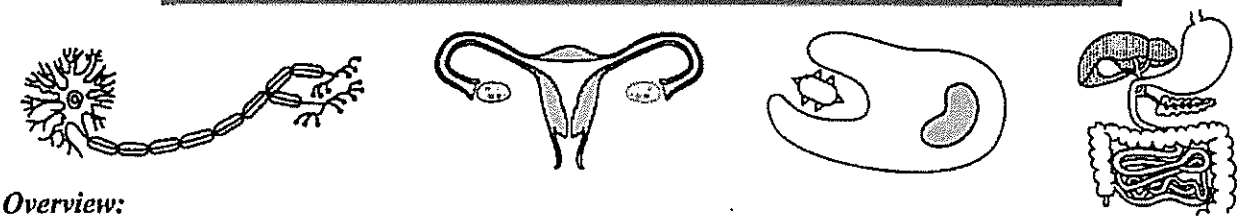
HUMAN PHYSIOLOGY, REPRODUCTION, AND HOMEOSTASIS



Overview:

In multicellular organisms such as humans, the organization of cells into complex structures allows for the maintenance of *homeostasis* – a self-regulating process to maintain the organism's internal conditions. This concept results in a *dynamic equilibrium* of body functions that is maintained by constant feedback and adjustments within the organism. Organisms require systems that coordinate actions and interact with one another. Every system has structures that have a specific function or functions. When homeostasis is disrupted by failure or malfunction within the structure, the organism may experience illness or disease, which could lead to death.

Essential Information:

Organization – The basic organization of function begins with the cell. Specific types of cells have special functions based on their genetic expression. When these cells are grouped together for a common purpose, they are called tissues. Organs contain tissues of varying functions that work towards a common goal. For example, the stomach has several types of tissues, all functioning to aid in digestion. When organs are arranged to interact together, they make up a system, such as the digestive or reproductive system. Each system within the human body plays a role that accomplishes a particular life function by coordinating specific actions within living organisms, and through cell communication and system interaction, homeostasis is maintained throughout the whole organism.

Systems:

Digestive System – The *digestive system* breaks down nutrients into usable form for cells. Large organic compounds, such as carbohydrates and proteins must be broken down into smaller building-block components like simple sugars and amino acids, respectively. Specific organs within this system, like the stomach and small intestine, supply *enzymes* that aid in this digestion. The large intestine functions to absorb water and pass solid waste from the body.

Respiratory System – The *respiratory system* functions to supply the cells with necessary O_2, as well as to remove the waste product CO_2. Specific organs and structures within this system provide necessary conditions for gas exchange. Air is moved in and out of the body through tubes, known as the trachea and bronchi, that lead to the lungs. Within the lungs, tiny air sacs, known as *alveoli*, allow for the diffusion of gases (O_2 and CO_2) across their thin membranes. Alveoli are surrounded by tiny capillaries, which efficiently absorb O_2 for use and release CO_2 for removal. Respiratory pigments, such as *hemoglobin* found on red blood cells, allow gases to be carried to and from the cells. Environmental air pollution as well as personal actions, like smoking, can lead to diseases within the lungs. *Emphysema* can develop where lung function is diminished by the loss of ability to exchange gases. *Asthma* can develop through exposure to allergens or environmental pollutants, which cause bronchi to constrict, limiting airflow.

Circulatory System – The *circulatory system* acts to transport needed nutrients to cells and to remove waste from cells. This system consists of a muscular pump, the heart, which provides the force to circulate blood to all cells then back via various blood vessels. These include *arteries* that carry blood away from the heart, *veins* that return blood to the heart, and thin-walled *capillaries* that allow for molecular exchange at the cellular level. Blood consists of a watery plasma that carries gases, nutrients, and wastes and contains *platelets* that act to clot blood. Specific cells within the blood include *red blood cells* that carry oxygen and the larger *white blood cells* that function in body defense. With an increase in human body activity, the circulatory system responds by increasing the pulse rate (measurement of heart activity). This reflects the circulatory system's role in supplying needed nutrients such as oxygen and glucose to muscle cells.

Excretory System – The *excretory system's* main function is to remove harmful wastes and to maintain water balance. The kidneys act to filter out *urea* – produced in the liver from the breakdown of amino acids. This occurs within the kidney's structural unit known as the *nephron,* which also reabsorbs water to maintain homeostasis. The resulting waste product, urine, is stored in the bladder until it is eliminated from the body through the urethra.

Regulatory Systems – In order to coordinate internal activities with changes from both inside and outside the body, humans rely on both the nervous and the endocrine systems. The *nervous system* responds to external stimuli or changes in the outside environment. Its basic unit of function is the nerve cell or *neuron.* Nerves collect information through the senses and transmit that information by relaying impulses through electronic activity within the nerve cell. At the end of a nerve cell a gap exists called a *synapse* (see diagram 2). Here, chemical messengers, know as *neurotransmitters*, are released from one neuron, traveling over the synapse to the next neuron where it binds to receptor proteins on that cell's membrane, continuing that impulse.

The *endocrine system* uses chemical messengers or *hormones* produced by *glands* to regulate metabolism and internal balance. Hormones are secreted directly into the bloodstream and travel to *target cells* on which the hormone acts. Target cells have specific receptor molecules on their membranes which bind with specific hormones, initiating a cellular response (see diagram 4). Each hormone has a specific function. *Insulin*, produced by the pancreas, allows cells to take in sugar, thus regulating blood sugar levels. *Diabetes* results from a malfunction of the pancreas when not enough insulin or no insulin is produced and cells cannot receive the correct amount of sugar. This causes dangerously high blood sugar levels. The thyroid gland releases thyroxine, responsible for controlling metabolism. The ovary produces *estrogen* and *progesterone* which are involved in female reproductive development and control of the menstrual cycle. Testes produce *testosterone*, responsible for male reproductive development. Levels of hormones are controlled by a mechanism known as *feedback.* Feedback allows for messages to be received by glands which start or stop the production of hormones depending on hormone level. If hormone levels get too high, the gland producing the hormone will reduce or stop releasing the hormone until levels reach a point where more is needed (see diagram 5).

Immune System – The *immune system* aids the body's defense against pathogens. *Pathogens* are disease-causing organisms such as viruses or bacteria. The body reacts to foreign invaders by recognizing foreign proteins or *antigens* they carry. These antigens activate *T cells* which directly attack pathogen-infected cells and activate *B cells* which produce plasma cells that release antibodies. Antibodies have receptor molecules that can bind to antigens or pathogen-infected cells, marking them for

destruction. After an initial immune response, the body also produces *memory cells* that provide immunity for future attacks. *Vaccines* contain small amounts of weakened or heat-killed pathogens and, when administered, will result in an immunity to that particular pathogen. On occasion, the body produces an immune response to a harmless substance, like pollen. This is known as an *allergic reaction*. Individuals who receive a transplant, even if they are a close match, must take medicine to suppress the immune response so that their immune system will not attack the transplanted organ and reject it. *HIV* is a virus that weakens the immune system by destroying T cells leaving its victims with AIDS and unable to fight off other pathogens.

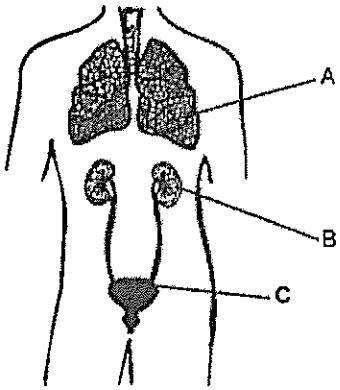
Reproductive System – Sexual reproduction allows for the union of gametes to form a new individual. Specialized structures within the male and female provide the necessary function. In the *testes* of the male, meiosis produces sperm cells (gametes), which mature in the *vas deferens* or sperm duct. Upon release, the sperm are mixed with fluids from glands that provide nutrients and a medium for movement and exit the male's body through the urethra in the penis. In females, the *menstrual cycle* regulates the process of reproduction based on release of hormones. Estrogen and progesterone released from the ovary prepare and maintain the uterine lining for pregnancy. Meiosis occurs in the ovaries producing an egg cell in cyclic fashion, once a month. The egg cells mature and are released from the ovary, then travel down the *fallopian tube* or oviduct towards the *uterus*, where depending on fertilization, they will be implanted in the uterine wall or released through the vagina. *Fertilization* takes place within the fallopian tube where the sperm enters the egg and forms a *zygote*. The genetic information from the sperm and egg fuse together providing a complete set of genetic instructions (having full number of chromosomes). After fertilization, the zygote begins a series of rapid cell divisions or mitosis until it forms a ball of cells. At this point, *differentiation* begins to occur. All cells resulting from cell divisions have the same DNA, but certain cells use specific genes that reflect a specific function. For example, liver cells and muscle cells have the same DNA, but certain genes used in liver cells are not used in muscle cells, so their function will be different. The developing *embryo* (up to 8 weeks) moves to the uterus and implants in the uterine wall where a placenta and umbilical cord will develop. The *placenta* provides a means of exchange for nutrients, wastes, and gases between the developing fetus and mother. The blood of the baby and mother will not mix; the exchange takes place by diffusion. The *umbilical cord* connects the baby to the placenta and acts to transport nutrients, gases, and waste. The *fetus* (after 8 weeks) will develop within the uterus until the time of birth. The health of the baby can be directly impacted by the action of the mother. Pregnant mothers should refrain from smoking and using drugs or alcohol and should maintain a healthy diet to ensure proper organ development of the embryo and fetus.

Additional Information:

- When the pancreas fails to produce adequate amounts of insulin, a condition known as diabetes can occur. The body cells will fail to receive adequate amounts of sugar for metabolism. Individuals with this type of diabetes may require insulin to be introduced via injection to help maintain homeostasis. Other types of diabetes are brought on by unhealthy lifestyles, such as obesity and lack of exercise.
- Poor diet choices and lack of exercise can lead to conditions that are harmful to the circulatory system. Cholesterol and fats can build up in blood vessels leading to high blood pressure, as well as heart attacks.
- Smoking can lead to a lower birth weight baby, drugs can lead to developmental problems within the nervous system of the fetus and alcohol can lead to fetal alcohol syndrome (FAS).

Diagrams:

1. **Respiratory and Excretory System** – This diagram represents two of the systems found within the human body, the respiratory and the excretory systems. In the respiratory system, lungs (structure *A*) allow for gas exchange through small air sacs known as alveoli. The excretory system is represented by the kidneys (structure *B*), which filter out harmful wastes and maintain water balance, and the urinary bladder (structure *C*), which stores urine.



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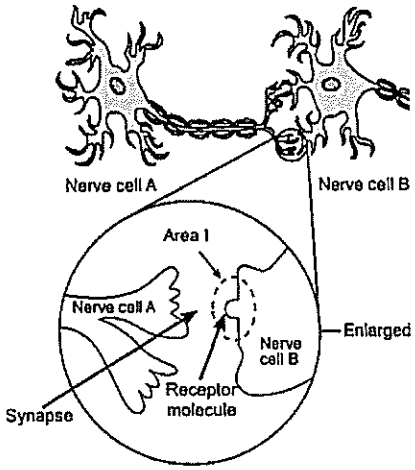
2. **The Nervous System** – The nervous system is made up of many nerves that transmit electrical impulses. Between nerve cells are gaps known as synapses as shown in the lower diagram. Chemical messengers known as neurotransmitters travel from nerve cell *A* to nerve cell *B* and connect with receptor molecules labeled within area 1. When the receptor receives the message, it initiates an impulse to continue through the next nerve cell.



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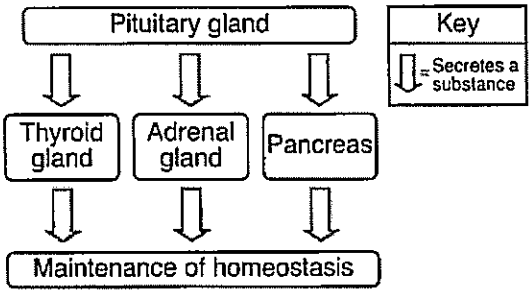
3. **Hormones in the Endocrine System** – The endocrine system is composed of glands that secrete chemical messengers known as hormones. In this diagram, the pituitary gland secretes hormones that target three glands, the thyroid, adrenal, and pancreas, which also secrete chemicals that maintain homeostasis within the human body.



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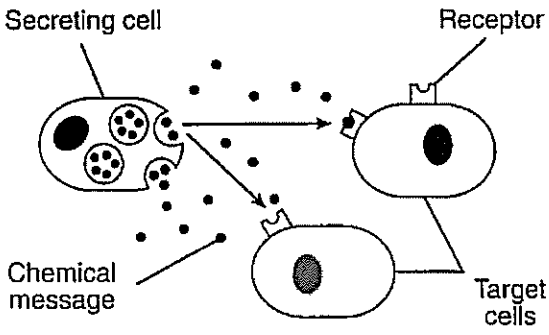
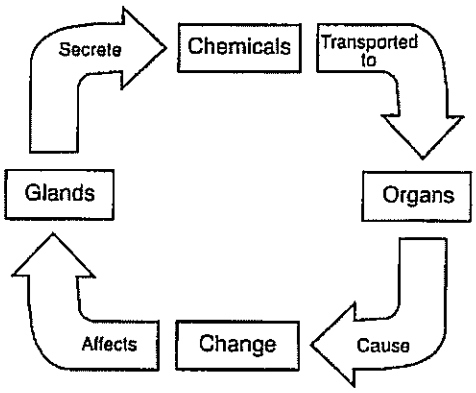
4. **Chemical Messengers and Receptors** – This diagram shows how chemical messengers work on specific cells by binding to special receptors on the cell's membrane. A secreting cell releases hormones or chemical messages into the bloodstream that flow to specific target cells that contain receptors. The shape of the receptor matches the shape of the chemical messenger, initiating a reaction within the target cell.



5. **Feedback and Dynamic Equilibrium** – This diagram provides a visual representation of the process of feedback. Feedback is a mechanism where processes within the human body are regulated based on levels of activity. When levels are too high, the activity shuts down, and when levels are too low, activity increases. In the diagram, glands secrete chemicals which move to organs and cause a change in activity. Depending on the level of activity, the change will affect the amount of chemical produced by the gland. Dynamic equilibrium results when all systems are properly functioning.



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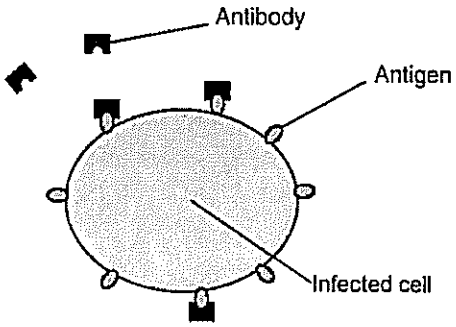
6. **Importance of Cell Receptors in The Immune System** – The diagram to the right represents a component of the immune response, the body's defense against pathogens and foreign invaders. Antibodies, produced by specialized white blood cells called *B* cells, have specific receptors that bind to antigens or foreign proteins on infected cells or on pathogens. The shape of the antibody receptor fits with a particular antigen, identifying it as foreign. When the antibodies bind to these cells, the cells are then marked for destruction by other white blood cells.



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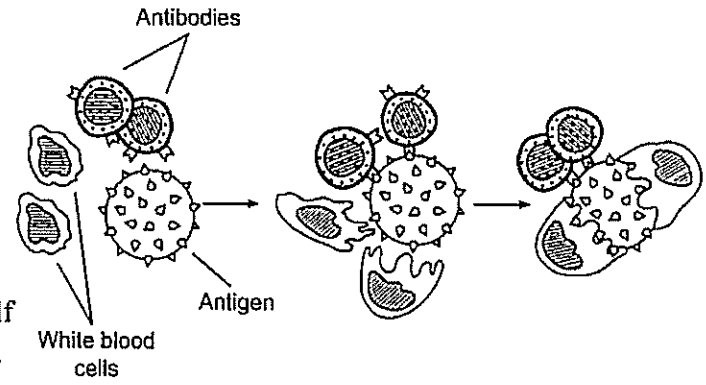
7. **Immune Response** – The diagram represents an immune response that can occur in the human body. Antibodies are proteins produced by the immune system that attach themselves to an antigen using specific receptor molecules. The antigen, a foreign protein or pathogen, is then marked for destruction. White blood cells will engulf the antigen, eliminating the foreign intruder.



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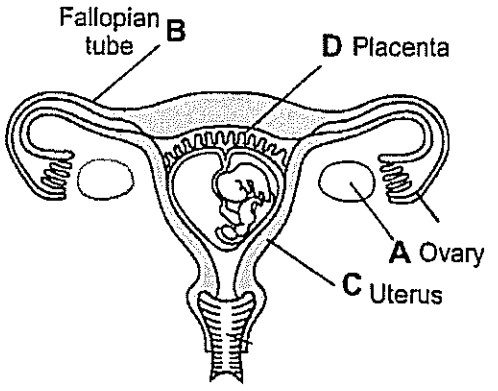
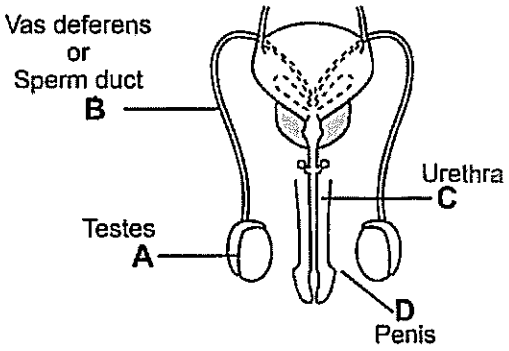
8. **Female Reproduction System** – This diagram represents the female reproductive system. This system contains several structures, each with a specific function. Structure *A* is the ovary where egg or gamete production takes place by meiosis. Structure *B* is the fallopian tube which carries eggs from the ovary to the uterus. Fertilization takes place here. Structure *C* is the uterus, which serves to hold a developing fetus. Structure *D*, the placenta, is where the exchange of nutrients, wastes, and gases occur.



9. **Male Reproduction System** – This diagram represents the male reproductive system. Structure *A* is the testes where sperm production takes place and testosterone is produced. Structure *B* is the sperm duct or vas deferens which stores sperm until ready for use. Structure *C* is the urethra, which serves as a conduit for the sperm to exit the male's body. Structure *D* is the penis that will act to deliver the sperm into the female's body.



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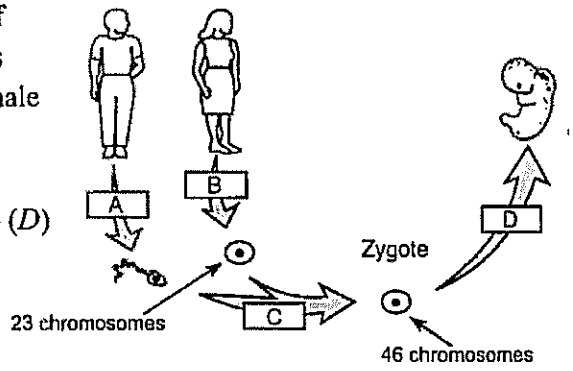
10. **Reproduction and Development** – The processes of reproduction and development are represented in this diagram. The male contributes a sperm (*A*) and a female contributes an egg (*B*) leading to fertilization (*C*) producing a zygote, containing the full set of genetic instructions. The zygote will develop into an embryo (*D*) and eventually become a fetus until birth.



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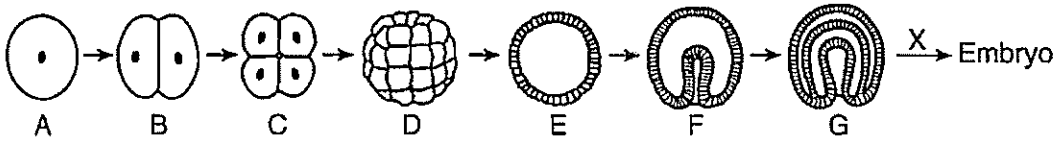
11. **Cell Division after Fertilization** – The process of development and differentiation is represented in the diagram below. After a zygote is formed at *A*, it begins a series of rapid mitotic cell divisions, producing a ball like structure as shown in steps *B* to *D*. In steps *F* and *G*, the embryo begins to carry out differentiation, a process where cells take on specific functions.



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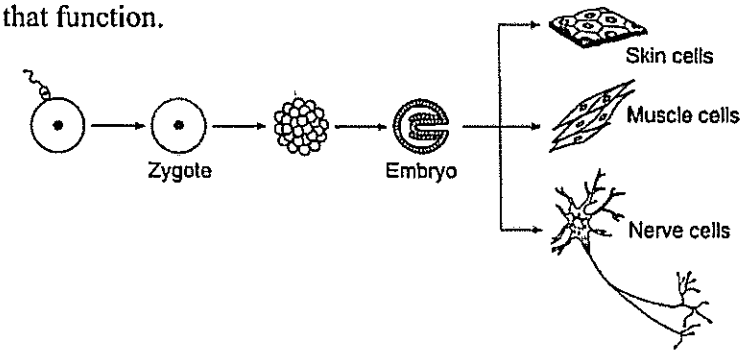
12. **Differentiation** – In the process of differentiation, a fertilized cell will differentiate into specific types of cells (Skin, muscle, and nerve cells, etc.) that carry out specific functions. Each of these cells, containing the same DNA, develops specific functions because certain genes in each cell are used or turned on to direct that function.



Vocabulary Refresher

Group A *Directions* - Match the correct definition for the following terms:

1. _____Dynamic equilibrium
2. _____Digestive system
3. _____Cell Communication
4. _____Enzymes
5. _____Respiratory system
6. _____Hemoglobin
7. _____Emphysema
8. _____Asthma
9. _____Circulatory system
10. _____Capillaries
11. _____Arteries
12. _____Veins
13. _____Platelets
14. _____Diabetes

A. The system of organs involved in the intake and exchange of oxygen and carbon dioxide.

B. A respiratory disease in which lungs have a diminished ability to absorb oxygen.

C. A condition in which the bronchi tubes become restricted due to a reaction to allergens or environmental air pollutants.

D. Muscular blood vessels that transport blood away from the heart.

E. Blood vessels that transport blood back to the heart.

F. The use of chemical signals that transfer information from one cell to another.

G. The smallest of all blood vessels that allow for exchanges to occur at the cellular level.

H. Acts to transport nutrients and oxygen to cells and to remove waste products from cells.

I. A set of conditions that are constantly changing within an organism, in order to maintain a stable environment for the organism.

J. A group of organs that all work towards breaking down nutrients into a smaller, usable form for cell use.

K. A disorder that occurs when the body fails to utilize insulin to process sugars.

L. Blood cell fragments used to clot blood.

M. A respiratory pigment, located on red blood cells, mainly responsible for transporting oxygen.

N. Protein molecules that act as biological catalysts, which speed up chemical reactions.

Vocabulary Refresher

Group B *Directions* - Match the correct definition for the following terms:

1. _____Excretory system
2. _____Hormones
3. _____Nervous system
4. _____Fertilization
5. _____Antigen
6. _____Red blood cells
7. _____White blood cells
8. _____Glands
9. _____Urea
10. _____Nephron
11. _____Homeostasis
12. _____Pathogen
13. _____Neurotransmitters
14. _____Estrogen and Progesterone

A. Disc shaped cells used to carry oxygen and carbon dioxide within the blood.

B. Cells which act to defend the human body against pathogens and foreign invaders.

C. A filtering structural unit located in the kidney that removes waste matter from the blood.

D. Maintaining a stable environment within an organism.

E. A water-soluble by-product of metabolism that is filtered out by the kidneys and excreted as urine.

F. Made up of millions of nerve cells that respond to external stimuli or changes from the outside environment.

G. Chemical substances that transmit nerve impulses across a synapse.

H. An agent that causes disease, especially a living microorganism such as bacteria and virus.

I. A substance (foreign protein) that when introduced into the body stimulates the production of an antibody; these substances are found in toxins, bacteria, cells of transplanted organs, etc.

J. Chemical messengers that are produced and secreted by glands into the bloodstream where they travel to target cells to illicit a response.

K. Hormones produced by the ovary that are responsible for maintaining the uterus.

L. The union of male and female gametes to form a zygote. This occurs in the fallopian tube (oviduct).

M. Groups of tissues that secrete specific hormones.

N. A system of organs involved in the removal of harmful waste as well as to maintain water balance.

Vocabulary Refresher

Group C *Directions* - Match the correct definition for the following terms:

1. _____Vaccines
2. _____Feedback
3. _____B cells
4. _____Receptor proteins
5. _____Synapse
6. _____Endocrine system
7. _____Memory cells
8. _____Insulin
9. _____Target cells
10. _____Testosterone
11. _____Differentiation
12. _____T cells
13. _____Immune system
14. _____Ovary

A. Membrane proteins that bind with specific molecules to produce a cellular response.

B. The bodily system that consists of glands and the hormones that they secrete.

C. Cells that contain specific receptors that will bind with specific hormones to produce a specific reaction.

D. A hormone produced by the pancreas that allows cells to take in sugar, thus regulating blood sugar levels.

E. The organ that produces the hormones, estrogen and progesterone, which are involved in female reproductive development as well as promotes gamete (egg) formation.

F. A mechanism that allows for the regulation of hormones or body temperature levels by increasing or decreasing activity within that system.

G. A hormone that is produced primarily in the testes and is responsible for the development of male sex characteristics.

H. A system that is involved in the defense of the human body through action of white blood cells.

I. Type of white blood cells that produce plasma cells which release antibodies.

J. Type of white blood cells that directly attack pathogen-infected cells and serve to activate other white blood cells.

K. Contain weakened pathogens that create an immunity to that particular pathogen.

L. T and B cells that have receptors to recognize previous pathogens and readily begin an immune response.

M. The junction or gap at which a nerve impulse passes across from one nerve to another.

N. A process that occurs after rapid cell division of the zygote where cells begin to develop different functions based on gene expression.

Vocabulary Refresher

Group D *Directions* - Match the correct definition for the following terms:

1. _____Umbilical cord
2. _____Fetus
3. _____Uterus
4. _____Allergic reaction
5. _____HIV
6. _____Menstrual cycle
7. _____Antibodies
8. _____Fallopian tubes
9. _____Embryo
10. _____Zygote
11. _____AIDS
12. _____Testes
13. _____Vas deferens
14. _____Placenta

A. An condition in which the body produces an immune response to a normally harmless substance, like pollen.

B. Secreted in response to antigens, they have receptor molecules that can bind to antigens or infected cells marking them for destruction.

C. A virus that weakens the immune system by destroying T cells.

D. A severe immunological disorder caused by the HIV virus where the human immune system is weakened and compromised.

E. A pair of slender ducts through which the egg passes from the ovaries to the uterus in the female reproductive system.

F. A flexible cord-like structure that connects the fetus to the placenta; it transports nourishment, gases, and waste products via the arteries and veins found within.

G. Where sperm cells mature and are stored.

H. Formed when the sperm and egg unite – has a full set of chromosomes.

I. A membranous organ that provides a means of exchange for nutrients, wastes, and gases between the developing fetus and mother.

J. A developing baby after 8 weeks.

K. This recurring monthly occurrence in women regulates reproduction by releasing an egg produced in the process known as ovulation.

L. A developing baby up to 8 weeks of life.

M. A muscular organ located in the pelvic cavity of females in which the fertilized egg implants and develops.

N. Male organs where the process of sperm production takes place through the process of meiosis.

1. Which situation indicates that a disruption of homeostasis has taken place?

   (1) the presence of hormones that keep the blood sugar level steady
   (2) the maintenance of a constant body temperature
   (3) cell division that is involved in normal growth
   (4) a rapid rise in the number of red blood cells 1 _____

2. A human liver cell is very different in structure and function from a nerve cell in the same person. This is best explained by the fact that

   (1) different genes function in each type of cell
   (2) liver cells can reproduce while the nerve cells cannot
   (3) liver cells contain fewer chromosomes than nerve cells
   (4) different DNA is present in each type of cell 2 _____

3. Which substances may form in the human body due to invaders entering the blood?

   (1) nutrients (3) antibodies
   (2) vaccines (4) red blood cells 3 _____

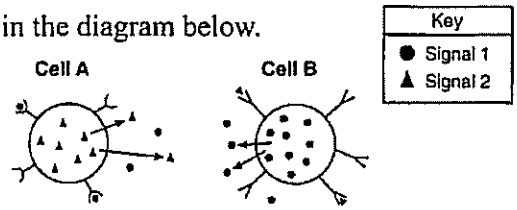
4. A protein on the surface of HIV can attach to proteins on the surface of healthy human cells. These attachment sites on the surface of the cells are known as

   (1) receptor molecules
   (2) genetic codes
   (3) molecular bases
   (4) inorganic catalysts 4 _____

5. To communicate between cells, many multicellular animals use

   (1) nerve signals and respiratory gases
   (2) respiratory gases and hormones
   (3) bones and muscles
   (4) nerve signals and hormones 5 _____

6. Cellular communication is illustrated in the diagram below.



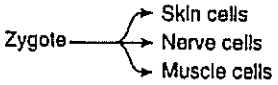
   Information can be sent from

   (1) cell *A* to cell *B* because cell *B* is able to recognize signal 1
   (2) cell *A* to cell *B* because cell *A* is able to recognize signal 2
   (3) cell *B* to cell *A* because cell *A* is able to recognize signal 1
   (4) cell *B* to cell *A* because cell *B* is able to recognize signal 2 6 _____

7. Which activity would stimulate the human immune system to provide protection against an invasion by a microbe?

   (1) receiving antibiotic injections after surgery
   (2) choosing a well-balanced diet and following it throughout life
   (3) being vaccinated against chicken pox
   (4) receiving hormones contained in mother's milk while nursing 7 _____

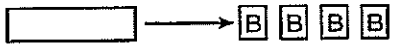
8. Which developmental process is represented by the diagram below?



   (1) fertilization (3) evolution
   (2) differentiation (4) mutation 8 _____

9. The diagram below represents one metabolic activity of a human.

Metabolic Activity A



Protein

Letters *A* and *B* are best represented by which row in the chart?

Row	Metabolic Activity A	B
(1)	respiration	oxygen molecules
(2)	reproduction	hormone molecules
(3)	excretion	simple sugar molecules
(4)	digestion	amino acid molecules

9 ____

10. Contractile vacuoles maintain water balance by pumping excess water out of some single-celled pond organisms. In humans, the kidney is chiefly involved in maintaining water balance. These facts best illustrate that

(1) tissues, organs, and organ systems work together to maintain homeostasis in all living things

(2) interference with nerve signals disrupts cellular communication and homeostasis within organisms

(3) a disruption in a body system may disrupt the homeostasis of a single-celled organism

(4) structures found in single-celled organisms can act in a manner similar to tissues and organs in multicellular organisms 10 ____

11. Certain microbes, foreign tissues, and some cancerous cells can cause immune responses in the human body because all three contain

(1) antigens (3) fats

(2) enzymes (4) cytoplasm 11 ____

12. Which statement best describes how a vaccination can help protect the body against disease?

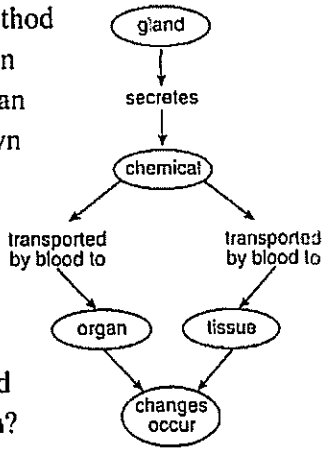
(1) Vaccines directly kill the pathogen that causes the disease.

(2) Vaccines act as a medicine that cures the disease.

(3) Vaccines cause the production of specific molecules that will react with and destroy certain microbes.

(4) Vaccines contain white blood cells that engulf harmful germs and prevent them from spreading throughout the body. 12 ____

13. An important method of communication between cells in an organism is shown in the diagram.



What is the chemical referred to in the diagram?

(1) a hormone important in maintaining homeostasis

(2) an enzyme detected a cell membrane receptor

(3) DNA necessary regulating cell functions

(4) a food molecule taken in by an organism 13 ____

14. The human reproductive system is regulated by

(1) restriction enzymes

(2) antigens

(3) complex carbohydrates

(4) hormones 14 ____

15. Which statement describes a feedback mechanism involving the human pancreas?

(1) The production of estrogen stimulates the formation of gametes for sexual reproduction.
(2) The level of oxygen in the blood is related to heart rate.
(3) The level of sugar in the blood is affected by the amount of insulin in the blood.
(4) The production of urine allows for excretion of cell waste. 15 ____

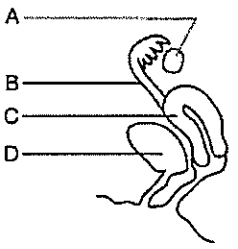
16. In the human pancreas, acinar cells produce digestive enzymes and beta cells produce insulin. The best explanation for this is that

(1) a mutation occurs in the beta cells to produce insulin when the sugar level increases in the blood
(2) different parts of an individual's DNA are used to direct the synthesis of different proteins in different types of cells
(3) lowered sugar levels cause the production of insulin in acinar cells to help maintain homeostasis
(4) the genes in acinar cells came from one parent while the genes in beta cells came from the other parent 16 ____

17. Which process normally occurs at the placenta?

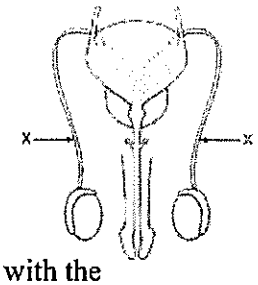
(1) Oxygen diffuses from fetal blood to maternal blood.
(2) Materials are exchanged between fetal and maternal blood.
(3) Maternal blood is converted into fetal blood.
(4) Digestive enzymes pass from maternal blood to fetal blood. 17 ____

18. Structures in a human female are represented in the diagram. A heavy dose of radiation would have the greatest impact on genetic information in future offspring if it reached gametes developing within structure



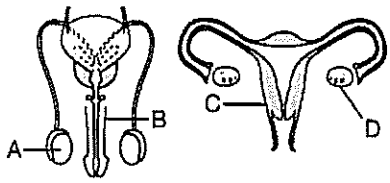
(1) *A* (3) *C*
(2) *B* (4) *D* 18 ____

19. Some body structures of a human male are represented in the diagram. An obstruction in the structures labeled **X** would directly interfere with the



(1) transfer of sperm to a female
(2) production of sperm
(3) production of urine
(4) transfer of urine to the external environment 19 ____

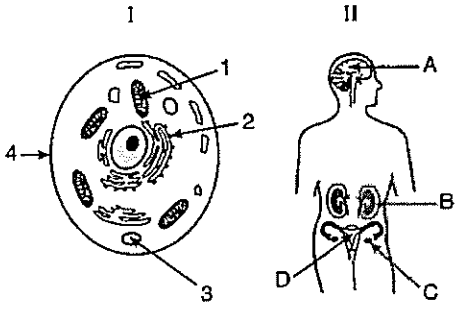
20. The diagram below represents human reproductive systems.



Which statement best describes part of the human reproductive process?

(1) Testosterone produced in *A* is transferred to *D*, where it influences embryonic development.
(2) Testosterone produced in *D* influences formation of sperm within *B*.
(3) Estrogen and progesterone influence the activity of *C*.
(4) Progesterone stimulates the division of the egg within *C*. 20 ____

21. Which structures in diagram I and diagram II carry out a similar life function?



(1) 1 and *C* (3) 3 and *A*
(2) 2 and *D* (4) 4 and *B* 21 ____

22. To increase chances for a successful organ transplant, the person receiving the organ should be given special medications. The purpose of these medications is to

(1) increase the immune response in the person receiving the transplant
(2) decrease the immune response in the person receiving the transplant
(3) decrease mutations in the person receiving the transplant
(4) increase mutations in the person receiving the transplant 22 ____

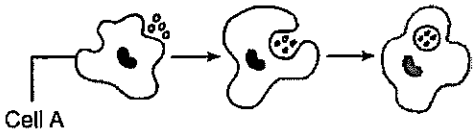
23. In sexually reproducing species, the number of chromosomes in each body cell remains the same from one generation to the next as a direct result of

(1) meiosis and fertilization
(2) mitosis and mutation
(3) differentiation and aging
(4) homeostasis and dynamic equilibrium 23 ____

24. Which organ system in humans is most directly involved in the transport of oxygen?

(1) digestive (3) excretory
(2) nervous (4) circulatory 24 ____

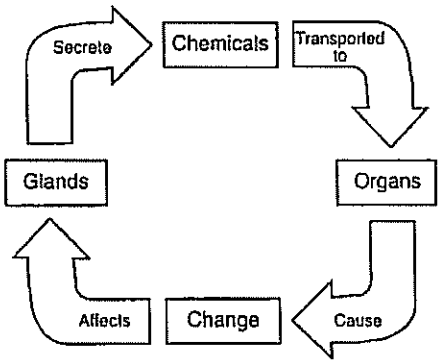
25. The diagram represents an event that occurs in the blood.



Which statement best describes this event?

(1) Cell *A* is a white blood cell releasing antigens to destroy bacteria.
(2) Cell *A* is a cancer cell produced by the immune system and it is helping to prevent disease.
(3) Cell *A* is a white blood cell engulfing disease-causing organisms.
(4) Cell *A* is protecting bacteria so they can reproduce without being destroyed by predators. 25 ____

26. The diagram below represents an interaction between parts of an organism.



The term chemicals in this diagram represents

(1) starch molecules
(2) DNA molecules
(3) hormone molecules
(4) receptor molecules 26 ____

27. Which hormone does not directly regulate human reproductive cycles?

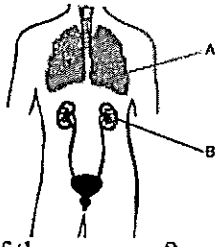
(1) testosterone (3) insulin
(2) estrogen (4) progesterone 27 ____

28. A large number of sperm cells are produced by males every day. This large number of sperm cells increases the chance that

(1) at least one sperm cell will be reached when the eggs swim toward the sperm cells in the ovary
(2) several sperm cells will unite with an egg so the fertilized egg will develop properly
(3) some of the sperm cells will survive to reach the egg
(4) enough sperm cells will be present to transport the egg from where it is produced to where it develops into a fetus

28 ____

29. Some organs of the human body are represented in the accompanying diagram.



Which statement best describes the functions of these organs?

(1) *B* pumps blood to *A* for gas exchange.
(2) *A* and *B* both produce carbon dioxide, which provides nutrients for other body parts.
(3) *A* releases antibodies in response to an infection in *B*.
(4) The removal of wastes from both *A* and *B* involves the use of energy from ATP. 29 ____

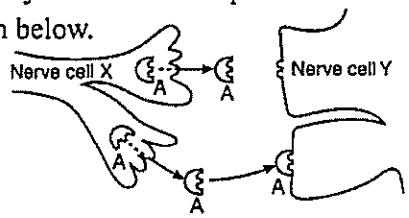
30. Kangaroos are mammals that lack a placenta. Therefore, they must have an alternate way of supplying the developing embryo with

(1) nutrients
(2) carbon dioxide
(3) enzymes
(4) genetic information 30 ____

31. Which cell process occurs only in organisms that reproduce sexually?

(1) mutation (3) meiosis
(2) replication (4) mitosis 31 ____

Base your answers to question 32 the diagram below.



32. *a*) The process represented in the diagram best illustrates

(1) cellular communication
(2) muscle contraction
(3) extraction of energy from nutrients
(4) waste disposal a ____

b) Which statement best describes the diagram?

(1) Nerve cell *X* is releasing receptor molecules.
(2) Nerve cell *Y* is signaling nerve cell *X*.
(3) Nerve cell *X* is attaching to nerve cell *Y*.
(4) Nerve cell *Y* contains receptor molecules for substance *A*. b ____

c) A drug is developed that, due to its molecular shape, blocks the action of substance *A*. Which shape would the drug molecule most likely resemble?


(1) (2) (3) (4) c ____

33. Which two systems are most directly involved in providing molecules needed for the synthesis of fats in human cells?

(1) digestive and circulatory
(2) excretory and digestive
(3) immune and muscular
(4) reproductive and circulatory 33 ____

34. The most immediate response to a high level of blood sugar in a human is an increase in the

(1) muscle activity in the arms
(2) blood flow to the digestive tract
(3) activity of all cell organelles
(4) release of insulin 34 ____

35. The virus that causes AIDS is damaging to the body because it

(1) targets cells that fight invading microbes
(2) attacks specific red blood cells
(3) causes an abnormally high insulin level
(4) prevents the normal transmission of nerve impulses 35 ____

36. Some stages in the development of an individual are listed below.

(A) differentiation of cells into tissues
(B) fertilization of egg by sperm
(C) organ development
(D) mitotic cell division of zygote

Which sequence represents the correct order of these stages?

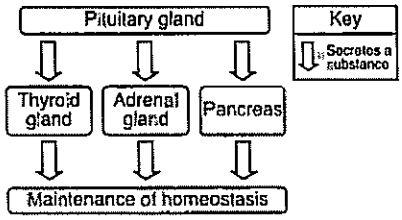
(1) *A–B–C–D* (3) *D–B–C–A*
(2) *B–C–A–D* (4) *B–D–A–C* 36 ____

37. A function of white blood cells is to

(1) transport oxygen to body cells
(2) produce hormones that regulate cell communication
(3) carry glucose to body cells
(4) protect the body against pathogens

37 ____

38. The diagram below illustrates some functions of the pituitary gland. The pituitary gland secretes substances that, in turn, cause other glands to secrete different substances.

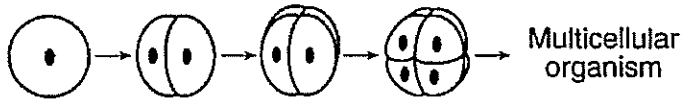


Which statement best describes events shown in the diagram?

(1) Secretions provide the energy needed for metabolism.
(2) The raw materials for the synthesis of secretions come from nitrogen.
(3) The secretions of all glands speed blood circulation in the body.
(4) Secretions help the body to respond to changes from the normal state

38 ____

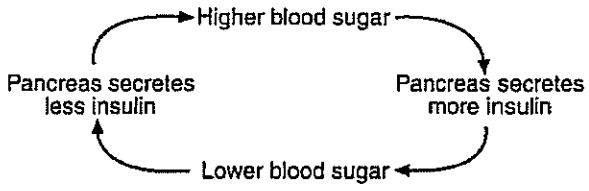
39. Which phrase best describes a process represented in the diagram below?



Fertilized egg

(1) a zygote dividing by mitosis (3) a gamete dividing by mitosis
(2) a zygote dividing by meiosis (4) a gamete dividing by meiosis 39 ____

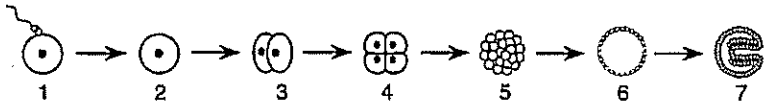
40. The diagram shows the interaction between blood sugar levels and pancreatic activity. This process is an example of



(1) a feedback mechanism maintaining homeostasis
(2) an immune system responding to prevent disease
(3) the digestion of sugar by insulin
(4) the hormonal regulation of gamete production

40_____

41. The sequence of diagrams below represents some events in a reproductive process.

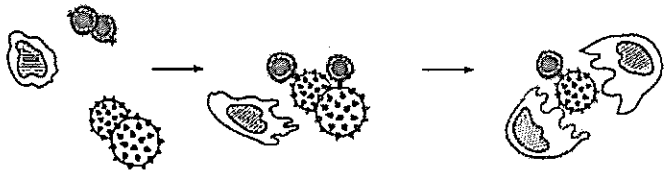


To regulate similar events in human reproduction, what adaptations are required?

(1) the presence of genes and chemicals in each cell in stages 1 to 7
(2) an increase in the number of genes in each cell in stages 3 to 5
(3) the removal of all enzymes from the cells in stage 7
(4) the elimination of mutations from cells after stage 5

41_____

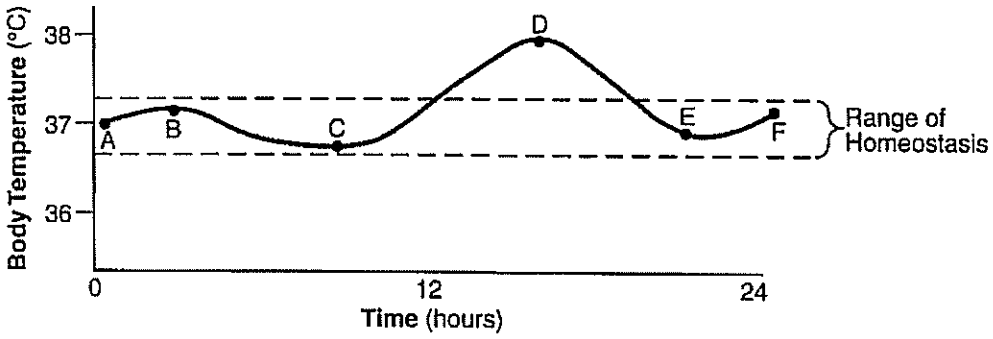
42. The diagram represents what can happen when homeostasis in an organism is threatened. Which statement provides a possible explanation for these events?



(1) Antibiotics break down harmful substances by the process of digestion.
(2) Some specialized cells mark and other cells engulf microbes during immune reactions.
(3) Embryonic development of essential organs occurs during pregnancy.
(4) Cloning removes abnormal cells produced during differentiation.

42_____

43. The data in the graph below show evidence of disease in the human body.

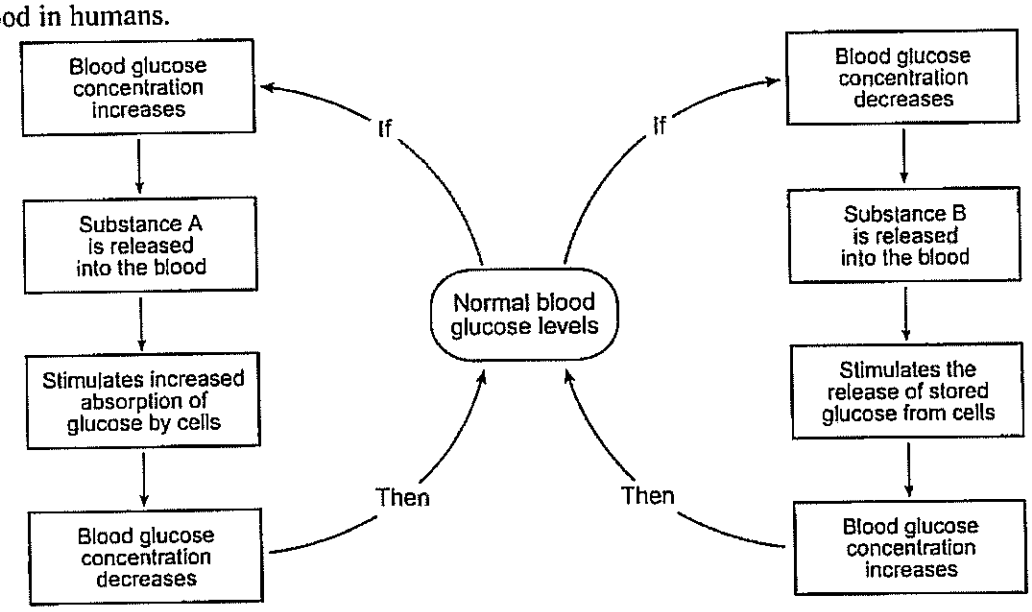


A disruption in dynamic equilibrium is indicated by the temperature change between points

(1) *A* and *B* (2) *B* and *C* (3) *C* and *D* (4) *E* and *F*

43_____

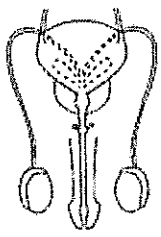
Base your answers to question 44 on the diagram below and on your knowledge of biology. The diagram represents the effect of two chemical substances, *A* and *B*, in maintaining the level of glucose in the blood in humans.



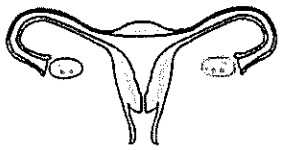
44. *a*) The interaction of substances *A* and *B* is an example of
(1) a genetic mutation (3) an immune response
(2) homeostatic feedback (4) active transport a_____

b) Which statement is correct regarding the substances involved in these interactions?
(1) Substance *A* is insulin, which is released by cells in the pancreas.
(2) Substance *B* is a chemical receptor molecule produced by blood cells.
(3) Both substances *A* and *B* are classified as biological catalysts.
(4) Substance *A* is a chemical that is produced by specialized blood cells. b_____

The diagrams below represent organs of two individuals. The diagrams are followed by a list of sentences. For each phrase in question 45, select the sentence from the list below that best applies to that phrase. Then record its number in the space provided.



Individual A



Individual B

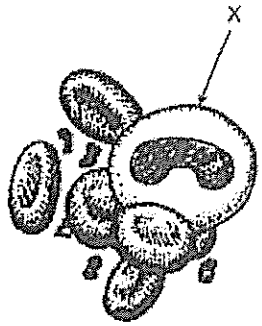
1. The phrase is correct for both Individual *A* and Individual *B*.
2. The phrase is not correct for either Individual *A* or Individual *B*.
3. The phrase is correct for Individual *A*, only.
4. The phrase is correct for Individual *B*, only

45. *a*) Contains organs that produce gametes _____

b) Contains organs involved in internal fertilization _____

c) Contains a structure in which a zygote divides by mitosis _____

Base your answers to question 46 on the structures in the diagram of human blood that help to maintain homeostasis in humans.



46. *a*) Identify the cell labeled **X**. _____

b) State one way a cell such as cell **X** helps to maintain homeostasis.

_____

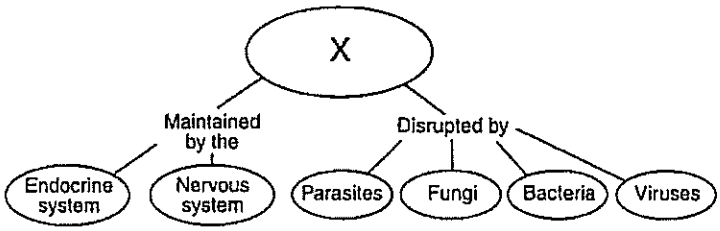
_____

47. Using appropriate information, fill in spaces *A* and *B* in the chart. In space *A* identify an organ in the human body where molecules diffuse into the blood. In space *B* identify a specific molecule that diffuses into the blood at this organ. Rows 1 and 2 must have different answers.

	An organ in the human body where molecules diffuse into the blood	A specific molecule that diffuses into the blood at this organ
1	A	B
2	A	B

48. What term or phrase does letter **X** most likely represent?

_____

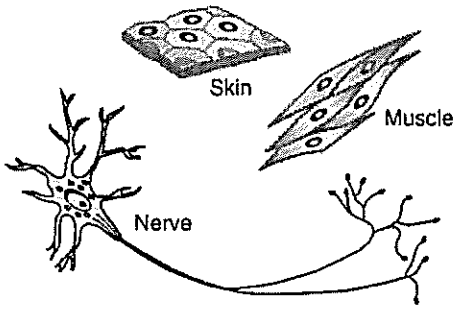


49. The types of human cells shown are different from one another, even though they all originated from the same fertilized egg and contain the same genetic information. Explain why these genetically identical cells can differ in structure and function.

_____

_____

_____



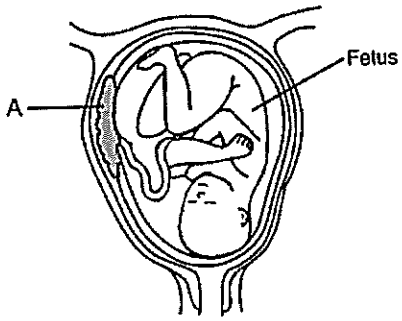
50. Estrogen is one of the hormones produced by human females. Identify *one* organ that produces estrogen and state *one* specific function of estrogen in a human female.

Organ: _____

Function: _____

Base your answers to questions 51 on the statement and diagram.

Women are advised to avoid consuming alcoholic beverages during pregnancy.



51. *a*) Identify the structure labeled *A* and explain how the functioning of structure *A* is essential for the normal development of the fetus.

Structure *A*: _____

Function: _____

_____

b) Explain why consumption of alcoholic beverages by a pregnant woman is likely to be more harmful to her fetus than to herself.

_____

_____

c) What structure is the fetus being developed in? _____

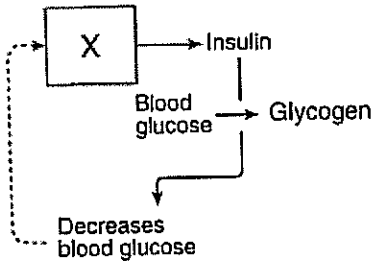
Base your answers to question 52 on the accompanying diagram.

52. *a*) Identify the organ labeled **X**.

_____

b) The dashed line in the diagram represents

_____



Base your answers to question 53 on the information below.

Vaccines play an important role in the ability of the body to resist certain diseases.

53. *a*) Describe the contents of a vaccine.

_____

b) Identify the system in the body that is most directly affected by a vaccination.

_____

c) Explain how a vaccination results in the long-term ability of the body to resist disease.

_____

_____

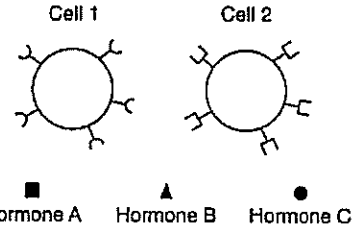
1. What usually results when an organism fails to maintain homeostasis?
   (1) Growth rates within organs become equal.
   (2) The organism becomes ill or may die.
   (3) A constant sugar supply for the cells is produced.
   (4) The water balance in the tissues of the organism stabilizes. 1 _____

2. Which statement accurately compares cells in the human circulatory system to cells in the human nervous system?
   (1) Cells in the circulatory system carry out the same life function for the organism as cells in the nervous system.
   (2) Cells in the circulatory system are identical in structure to cells in the nervous system.
   (3) Cells in the nervous system are different in structure from cells in the circulatory system, and they carry out different specialized functions.
   (4) Cells in the nervous system act independently, but cells in the circulatory system function together. 2 _____

3. Feedback interactions in the human body are important because they
   (1) determine the diversity necessary for evolution to occur
   (2) direct the synthesis of altered genes that are passed on to every cell in the body
   (3) regulate the shape of molecules involved in cellular communication
   (4) keep the internal body environment within its normal range 3 _____

4. Hormones and secretions of the nervous system are chemical messengers that
   (1) store genetic information
   (2) carry out the circulation of materials
   (3) extract energy from nutrients
   (4) coordinate system interactions 4 _____

5. The diagram represents cells and hormones present in the human body.



   Which statement correctly describes an interaction between the hormones and the cells?
   (1) Hormone *A* is synthesized by cell 2 and targets cell 1.
   (2) Hormone *B* bonds with both cell 1 and cell 2.
   (3) Specific reactions carried out by cell 1 are regulated by hormone *C*.
   (4) The specialized receptor molecules on cell 1 secrete hormone *B*. 5 _____

6. In the body of a human, the types of chemical activities occurring within cells are most dependent on the
   (1) biological catalysts present
   (2) size of the cell
   (3) number of chromosomes in the cell
   (4) kind of sugar found on each chromosome 6 _____

7. Drugs to reduce the risk of rejection are given to organ transplant patients because the donated organ contains
   (1) foreign antigens
   (2) foreign antibodies
   (3) DNA molecules
   (4) pathogenic microbes 7 _____

8. Communication between cells is affected if there is decreased ability to produce

(1) digestive enzymes and gametes
(2) antibodies and chloroplasts
(3) hormones and nerve impulses
(4) antibiotics and guard cells 8 ____

9. People with AIDS are unable to fight multiple infections because the virus that causes AIDS

(1) weakens their immune systems
(2) produces antibodies in their blood
(3) attacks muscle tissue
(4) kills pathogens 9 ____

10. The main function of the human digestive system is to

(1) rid the body of cellular waste materials
(2) process organic molecules so they can enter cells
(3) break down glucose in order to release energy
(4) change amino acids into proteins and carbohydrates 10 ____

11. The immune system of humans may respond to chemicals on the surface of an invading organism by

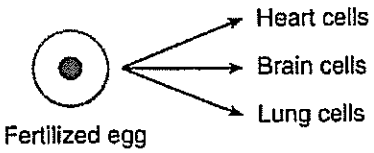
(1) releasing hormones that break down these chemicals
(2) synthesizing antibodies that mark these organisms to be destroyed
(3) secreting antibiotics that attach to these organisms
(4) altering a DNA sequence in these organisms 11 ____

12. Many vaccinations stimulate the immune system by exposing it to

(1) antibodies (3) mutated genes
(2) enzymes (4) weakened microbes

12 ____

13. The diagram below represents a process that occurs during normal human development.

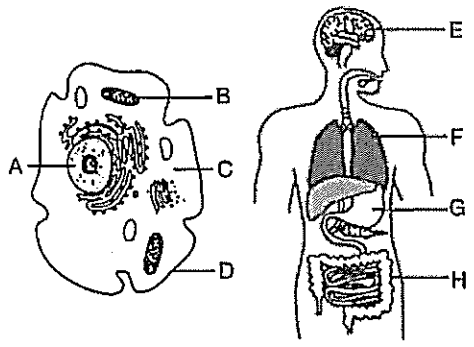


Which statement is correct regarding the cells and DNA?

(1) All the cells have identical DNA.
(2) The DNA of the fertilized egg differs from the DNA of all the other cells.
(3) The DNA of the fertilized egg differs from some, but not all, of the other cells.
(4) Only the fertilized egg contains DNA.

13 ____

14. A single cell and a multicellular organism are represented below.



Which structures are correctly paired with their primary function?

(1) *A* and *G*—transmission of nerve impulses
(2) *B* and *E*—photosynthesis
(3) *C* and *H*—digestion of food
(4) *D* and *F*—gas exchange 14 ____

15. Many viruses infect only a certain type of cell because they bind to certain

(1) other viruses on the surface of the cell
(2) mitochondria in the cell
(3) hormones in the cell
(4) receptor sites on the surface of the cell 15 ____

16. The interaction of which two systems provides the molecules needed for the metabolic activity that takes place at ribosomes?

(1) digestive and circulatory
(2) reproductive and excretory
(3) immune and nervous
(4) respiratory and muscular 16 ____

17. Some human white blood cells help destroy pathogenic bacteria by

(1) causing mutations in the bacteria
(2) engulfing and digesting the bacteria
(3) producing toxins that compete with bacterial toxins
(4) inserting part of their DNA into the bacterial cells 17 ____

18. What will most likely happen to wastes containing nitrogen produced as a result of the breakdown of amino acids within liver cells of a mammal?

(1) They will be digested by enzymes in the stomach.
(2) They will be removed by the excretory system.
(3) They will be destroyed by specialized blood cells.
(4) They will be absorbed by mitochondria in nearby cells. 18 ____

19. In some individuals, the immune system attacks substances such as grass pollen that are usually harmless, resulting in

(1) an allergic reaction
(2) a form of cancer
(3) an insulin imbalance
(4) a mutation 19 ____

20. As a human red blood cell matures, it loses its nucleus. As a result of this loss, a mature red blood cell lacks the ability to

(1) take in material from the blood
(2) release hormones to the blood
(3) pass through artery walls
(4) carry out cell division 20 ____

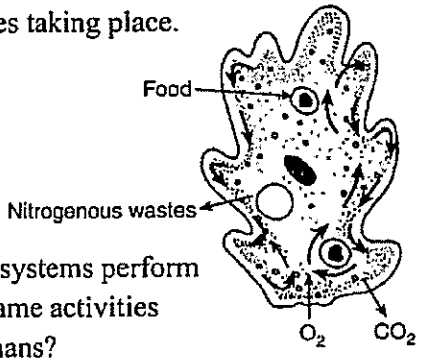
21. Which transplant method would prevent the rejection of tissue after an organ transplant?

(1) using organs cloned from the cells of the patient
(2) using organs produced by genetic engineering to get rid of all proteins in the donated organs
(3) using organs only from pigs or monkeys
(4) using an organ donated by a close relative because the proteins will always be identical to those of the recipient 21 ____

22. Which system is correctly paired with its function?

(1) immune system—intake and distribution of oxygen to cells of the body
(2) excretory system—remove potentially dangerous materials from the body
(3) digestive system—transport energy-rich molecules to cells
(4) circulatory system—produce building blocks of complex compounds 22 ____

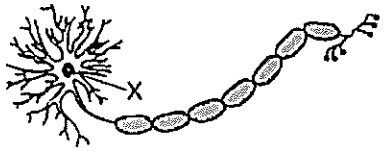
23. In the diagram of a single-celled organism shown below, the arrows indicate various activities taking place.



Which systems perform these same activities in humans?

(1) digestive, circulatory, and immune
(2) excretory, respiratory, and reproductive
(3) respiratory, excretory, and digestive
(4) respiratory, nervous, and endocrine 23 ____

Base your answers to question 24 on the diagram below of a cell associated with coordination.



24. *a*) Structure **X** would be involved in the

(1) storage of digestive enzymes
(2) absorption of energy from the Sun
(3) development of pathogens
(4) synthesis of proteins a ____

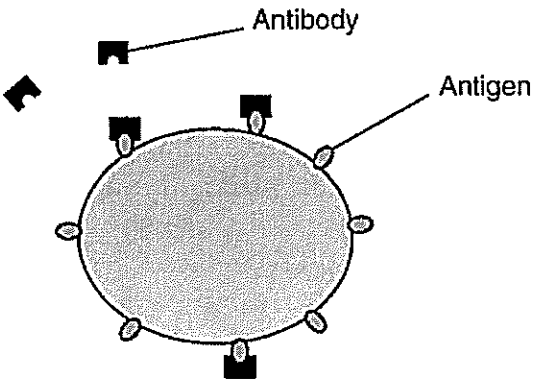
b) Which statement best describes a function of the entire structure shown in the diagram?

(1) It unites with an egg cell during fertilization.
(2) It synthesizes a hormone involved in the control of blood sugar level.
(3) It releases chemicals involved in cellular communication.
(4) It controls the replication of genetic material. b ____

25. Which statement correctly describes the genetic makeup of the sperm cells produced by a human male?

(1) Each cell has pairs of chromosomes and the cells are usually genetically identical.
(2) Each cell has pairs of chromosomes and the cells are usually genetically different.
(3) Each cell has half the normal number of chromosomes and the cells are usually genetically identical.
(4) Each cell has half the normal number of chromosomes and the cells are usually genetically different. 25 ____

26. An activity that occurs in the human body is shown below.



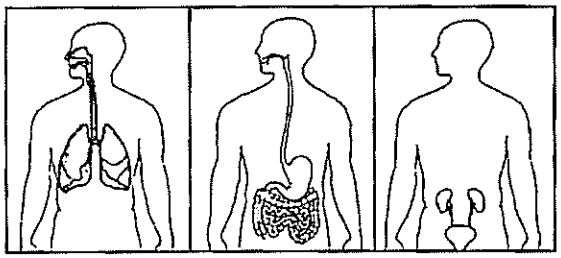
This activity helps to

(1) provide protection against pathogens
(2) produce antibiotics to control disease
(3) eliminate harmful gene alterations
(4) regulate production of ATP by the cell 26 ____

27. Human egg cells are most similar to human sperm cells in their

(1) degree of motility
(2) amount of stored food
(3) chromosome number
(4) shape and size 27 ____

28. The diagram below represents three human body systems.



A B C

Which row in the chart below correctly shows what systems *A*, *B*, and *C* provide for the human body?

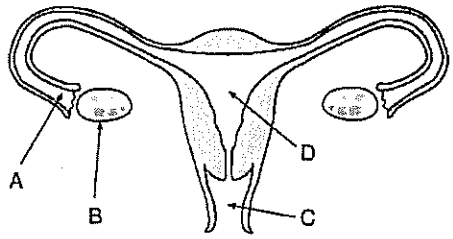
Row	System A	System B	System C
(1)	blood cells	glucose	hormones
(2)	oxygen	absorption	gametes
(3)	gas exchange	nutrients	waste removal
(4)	immunity	coordination	carbon dioxide

28 ____

29. Regulation of sexual reproductive cycles of human males is related most directly to the presence of the hormone

(1) estrogen (3) testosterone
(2) progesterone (4) insulin 29 ____

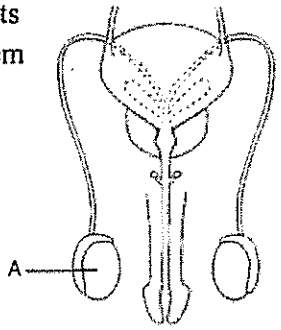
Base your answers to question 30 on the diagram below, which represents the human female reproductive system.



30. New inherited characteristics may appear in offspring as a result of new combinations of existing genes or may result from mutations in genes contained in cells produced by structure

(1) *A* (2) *B* (3) *C* (4) *D* 30 ____

31. The diagram represents the reproductive system of a mammal.



The hormone produced in structure *A* most directly brings about a change in

(1) the ability to carry out respiration
(2) physical characteristics
(3) the rate of digestion
(4) blood sugar concentration 31 ____

32. Estrogen has a direct effect on the

(1) formation of a zygote
(2) changes within the uterus
(3) movement of an egg toward the sperm
(4) development of a placenta within the ovary 32 ____

33. Sexual reproduction involves the processes listed below.

Processes

A. Differentiation C. Gamete production
B. Fertilization D. Mitosis

Which sequence represents the order in which these processes occur?

(1) $A \rightarrow B \rightarrow C \rightarrow D$
(2) $B \rightarrow A \rightarrow C \rightarrow D$
(3) $C \rightarrow B \rightarrow D \rightarrow A$
(4) $D \rightarrow B \rightarrow C \rightarrow A$ 33 ____

34. For a human zygote to become an embryo, it must undergo

(1) fertilization (3) meiotic divisions
(2) recombination (4) mitotic divisions

34 ____

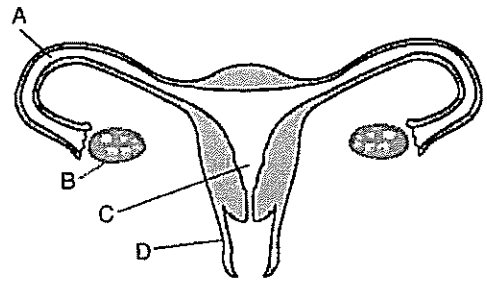
35. German measles is a disease that can harm an embryo if the mother is infected in the early stages of pregnancy because the virus that causes German measles is able to

(1) be absorbed by the embryo from the mother's milk
(2) be transported to the embryo in red blood cells
(3) pass across the placenta
(4) infect the eggs 35 ____

36. The reproductive system of the human male produces gametes and

(1) transfers gametes to the female for internal fertilization
(2) produces enzymes that prevent fertilization
(3) releases hormones involved in external fertilization
(4) provides an area for fertilization 36____

37. A diagram of human female reproductive structures is shown below.



Which structure is correctly paired with its function?

(1) A — releases estrogen and progesterone
(2) B — produces and releases the egg
(3) C — provides the usual site for fertilization
(4) D — nourishes a developing embryo 37 ____

38. The structure that makes nutrients most directly available to a human embryo is the

(1) gamete (3) stomach
(2) ovary (4) placenta 38 ____

39. Which reproductive structure is correctly paired with its function?

(1) uterus—usual site of fertilization
(2) testis—usual location for egg development
(3) ovary—delivers nutrients to the embryo
(4) sperm—transports genetic material 39 ____

40. As women age, their reproductive cycles stop due to decreased

(1) digestive enzyme production
(2) production of ATP
(3) levels of specific hormones
(4) heart rate 40 ____

41. Which row in the chart below indicates the correct process for each event indicated?

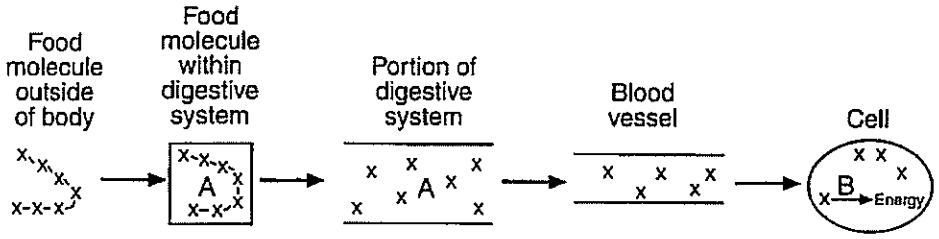
Row	Formation of Egg	Formation of Sperm	Growth of Embryo
(1)	mitosis	mitosis	meiosis
(2)	mitosis	meiosis	mitosis
(3)	meiosis	mitosis	meiosis
(4)	meiosis	meiosis	mitosis

41 ____

42. Abnormalities present in the cells that line the uterus may prevent the production of offspring by directly interfering with the

(1) development of the embryo
(2) differentiation of gametes into zygotes
(3) secretion of estrogen by the ovary
(4) production and release of egg cells 42 ____

43. The diagram below represents events involved as energy is ultimately released from food.

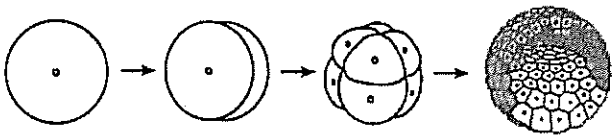


Which row in the accompanying table best represents the chain of **X**s and letters *A* and *B* in the diagram?

X-X-X-X-X-X-X	A and B
(1) nutrient	antibodies
(2) nutrient	enzymes
(3) hemoglobin	wastes
(4) hemoglobin	hormones

43_____

44. Part of embryonic development in a species is illustrated in the accompanying diagram. Which set of factors plays the most direct role in controlling the events shown in the diagram?



(1) genes, hormones, and cell location
(2) antibodies, insulin, and starch
(3) ATP, amino acids, and inorganic compounds
(4) abiotic resources, homeostasis, and selective breeding

44_____

45. The data in the table indicate the presence of specific reproductive hormones in blood samples taken from three individuals. An **X** in the hormone column indicates a positive lab test for the appropriate levels necessary for normal reproductive functioning in that individual.

Data Table

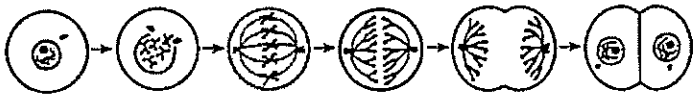
Individuals	Hormones Present		
	Testosterone	Progesterone	Estrogen
1		X	X
2			X
3	X		

Which processes could occur in individual 3?

(1) production of sperm, only
(2) production of sperm and production of eggs
(3) production of eggs and embryonic development
(4) production of eggs, only

45_____

46. Which activity most directly involves the process represented in the diagram below?



(1) a gamete reproducing sexually
(2) a white blood cell engulfing bacteria
(3) a zygote being produced in an ovary
(4) an animal repairing damaged tissue

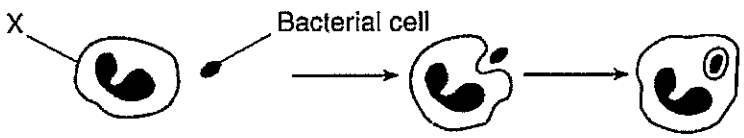
46_____

47. Which row in the chart below contains an event that is paired with an appropriate response in the human body?

Row	Event	Response
(1)	a virus enters the bloodstream	increased production of antibodies
(2)	fertilization of an egg	increased levels of testosterone
(3)	dehydration due to increased sweating	increased urine output
(4)	a drop in the rate of digestion	increased respiration rate

47_____

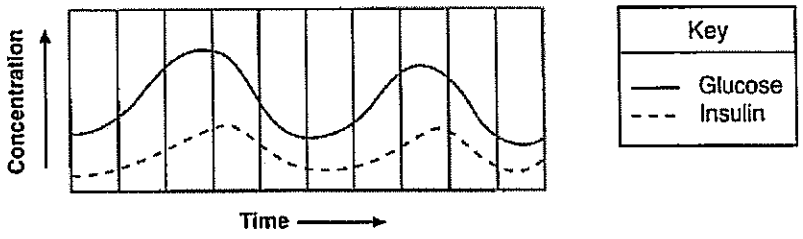
48. The diagram shows a cell in the human body engulfing a bacterial cell. The cell labeled **X** is most likely a



(1) red blood cell (3) liver cell
(2) white blood cell (4) nerve cell

48_____

49. The graph shows the levels of glucose and insulin in the blood of a human over a period of time. This graph represents



(1) an allergic reaction
(2) an antigen-antibody reaction
(3) maintenance of homeostasis
(4) autotrophic nutrition

49_____

50. Humans require multiple systems for various life functions. Two vital systems are the circulatory system and the respiratory system. Select one of these systems, write its name in the chart below, then identify two structures that are part of that system, and state how each structure you identified functions as part of the system.

System:	
Structure	Function
(1)	
(2)	

51. Cell communication involves a cell detecting and responding to signals from other cells. Receptor molecules play an important role in these reactions. Human cells have insulin receptors that are needed for the movement of glucose out of the blood.

a) State one way that the shape of the insulin receptor is related to its role in cell communication.

_____

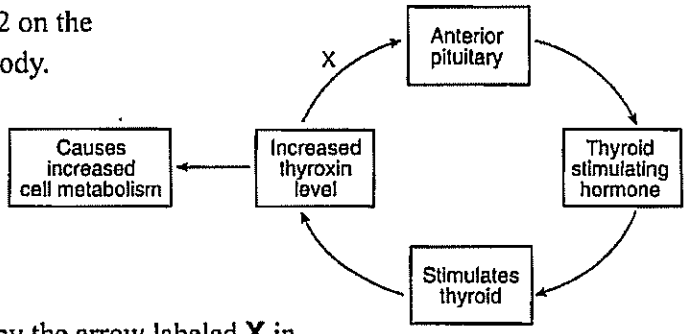
_____

b) A typical human liver cell can have over 90,000 insulin receptors. If a genetic error occurred, resulting in each liver cell in a person having only 1,000 insulin receptors, what specific effect would this have on the liver cells?

_____

_____

Base your answers to question 52 on the diagram of activities in the human body.



52. *a*) This diagram illustrates part of
(1) a feedback mechanism
(2) an enzyme pathway
(3) a digestive mechanism
(4) a pattern of learned behavior

a_____

b) Describe the action represented by the arrow labeled **X** in the diagram and state one reason that this action is important.

Action of **X** : _____

Reason : _____

c) Identify one hormone involved in another biological relationship and an organ that is directly affected by the hormone you identified.

Hormone: _____ Organ affected: _____

53. State one way white blood cells protect the body from foreign microbes.

_____

54. Acetylcholine is a chemical secreted at the ends of nerve cells. This chemical helps to send nerve signals across synapses (spaces between nerve cells). After the signal passes across a synapse, an enzyme breaks down the acetylcholine. LSD is a drug that blocks the action of this enzyme. Describe one possible effect of LSD on the action of acetylcholine.

_____

_____

Base your answer to question 55 on the information below.

Immunization protects the human body from disease. The success of vaccinations can be seen in the fact that smallpox has been eliminated worldwide from the list of common infectious diseases. The only remaining smallpox viruses on Earth are thought to be those kept in certain research laboratories. The United States is now committed to the goal of immunizing all children against common childhood diseases. However, many parents are choosing not to immunize their children against childhood diseases such as diphtheria, whooping cough, and polio. For example, the mother of a newborn baby is concerned about having her child receive the DPT (diphtheria, whooping cough, and tetanus) vaccine. Since these diseases are caused by bacteria, she believes antibiotic therapy is a safe alternative to vaccination.

55. Discuss the use of antibiotics and vaccines in the treatment and prevention of bacterial diseases. In your answer be sure to include:

a) what is in a vaccine _____

b) how a vaccine promotes immunity _____

c) one advantage of the use of vaccinations to fight bacterial diseases

_____

d) one disadvantage of the use of antibiotics to fight bacterial diseases

_____

56. Consuming large volumes of soft drinks containing sugar during the day can disrupt homeostasis. Describe how the human body responds to restore sugar balance. In your answer, be sure to:

a) identify the hormone responsible for restoring homeostasis _____

b) identify the organ that releases this hormone _____

c) state one possible reason why sugar levels may remain high even though this hormone has been released _____

57. Explain how the change in heart rate helps to maintain homeostasis during exercise.

_____

58. Identify the relationship that exists between a virus and a human when the virus infects the human.

_____

59. Identify the organ that produces insulin. _____

Base your answer to question 60 on the information below and on your knowledge of biology.

The Critical Role of the Placenta

The proper functioning of the placenta is critical to the growth and development of a healthy fetus. For example, the placenta appears to act as a nutrient sensor. It regulates the amounts and types of nutrients that are transported from the mother to the fetus.

Improper functioning of the placenta can alter the structure and function of specific cells and organ systems in the developing fetus, putting it at risk for health problems as an adult. For example, in some pregnancies, the placenta develops a resistance to blood flow. This resistance appears to force the heart of the fetus to work harder. This could result in an increased chance of the individual developing heart disease as an adult. A group of hormones known as glucocorticoids affects the development of all the tissues and organ systems. One of the things this group of hormones does is to alter cell function by changing the structure of cell membrane receptors.

60. Discuss the importance of the placenta in the development of a healthy fetus. In your answer, be sure to:

a) identify *two* factors that could influence the nutrients that can pass from the mother to the fetus

_____ and _____

b) identify the group of hormones that alter cell membrane receptors and explain how this alteration can affect cell function Hormone: _____

Explanation: _____

c) state the role of the uterus in the development of the fetus and the placenta

_____

61. Nutrients in a diet, such as proteins, carbohydrates, and minerals, play an important role in homeostasis within the human body. Lack of these nutrients can lead to malfunctions that disrupt this internal balance. Explain how diet can influence homeostasis. In your answer, be sure to:

a) select a nutrient from the passage and write it on the line. Nutrient: _____

b) state one role this nutrient plays in the body

_____

c) describe, using one specific example, how a decrease in this nutrient can alter homeostasis

_____

62. Organ systems of the human body interact to maintain a balanced internal environment. As blood flows through certain organs of the body, the composition of the blood changes because of interactions with those organs. State one change in the composition of the blood as it flows through the respiratory system.

_____

63. State one reason that most foods must be digested before they can enter a cell.

_____

Base your answers to question 64 on the information below.

Human reproduction is influenced by many different factors.

64. *a*) Identify one reproductive hormone and state the role it plays in reproduction.

Hormone: _____

Role: _____

b) Identify the structure in the uterus where the exchange of material between the mother and the developing fetus takes place. _____

c) Identify one harmful substance that can pass through this structure and describe the negative effect it can have on the fetus.

Substance: _____

Negative effect: _____

Base your answers to question 65 on the passage below.

When humans perspire, water, urea, and salts containing sodium are removed from the blood. Drinking water during extended periods of physical exercise replenishes the water but not the sodium. This increase in water dilutes the blood and may result in the concentration of sodium dropping low enough to cause a condition known as hyponatremia. Symptoms of hyponatremia include headache, nausea, and lack of coordination. Left untreated, it can lead to coma and even death. The body has a variety of feedback mechanisms that assist in regulating water and sodium concentrations in the blood. The kidneys play a major role in these mechanisms, as they filter the blood and produce urine.

65. *a*) Many runners pour water on their bodies during a race. Explain how this action helps to maintain homeostasis.

_____

b) How would running in a marathon on a warm day most likely affect urine production? Support your answer.

Urine production: _____

Supporting statement: _____

c) Many people today drink sport drinks containing large amounts of sodium. Describe one possible effect this might have on a person who is not very active.

_____

66. All organisms need to reproduce for the continuation of their species. Discuss the process of reproduction in humans. In your answer, be sure to:

a) identify one hormone present in a female that is involved in regulating the reproductive cycle

_____

b) state one way the nucleus of a sex cell is different from the nucleus of a body cell

_____

c) state how the normal chromosome number for humans is maintained from one generation to the next. _____

_____

d) identify one action by the mother that can influence the development of the embryo and state a result of that influence.

Action: _____

Result: _____

67. The immune system protects against foreign substances and even some cancers. Explain how the immune system functions. In your answer, be sure to:

a) identify one way the immune system fights pathogens

_____

b) identify the substance in a vaccine that stimulates the immune system

_____

c) describe the response of the immune system to the vaccine

_____

d) identify one disease that damages the immune system and state how it affects this system

Disease: _____

Affects: _____

e) Most people who get vaccinated develop immunity to the disease. Explain why the contents of the vaccine usually do not cause people to get sick.

_____

68. Suggest one way that doctors or patients can help to reduce the chances of bacteria becoming resistant to an antibiotic. _____

_____

69. State the relationship between intensity of physical activity and pulse rate.

_____

Human Physiology, Reproduction, and Homeostasis

Set 1 – Answers

1. 4 Homeostasis is the maintenance of balance within a living organism. A rapid rise in the number of red blood cells would create a disruption in the circulatory system. The increase in red blood cells would disrupt that balance and thus homeostasis.

2. 1 Cell structure and function are the result of the expression (function) of genes within that cell. The type of cell (liver vs. nerve) and each cell's job is determined by which genes have been "turned on" within that cell.

3. 3 Antibodies are produced by the immune system when it detects harmful antigens. Each type of antibody is unique and defends the body against one specific type of antigen.

4. 1 Proteins found on the surface of cells and on the surface of viruses (HIV) that allow for attachment based on shape are known as receptors. Receptor molecules play an important role in the immune system.

5. 4 Nerves collect information through the senses and transmit that information via impulses. Impulses are transmitted from nerve cell to nerve cell relaying a message for a particular response. The endocrine system uses chemical messengers or hormones produced by glands to regulate metabolism and internal balance. Hormones are secreted directly into the bloodstream and travel to target cells on which the hormone acts.

6. 3 Information can be sent from Cell *B* (with round signals) to Cell *A* (with round receptors) due to there matching shape. Communication between cells involves chemical signals and membrane receptors. In order for the "message" to be received, the receiving cell must have the correctly shaped receptor to match the shape of the signal.

7. 3 The human immune system responds to an invasion by microbes by carrying out an immune response. This involves white blood cells, specifically T cells and B cells. These cells attack the microbes, or produce antibodies, as well as producing memory cells. Memory cells will ensure a swift response to any subsequent attacks by the same microbe. Vaccines carry a weakened or dead form of the microbe. T cells and B cells will carry out the immune response against this vaccine and provide memory cells for future protection.

8. 2 Differentiation is the process where developing embryonic cells are genetically programmed into a type of cell with a certain function. For example, certain cells will be programmed to become skin cells, while other cells are programed to become nerve cells.

9. 4 The metabolic process best represented by the diagram would be digestion – the breaking down of materials into smaller useful forms. As diagrammed, the organic protein is broken down into its building block components – amino acids (*B*).

10. 4 Both contractile vacuoles and kidneys have a similar function – maintaining water balance. Although found in different organisms, both structures function to maintain homeostasis (in this case, water balance) within that organism.

11. 1 Foreign materials or foreign proteins that enter or grow within the human body are known as antigens. These antigens will cause a immune response because white blood cells will recognize these antigens as foreign to the human body and attack them.

12. 3 Vaccines contain weakened or heat-killed microbes that, when injected into the human body initiate an immune response. An immune response will activate white blood cells to attack infected cells using specific molecules and to mark microbes for destruction using antibodies.

13. 1 Glands secrete hormones directly into the bloodstream and travel to target cells on which the hormone acts. Levels of hormones are controlled by a mechanism known as feedback. Feedback allows for messages to be received by glands, which start or stop the production of hormones depending on hormone level.

14. 4 Regulation of the human reproductive system is controlled by hormones. Hormones from the pituitary gland stimulate development of the ovaries and testes, and hormones from pituitary gland and the ovaries regulate the menstrual cycle.

15. 3 Insulin, produced by the pancreas, allows cells to take in sugar, thus regulating blood sugar levels. This constantly changing situation requires a feedback mechanism to maintain the correct hormone balance.

16. 2 The pancreas has two different regions – digestion and blood sugar maintenance. Each with a specific function. The cells in these two regions use different areas of their DNA to direct the production of different proteins within the cell. Digestive enzymes are produced in the digestive section of the pancreas, whereas hormones are produced in the endocrine or sugar-maintenance area of the pancreas.

17. 2 The placenta is the site of exchange between the blood of the mother (maternal) and that of the baby (fetal). Materials such as nutrients, wastes, and gases are exchanged. Even harmful substances such as alcohol and drugs can be passed from mother to baby at the placenta.

18. 1 The diagram represents the female reproductive system. Structure *A* represents the ovary where female gametes, eggs, are developed. Radiation can cause mutations within the eggs and these mutations can be passed onto future generations.

39. 1 A newly fertilized egg is known as a zygote. In the zygote, mitosis is occurring. Mitosis is a form of cell division where two daughter cells are produced from a parent cell that are genetically identical to the parent cell, having the full amount of chromosomes.

40. 1 Homeostasis is the maintenance of a stable internal environment. In this diagrammed interaction, the pancreas, a part of the endocrine system, plays a role in the regulation of blood sugar. This process is known as a feedback mechanism.

41. 1 In the sequence of stages shown, stage 1 shows fertilization where sperm enters the egg setting off a series of rapid cell divisions. These divisions, stages 3 to 5, lead to the initial differentiation of cells. All of these processes require genetic information from the genes as well as chemicals, usually enzymes, to proceed.

42. 2 The diagram represents cells within an immune response. The introduction of microbes (antigens, the round "spiked" particles) will cause this response. Part of the immune response may involve antibodies (the dark small particles) acting as markers on the antigen to signal white blood cells, which will then engulf the foreign invader.

43. 3 Between position *C* and *D*, the graph shows that the body temperature was outside the range of homeostasis. At this high body temperature, the internal body environment is not within its normal range, and dynamic equilibrium is disrupted.

44. *a*) 2 To regulate blood glucose levels in humans, chemical messengers are produced to increase or decrease those sugar levels. Homeostatic feedback allows for those levels to be decreased or increased with substance *A* or *B* respectively, maintaining a normal blood glucose level.

b) 1 Insulin is a chemical messenger produced in the pancreas, which allows cells to take in glucose from the blood, thus reducing blood glucose levels. According to the diagram, substance *A* does that.

45. *a*) 1 Diagram *A* represents the male reproductive system containing the testes, and diagram *B* represents the female reproductive system containing the ovaries. Each of these glands is responsible for the formation of gametes (sperm and eggs, respectively).

b) 1 The male (*A*) has a penis to direct sperm into the female body. The female (*B*) has a vagina which serves to receive and funnel sperm into uterus and oviducts so that internal fertilization can occur. Remember, fertilization takes place within the oviduct of the human female.

c) 4 A zygote forms after fertilization has taken place. The zygote divides mitotically as it grows within the oviduct and uterus of the female.

46. *a*) Answer: white blood cell

Explanation: Structure *X* represents a white blood cell. In blood, white blood cells are somewhat larger than red blood cells and have lobed nuclei.

b) Answer: destroys foreign antigens

Explanation: White blood cells are involved in the body's immune response. They perform several functions, they attack antigens or foreign proteins and may engulf foreign proteins.

47.

A – Organ		B – Molecule diffused
Lung	⟶	Oxygen
or Small Intestine	⟶	Glucose or amino acids
or Large Intestine	⟶	Water
or Kidney	⟶	Water

Explanation: Diffusion is a process where a molecule moves from an area of high concentration to low concentration or along a concentration gradient. In each case, the molecule that diffuses (B), moves across the cell membrane and passes through a capillary wall into the blood. This process allows organisms to maintain homeostasis.

48. Answer: Letter **X** can represent any of the following terms: regulation *or* homeostasis *or* dynamic equilibrium *or* coordination *or* human body *or* organism

Explanation: The diagram defines the process of regulation within an organism in its environment. Every living thing must maintain a constant internal balance, yet is subject to disruption by foreign invaders and pathogens, such as: parasites, fungi, bacteria and viruses. Letter *X* represents the processes by which an organism tries to maintain this balance – homeostasis.

49. Answer: Different parts of genetic information are used in different cells.
or Different cells are influenced by their environments in the body.

Explanation: During the process of differentiation, cells are genetically programmed (certain genes are expressed) to perform certain functions or have particular structures. They become specialized for one type of job. For example, skin cells provide a barrier, muscle cells allow for movement, and nerve cells transmit impulses.

50. Organ: ovary/adrenal gland

Function: regulate the reproductive system
or Estrogen affects the development of the sex organs/sex cells.
or Estrogen plays a role in the menstrual cycle.

Explanation: Estrogen, produced by the ovary, is a hormone that regulates the uterus lining during the female menstrual cycle.

51. *a*) Answer: Structure *A* is the placenta.

Function: The placenta is essential for development because it serves as the exchange surface (site) for nutrients, wastes, and gases between mother and fetus. The placenta is a tissue rich in blood vessels found in the uterus. It supplies needed nutrients by diffusion to the umbilical cord, which transports these nutrients to the baby's circulatory system. Remember that the blood of the mother does not come into contact with that of the baby.

b) Acceptable responses include, but are not limited to:
When the alcohol from the mother's bloodstream enters the fetus, the relative amount is much greater due to the smaller size of the fetus.
or The fetus is still developing.

Explanation: Alcohol will enter the baby's system through exchange at the placenta. The amount of alcohol in relationship to the size of the fetus is much greater than it is to the size of the mother and could lead to poisoning or developmental problems of the fetus. Because the fetus is developing organs and a nervous system, addition of alcohol could affect that development. This condition is known as Fetal Alcohol Syndrome (FAS).

c) Answer: uterus

Explanation: The uterus is the organ where the fetus develops in.

52. *a*) Answer: Letter **X** is the pancreas.

Explanation: The pancreas produces the hormone, insulin, which regulates blood sugar.

b) Answer: a feedback mechanism

Explanation: A feedback mechanism regulates the production of a hormone. The dashed line represents feedback information to the pancreas (**X**), which would reduce or increase the production of insulin as needed.

53. Answers:

a) A vaccine contains dead or weakened pathogens or their products.

b) the immune system

c) White blood cells produce antibodies for a particular pathogen.
or White blood cells are prepared to recognize a particular pathogen in the future.
or causes the immune system to produce antibodies
or stimulates an immune response

Explanation: Vaccines contain small amounts of weakened pathogens, and when administered, will result in an immunity to that particular pathogen. White blood cells in the body, like T cells and B cells, react to foreign invaders by recognizing foreign proteins or antigens they carry. These antigens activate T cells, which directly attack pathogen-infected cells, and activate B cells, which produce plasma cells that release antibodies.