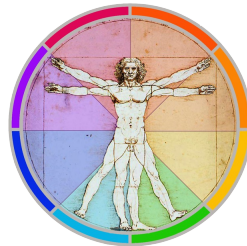


# HUBS191 Lecture Material

This pre-lecture material is to help you prepare for the lecture and to assist your note-taking within the lecture, it is NOT a substitute for the lecture !



Please note that although every effort is made to ensure this pre-lecture material corresponds to the live-lecture there may be differences / additions.

# ***HUBS 191***

## ***Lecture 30***

### Introduction to Immunology and the Immune System

**A/Prof Joanna Kirman**



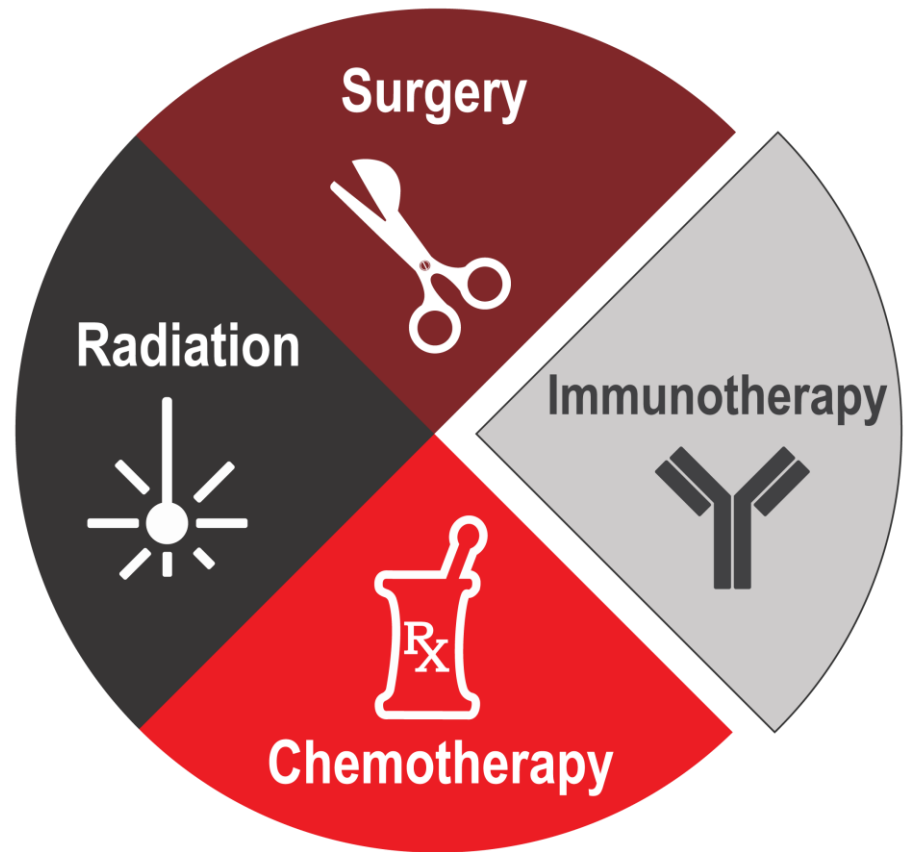
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# Immunology has led to important medical advances ...

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that help protect and/or treat:

- Influenza/COVID-19
- Common cold
- Tuberculosis
- HIV
- Allergy
- Asthma
- Diabetes
- Arthritis
- Multiple sclerosis
- Cancer ...



# Objectives

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## **To be able to:**

- Define how the immune system protects the body
- Describe the main features of the human lymphatic system
- Describe the physical and chemical barriers that prevent pathogen entry into the human body
- List the main features of the 2 arms of the immune system (innate and adaptive)

## **Readings:**

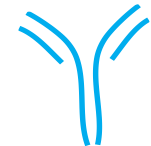
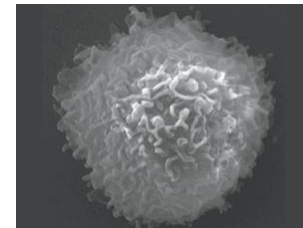
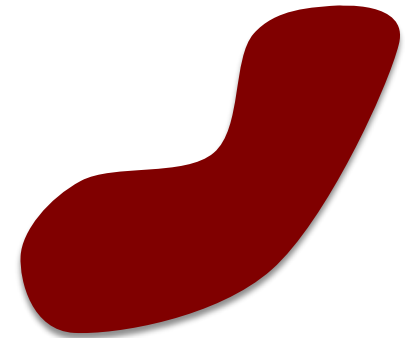
- Martini Global edition 3e Module 20.1 p793
- Marieb 10e Chapter 21 pages 791-793 (until the end of section 21.1, including Figure 21.1 and Table 21.1)

# Obj 1. Define the Immune System

# What is immunology?

5

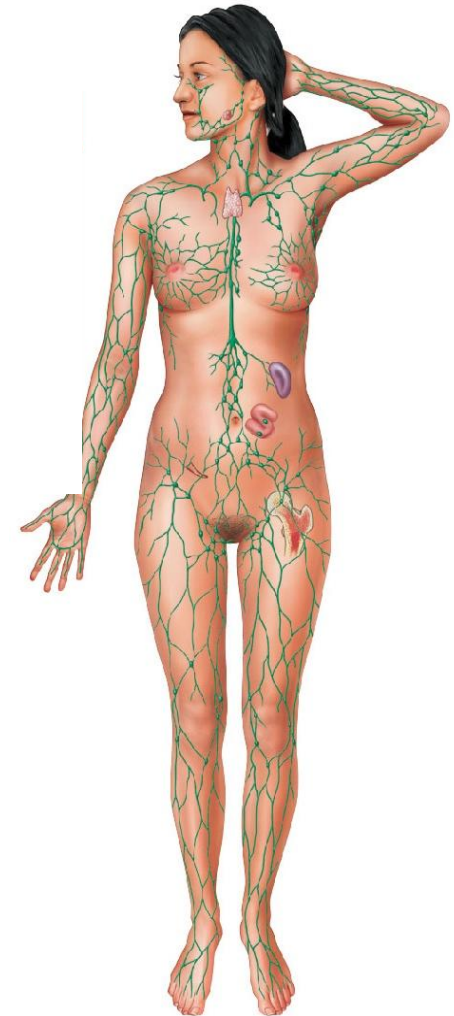
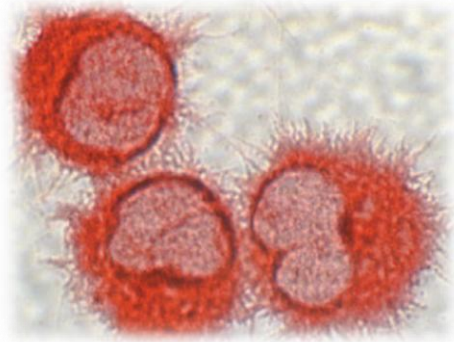
- The study of an organism's defense system (immune system) in health and disease.
- The immune system is composed of:
  - ▣ Organs (eg spleen)
  - ▣ Cells (eg T cells)
  - ▣ Molecules (eg antibodies)



# What is the immune system?

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- An **organised system** of organs, cells and molecules that interact together to defend the body against disease (eg pathogenic microorganisms and cancer).



# Why is immunology important?

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## Examples of diseases affected by the immune response:

### □ Infectious Diseases

- HIV/AIDS
- Tuberculosis
- Influenza
- Malaria
- SARS-CoV-2

### □ Inflammatory Diseases

- Arthritis/Rheumatism
- Allergy/Asthma
- Lupus
- Diabetes
- Crohn's Disease/ Inflammatory Bowel Disease
- Multiple sclerosis

### □ Cancer



*David Vetter "Boy in the Bubble"*



# What are microbes?

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Smaller (nm)

□ Viruses



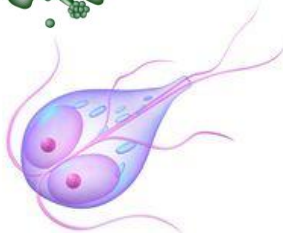
□ Bacteria



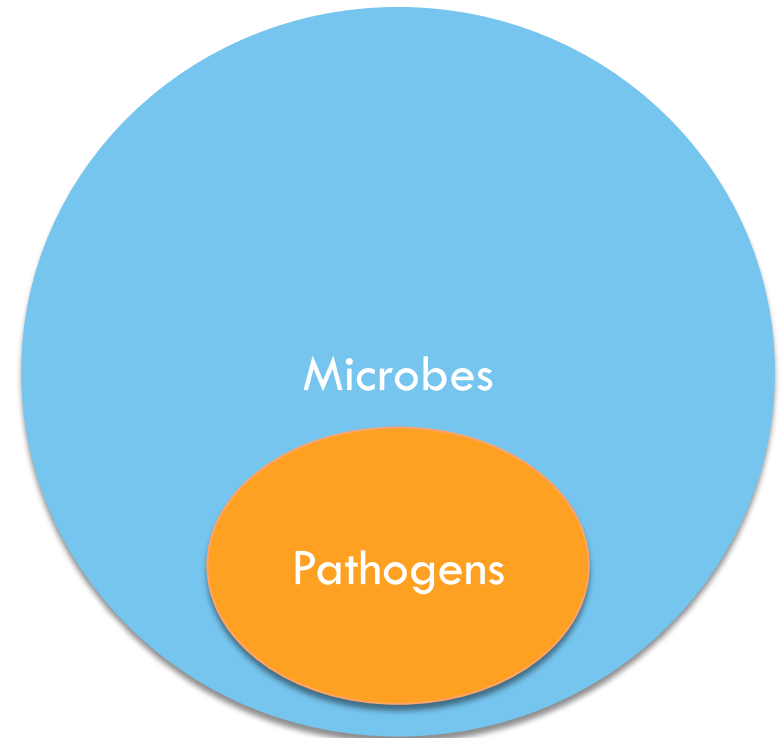
□ Fungi



□ Protozoa



Larger (mm)

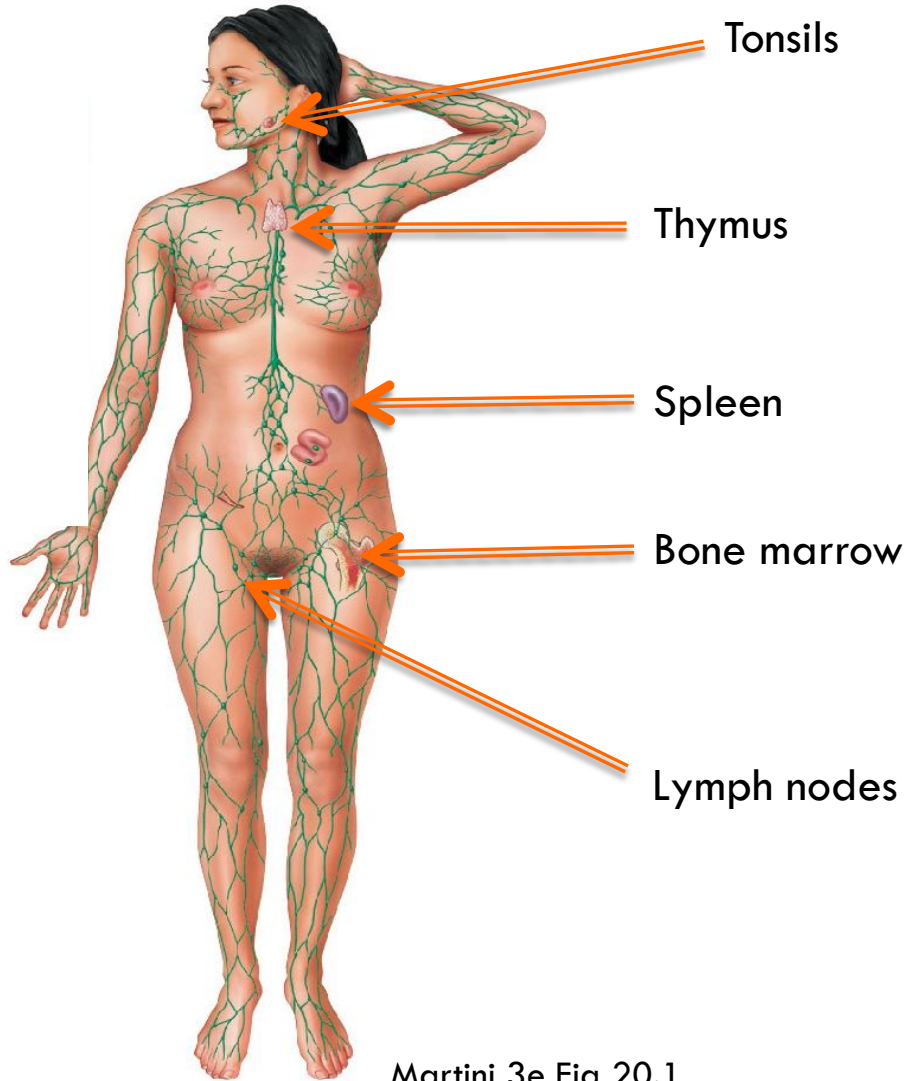


Some microbes are **pathogens** (disease-causing)

# Obj 2. The lymphatic system

# Organs of the immune system

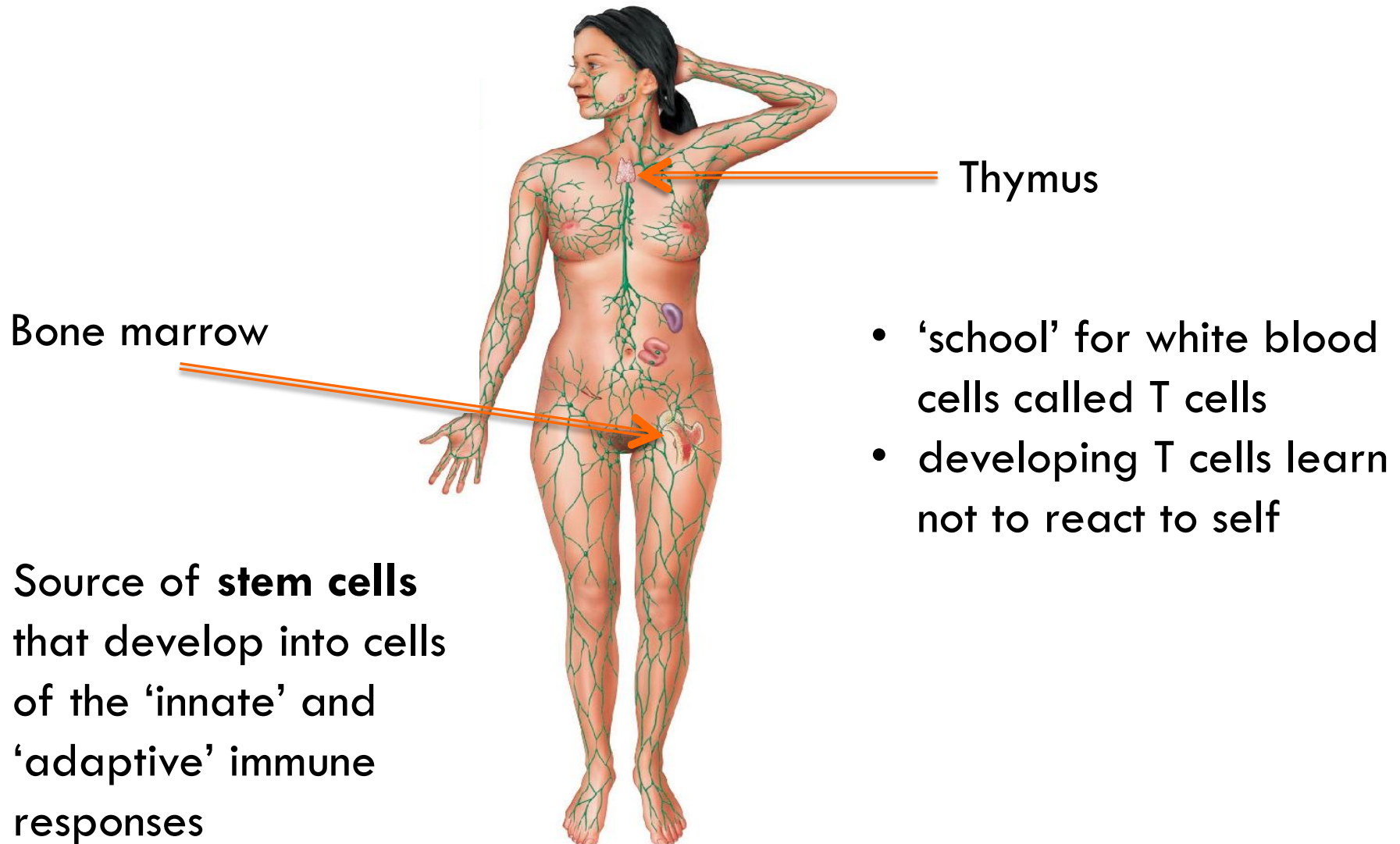
10



- **Primary and secondary lymphoid organs**
- Primary: production of white blood cells (lymphocytes)
- Secondary: sites where immune responses are initiated

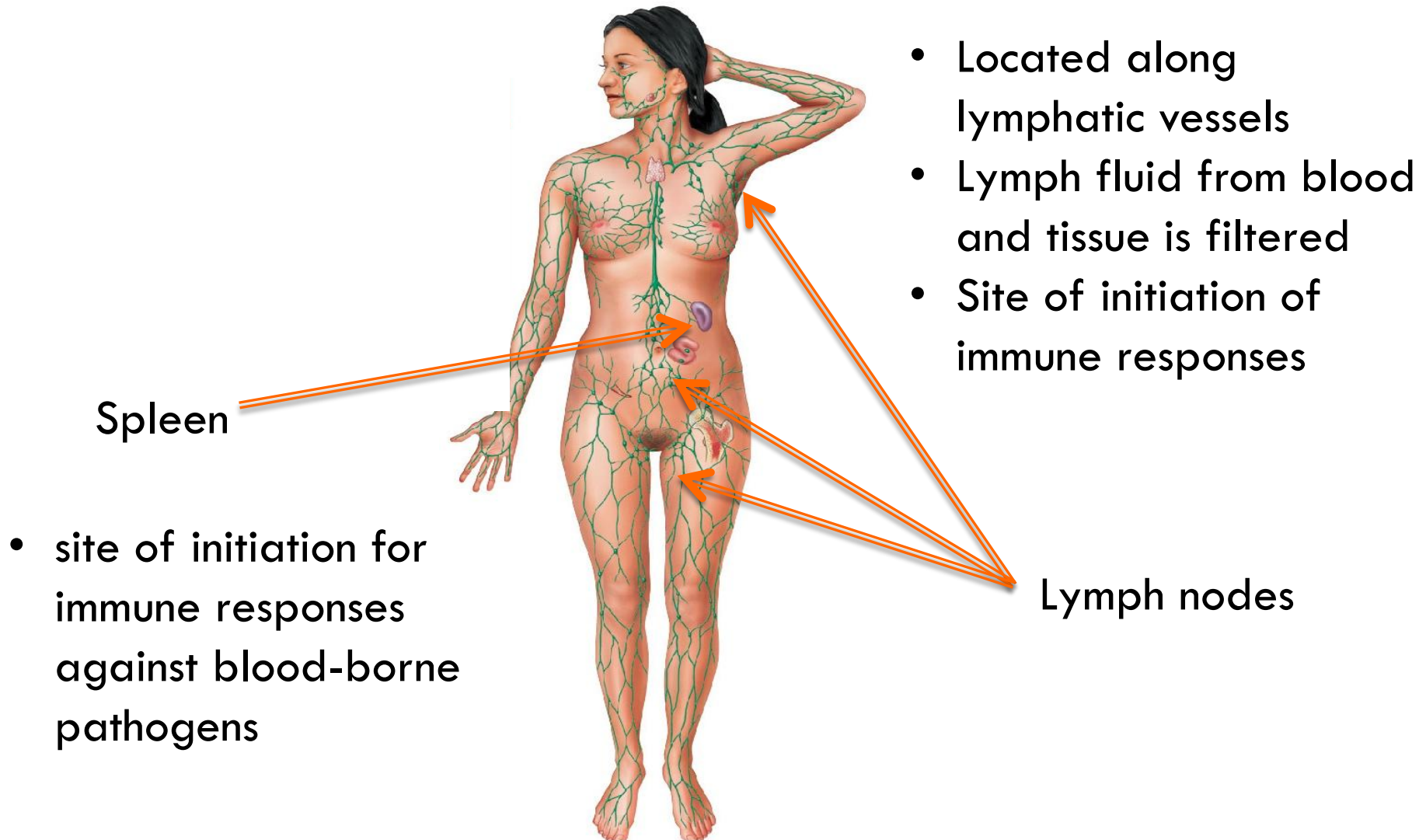
# Primary lymphoid organs

11



# Secondary lymphoid organs

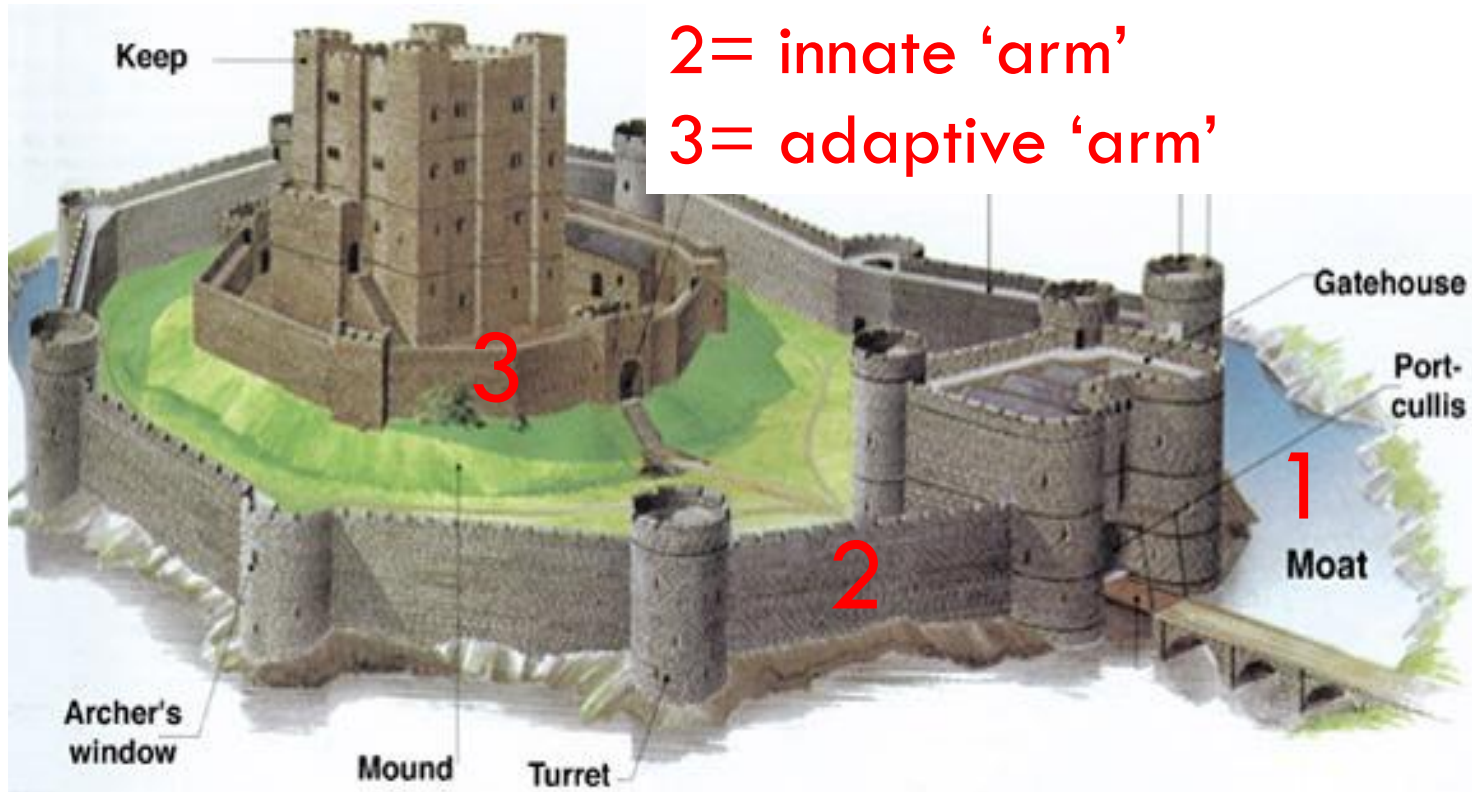
12



# The medieval castle as a model for the immune system: 3 layers of defense

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1 = chemical and physical barriers  
2 = innate 'arm'  
3 = adaptive 'arm'



# Obj 3. Physical and chemical barriers

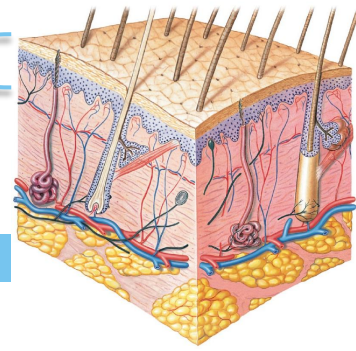
14

## **Skin and mucosal surfaces**



# Physical Barrier: The Skin

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## Epidermis:

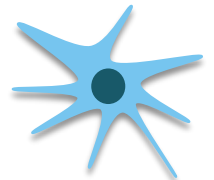
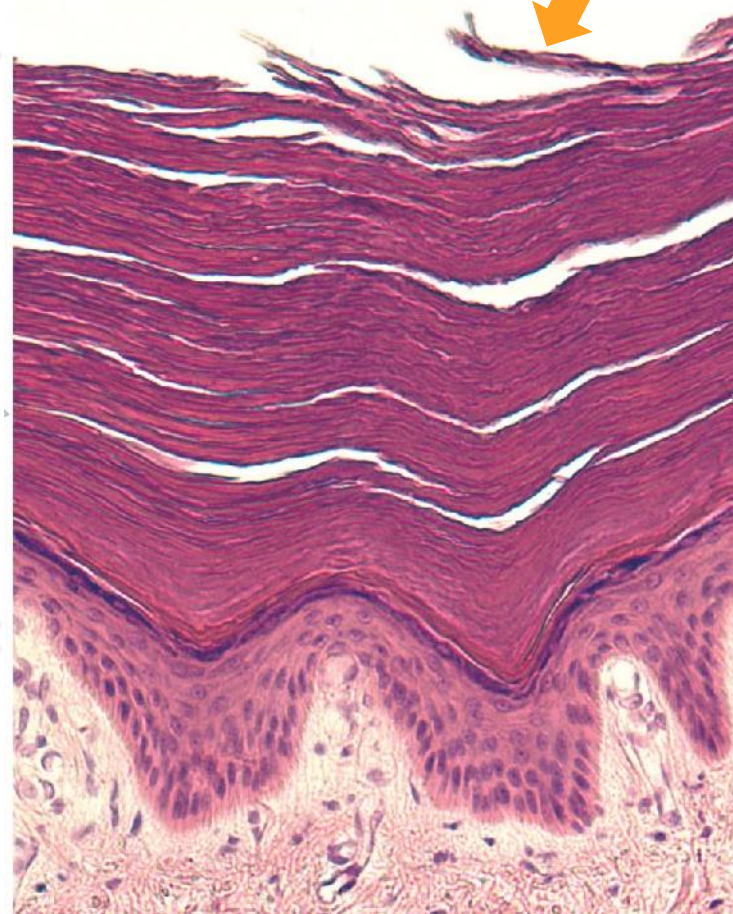
Dead cells, keratin and *phagocytic immune cells*

epidermis

## Dermis:

Thick layer of connective tissue, collagen and blood vessels and *phagocytic immune cells*

dermis



dendritic cell (immune cells) in this layer

Constant renewal of outer layer

Cross section through skin

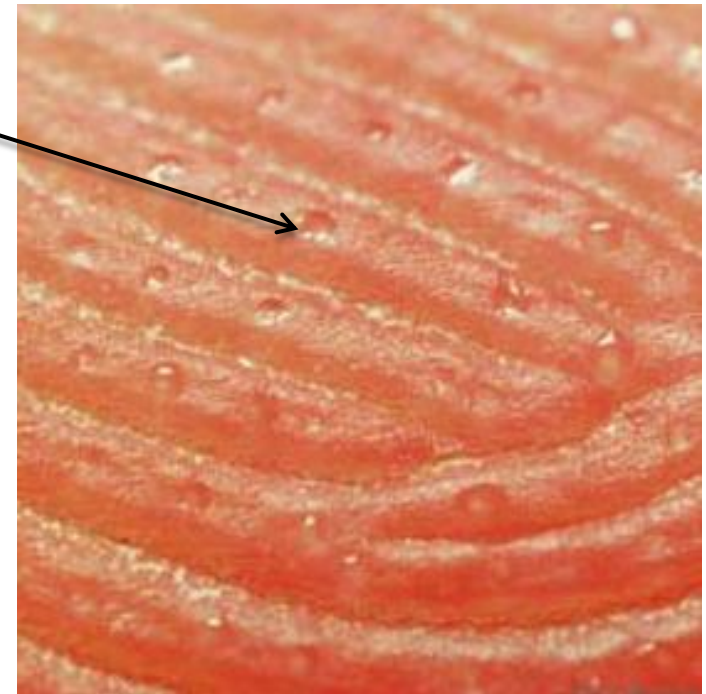
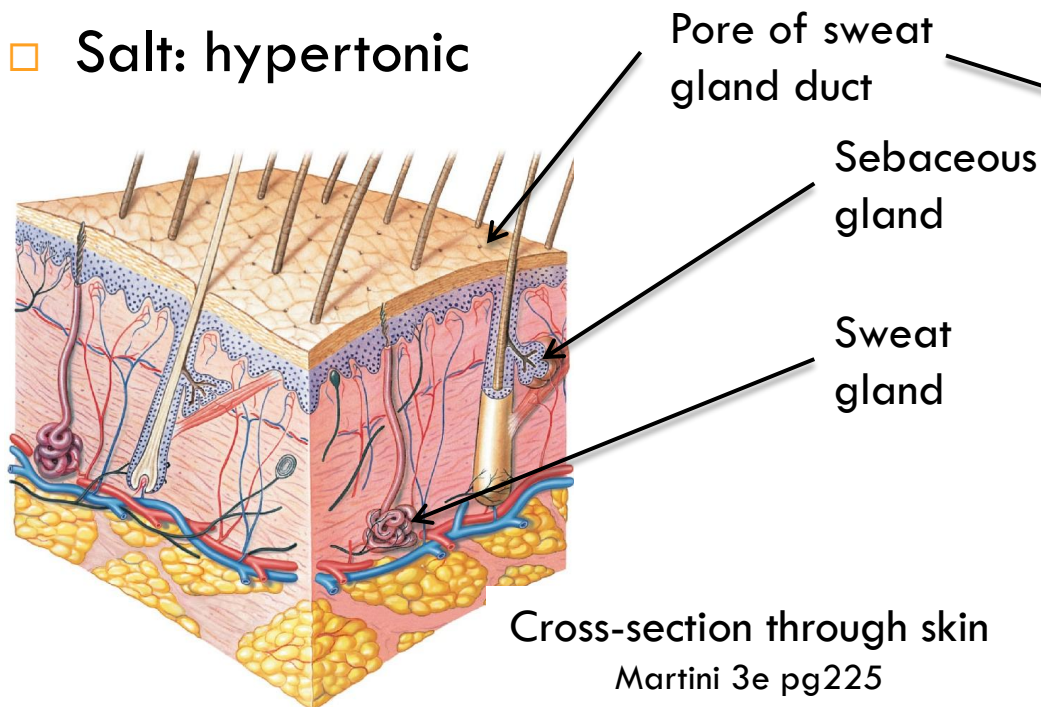
Martini 3e Page 226-7



# Chemical defenses of the skin

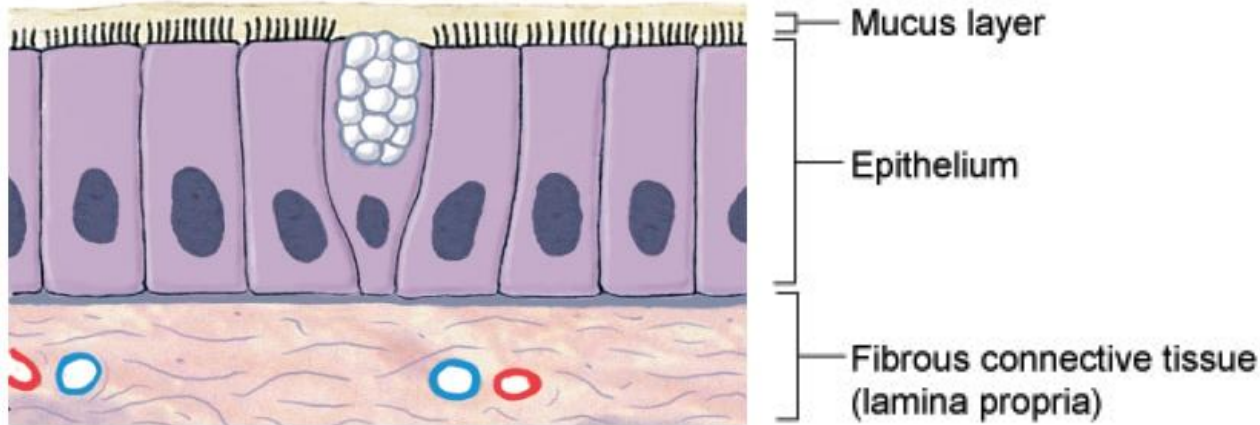
16

- Antimicrobial peptides e.g. skin 'defensins' – forms pores in microbial cell membranes
- Lysozyme: breaks down bacterial cell walls
- Sebum: low pH
- Salt: hypertonic

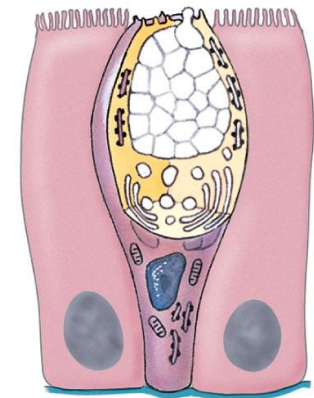


# Mucous Membranes

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Martini 3e pg210



Mucous-producing  
goblet cell

Martini 3e pg199

- 1-2 layers
- Epithelium: tightly packed live cells, constantly renewed, mucus-producing goblet cells

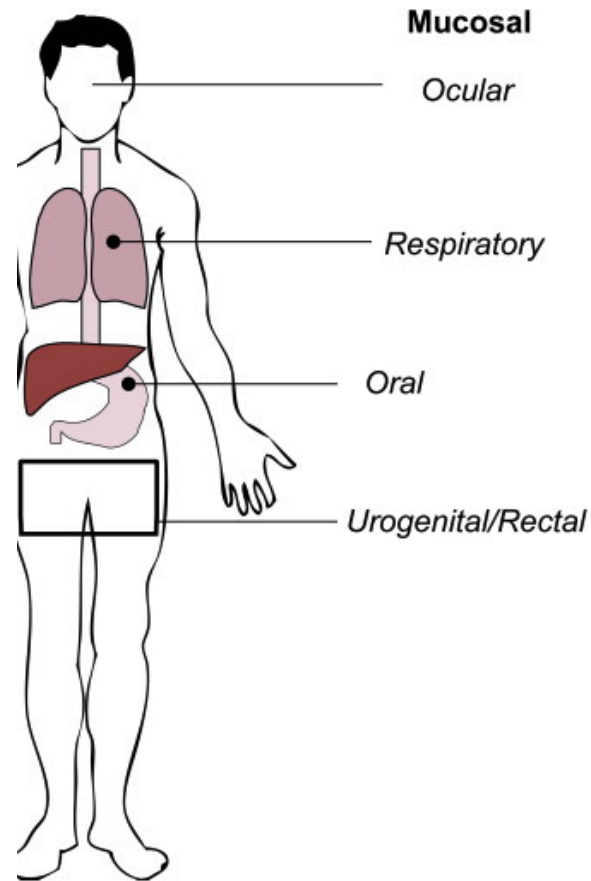
# Mucosal Membranes

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## □ Where are they?



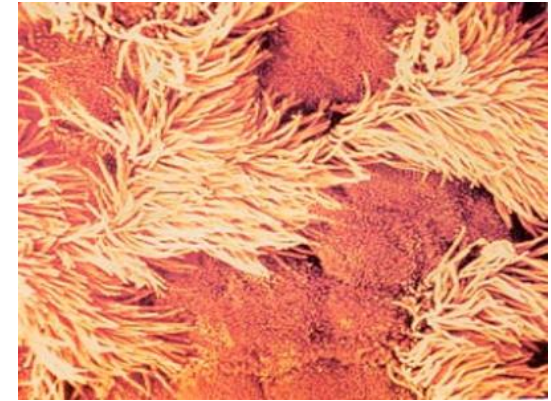
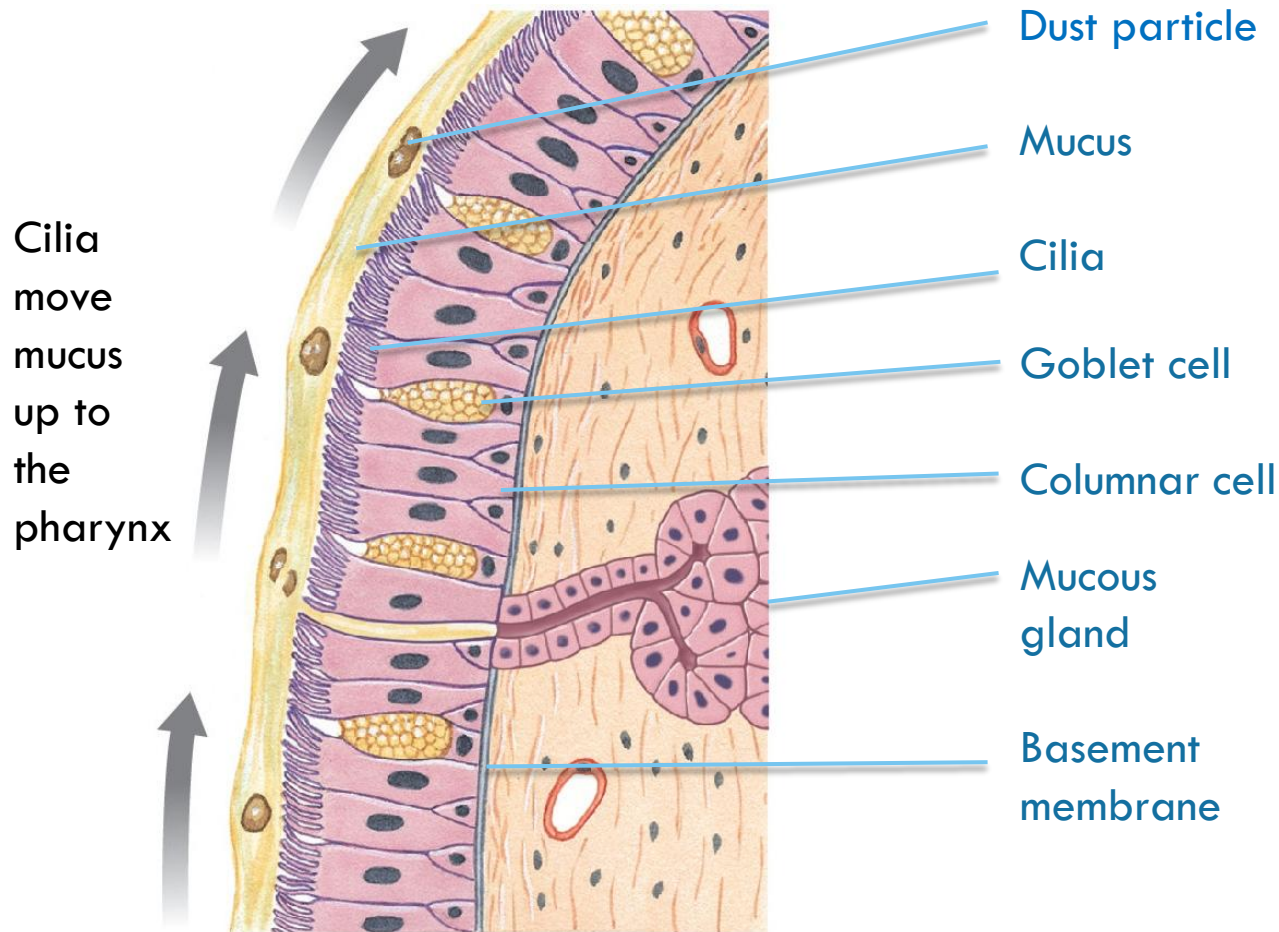
*Personal protective equipment (PPE) to prevent COVID-19*



*Mucosal membranes line parts of the body that lead to the outside and are exposed to air*

# The mucociliary escalator

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# Chemical defenses of mucosal surfaces

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- Stomach – low pH
- Gall bladder – bile
- Intestine – digestive enzymes
- Mucus
- Defensins
- Lysozyme (tears, urine)





# Summary: skin vs mucous membranes

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	Skin	Mucous membranes
<b>Number of cell layers</b>	Many	1 to a few
<b>Tightly packed cells?</b>	Yes	Yes
<b>Cells dead or alive?</b>	Outer layers dead; inner layers alive	Alive
<b>Mucus present?</b>	No	Yes
<b>Lysozyme and defensins present?</b>	Yes	In some cases
<b>Sebum present?</b>	Yes	No
<b>Cilia present?</b>	No	In trachea and uterine tubes

# Obj 4. Innate vs Adaptive Immunity

# Two intertwined 'arms' of the immune system

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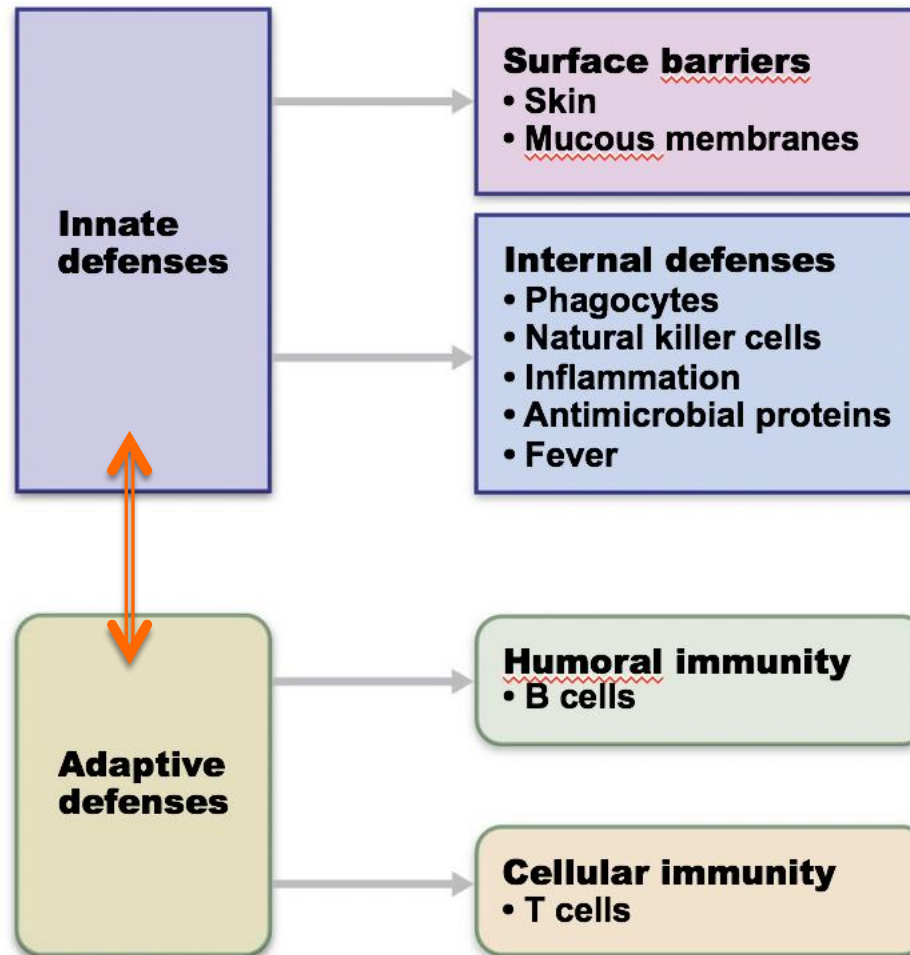


Figure 21.1 Marieb



# Two intertwined 'arms' of the immune system

24

## □ **Innate immunity**

- Already in place
- Rapid (hours)
- Fixed
- Limited specificities
- Has no specific memory



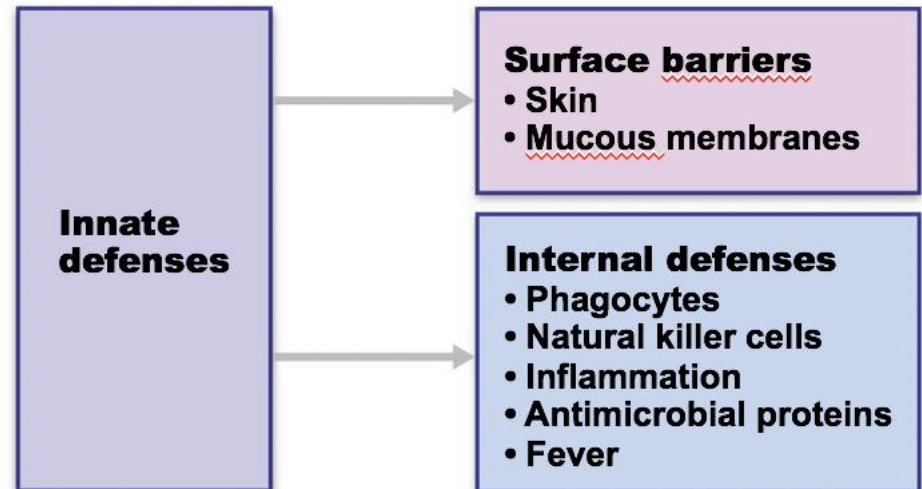
## □ **Adaptive immunity**

- Improves during the response
- Slow (days → weeks)
- Variable
- Highly specific
- Has long-term specific memory

# Innate Immunity

25

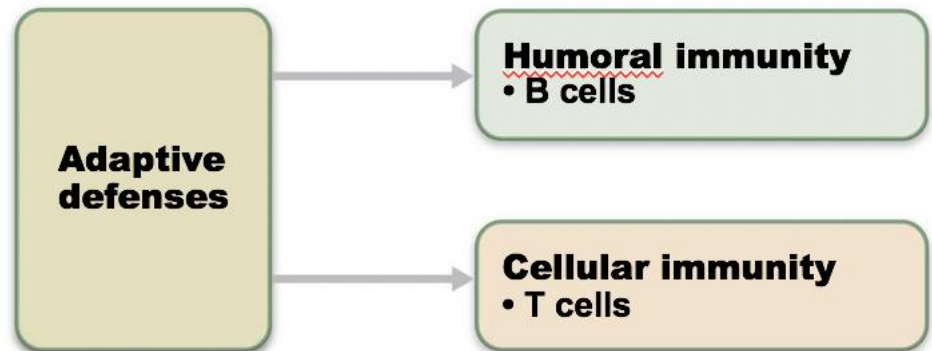
- Already in place
- Rapid (hours)
- Fixed
- Limited specificities (detects molecular components shared by many pathogens)
- Has no specific memory



# Adaptive Immunity

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- Improves during the response
- Slow (days → weeks)
- Variable
- Highly specific (detects molecular components specific to individual pathogens)
- Has memory



# HUBS191

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