**AP BIOLOGY 2019-20 March 13, 2020**

**Today’s Agenda (Day 123)**

1. HOUSEKEEPING:

🡪

1. Homework Check:

🡪 Chapter 40 & 43 Vocabulary

🡪 Chapter 40 Reading Guide

🡪 Chapter 45 Vocabulary

1. Class Activity:

**🡪 CONT’D: Chapter 40 PPT Review**

1. Section 40.4 – Energy requirements are related to animal size, activity and environment

**🡪 BEGIN: Chapter 43 PPT Review**

HOMEWORK:

* Read Unit 7: Animal Form & Function – Chapters 40, 43, 45, 49-50
* Read Unit 8: Ecology – Chapters 52 – 56
* Complete Chapter 45 Vocabulary & Reading Guides [in pairs]
* Continue working on **Coral Reef Campaign:** Phase IV

Chapter 40 – Basic Principles of Animal Form and Function

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Acclimatization | Adipose tissue | Anatomy | Basal metabolic rate | Bioenergetics | Blood | Bone |
| Cardiac muscle | Cardiac muscle | Cartilage | Circadian rhythm | Conduction | Conformer | Convection |
| Countercurrent exchange | Ectothermic | Endocrine system | Endothermic | Fibroblasts | Fusiform | Glial cells |
| Hibernation | Homeostasis | Homeotherm | Hormones | hypothalamus | Integumentary system | Interstitial fluid |
| Ligaments | Macrophages | Metabolic rate | Muscle tissue | Negative feedback | Nervous system | Nervous tissue |
| Neurons | Organ system | Organs | Physiology | Poikilotherm | Positive feedback | Regulator |
| Response | Sensor | Set point | Skeletal muscle | Smooth muscle | Standard metabolic rate | Stimulus |
| Tendons | Thermogenesis | Thermoregulation | Tissues | Torpor | Vasoconstriction | vasodilation |

Chapter 43 – The Immune System

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Acquired immunodeficiency syndrome | Active immunity | Adaptive immunity | Allergens | Anaphylactic shock | Antibody | Antigen |
| Antigen presentation | Antigen receptor | Antigenic variation | Antigen-presenting cell | Autoimmune disease | B cells | Cell-mediated immune response |
| Clonal selection | Complement system | Cytokines | Cytotoxic T cells | Dendritic cells | Effector cells | Eosinophils |
| Epitope | Heavy chains | Helper T cell | Histamine | Humoral immune response | Immune system | Immunization |
| Immunoglobulin | Inflammatory response | Innate immunity | Interferons | Latency | Light chains | Lupus |
| lymphocytes | Lysozymes | Macrophage | Major histocompatibility complex molecule | Mast cells | Memory cells | Monoclonal antibodies |
| Natural killer cells | Neutralization | Neutrophils | Opsonization | Passive immunity | Phagocytosis | Plasma cells |
| Primary immune response | Pus | Rheumatoid arthritis | Secondary immune response | T cells | Thymus | Toll-like receptor |

Chapter 45 – The Endocrine System

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Adrenal gland | Adrenocorticotropic hormone | Androgen | Anterior pituitary | Autocrine signaling | Calcitonin | Catecholamine | Corticosteroid |
| Endocrine glands | Epinephrine/  adrenaline | Estradiol | Estrogen | Follicle-stimulating hormone | Glucagon | Glucocorticoids | Growth hormone |
| Hormone cascade pathway | Hormone | Insulin | Local regulators | Luteinizing hormone | Melanocyte-stimulating hormone | Melatonin | Mineralocorticoid |
| Neurohormone | Neurotransmitters | Nitric oxide | Norepinephrine/  noradrenaline | Oxytocin | Paracrine signaling | Parathyroid glands | Parathyroid hormone |
| Pheromones | Pineal gland | Pituitary gland | Posterior pituitary | Progesterone | Progestin | Prolactin | Signal transduction |
| Simple endocrine pathway | Testosterone | Thyroid gland | Thyroid hormone | Thyroid-stimulating hormone | Tropic hormone/  Tropin | Vasopressin/  Antidiuretic hormone |  |

REMINDERS:

* **Coral Reef Campaign:** Phase IV **– March 16; 11:59:59 pm**
* Chapter 45 Vocabulary – March 13
* Chapter 43 & 45 Reading Guides – March 14 & 15
* **Chapter 40 & 43 Vocabulary Quiz 🡪 March 16**
* **Chapter 40, 43 & 45 Test 🡪 March 19**
* **Chapter 49 & 50 Test 🡪 March 26**
* **Chapter 52 & 53 Test 🡪 April 2**
* **Chapter 54 - 56 Test 🡪 April 9**

**AP BIOLOGY 2019-20 READING GUIDE**

# Chapter 40: Basic Principles of Animal Form and Function

## Concept 40.1 Animal form and function are correlated at all levels of organization

1. Animals need to exchange materials with their environment. This process occurs as substances dissolved in an aqueous medium move across the plasma membrane of each cell. For each of the following organisms, explain how this is possible: **amoeba**

**hydra**

**tapeworm**

**whale**

1. What is *interstitial fluid*?

1. What is a *tissue*?

1. There are four types of tissues. For each, give examples, the general function, and where you would find each type.

|  |  |  |  |
| --- | --- | --- | --- |
| **Tissue Type** | **Examples** | **General Function** | **Locations** |
| Epithelial | *cuboidal simple columnar simple squamous stratified squamous* |  |  |
| Connective | *cartilage*  *adipose*  *blood*  *bone*  *fibrous connective*  *loose connective* |  |  |
| Muscle | *skeletal*  *smooth*  *cardiac* |  |  |
| Nervous | Cell types:  *neurons*  *glial cells* |  |  |

## Concept 40.2 Feedback control loops maintain the internal environment in many animals

1. Explain the difference between animals that are *regulators* and those that are *conformers*.

1. The example in the text is related to temperature regulation. Would ectotherms be regulators or conformers?

1. Throughout the text, a common theme has been regulation of homeostasis by feedback loops. We discuss feedback loops again as we look at hormone levels. What is meant by a *set point*?

1. Describe an example of a *negative feedback loop*. Clearly identify the *set point*, the *stimulus*, and the *response*.

1. We sometimes say that in negative feedback “more gets you less,” and in positive feedback “more gets you more.” Describe an example of a *positive feedback loop*.

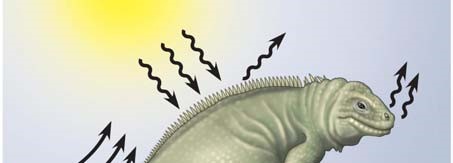
## Concept 40.3 Homeostatic processes for thermoregulation involve form, function, and behavior

1. What is *thermoregulation?*

1. Describe the difference between *endothermy* and *ectothermy*, and give an animal that exhibits each.

|  |  |  |
| --- | --- | --- |
| **Property** | **Description** | **Example** |
| *Endothermy* |  |  |
| *Exothermy* |  |  |

1. What are the four processes by which heat is exchanged with the environment? Use this figure to name and explain each process.



1. Discuss how each of the following are involved in thermoregulation:

**fur/feathers**

**adipose tissue**

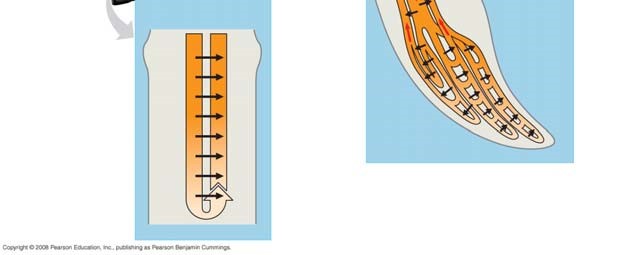
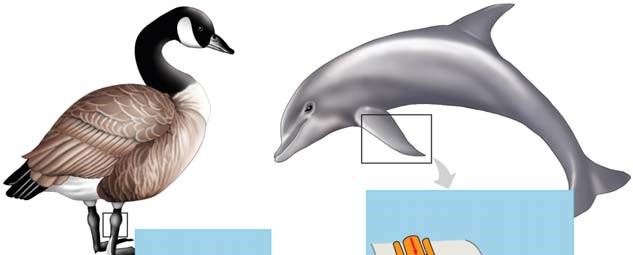
**goose bumps**

**vasodilation/vasoconstriction**

**panting/sweating**

**burrowing/sunning**

1. Heat loss in extremities is reduced by *countercurrent exchange*. Use this figure to explain how *countercurrent exchange* works.



1. What is the role of the *hypothalamus* in temperature regulation?

## Concept 40.4 Energy requirements are related to animal size, activity, and environment

1. What is the *metabolic rate*? In what units is it usually measured?

1. What is *basal metabolic rate (BMR)*?

1. What is the relationship between *BMR* and body mass?

1. What are the evolutionary advantages of *torpor* and *hibernation*?

1. If a mouse and a small lizard of the same mass (both at rest) were placed in experimental chambers under identical environmental conditions, which animal would consume oxygen at a higher rate? Explain.

*Testing Your Knowledge: Self-Quiz Answers*

Now you should be ready to test your knowledge. Place your answers here:

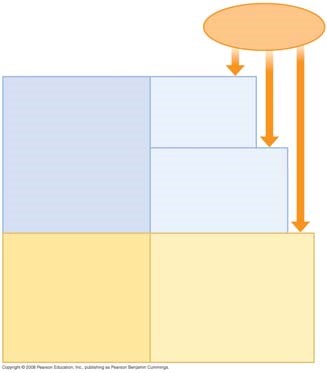
1.\_\_\_\_\_\_\_\_\_ 2.\_\_\_\_\_\_\_\_\_ 3.\_\_\_\_\_\_\_\_\_ 4.\_\_\_\_\_\_\_\_\_ 5.\_\_\_\_\_\_\_\_\_ 6.\_\_\_\_\_\_\_\_\_\_

**AP BIOLOGY 2019-20 READING GUIDE**

# Chapter 43: The Immune System

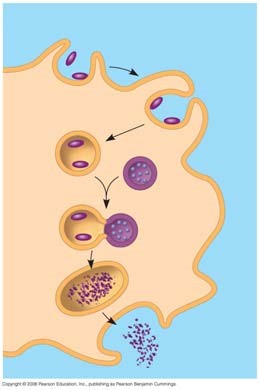
Our students consider this chapter to be a particularly challenging and important one. Expect to work your way slowly through the first three concepts. Take particular care with Concepts 43.2 and 43.3. It is rewarding, however, in Concept 43.4 to put your new knowledge to work and truly understand the devastation caused by the destruction of helper T cells by HIV.

*Overview:* The immune responses of animals can be divided into *innate immunity* and *acquired immunity*. As an overview, complete this figure indicating the divisions of both innate and acquired immunity.



## Concept 43.1 In innate immunity, recognition and response rely on shared traits of pathogens

1. We first encountered *phagocytosis* in Concept 7.5, but it plays an important role in the immune systems of both invertebrates and vertebrates. Review the process by briefly explaining the six steps to ingestion and destruction of a microbe by a phagocytic cell.



1. Explain the role of the *Toll receptor* in producing antimicrobial peptides.

1. List the three innate defenses vertebrates share with invertebrates and the two defenses unique to vertebrates.

1. In the chart below, list five examples of *barrier defenses* and how they work.

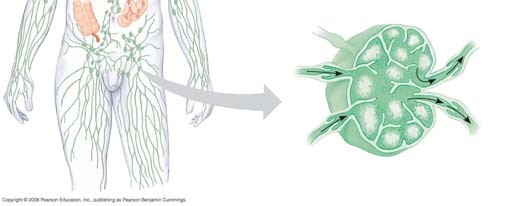
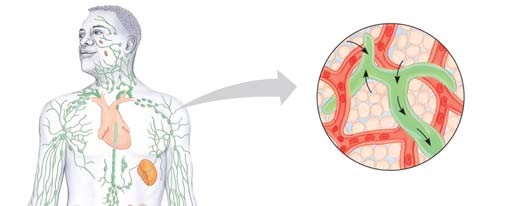
|  |  |
| --- | --- |
| **Barrier Defense** | **How the Barrier Repels Pathogens** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

1. Explain how *Toll-like receptors* are used in cellular innate defenses, using TLR3 and TLR4 as examples.

1. In the chart below, explain the role of the four phagocytic cells.

|  |  |
| --- | --- |
| **Phagocytic Cell Type** | **Role in Innate Defense** |
| *Neutrophils* |  |
| *Macrophages* |  |
| *Eosinophils* |  |
| *Dendritic cells* |  |

1. In the figure below, trace the flow of lymph in four stages. For each stage, explain the role of the lymphatic system in innate defense.

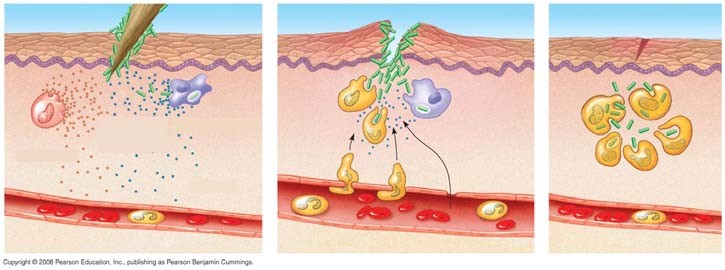


1. Explain the role of the following two antimicrobial compounds.

**Interferon**

**Complement**

1. Use the figure below to explain the three steps of an *inflammatory response*.



1. What role do *natural killer* cells play in the immune system?

1. It might seem like pathogens have little hope of mounting an infection, but do not forget that pathogens are constantly evolving ways to circumvent our immune system. As examples, how do the pathogens that cause pneumonia and tuberculosis avoid our immune responses?

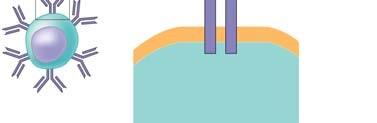
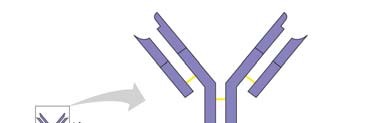
## Concept 43.2 In acquired immunity, lymphocyte receptors provide pathogen-specific recognition

1. From the first four paragraphs of this concept, summarize where *T cells* and *B cells* develop, and give an overview of their functions. (Note that they are a type of white blood cell known as a *lymphocyte*.)

1. What is *immunological memory*, and why is it important?

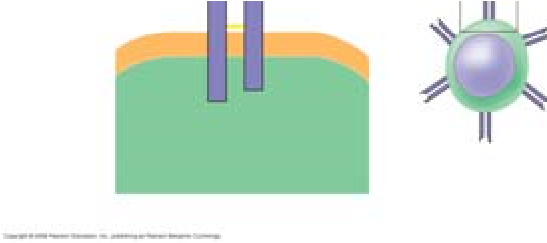
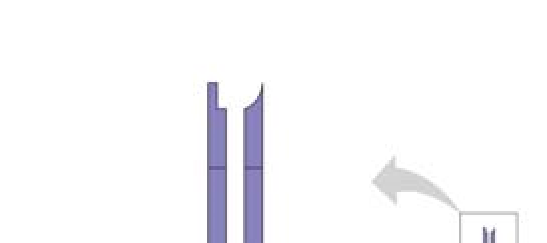
1. Explain how *cytokines* help coordinate the innate and acquired immune responses.

1. The following brief questions will serve as a primer for immune system recognition.
   1. What is an *antigen*?
   2. What is the relationship between an *antigen receptor*, an *antibody*, and an *immunoglobin*?
   3. How is an *epitope* related to an antigen? (Look at Figure 43.10.)
2. In the figure of a B cell below, label the *antigen-binding sites, light and heavy chains, variable and constant regions, transmembrane region*, and *disulfide bridges*.



1. What forms the specific *antigen-binding site*? (Be sure to note that each B cell produces only one type of antigen receptor. For any one cell, all antigen receptors or antibodies produced are identical.)

1. In the figure of a T cell below, label the *antigen-binding site, alpha and beta chain, variable and constant regions, transmembrane region*, and *disulfide bridge*.



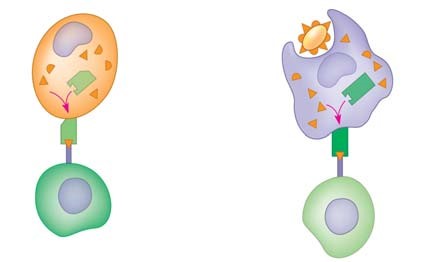
1. T cells also display only one type of antigen receptor on the surface of the cell. Compare and contrast a T cell with a B cell.
2. *B-cell receptors* recognize and bind to antigens whether they are free antigens (like a secreted toxin) or on the surface of a pathogen. Explain the role of the *major histocompatibility complex (MHC)* to *T-cell receptor* binding.

1. Explain how an infected host cell uses the MHC molecule to display an antigen.

1. Explain the differences between Class I and Class II MHC molecules, noting type of cells that display the molecule, types of diseases involved with each molecule, and what type of T cell recognizes the MHC molecules.

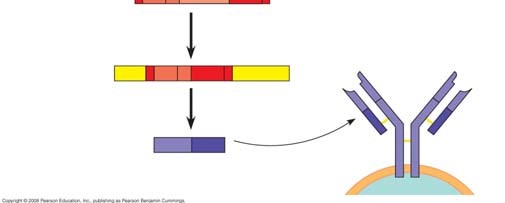
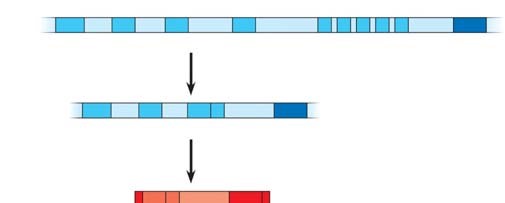
|  |  |  |  |
| --- | --- | --- | --- |
| **MHC Class** | **Displayed by?** | **Diseases associated with**  **(cancer, viral or bacterial)?** | **Recognized by which T cells?** |
| Class I MHC |  |  |  |
| Class II MHC |  |  |  |

1. Using Figure 43.12 as a guide, label completely the figure below.



1. List three properties of the *acquired immune system*.

1. One of the early problems in immunology was trying to understand how an organism with a limited number of genes (for humans, about 20,500) could produce a million different B-cell protein receptors and 10 million different T-cell protein receptors! The answer resulted in a Nobel Prize and a startling exception to the notion that all cells have exactly the same DNA. Use the figure below to label and explain the four steps involved in producing genetically unique B-cell receptors.



1. Explain how the body develops *self-tolerance* in the immune system.

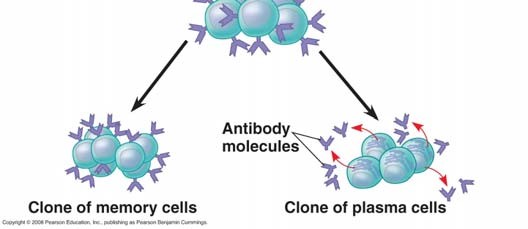
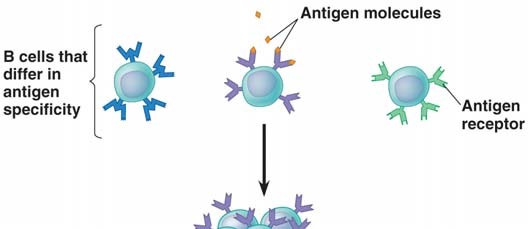
1. Define the following terms.

**Effector cells**

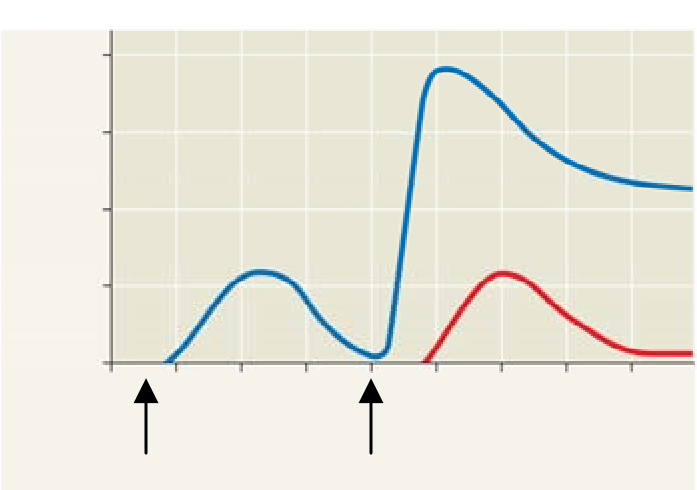
**Memory cells**

**Clonal selection**

1. Using the blue text in the margin of Figure 43.14, explain the four key events to clonal selection.



1. Graphs similar to the one below have been seen on several AP Biology exams. It depicts the primary and secondary immune response. The first arrow shows exposure to antigen A. The second arrow shows exposure to antigen A again, and also antigen B. Label this graph and then use it to explain the difference between a *primary* and *secondary immune response*.



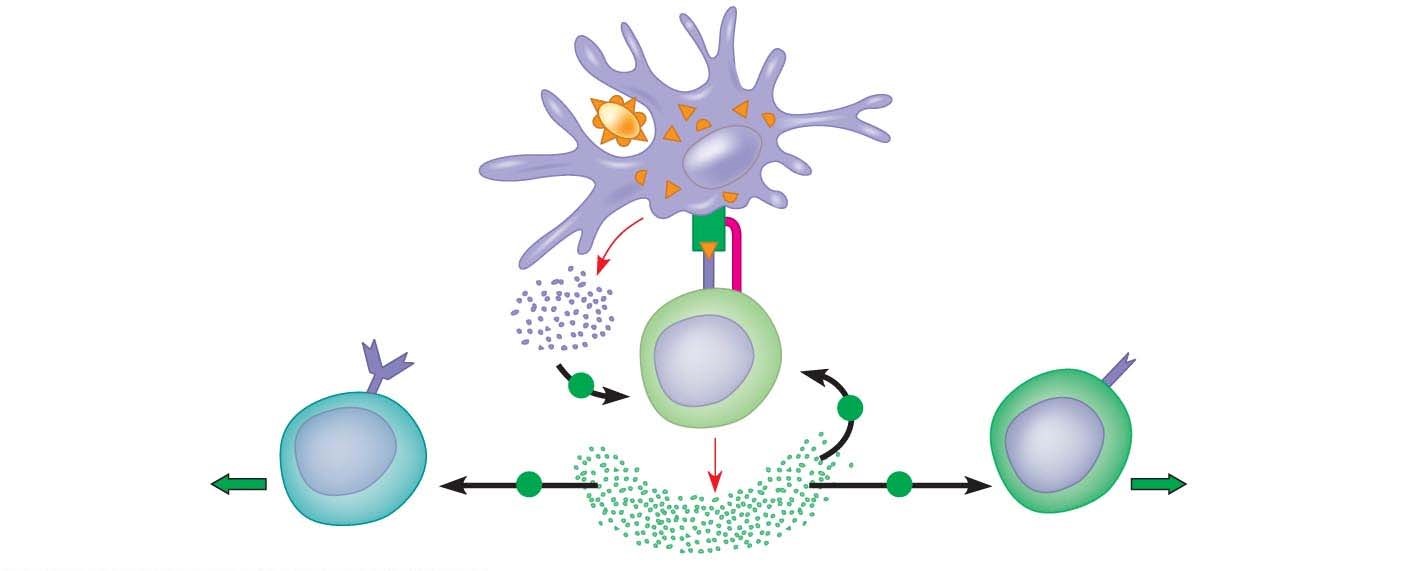
## Concept 43.3 Acquired immunity defends against infection of body cells and fluids

1. Explain fully the function of the two divisions of acquired immunity.

**Humoral immune response**

**Cell-mediated immune response**

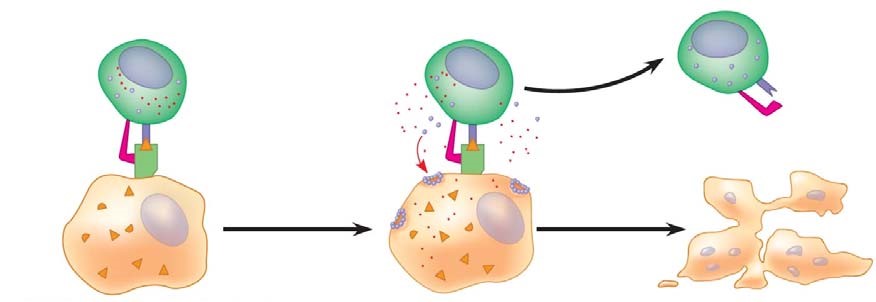
1. *Helper T cells* play a critical role in activation of both T cells and B cells. In full detail, label and explain the three steps involved using Figure 43.17. This is an important step!



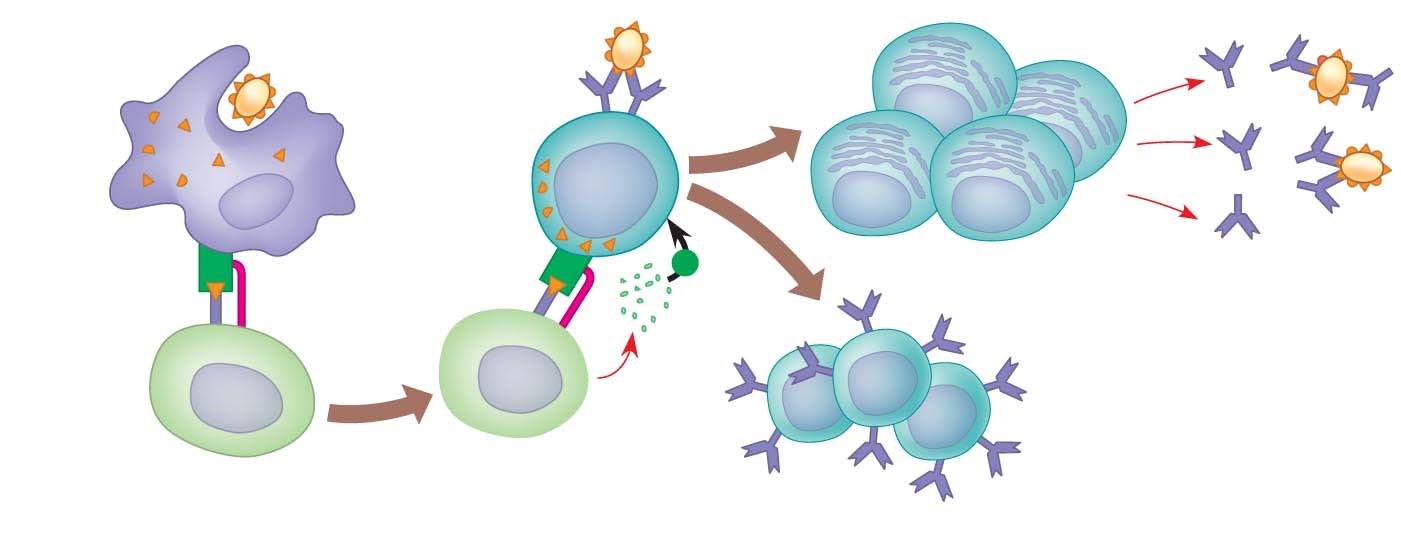
1. Explain the role of *dendritic cells* and *macrophages* in starting a primary and secondary immune response.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the effector cells in cell-mediated immunity.

1. What must occur for a *cytotoxic T cell* to become activated?
2. Completely label the diagram below. Then carefully explain the three primary steps that occur as a cytotoxic T cell destroys a target cell.



1. How is B-cell antigen presentation unique?
2. Completely label the diagram below. Then carefully explain the three primary steps that occur in *B cell activation.*



1. What is the difference between *plasma cells* and *memory cells* produced from the activation of B cells?

1. Explain how *monoclonal antibodies* are used in home pregnancy kits.

1. Why is the antibody response to a microbial infection *polyclonal*?

1. Explain these three ways antibodies can dispose of antigens.

**Viral neutralization**

**Opsonization**

**Activation of complement**

1. Using examples, explain the difference between *active and passive immunity*.

1. Describe how *immunizations* can serve as an example of active immunity.

1. Why is immune rejection an example of a healthy immune system?

1. Briefly describe the following features of immune rejection.
   1. Explain how antibodies against blood types are present.

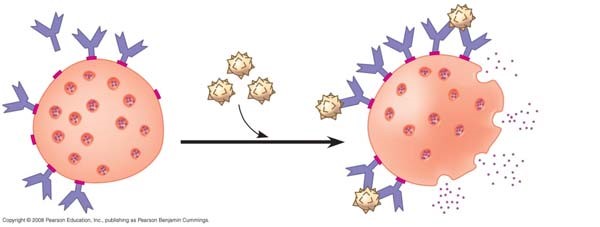
* 1. What is the role of MHC in tissue and organ transplants?

* 1. Why are bone marrow transplants medically unique?

## Concept 43.4 Disruptions in immune system function can elicit or exacerbate disease

1. What are allergies?

1. Label Figure 43.23 and then use it to explain a typical allergic response.



1. Explain what happens if a person experiences *anaphylactic shock*.

1. *Autoimmune diseases* occur when the immune system turns against particular molecules of the body. Describe the cause and symptoms of the following autoimmune diseases.

**Lupus**

**Rheumatoid arthritis**

**Type 1 diabetes mellitus**

**Multiple sclerosis**

1. Explain how *immunodeficiency diseases* are different from *autoimmune diseases*.

1. Just as our immune system has evolved to thwart pathogens, pathogens have evolved to thwart our immune system. Describe the following pathogen strategies.

**Antigenic variation**

**Latency**

**Attack on the immune system: HIV**

1. Explain how the high mutation rate in surface antigen genes in HIV has hampered development of a vaccine for AIDS. (You might take note that HIV—human immunodeficiency virus—is the virus that causes the disease AIDS—acquired immunodeficiency syndrome. These acronyms are often used incorrectly.)

*Testing Your Knowledge: Self-Quiz Answers*

Now you should be ready to test your knowledge. Place your answers here:

1. \_\_\_\_\_\_\_\_ 2.\_\_\_\_\_\_\_\_ 3. \_\_\_\_\_\_\_\_ 4. \_\_\_\_\_\_\_\_\_ 5. \_\_\_\_\_\_\_\_ 6. \_\_\_\_\_\_\_\_\_ 7. \_\_\_\_\_\_\_\_\_\_

**AP BIOLOGY 2019-20 READING GUIDE**

# Chapter 45: Hormones and the Endocrine System

***Overview***

1. What is a *hormone*?

1. Why does a hormone elicit a response only with *target cells*?

1. The body has two long-distance regulating systems. Which involves chemical signals by hormones?

1. What is the other major communication and control system?

***Concept 45.1 Hormones and other signaling molecules bind to target receptors, triggering specific response pathways***

1. Explain the difference between an *endocrine gland* and an *exocrine gland*. Give an example of each.

1. Several types of secreted signaling molecules are discussed in this chapter. Compare the action of each of the following, and give an example.

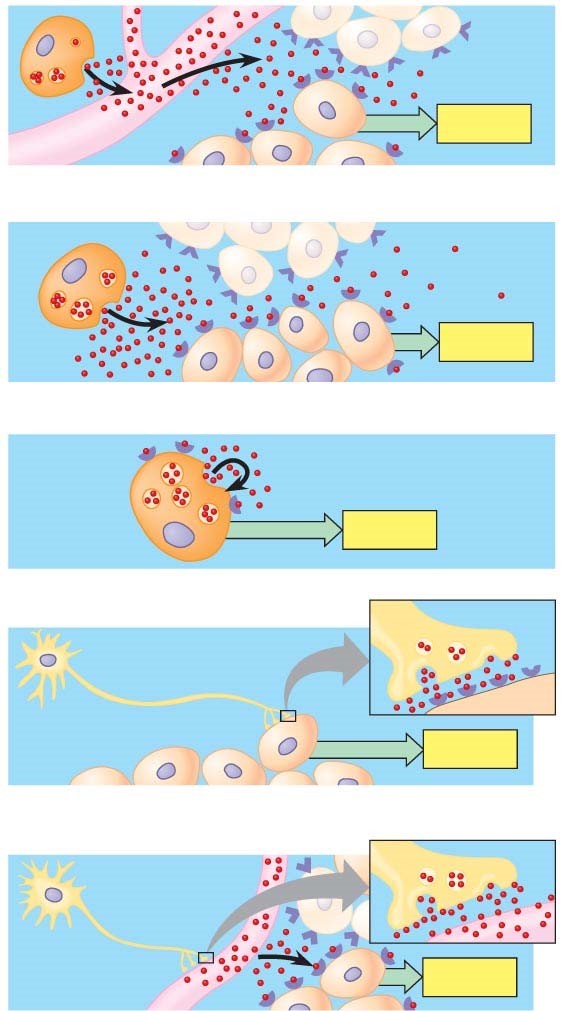
**hormones**

**local regulators**

**neurotransmitters**

**pheromones**

1. These figures show five different types of signals. Label and explain each one.



1. Recall that target cells have receptors for specific hormones. Where are the receptors for lipid-soluble hormones found?

1. Where are the receptors for the water-soluble proteins found? Explain this difference for the two types of hormones.

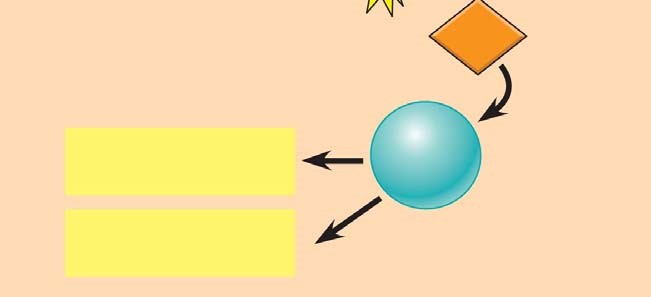
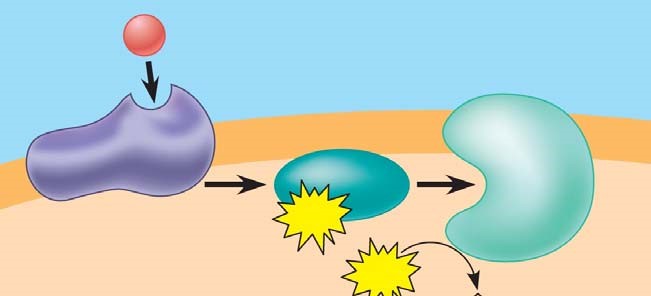
1. Carefully read the section *Cellular Response Pathways*, and use that information to complete this table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Hormone Type** | **Method of Secretion** | **Mode of Travel in Bloodstream** | **Location of Receptors** | **Examples** |
| *water-soluble* |  |  |  |  |
| *lipid-soluble* |  |  |  |  |

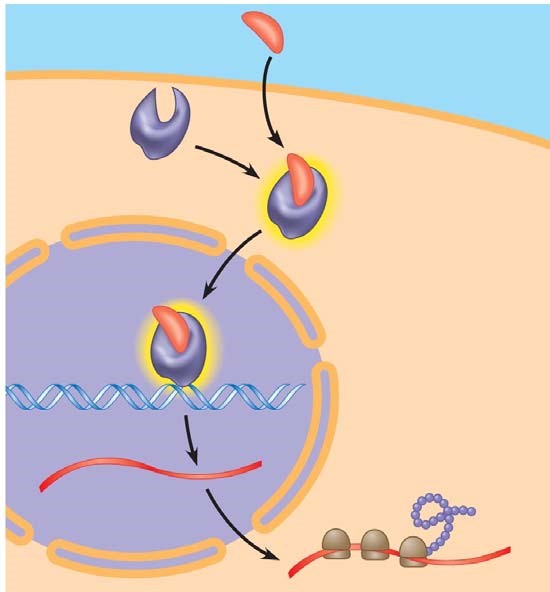
1. What endocrine gland secretes *epinephrine*?

1. What are the two intracellular responses in the liver to epinephrine? How do these help the body deal with short-term stress?

1. Use the following figure to explain the *signal transduction* pathway for *epinephrine.* (You may need to review signal transduction in Chapter 11).



1. *Lipid-soluble hormones*, such as estradiol, bind to *intracellular receptors*. Explain the action of this *steroid* in the following figure.



1. One hormone can have several different effects. For example, epinephrine can cause the release of glucose from liver cells, dilate blood vessels to skeletal muscles, and constrict intestinal blood vessels. All these effects prepare the body for “fight or flight.” Explain how these multiple effects are possible.

1. There are some interesting effects of a couple of *local regulators* discussed in your text. Explain how the local regulator *nitric oxide (NOO)* is affected by Viagra, a drug used to treat male erectile dysfunction.

1. Now read about *prostaglandins*, and explain why they contribute to menstrual cramps in females.

***Concept 45.2 Negative feedback and antagonistic hormone pairs are common features of the endocrine system***

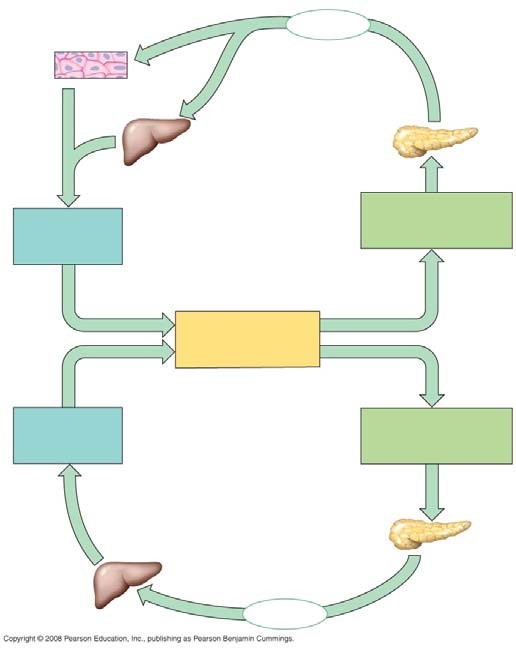
1. Throughout this course, we have emphasized *feedback loops*. What occurs in a *negative feedback* loop?

1. Complete the following chart for this pair of *antagonistic* hormones.

|  |  |  |
| --- | --- | --- |
| **Hormone** | **Secreted by** | **Action** |
| *insulin* |  |  |
| *glucagon* |  |  |

Make sure you specifically noted *alpha cells or beta cells* in the chart above.

1. On the AP Biology exam, you will be expected to explain a feedback loop. Use this figure to explain the control of blood glucose by *insulin* and *glucagon*. This is a commonly used example, and one you should know.

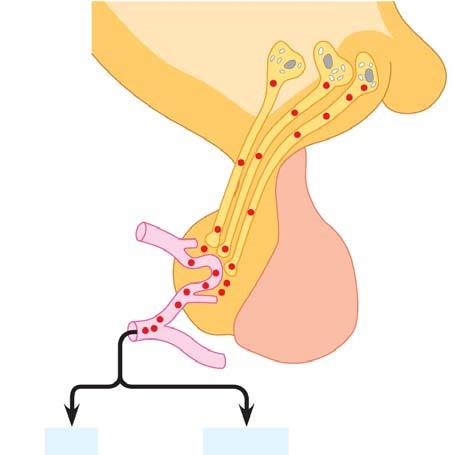


1. What occurs in *diabetes mellitus*?
2. Distinguish between *type 1 diabetes* and *type 2 diabetes*.

1. Which type of diabetes is correlated with obesity?

***Concept 45.3 The endocrine and nervous systems act individually and together in regulating animal physiology***

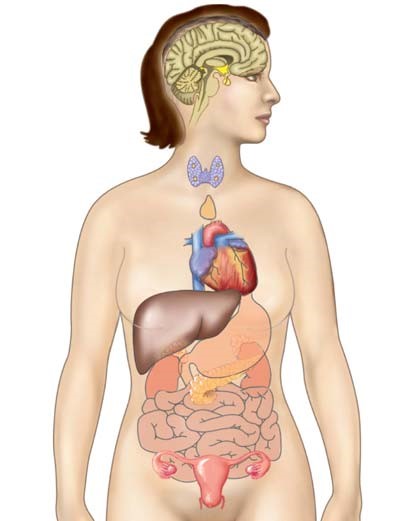
1. The *hypothalamus* directly secretes hormones that travel to the *posterior pituitary* and regulating hormones that affect secretions of hormones by the *anterior pituitary*. On this sketch, label *hypothalamus, anterior pituitary*, and *posterior pituitary* and the two hormones secreted from the posterior pituitary.



Anterior pituitary hormones

1. Return to the figure above, and list the hormones secreted by the anterior pituitary.
2. You will find it useful to be able to link hormones with the tissue that secretes them, and know their functions. Pull together the information from this chapter to complete the following chart.

|  |  |  |
| --- | --- | --- |
| **Hormone** | **Secreted by** | **Action and/or Effect of Hypo- or Hypersecretion** |
| *growth hormone* |  |  |
| *FSH, LH* |  |  |
| *TRH* |  |  |
| *prolactin* |  |  |
|  | thyroid |  |
|  | parathyroid |  |
|  | alpha cells of pancreas |  |
| *insulin* |  |  |
| *testosterone* |  |  |
| *estradiol* |  |  |
| *cortisone* |  |  |
| *epinephrine* |  |  |
| *aldosterone* |  |  |
| *cortisol* |  |  |



1. Let’s pull out a few more details from this section. How is *oxytocin* an example of a hormone that is under *positive regulation*?

1. What are *tropic hormones*? Give three examples, and tell what each hormone regulates.

1. What two hormones are antagonistic controllers of blood calcium levels?

1. How does *parathyroid hormone (PTH)* raise blood calcium? (three ways)

1. Why are *glucocorticoids* effective in treating arthritis?What is the problem with their long-term use?

1. The chart you just completed does not cover all the hormones, but it will give you a good start in learning this complex system. To extend this exercise, label the endocrine organs on the figure below and then, next to each organ, list a hormone or hormones secreted by the organ.

*Testing Your Knowledge: Self-Quiz Answers*

Now you should be ready to test your knowledge. Place your answers here:

1.\_\_\_\_\_\_\_ 2.\_\_\_\_\_\_\_ 3.\_\_\_\_\_\_\_ 4. \_\_\_\_\_\_\_ 5. \_\_\_\_\_\_\_\_ 6. \_\_\_\_\_\_\_\_ 7.\_\_\_\_\_\_\_\_ 8.\_\_\_\_\_\_\_\_

**CORAL REEF PROTECTION CAMPAIGN LAUNCH**

**PROJECT IDEA: TENTATIVE GUIDELINES**

Directions: With your team, research and find answers to the prompts listed below. Slowly develop ideas that we, the people of St. Maarten and the Caribbean, could undertake to help protect our coral reefs. Please be sure to cite ALL references (in proper APA format)

**~~Phase I~~** ~~[Due: Feb. 27]~~

* ~~What is a coral/reef?~~
* ~~How many different types of corals exist in the world?~~
* ~~Where do corals/reefs exist within the world? Which region has the greatest concentration of it?~~
* ~~How does it form? What inhibits its formation? What factors harm their continued existence?~~
* ~~What is its function within the aquatic ecosystem? What is the value of corals/reefs [ie. economically, environmentally, culturally, politically, etc.,]. Who/which groups of people stand to benefit most from the sustained health of coral reefs?~~

**~~Phase II~~** ~~[Due: Feb. 27]~~

* ~~What is the current state of the world’s corals/reefs? Why? How has the health of corals/reefs changed over the last century?~~
* ~~What is the current state of the Caribbean coral reefs? How did this come about? What are the top 3 factors threatening them?~~
* ~~What has the Netherlands historically done to protect coral reefs? Have they been successful? Explain.~~

**~~Phase III~~** ~~[Due: March 2]~~

* ~~Of the 5 greatest threats to corals/reefs, further investigate any three factors in which you believe you are instrumental in an approach to protect them.~~
* ~~What are some strategies that nations have undertaken to protect corals/reefs?~~
* ~~Of the myriad of ways one can protect coral reefs, investigate no less than 3 nations where they have achieved success in maintaining/protecting their coral reefs.~~

**Phase IV** [Due: March 16]

* With your team members, devise a strategy/approach to protect the Caribbean coral reefs from more than one perspective. Be sure to note which significant people/groups of people you will need to recruit to successfully implement ideas.

-education/awareness (locally, regionally, globally)

-making best use of social media format, targeting towards various demographic groups (youth, teens, early adulthood, middle adulthood, late adulthood)

-from the water/underwater

-changes to our current way of life (ie. how we live)

-economically

-politically

**Phase V** [Due: March 23]

Project products: a) slide presentation (between 5 – 10 minutes in length; must incorporate audio)

b) PSA (no less than 2 minutes in length—audio or video)

c) a working timeline strategy/proposal [3-month, 6-month, 1 year, 18 months, 2 years, 3 years, 5 years implementation]