### Johns Hopkins Engineering

### Immunoengineering

Module 2/Lecture 2A

Immune Response to Pathogens: Introduction



## Today's Learning Objectives

- List examples of pathogens and routes of infection
- Identify major cellular and protein components of the immune response to pathogens and their function
- Describe how information is communicated by the immune system
- Explain differences between the immune response to bacteria and viruses and explain how infection is resolved
- Define immunological memory and context with vaccines

If a country attacked you, list some things you would want going into war. (think as a nation)

# If a country attacked you, list some things you would want going into war (think as a nation)

- Food/Water/Nutrients
- Weapons
- Medicine
- Shelter
- Allies
- Army
- Transport
- Funding/support/propaganda
- Leadership
- Tanks/Ships
- Known target
- Spies
- Intelligence agency

- Fence/Barracks/Barrier
- Detector/Camera
- Sentinel
- Radars/communication
- Bases
- Engineering war department
- Computers
- Target missiles
- Special forces Marine corp
- Way to detect an ally
- Ways to stop the war
- Learning from war

# If a country attacked you, list some things you would want going into war (think as a nation)

- Detection
- Recognition
- Communication
- People: Soldiers, Leaders, Engineers, Doctors, etc.
- Transportation/Housing/Nutrition
- Weapons and Training

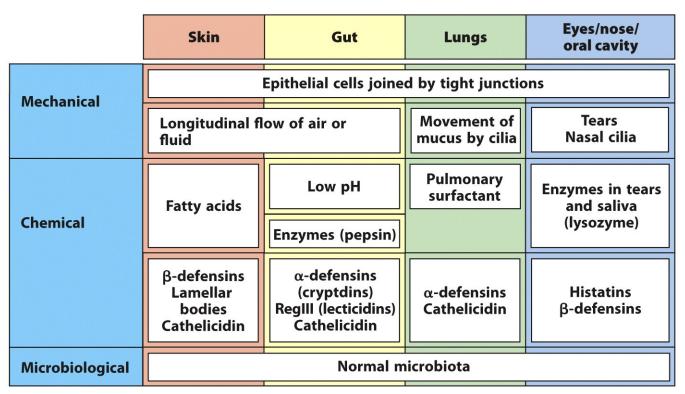
## This is war!

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The immune system protects against four classes of pathogens							
Type of pathogen	Examples	Diseases					
Extracellular bacteria, parasites, fungi	Streptococcus pneumoniae Clostridium tetani Trypanosoma brucei Pneumocystis carinii	Pneumonia Tetanus Sleeping sickness <i>Pneumocystis</i> pneumonia					
Intracellular bacteria, parasites	Mycobacterium leprae Leishmania donovani Plasmodium falciparum	Leprosy Leishmaniasis Malaria					
Viruses (intracellular)	Variola Influenza Varicella	Smallpox Flu Chickenpox					
Parasitic worms (extracellular)	Ascaris Schistosoma	Ascariasis Schistosomiasis					

Figure 1.24 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

#### Barriers to get in



## How do they get in?

Routes of infection for pathogens					
Route of entry	Mode of transmission	Pathogen	Disease	Type of pathogen	
Mucosal surfaces					
Mouth and respiratory tract	Inhalation or ingestion of infective material (e.g. saliva droplets)	Measles virus	Measles	Paramyxovirus	
		Influenza virus	Influenza	Orthomyxovirus	
		Varicella-zoster	Chickenpox	Herpesvirus	
		Epstein-Barr virus	Mononucleosis	Herpesvirus	
		Streptococcus pyogenes	Tonsilitis	Gram-positive bacterium	
		Haemophilus influenzae	Pneumonia, meningitis	Gram-negative bacterium	
	Spores	Neisseria meningitidis	Meningococcal meningitis	Gram-negative bacterium	
		Bacillus anthracis	Inhalation anthrax	Gram-positive bacterium	
Gastrointestinal tract	Contaminated water or food	Rotavirus	Diarrhea	Rotavirus	
		Hepatitis A	Jaundice	Picornavirus	
		Salmonella enteritidis, S. typhimurium	Food poisoning	Gram-negative bacterium	
		Vibrio cholerae	Cholera	Gram-negative bacterium	
		Salmonella typhi	Typhoid fever	Gram-negative bacterium	
Reproductive tract and other routes	Sexual transmission/ infected blood	Hepatitis B virus	Hepatitis B	Hepadnavirus	
		Human immunodeficiency virus (HIV)	Acquired immunodeficiency syndrome (AIDS)	Retrovirus	
	Sexual transmission	Neisseria gonorrhoeae	Gonorrhea	Gram-negative bacterium	
	4	Treponema pallidum	Synhilis	Racterium (snirochete)	
Figure 2.2 Janeway's Immunobiology, 8ed. (© Garland Science 2012					

## How do they get in?

Opportunistic pathogens						
Resident microbiota		Candida albicans	Candidiasis, thrush	Fungus		
	Resident lung microbiota	Pneumocystis jirovecii	Pneumonia	Fungus		
External epithelia						
External surface	Physical contact	Trichophyton	Athlete's foot	Fungus		
Wounds and abrasions	Minor skin abrasions	Bacillus anthracis	Cutaneous anthrax	Gram-positive bacterium		
	Puncture wounds	Clostridium tetani	Tetanus	Gram-positive bacterium		
	Handling infected animals	Francisella tularensis	Tularemia	Gram-negative bacterium		
Insect bites	Mosquito bites (Aedes aegypti)	Flavivirus	Yellow fever	Virus		
	Deer tick bites	Borrelia burgdorferi	Lyme disease	Bacterium (spirochete)		
	Mosquito bites (Anopheles)	Plasmodium spp.	Malaria	Protozoan		

Figure 2.2 Janeway's Immunobiology, 8ed. (© Garland Science 2012)

