

# Allergic Reactions

- 1 Responses of the immune system to usually harmless environmental substances are known as

  - (1) antigen production
  - (2) chromosomal mutations
  - (3) pathogens
  - (4) allergies

2 Which disorder could develop in the human body when the immune system attacks a usually harmless environmental substance?

  - (1) cancer
  - (2) AIDS
  - (3) an allergy
  - (4) an infection

3 Doctors often use certain medications to treat infections. A few people have a reaction to some of these medications, such as itching, swelling, or trouble breathing. This is an example of

  - (1) using antibodies to cure a medical problem
  - (2) the body's immune system overreacting to a usually harmless substance
  - (3) the body creating a mutation to fight unknown pathogens
  - (4) a vaccine causing the body to produce antigens against the infection

Base your answers to questions 4 on the information below and on your knowledge of biology.

### Beware of Dust Mites

Quietly lurking within our mattresses, under our beds, and inside sofas and carpets are creatures too small to be seen without a microscope. Dust mites are arthropods closely related to spiders, scorpions, and ticks. They feed on the dead skin cells regularly shed by humans and their animal pets. The average human sheds about 10 grams of dead skin a week. Cats and dogs create even more dander for dust mites to eat. The mites also eat pollen, fungi, and bacteria. They do not drink water but absorb it from the air.

Dust mites do not carry diseases and are harmless to most people. It's their bathroom habits that make some of us itch and sneeze. Many people develop severe allergies to dust mite feces



(wastes). If you lie on a rug where dust mites live, you might develop itchy red bumps on your skin. Breathe in dust containing their feces and you might have more serious symptoms, such as difficulty breathing or a severe asthma attack.

Dust mites thrive in warm, humid environments — eating and nesting in dust-collecting bedding, fabric, and carpet. Think about this! A typical mattress can contain anywhere from 100,000 to 10 million dust mites. Nearly 100,000 dust mites can live in one square yard of carpet.

During a process called sensitization, a person's immune system mistakenly identifies the inhaled dust mite waste as an invader. The next time the person is exposed to the dust mite waste, the immune system launches an allergic reaction.

- 4 The immune system of an individual who is allergic to dust mite waste produces
  - (1) specialized chemicals that mark dust mite waste for destruction
  - (2) viruses that combat dust mites
  - (3) white blood cells that attack human skin cells
  - (4) white blood cells that attack the skin cells of cats and dogs
  
- 5 A 6-year-old child ate a peanut butter sandwich at snack time in school. Five minutes later, her throat became swollen and she collapsed. This allergic reaction occurred because her body
  - (1) recognized an antigen in peanut butter and produced antibiotics against it
  - (2) digested the white blood cells that can recognize an antigen in peanut butter
  - (3) did not recognize an antigen in peanut butter and could not produce antibodies against it
  - (4) recognized an antigen in peanut butter and produced an immune response

6 When people receive organ transplants, they often need to take medications that decrease immune responses because

- (1) transplanted organs contain antigens that can trigger white blood cell activity
- (2) hormones present in replacement organs prevent the synthesis of antibiotics
- (3) transplanted organs produce their own antibiotics
- (4) antigens present in these organs attack antibodies already present in the blood

7 Itching and other skin problems are signs that a cat or dog may have fleas. Fleas are parasites known for their biting and blood-sucking abilities. When they bite, flea saliva enters the pet's circulatory system, sometimes causing an allergic response commonly seen as a "hot spot" on the pet's neck or the base of its tail.



Source: <https://www.planetnatural.com/pest-problem-solver/household-pests/flea-control/>

These observations are best explained by the fact that

- (1) flea saliva may stimulate an immune response in cats and dogs
- (2) fleas are microbes whose bites cause a decreased blood flow
- (3) flea saliva is a toxic substance that is released when fleas prey on cats and dogs
- (4) fleas are host organisms whose saliva digests cat and dog fur, leaving "hot spots"

8 Recently, a human trachea (a respiratory organ) was produced by using a patient's own stem cells. The benefit of using the patient's own cells to produce a trachea instead of receiving one from a donor is that

- (1) there will be more enzymes produced to help maintain homeostasis in the trachea
- (2) there will be an increase in the quantity of antibodies that the patient produces in response to the new trachea
- (3) there is less of a chance that the patient's immune system will attack the trachea
- (4) there will be a greater response to any infectious agent that may enter the body

9 An allergic reaction to certain types of natural, unprocessed foods, such as peanuts, is caused by

- (1) a lack of digestive enzymes
- (2) a response to specific antigens
- (3) microorganisms living within the food
- (4) high levels of carbon dioxide in the air

10 Every time a child visited a cousin who has two cats, the child's eyes turned red, itched, and began to water. Then, the child began to have trouble breathing. It is most likely that the child reacted this way because

- (1) normally harmless cat antigens stimulated the immune system
- (2) it is difficult for the respiratory system to filter cat antigens out of the inhaled air
- (3) cat antigens are a health hazard, since they always cause disease
- (4) cat antigens stop the immune system from making antibodies, so bacteria cause these responses

- 11 An organ, such as a kidney, used for transplant needs to be tested for compatibility with the person who is to receive the organ. If this is not done, the
- (1) donated organ might attack the body
  - (2) donated organ might attack the immune system
  - (3) immune system might attack its own body cells
  - (4) immune system might attack the donated organ
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Base your answer to question 12-15 on the information below and on your knowledge of biology.

#### Artificial Placenta

It is estimated that every year more than 15 million babies are born too early. The lungs of these premature infants are often immature and easily damaged. Premature births happen for a variety of reasons—some known and some unknown. Those that are known include infections and conditions such as diabetes and high blood pressure. Scientists are researching what causes premature births, in an attempt to develop solutions to prevent them.

Scientists are also working on the development of an artificial placenta. At the University of Michigan, five premature lambs were placed in artificial placentas and kept alive for weeks. During this time, each lamb's blood was circulated through its artificial placenta.

- 12-15 Discuss how the development of an artificial placenta is an important step in the study of premature births. In your answer, be sure to:

- explain why it would be harmful for a human mother's blood to pass across the placenta and into the fetus [1]
- state how an artificial placenta would be of benefit to the lungs of premature infants [1]
- explain why the lambs' blood must be filtered as it circulates through the artificial placenta [1]
- state one reason why premature lambs were likely used as model organisms in this study rather than mice [1]

- 16-18 A student was visiting a friend at her home. Her friend owned two cats. After playing with the cats for a while, the student began to sneeze. Her nose began to run and her eyes became red, watery, and itchy. It also became hard for her to breathe. A few minutes after leaving her friend's home, the symptoms disappeared.

Provide a biological explanation for the symptoms the girl developed at her friend's house. In your response, be sure to:

- identify the body system that was responsible for triggering the reaction she experienced [1]
- identify the type of reaction the student was most likely experiencing [1]
- state one reason why her symptoms are not likely due to an infectious agent [1]

Base your answers to questions 19 on the information below and on your knowledge of biology.

### Battling Cancer with T-cell Therapy

One reason that cancer is able to spread through tissues and organs is that cancer cells are actually the patient's own cells. The immune system of the patient does not recognize these cancer cells as foreign and, therefore, does not reject and destroy them.

Over the past eight years, immunologists have been developing a treatment for B-cell leukemia that involves using genetically engineered T cells to recognize and destroy B cells, all of which carry a protein, CD19. CD19 is found on the surface of both healthy and cancerous B cells. B cells are immune system cells that produce antibodies.

The procedure used in this treatment is outlined below:

1. T cells are removed from the patient with B-cell leukemia.
2. The T cells are genetically engineered to recognize the CD19 protein.
3. The patient is injected with the engineered T cells, which attach to cells with CD19 and destroy them.
4. The engineered T cells destroy both cancerous and healthy B cells.

This procedure has been successful in several patients. Currently, studies are continuing with more B-cell leukemia patients. It is hoped that the studies will be expanded to include other types of cancer, and that this treatment will be available to treat a variety of cancers in the future.

- 19 Explain why the engineered T cells taken from one cancer patient will not work as a cancer treatment if injected into another patient with B-cell leukemia. [1]

Base your answers to questions 20 on the information below and on your knowledge of biology

Fungi are interesting organisms that interact with humans in many ways. Yeasts are fungi used in the food industry to produce products such as bread and certain beverages. Some fungi are valuable in medicine. For example, the drug cyclosporine, which is capable of suppressing the response of the immune system to foreign antigens, and the antibiotic penicillin are both products from fungi. Other fungi are less welcomed by humans. The irritation of athlete's foot is caused by a fungus, and a number of allergies are caused by reproductive spores released by fungi.

- 20 Describe the role of a drug like cyclosporine when transplanting organs from one person to another person. [1]

## **Answer Keys**

1 4

2 3

3 2

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6 1

7 1

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9 2

10 1

11 4

12-15 The student's response to the bulleted items in the question need not appear in the following order.

- 12. Allow 1 credit for stating why it would be harmful for a human mother's blood to pass across the placenta and into the fetus. Acceptable responses include, but are not limited to:
  - The mother's blood may be interpreted as a pathogen and attacked by the fetus's immune system.
  - The mother's blood could contain chemicals and pathogens that could harm the fetus.
  - It could cause an immune response.
  - It could be a different blood type that could cause a reaction.
  - It could harm the fetus's organs.
- 13. Allow 1 credit for describing how an artificial placenta would be of benefit to the lungs of premature infants. Acceptable responses include, but are not limited to:
  - The lungs would be able to continue to mature, and the premature infant would not have to breathe on its own too soon.
  - The artificial placenta would perform the same processes as the natural placenta, allowing the lungs to continue to develop.
  - The artificial placenta would supply oxygen until lungs developed.
  - It would be of benefit because it prevents the accumulation of carbon dioxide.
  - It would help lessen complications associated with the mother's high blood pressure/diabetes.
- 14. Allow 1 credit for explaining why the lambs' blood must be filtered as it circulates through the artificial placenta. Acceptable responses include, but are not limited to:
  - The blood contains waste products that need to be removed.
  - Filtering removes wastes from the blood.
- 15. Allow 1 credit for discussing why premature lambs were likely used as model organisms in this study rather than mice. Acceptable responses include, but are not limited to:
  - Lambs are larger and more similar to human fetuses than mice are.
  - The development of a premature lamb is more similar to that of a human.

16-18 The student's response to the bulleted items in the question need not appear in the following order.

- 16. Allow 1 credit for identifying the body system that was responsible for triggering the reaction she experienced as the immune system.
- 17. Allow 1 credit for identifying the type of reaction the student was most likely experiencing.
- Acceptable responses include, but are not limited to:
  - an allergic reaction or allergy
  - an immune response to a usually harmless substance
- 18. Allow 1 credit for stating one reason why her symptoms are not likely due to an infectious agent.
- Acceptable responses include, but are not limited to:
  - An infection would probably take longer to develop.
  - An infection by a pathogen would probably not end so suddenly.
  - The symptoms went away when she left her friend's house.

19 Allow 1 credit. Acceptable responses include, but are not limited to:

- — The person's immune system will reject/attack cells from the donor.
- — The cells of different individuals have different proteins on their surfaces.
- — Each person's cells are different, and one person's immune system will fight cells from another person.
- — Each person's cells/proteins/genes are different.

20 Allow 1 credit. Acceptable responses include, but are not limited to:

- — The transplanted organ contains foreign antigens. Cyclosporine suppresses the immune response to these antigens.
- — It stops rejection of the organ.
- — It suppresses the response of the immune system.