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VCE Biology $\frac{3}{4}$
The Innate Immune System [3.2]
Homework

Admin Info & Homework Outline:

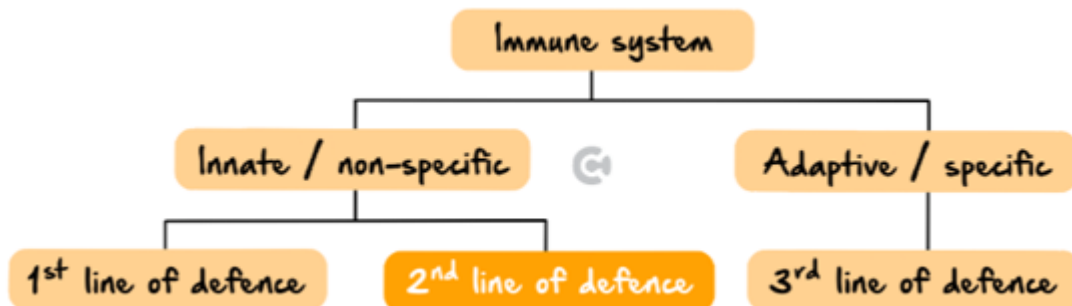
Student Name	
Questions You Need Help For	
Homework Questions	Pg 2-Pg 20



Section A: Homework Questions (50 Marks)

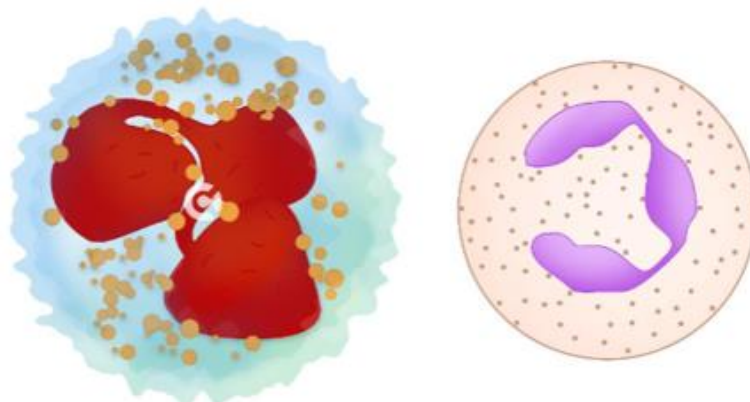
Overview

- The innate immune system is the first layer of defense against pathogens.
- 🔗 Barriers prevent the entry of the pathogen; this lesson will focus on what occurs next.
- The innate immune system is _____ and delivers a _____ response to any pathogens that make it through to the intracellular space.



Neutrophils

- They are classed as a phagocyte - _____.
- 🔗 The vast majority of the immune cells in your body are neutrophils - _____.
- First responders, but also are very expendable.
- Common component of pus.

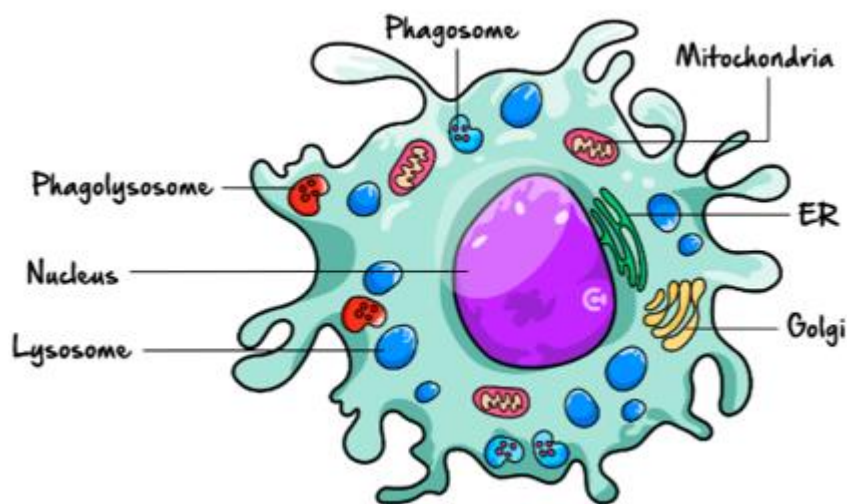


3D rendering of a neutrophil



Macrophages

- These are larger immune cells - also _____.
- ❏ Broader range of function and longer lived than compared to neutrophils.
- ❏ Can be found as a permanent part of some tissues.
- ❏ Can also release cytokines to induce other responses of the immune system.
- Involved with antigen presentation.



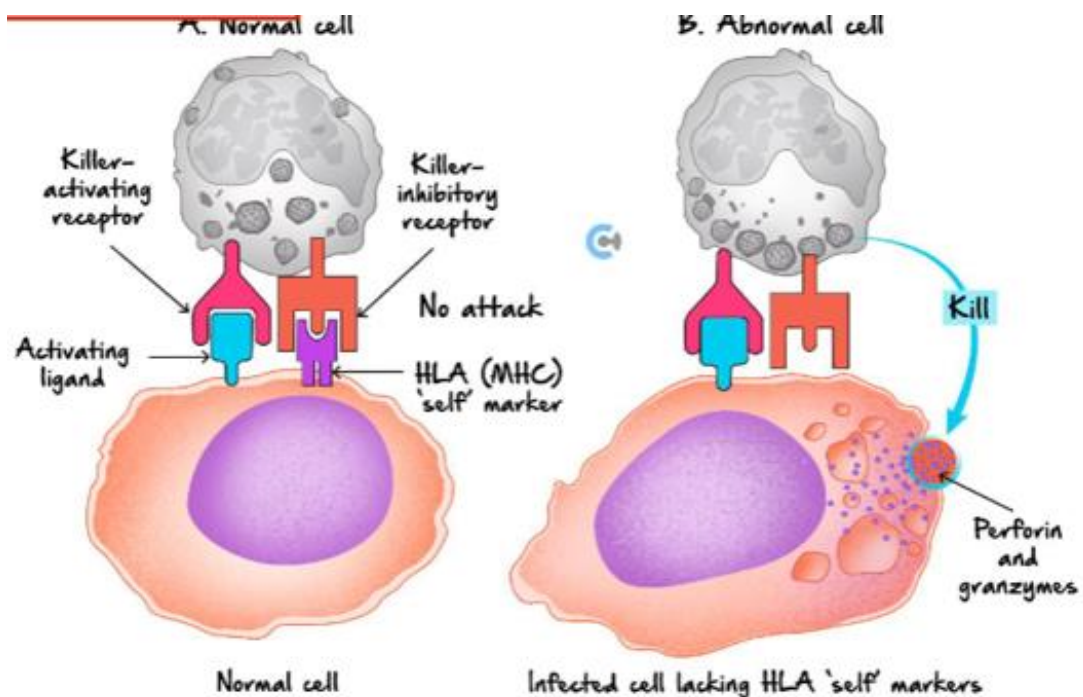
Dendritic Cells

- Another cell that engages in phagocytosis, primarily found in tissues, but can travel through the bloodstream.
- ❏ More specialised for the process of antigen presentation. Why?



Natural Killer Cells

- These are cells that do not target foreign cells but actually focus on targeting your own unhealthy cells, or infected cells.
- ❏ Why might cells be unhealthy?
- ❏ How could the unhealthy cell be recognised?
- This natural killer cell will then release perforins and granzymes which will trigger the cell's death by _____.

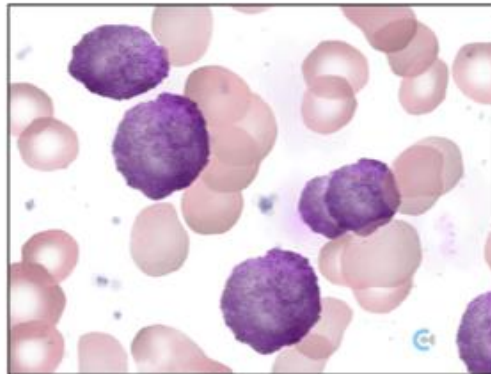


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Mast Cells

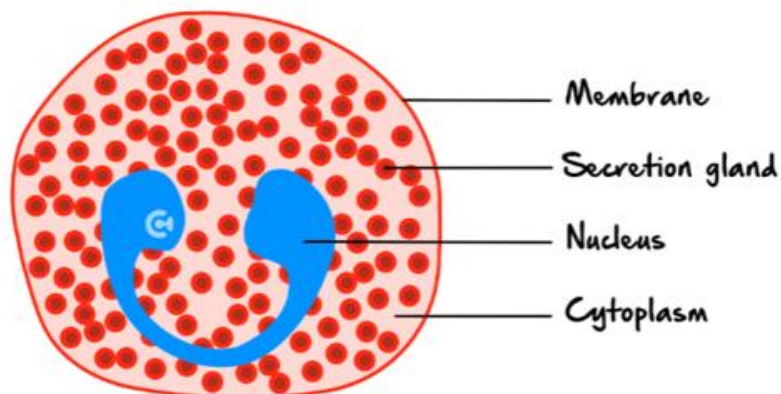
- Immune cell that is primarily responsible for the release of _____ and other mediators that activate the immune system.
- ❏ Not directly involved in the defense but rather stimulates other cells to do so - releases other kinds of cytokines as well.
- Remains in tissue.



Eosinophils

- Immune cells which release _____ - impacting pathogens which cannot be ingested fully via phagocytosis.
- ❏ Able to phagocytose, but to a very limited extent.
- Degranulate upon contact - what process would we call this ordinarily?

Structure of an Eosinophil



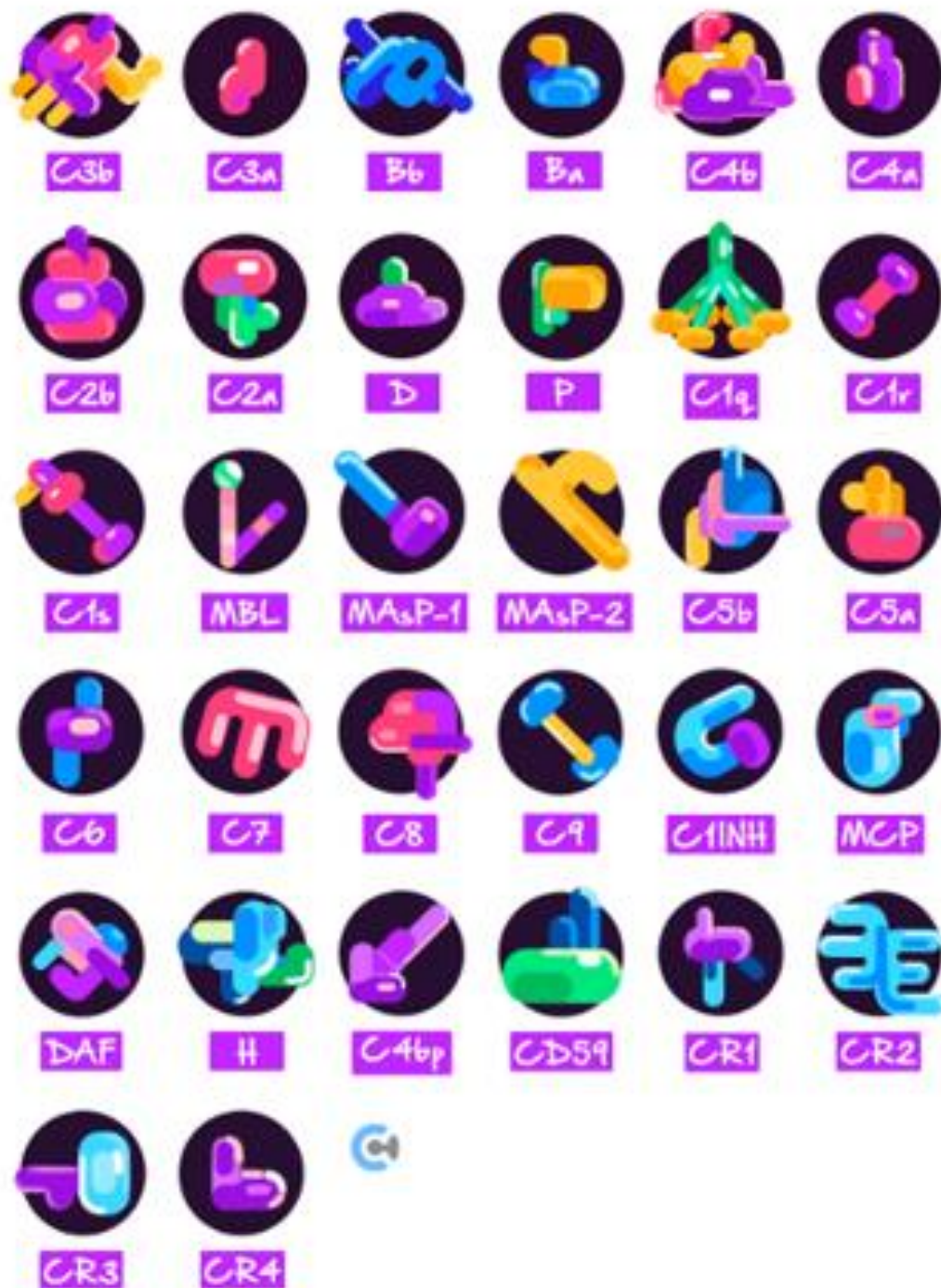


The Complement System

➤ The complement system is a set of proteins that float around the body in the blood, and act as an innate defense against pathogens.

🇬🇧 Primarily focused against bacteria.

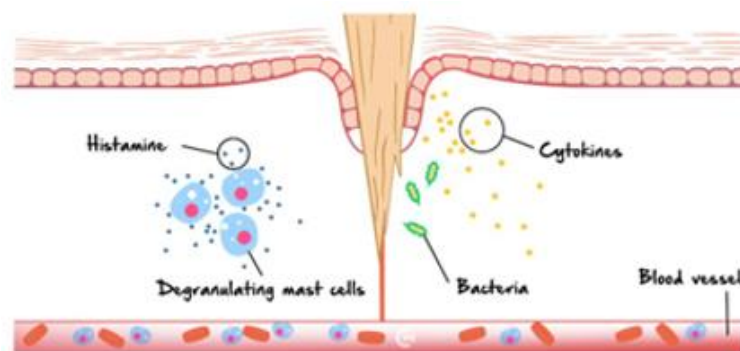
The Complement System



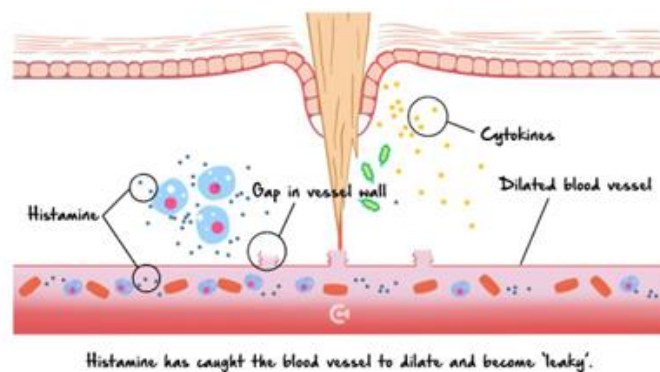


Overview of the inflammatory Response

- The inflammatory response is an innate response to pathogenic infection and injury, which serves to rapidly shut down further infections and damage by increasing blood flow to an affected tissue.
- 🔗 There are three main aspects to it - _____.
- Classic example is a splinter.
- *Initiation* - When the splinter pierces the protective layer of the skin, it damages skin cells and _____ may have been present in the splinter to the body. Damaged cells release cytokines, mast cells degranulate releasing _____.

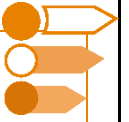


- *Vasodilation* - _____ travels from the mast cells, to the nearby blood vessels, binding to specific receptors which trigger vasodilation - _____. The permeability of the vessel wall also increases - _____.



Fever

- Increasing central body temperature - to disrupt the function of pathogens. How?
- 🔗 Can fevers be bad for us too?



Sub-Section [3.2.1]: Explain How the Innate Response is Triggered in Response to Infection & its Defining Characteristics

Question 1 (1 mark)



Which of the following is a key feature of the inflammatory response?

- A. Increased blood flow and capillary permeability.
- B. Immediate antibody production.
- C. Clonal selection of T lymphocytes.
- D. Suppression of immune cell activity.

Question 2 (1 mark)



What is the role of complement proteins in the innate immune response?

- A. They stimulate the production of antibodies.
- B. They enhance phagocytosis, induce inflammation, and form membrane attack complexes.
- C. They recognise specific antigens on pathogens.
- D. They produce cytokines for long-term immunity.

Question 3 (1 mark)



How do natural killer (NK) cells contribute to the innate immune response?

- A. By engulfing pathogens.
- B. By recognising and destroying virus-infected or cancerous cells.
- C. By producing antigen-specific antibodies.
- D. By presenting antigens to T cells.

Question 4 (2 marks)

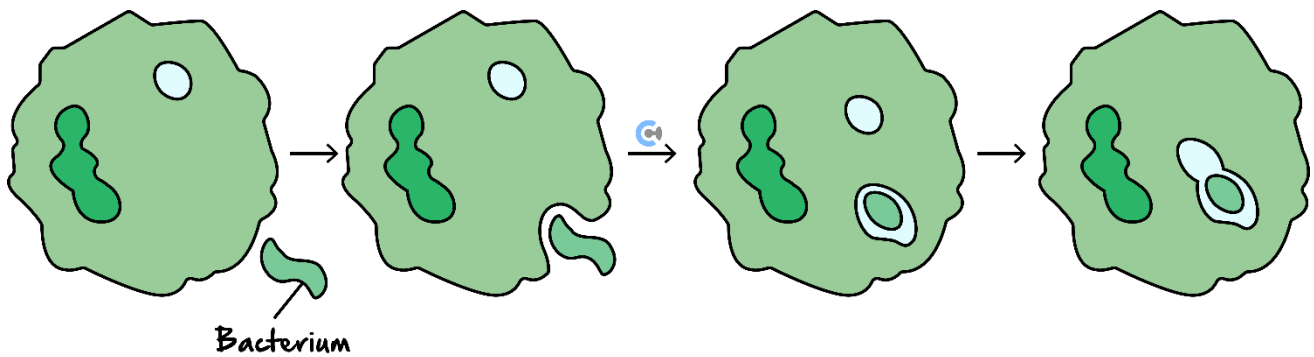


Why is the innate immune response considered non-specific?

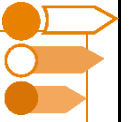
Question 5 (3 marks)



Describe the significance of the process given in the diagram.



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Sub-Section [3.2.2]: Identify & Describe the Function of the Cellular Components of the Innate Immune Response - Macrophages, Neutrophils, Dendritic Cells, Mast Cells, Eosinophils

Question 6 (1 mark)



Which cell type is particularly specialised in combating parasitic infections and modulating allergic responses?

- A. Neutrophils
- B. Dendritic cells
- C. Macrophages
- D. Eosinophils

Question 7 (1 mark)



Which of the following is a primary function of macrophages in the innate immune response?

- A. Producing antibodies.
- B. Phagocytosis and antigen presentation.
- C. Releasing histamine.
- D. Generating active oxygen species exclusively.

Question 8 (1 mark)



What role do neutrophils play at the onset of an infection?

- A. They synthesise antibodies.
- B. They directly present antigens to T cells.
- C. They rapidly migrate to the infection site and perform phagocytosis.
- D. They secrete cytokines exclusively for adaptive immunity.

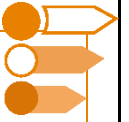
Question 9 (2 marks)


In what manner do dendritic cells bridge innate and adaptive immunity?

Question 10 (3 marks)


Discuss the importance of antigen presentation by macrophages and dendritic cells in the context of innate immunity.

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Sub-Section [3.2.3]: Identify & Describe the Role of Non-Cellular Components of the Innate Immune Response - Complement Proteins & Interferons

Question 11 (1 mark)



Which of the following is an example of a non-cellular component of the innate immune response?

- A. Macrophages
- B. Neutrophils
- C. Complement proteins
- D. Dendritic cells

Question 12 (1 mark)



Which non-cellular component is primarily responsible for inhibiting viral replication?

- A. Complement proteins
- B. Antibodies
- C. Interferons
- D. Cytokines

Question 13 (1 mark)



How do interferons primarily protect neighbouring cells during a viral infection?

- A. They promote phagocytosis by neutrophils.
- B. They inhibit viral replication by inducing an antiviral state in neighbouring cells.
- C. They directly lyse infected cells.
- D. They facilitate antigen presentation by dendritic cells.

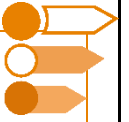
Question 14 (2 marks)

What are interferons, and how do they contribute to antiviral defense?

Question 15 (3 marks)

Discuss the roles of complement proteins in the innate immune response and explain how they contribute to pathogen elimination.

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Sub-Section [3.2.4]: Describe Key Innate Immune Processes - Phagocytosis, Inflammatory Response

Question 16 (1 mark)



Which of the following best characterises the inflammatory response?

- A. A highly specific adaptive process.
- B. A rapid, non-specific response that increases blood flow and immune cell recruitment.
- C. A mechanism that relies solely on antibodies.
- D. A process that primarily occurs in the lymph nodes.

Question 17 (1 mark)



What is the role of macrophages in the process of phagocytosis?

- A. They produce antibodies to mark pathogens.
- B. They engulf and digest pathogens and cellular debris.
- C. They secrete histamine.
- D. They form a physical barrier.

Question 18 (1 mark)



Which mediator is primarily responsible for increasing vascular permeability during inflammation?

- A. Interferon
- B. Histamine
- C. Complement protein C3
- D. Interleukin-2

Question 19 (2 marks)

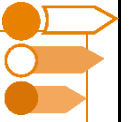
How does histamine contribute to the inflammatory response?

Question 20 (3 marks)

A student accidentally scrapes their knee while playing sport. A few minutes later, the area around the injury becomes red, swollen, and warm.

Describe two key innate immune processes that occur at the site of injury and explain how each process helps prevent the entry or spread of pathogens.

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Sub-Section [3.2.5]: Apply Knowledge of Innate Immune Response to Unfamiliar Contexts Such as Pathogen Infection

Question 21 (1 mark)



A person inhales fungal spores while gardening. Within hours, alveolar macrophages begin engulfing the spores. This response is best described as:

- A.** A specific immune response involving antibodies.
- B.** An innate immune response involving phagocytosis.
- C.** A cell-mediated adaptive response.
- D.** A humoral response involving T helper cells.

Question 22 (1 mark)



A virus infects a person's skin cells. Nearby natural killer (NK) cells detect and destroy the infected cells. This activity helps limit the spread of the virus by:

- A.** Producing memory cells specific to the virus.
- B.** Releasing antibodies to neutralise the virus.
- C.** Inducing apoptosis in the infected cells.
- D.** Engulfing viral particles directly.

Question 23 (1 mark)



A bee sting causes redness, swelling, and warmth in the affected area. These signs are due to the release of histamine from:

- A.** Neutrophils.
- B.** B cells.
- C.** Mast cells.
- D.** Cytotoxic T cells.

Question 24 (1 mark)


In a bacterial infection, neutrophils are among the first cells to arrive at the site of infection. Their main function in the innate immune response is to:

- A. Present antigens to T cells.
- B. Produce specific antibodies against bacteria.
- C. Engulf and digest bacterial cells.
- D. Activate memory B cells.

Question 25 (2 marks)


A researcher observes that mice lacking neutrophils are more susceptible to bacterial infections than normal mice. Explain why neutrophils are important in the innate immune response against bacteria.

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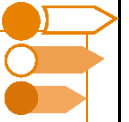

Question 26 (3 marks)

A student steps on a rusty nail, introducing bacteria deep into the skin tissue. Soon after, redness, heat, and swelling occur around the wound.

- a.** Name the immune process responsible for these symptoms. (1 mark)

- b.** Explain how this process supports the action of phagocytes in eliminating the bacteria. (2 marks)

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Sub-Section [3.2.6]: Explain the Symptoms Associated With the Inflammatory Response

Question 27 (1 mark)



Which of the following is not a typical symptom of the inflammatory response?

- A. Redness
- B. Swelling
- C. Fever
- D. Memory cell formation

Question 28 (1 mark)



The redness and warmth observed at the site of inflammation are primarily due to:

- A. Activation of cytotoxic T cells.
- B. Increased blood flow to the area.
- C. Antibody production.
- D. Phagocytosis of pathogens.

Question 29 (1 mark)



Swelling at the site of injury during inflammation is mostly caused by:

- A. Increased phagocyte division.
- B. Fluid and plasma leaking into tissues.
- C. Lymphocyte migration.
- D. Decreased capillary permeability.

Question 30 (1 mark)

Pain during inflammation is a result of:

- A. Antibodies binding to receptors.
- B. Interference with adaptive immunity.
- C. Chemical signals stimulating nearby nerve endings.
- D. Increased oxygen in the tissue.

Question 31 (2 marks)

Describe two symptoms of the inflammatory response and explain the physiological reason for each.

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Question 32 (3 marks)


A student grazes their knee during a fall. Shortly after, the area becomes red, swollen, and painful.

Describe the immune process responsible for these symptoms and explain how two of these symptoms assist in defending the body against infection.

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