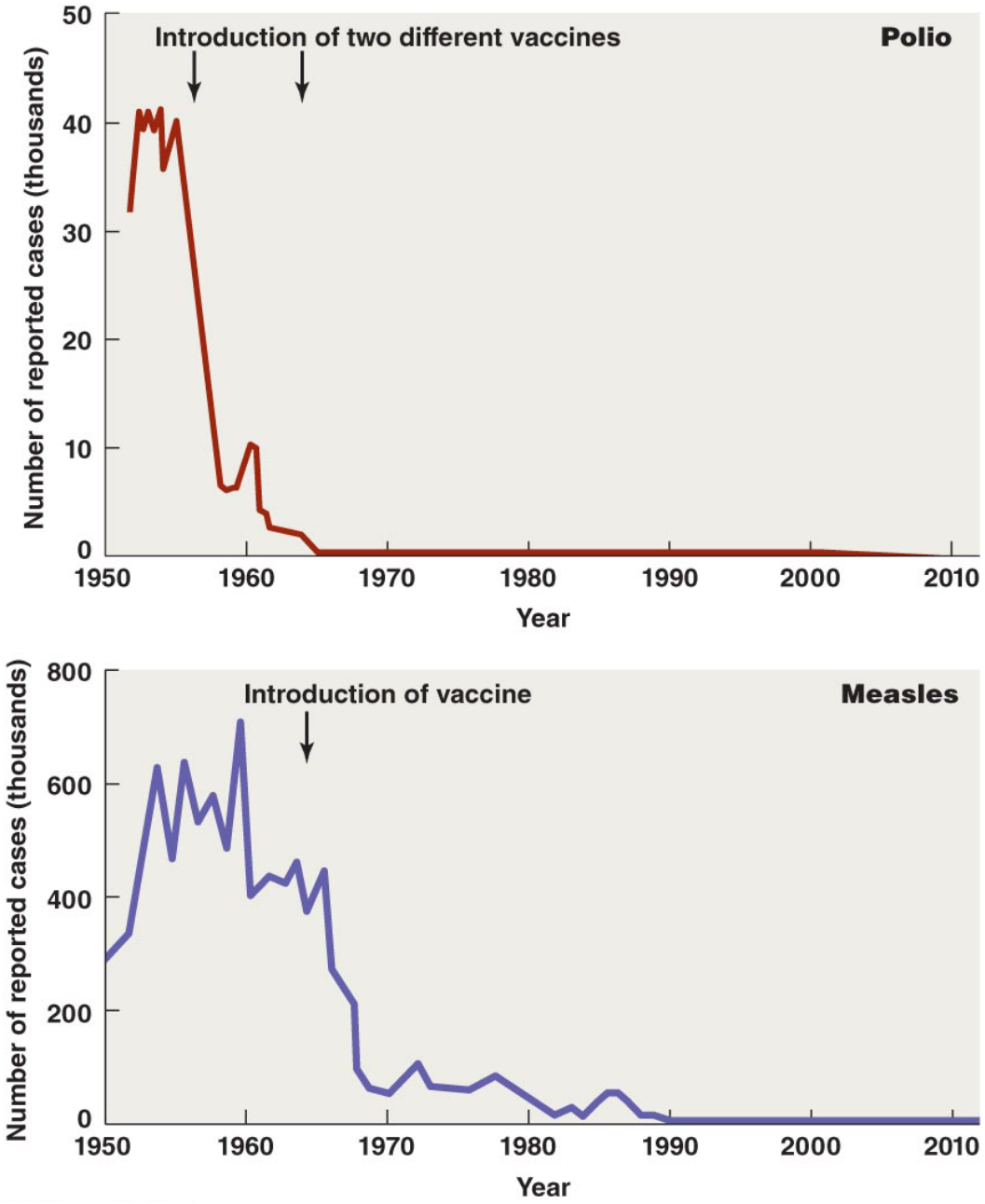
IMMUNIZATION

- **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 was known as *variolation*
  - Variolation spread to England and America but was stopped because of 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 that vaccines protect through the action of antibodies

FIGURE 17.1 THE EFFECT OF IMMUNIZATION IN REDUCING THE PREVALENCE OF TWO INFECTIOUS DISEASES IN THE UNITED STATES.



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- **Brief History of Immunization**
  - Many developing nations do not receive vaccines
  - Effective vaccines have not been developed for some pathogens
  - Vaccine-associated risks discourage investment in developing new vaccines

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- **Active Immunization**
  - Vaccine types
    - Attenuated (modified live) vaccines
      - Use pathogens with reduced virulence
      - Process of reducing virulence is 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
        - Deactivated but whole microbes
      - Subunit vaccines
        - Antigenic fragments of microbes
      - Often require multiple doses to achieve full immunity
      - Often contain adjuvants
        - Chemicals added to increase effective antigenicity

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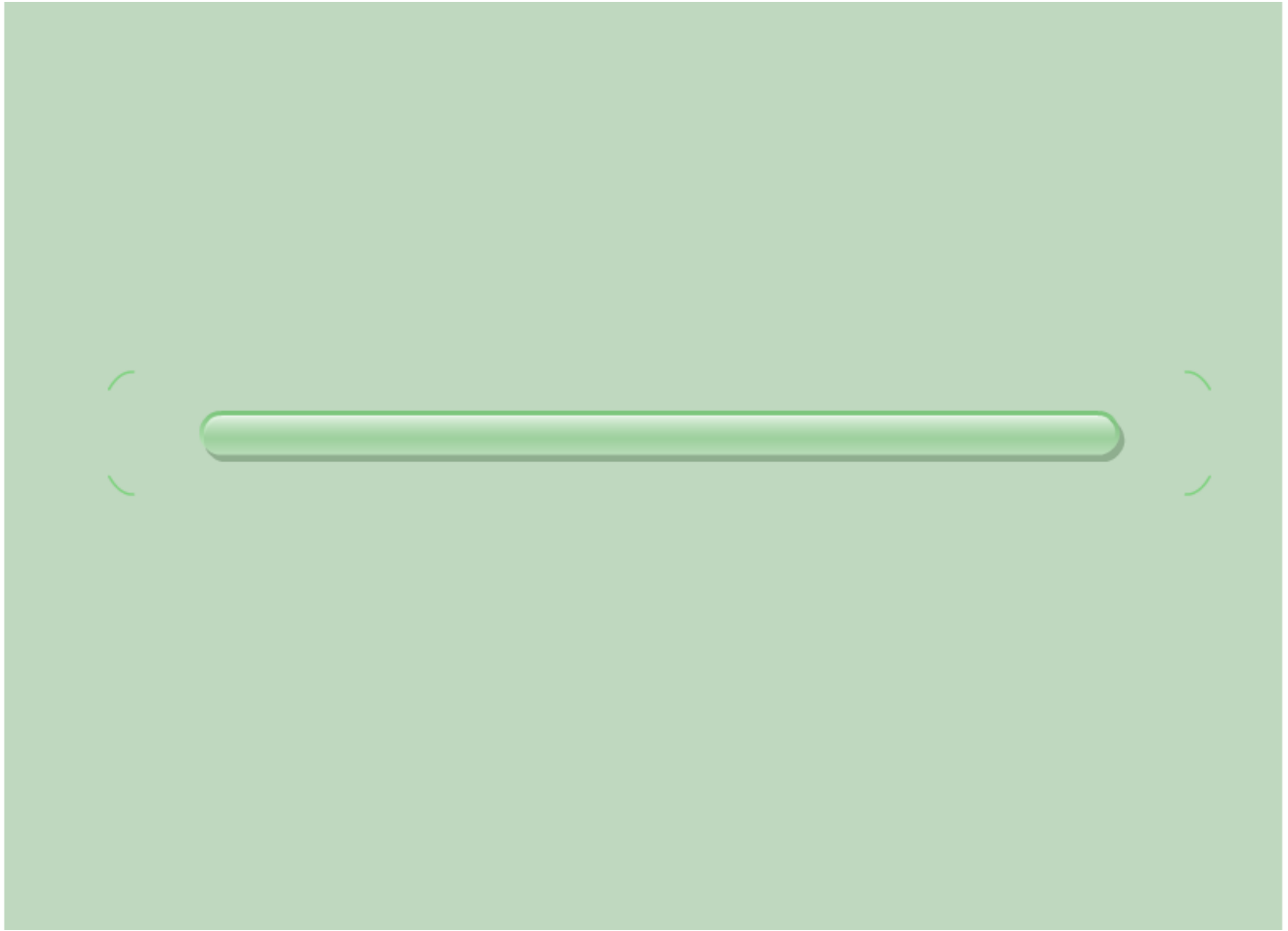
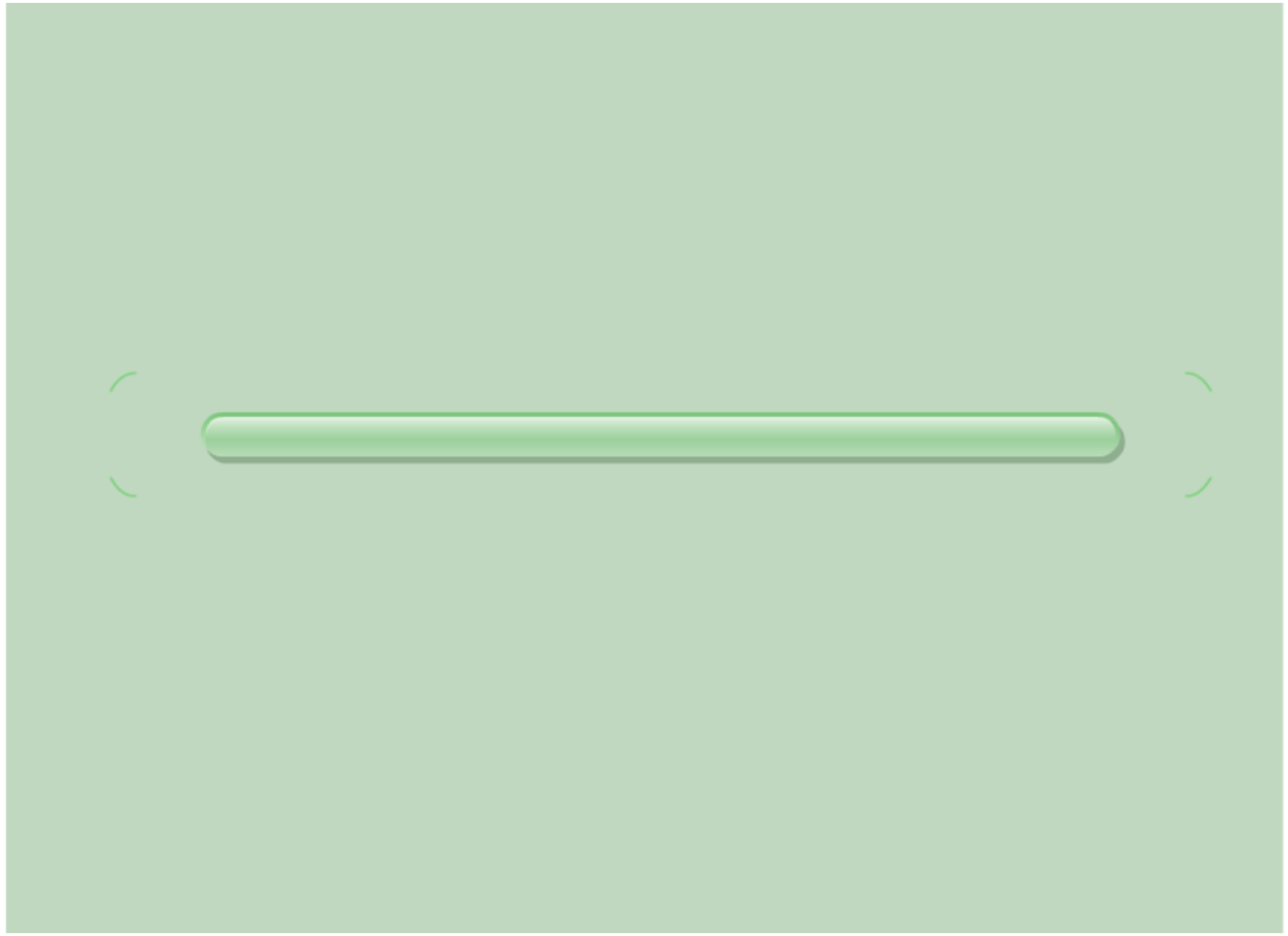
- **Active Immunization**
  - Vaccine types
    - Toxoid vaccines
      - Chemically or thermally modified toxins used to stimulate active immunity
      - Useful for some bacterial diseases
      - Stimulate antibody-mediated immunity
      - Require multiple doses because toxoids possess few antigenic determinants

VACCINES: FUNCTION



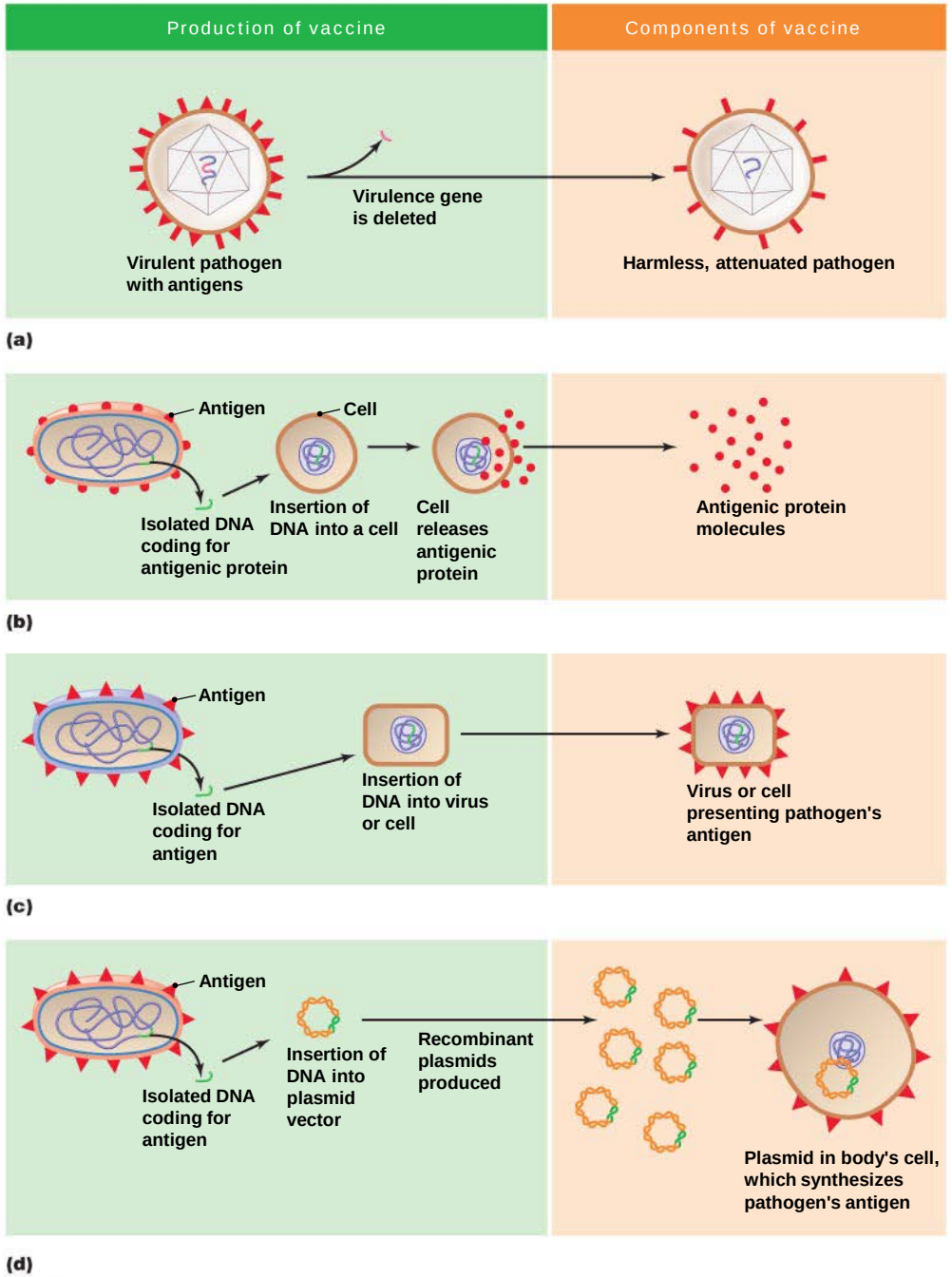
VACCINES: TYPES



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.



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.

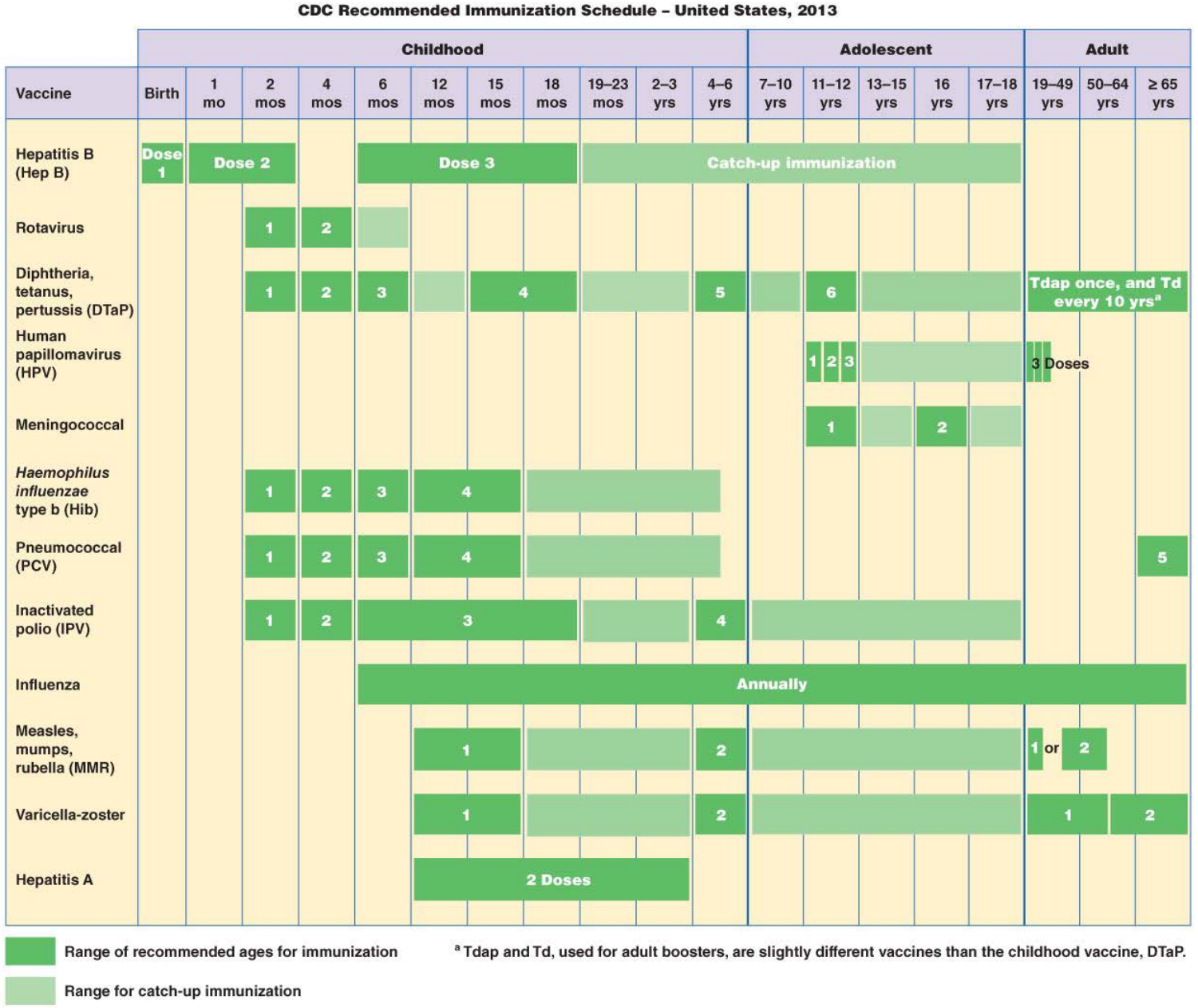


TABLE 17.1 Principal Vaccines to Prevent Human Diseases

Vaccine	Disease Agent	Disease	Vaccine Type	Method of Administration
Recommended by 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
Human papillomavirus (HPV)	Human papillomaviruses	Genital warts, cervical cancer	Inactive recombinant	Intramuscular
Meningococcal	*Neisseria meningiditis*	Meningitis	Inactive	Subcutaneous or 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

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, monkey pox 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
      - 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.

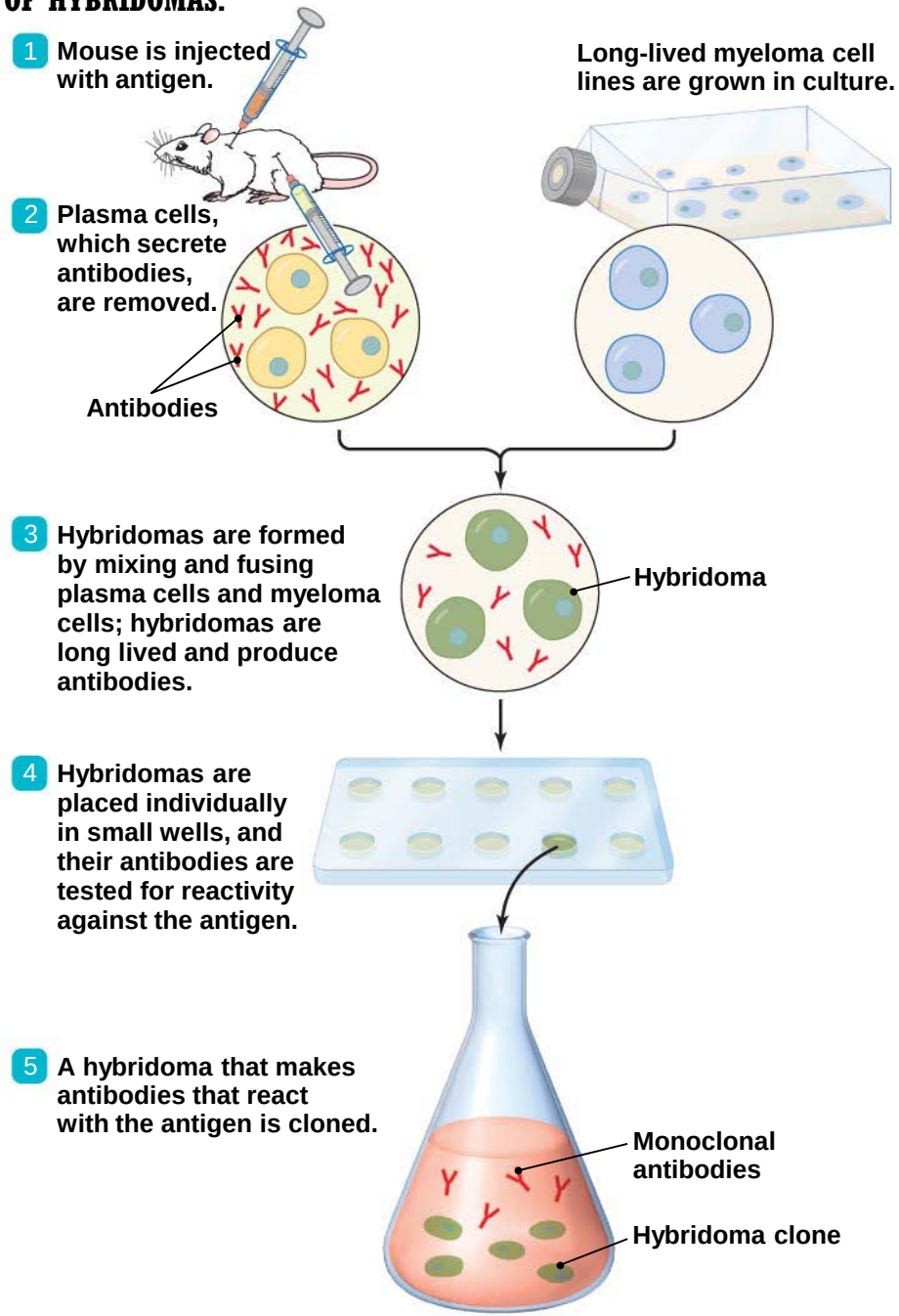


FIGURE 17.5 THE CHARACTERISTICS OF IMMUNITY PRODUCED BY ACTIVE IMMUNIZATION (RED) AND PASSIVE IMMUNOTHERAPY (GREEN).