

## Other Imbalance And Diseases

Base your answers to questions 1 on the information and data table below and on your knowledge of biology.

### The Enzyme Catalase

Catalase is an enzyme found in nearly all living organisms that breathe or are exposed to oxygen. According to recent scientific studies, low levels of catalase may play a role in the graying process of human hair. The body naturally produces hydrogen peroxide, and catalase breaks it down into water and oxygen. If there is a dip in catalase levels, hydrogen peroxide cannot be broken down. This causes hydrogen peroxide to bleach hair from the inside out. Scientists believe this finding may someday be used in anti-graying treatments for hair.

A pharmaceutical company, investigating ways to prevent hair from turning gray, took tissue samples from two different individuals. Both individuals were the same age. Each of the samples was placed in a solution of hydrogen peroxide. The volume of oxygen gas produced was measured every 5 minutes for 25 minutes. The data the company collected are shown below.

SEE BELOW.

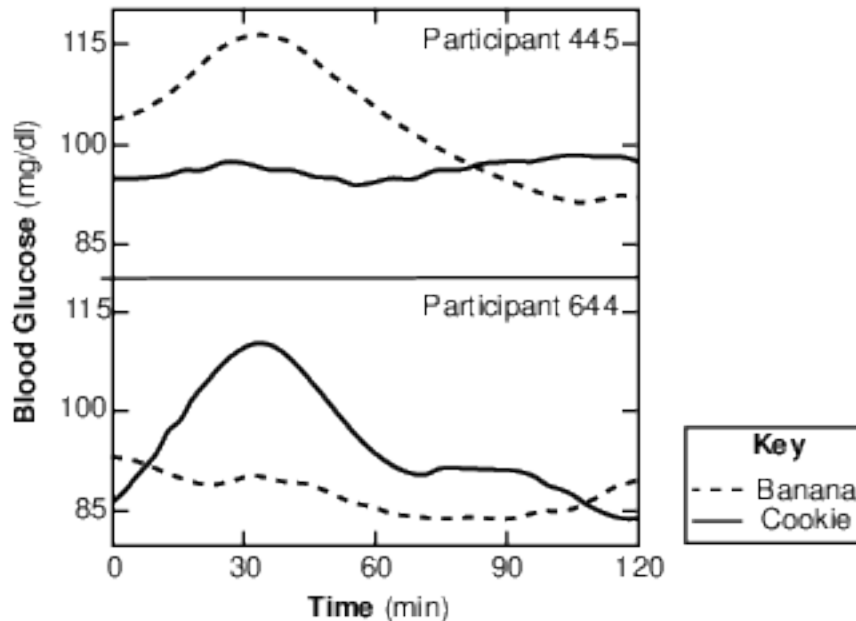
**Oxygen Production in the Breakdown of  
Hydrogen Peroxide by Catalase**

Time (min)	Sample from Person A (mL oxygen)	Sample from Person B (mL oxygen)
5	2.0	4.5
10	3.5	8.5
15	5.0	12.0
20	7.5	15.5
25	9.5	20.0

Directions: Using the information in the data table, construct a line graph on the grid on the next page, following the directions below.

- 1 If the temperature of the tissue samples used in the experiment had been raised from 37°C (body temperature) to 50°C, the results would have been different because
  - (1) more enzymes are produced at higher temperatures, increasing the amount of hydrogen peroxide
  - (2) more hydrogen peroxide is released at higher temperatures, increasing the activity of catalase
  - (3) increasing temperatures altered the structure of catalase, decreasing oxygen production
  - (4) increasing temperatures decreased the synthesis of amino acids, increasing levels of hydrogen peroxide

2 The chart below shows a comparison of the blood sugar levels for two individuals who took part in a scientific study.



Source: Science Daily 11/19/15

Scientists have observed that blood sugar levels rose by different amounts in the two individuals even though they were given identical portions of bananas and cookies. These results were obtained because

- (1) glucose is too large a molecule to be absorbed into the blood, so the researchers were only measuring the amount of glucose already present
- (2) participant 445 didn't like bananas, and his body absorbed more of the food that he likes
- (3) individuals have genetic differences that alter their responses to environmental factors
- (4) two different foods were used; the scientists should have had only one experimental variable

Base your answers to questions 3 on the passage below and on your knowledge of biology.

### Blood Doping

Some athletes who compete in endurance events, such as marathon runners or cyclists, believe that they will be more competitive if they can increase the number of red blood cells in their bloodstreams. One way of increasing the number of red blood cells in an athlete is to engage in blood doping.

Blood doping is an illegal practice in which athletes harvest their own blood months before a competition, isolate the red blood cells, and freeze them. Just before the date of the competition, the blood cells are returned to the athlete's bloodstream. Another type of blood doping involves using donated blood from another person (blood transfusions). In either case, the athlete will have more red blood cells available than competitors who do not engage in blood doping.

Athletes who use their own blood cells to blood dope often become anemic as a result. Anemia is a condition caused by a lack of red blood cells and/or iron in the blood. Iron is a necessary part of the pigment used to carry oxygen to the cells. Athletes who use donated blood to blood dope also run the risk of contracting a blood-borne disease.

- 3 An athlete might believe that there is a benefit to blood doping with red blood cells because it
- (1) could improve the delivery of oxygen to the muscles
  - (2) could increase the amount of training necessary
  - (3) would help to deliver necessary nutrient molecules to the cells
  - (4) would help an athlete to fight disease
- 4 The failure of the human body to effectively maintain dynamic equilibrium can result in
- (1) reproductive success
  - (2) gene manipulation
  - (3) differentiation
  - (4) disease
- 5 Increased concern over the number of heat-related illnesses among football players has led to a possible change in uniform design. Shoulder pads were designed that constantly blew cool, dry air underneath the shoulder pads. Tests showed that the use of the device during rest and recovery periods resulted in a reduction of body temperature and heart rate. This new device would help the athlete to
- (1) control the rate of muscle activity
  - (2) increase muscle strength
  - (3) maintain homeostasis
  - (4) eliminate the release of heat from the body
- 6 Sailors in the past may have heard the greeting from a passing ship, “Avast ye scurvy dogs.” This greeting would be a reference to a disease known as scurvy, which is due to inadequate intake of vitamin C. Which row in the chart below correctly identifies the cause of this disease and a possible treatment for it?

Row	Cause	Treatment
(1)	inherited trait	gene manipulation
(2)	organ malfunction	antibiotic injections
(3)	poor nutrition	fresh fruit
(4)	virus	vaccination

- (1) 1
- (2) 2
- (3) 3
- (4) 4

- 7 Typhoid fever, a disease that causes headaches, digestive upset, and a high fever, is caused by the bacterium *Salmonella typhi*. Typhoid can be spread from person to person by contaminated water or food or by a lack of cleanliness. Since the 19th century, the number of individuals infected with this disease has decreased. Which statement best explains why the number of people with this disease and other bacterial diseases has decreased over the last 100 years?
- (1) Scientists have corrected the damaged genes that cause typhoid fever and other infectious diseases.
  - (2) Public health officials have placed better controls on the use of the toxic substances that cause these diseases.
  - (3) Typhoid fever, like most other bacterial diseases, is often caused by a lack of proper nutrition.
  - (4) Personal habits, such as hand washing, have greatly reduced contamination from bacteria.
- 8 SCIDS (Severe Combined Immunodeficiency Syndrome) is a disorder where a genetic mutation inhibits the production and functioning of T-cells. T-cells are special types of white blood cells that play a role in the body’s immune response. A possible symptom of SCIDS would be an increase in the
- (1) number of antigens produced
  - (2) red blood cell count
  - (3) number of infections by pathogens
  - (4) ability to maintain homeostasis

Base your answers to questions 9 on the information below and on your knowledge of biology.

The fight-or-flight response in humans prepares the body to fight off or run away from a potential threat. This response results from a series of nerve and chemical signals that direct how cells function. This, in turn, determines the actions of organs in these situations.

Some of the changes experienced by the individuals as part of this response include:

increased pulse rate increased blood glucose levels increased breathing rate

- 9 Once the threat has passed, another series of changes returns the body to its original state. Why must this occur? [1]

Base your answer to question 10-12 on the information below and on your knowledge of biology.

10-12 Feedback mechanisms have evolved that maintain homeostasis. Describe how homeostasis is maintained through feedback. In your answer, be sure to:

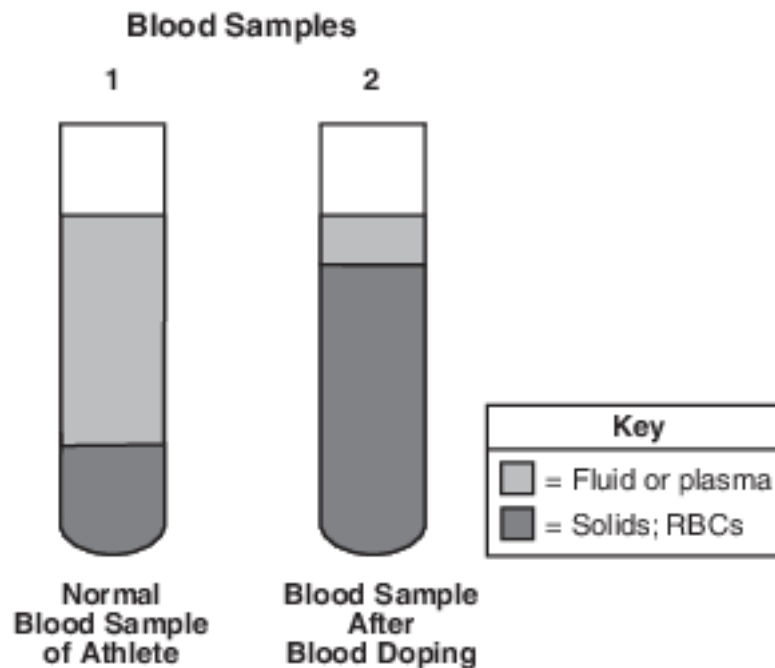
- identify one feedback mechanism in the human body [1]
- identify, other than death, one specific result if homeostasis fails in the human body [1]
- describe how a plant regulates water loss through a feedback mechanism that involves guard cells [1]

Base your answers to questions 13 on the information and diagram below and on your knowledge of biology.

### Blood Doping

Blood is a fluid tissue, which means that blood cells are suspended in a fluid called plasma. Blood tests are concerned with not only the number of blood cells present, but with the amount of plasma that surrounds the cells.

The diagram below represents tubes containing blood samples from an athlete before and after blood doping. Blood doping is an illegal practice reportedly used by some athletes a few weeks before an athletic event, and involves removing whole blood from an athlete, separating the oxygen-carrying red blood cells (RBCs), and then freezing them. These RBCs are thawed and returned to the athlete's body just before the athlete competes. Serious health risks are associated with this practice.



- 13 State one reason why the extra RBCs represented in sample 2 could be dangerous to the health of an athlete. [1]

Base your answers to questions 14 on the passage below and on your knowledge of biology.

### Medical Mystery

Recently, an elderly man went to a hospital. He felt tired and was coughing and dehydrated. At first, the doctor thought he had pneumonia, but an x ray showed a spot on his lung. Because the man was a smoker, the doctor expected to find a tumor.

Instead, the surgeon discovered a pea seed growing inside the man's lung. When the pea seedling was removed, the patient quickly regained his health.

- 14 When he first arrived at the hospital, the man reported feeling unusually tired. Explain why damage to the man's lung caused fatigue. [1]

## Answer Keys

1 3

2 3

3 1

4 4

5 3

6 3

7 4

8 3

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

- — The fight-or-flight response includes many changes in body activity, which could result in damage to the body if not returned to normal.
- — The fight-or-flight response sped up activity, which must now be slowed to normal.
- — Once the danger is over, the high activity levels of cells and organs are reduced to normal levels, preventing damage to the body.
- — so that homeostasis can be restored

10-12 The student's response to the bulleted items in the question need not appear in the following order.

- 10. Allow 1 credit for identifying one feedback mechanism in the human body. Acceptable responses include, but are not limited to:
  - — the change in heart rate in response to exercise
  - — the change in respiratory rate in response to exercise
  - — sweating or shivering in response to changes in body temperature
  - — the maintenance of blood sugar levels
  - — regulation of body temperature on a hot day
  - — increase in white blood cells in response to an infection
- 11. Allow 1 credit for identifying, other than death, one specific result if homeostasis fails in the human body. Acceptable responses include, but are not limited to:
  - — disease/gets sick
  - — disruption in the body's ability to carry out respiration/digestion/excretion, etc.
  - — The body is unable to respond to external/internal stimuli correctly.
  - — diabetes
  - — heat stroke/hypothermia
- Note: Do not allow credit for death.
- 12. Allow 1 credit for describing how a plant regulates water loss through a feedback mechanism that involves guard cells. Acceptable responses include, but are not limited to:
  - — Guard cells close openings in the leaves, slowing/stopping water loss.
  - — When guard cells close the stomata, less water evaporates out of the leaves.
  - — Guard cells regulate the rate of transpiration when they change shape.

- 13 Allow 1 credit. Acceptable responses include, but are not limited to:
- — RBCs are suspended in a fluid. There needs to be enough fluid surrounding these cells so
  - they flow freely in blood vessels, rather than clump or bunch together.
  - — Homeostasis could be disrupted.
  - — The circulatory system might not function well with “thick” blood.
  - — The heart might have trouble pumping the thicker blood.
  - — not enough plasma
- 14 Allow 1 credit. Acceptable responses include, but are not limited to:
- — If the lungs do not function well, less oxygen is available to release energy in his cells.
  - — He wouldn't get as much oxygen/air into his blood.
  - — The damage to the man's lung resulted in a decrease in his ability to breathe.
  - — Less carbon dioxide would be released and would build up.