RIPPLE ENGLISH
ACTIVE LEARNING PROGRAM

Workbook for:

"The Gene: Life as Information"

問題は解きっぱなしにしないで！

英語資格試験の学習は、**解いた後の復習をしなければほとんど効果はありません。**

答え合わせをしておしまいにせずに、**テキストの音読練習やリスニング、多読学習などのインプット学習を何度も反復して記憶に定着させましょう。**ホームページからダウンロードできる音読練習用のテキストをぜひご活用ください。

また、数日置いてから再度解き直すのも効果的です。答えを記憶してしまっているかもしれませんが、回答の根拠をなぞりながら繰り返し解くことで有効な復習になります！

The Gene: Life as Information

1. 1. There are 8 billion people on the planet and all of us are wonderfully unique. We have different eye color, height, shape of mouth and nose, and dramatically different way of thinking. But, at the same time, there are characteristics that we all share. Wherever you go, you will find people who walk, breathe and digest food the same way. Where do these diversity and similarity come from?

2. Human body is a collection of 30 to 40 trillion cells. Each of these cells contains a nucleus, and inside each nucleus is your genome, your DNA that carries your genetic information. Most of the cell's structures and operational systems are made from a variety of proteins. DNA is an encoded instruction, digital information on how to build proteins. This genetic code is read by the cell and put into practice. It specifies both the features we all share and the inherited characteristics that make us different to one another. In other words, genome is the software that codes for "you." It's your hair color, a significant part of your personality, and even **susceptibility** to specific diseases.

3. Think about how your computers and smartphones work. Any form of digital information is essentially a series of 2 letters: 0 and 1. Your devices read this binary code of information and turns it into a picture, a video, a spreadsheet or whatever and show it on the screen. Similarly, our DNA consists of 4 types of letters—Adenine, Thymine, Guanine and Cytosine, or A, T, G, C for short. The cell reads this quaternary code to build a protein, and the protein realizes the form or function of the organism. Genome has 3.2 billion letters of DNA. If it were a book with a standard-size font, it would have 1.5 million pages full of just four letters, 60 times the size of an ordinary encyclopedia. These 3.2 billion letters are divided and packaged into 23 pairs of chromosomes in a double helix form. But the vast majority has nothing to do with your genetic information. Only about 2 percent of DNA encodes proteins, which we call "genes." Human genome contains about 22,000 genes in total—only 1,800 more than worms and 25,000 fewer than rice or wheat. There is nothing particularly special about human genome.

(1) According to paragraph 2, which of the following is NOT true?
A. All of our cells have genetic information.
B. Different cell types have different set of DNA
C. Genetic information is about how to build proteins to form a cell's structure and function
D. Genome specifies mental and psychological features

(2) The word "susceptibility" in the passage is closest in meaning to
A. resilience
B. immunity
C. vulnerability
D. tendency

(3) According to paragraph 3, which of the following is true?
A. One pair of chromosome contains 3.2 billion letters of DNA
B. What's unique about human genome is that the vast majority is unrelated to genetic information
C. Rice and wheat have about 3,000 more genes that humans
D. The way that digital devices use information resembles the way lives do

4. Another critical function of DNA is its ability to copy itself very precisely. Most of the genetic code for the various cellular components are the same in all organisms from plants to animals, tiny bacteria to Home sapiens. That means the core information in those genes has been preserved for probably three billion years. DNA can replicate and preserve itself with very few errors. Then how does DNA's structure make it possible? DNA contains two chains. Each chain is a long sequence of four bases—A, T, G, C. The bases can only pair up in a single, precise way. A can only pair with T, and G can only pair with C. One chain is a reflection of the other. This means that if you know the order of bases along one chain of DNA, you immediately know the order of the other. If you break the double helix apart into two separate chains, each chain can act as a template to recreate a perfect copy of its original partner chain. This is the way that cell division takes place without almost no copy errors.

5. If DNA is an encoded blueprint of the cell and the whole human body, how does each cell decipher these encrypted messages to build proteins? Let's go back to the **analogy** of DNA and digital devices and see what happens when you text your friend "Hi." One letter on computers is encoded into 8-digit binary code. For example, capital H is represented as 01001000. When you text your friend "Hi," what you're actually sending is just a 16 digits of 0 and 1(Hi=01001000 01101001). **Genetic code functions quite similarly.** DNA consists of 4 bases—A, T, G, C. And three bases come together to carry one piece of information. But why does it have to be three-letter code? A protein is created from twenty simple chemicals named amino acids. A quaternary code of single digit would only represent four amino acids. A two-digit would code for 16. A triple digit of quaternary code can represent 64 messages, enough to express 20 kinds of amino aids and how to control them. For example, ACT specifies the amino acid Threonine, and ATG is the code to start the building of a protein.

(4) According to paragraph 4, DNA can be replicated with few errors because
A. DNA in other cells can be a backup for copy errors
B. There is a rule for reproducing the whole double helix from a single chain
C. Each cell memorizes the sequence of DNA
D. Telomere is protecting the DNA from physical damages

(5) The word "analogy" in the passage is closest in meaning to
A. parallel
B. narrative
C. anecdote
D. outline

(6) Which of the following text best expresses the essential information in the highlighted sentence?

Genetic code functions quite similarly.

A. Both cells and computers exchange electrical signals for communication.
B. Just like computers require 8 digits to express a single letter we can comprehend, genome requires 3 digits to express one piece of information.
C. Just like a single letter in computer consists of 8-digit binary code, a protein consists of 20 kinds of amino acids.
D. Both lives and digital devices encrypt its information for security purpose

6. By the end of the 20th century, entire genomes could be sequenced. This was the goal of the Human Genome Project, a $100 million ten-year effort. Since then, though, the price has plummeted. Today, sequencing a human genome takes a few days and costs less than $1000. It was a major step forward for biology and for medicine. When you understand your genome, you will learn the diseases to which you're most susceptible, and, more importantly, how to prevent and cure them.

7. The genome contains the memory to build every cell in every tissue in every organism. All the cells in your body have the same collection of 3.2 billion DNA letters. The next question is; what distinguishes a brain cell from a liver cell, a skin cell from a bone marrow cell, even though they have the exact same set of DNA? When the cell reads its genetic information, DNA code is transcribed into a messenger RNA code. The RNA copy then moves from the nucleus to the cytosol, where its messages are decoded to build a protein. But the transcription to RNA is done selectively; not all DNA is copied into RNA.

8. The key to understand this mechanism is gene regulation, the set of chemical reactions which cells use to turn genes 'on' and 'off'. For example, the cells in your kidney, skin and brain all contain the same total set of 22,000 genes. Gene regulation means the genes needed to make a kidney were turned 'on' in embryonic kidney cells, and those that function specifically to create skin or brain were turned 'off', and vice versa. Once the growing embryo instructs cells to be kidney cells, they remember that information and rarely change their identity. Once a cell is determined to be a kidney cell, it will remain part of the kidney by turning off unnecessary information. This mechanism of turning genes on and off is called "epigenetics." It does not change the DNA sequence of the genes themselves; instead, it works by adding chemical 'tags' to the DNA. These tags tell which genes should be on and off. Only parts of genes that are "on" are selectively transcribed into messenger RNA to build proteins.

(7) According to paragraph 6, genome sequencing technology could be useful in
A. identifying potential health risks
B. creating healthier, smarter individuals
C. understanding how we ruin our health
D. reducing the social welfare costs

(8) According to paragraph 7, which of the following is true?
A. DNA moves to cytosol, then DNA is transcribed into RNA.
B. DNA is transcribed into RNA, and then a part of RNA is decoded.
C. Specific part of DNA is transcribed into RNA
D. DNA is decoded by cytosol to create RNA code

(9) According to paragraph 8, a kidney cell can remain a kidney cell because
A. only necessary proteins are turned on and unnecessary ones are turned off
B. the cell has lost its genetic information for other types of cells
C. the embryo is instructing the cell to remain a kidney cell
D. the DNA is activated selectively

(10) Within the whole passage, all of the following were mentioned, EXCEPT
A. Lives and digital devices are evolving quite similarly.
B. DNA is a digital instruction to build and arrange amino acids.
C. Humans and other plants and animals share the central part of their genome.
D. Your brain cells and skin cells have the exact same sequence of DNA.

Answers
(1) B
(2) C
(3) D
(4) B
(5) A
(6) B
(7) A
(8) C
(9) D
(10) A

(1) ２段落の内容として誤っているのは

A. All of our cells have genetic information.
B. Different cell types have different set of DNA
C. Genetic information is about how to build proteins to form a cell's structure and function
D. Genome specifies mental and psychological features
Bの内容はそもそも言及されていない

(2) 文中の"susceptibility" と意味がもっとも近いのは

A. resilience （回復力）
B. immunity （抵抗力）
C. vulnerability （脆弱性）
D. tendency（傾向）
特定の病気への罹りやすさ、という意味の語なので、Cが最も意味が近い。

(3) ３段落の内容に合致しているのは

A. One pair of chromosome contains 3.2 billion letters of DNA
B. What's unique about human genome is that the vast majority is unrelated to genetic information
C. Rice and wheat have about 3,000 more genes that humans
D. The way that digital devices use information resembles the way lives do
A：32億文字のDNAが23対の染色体に分割されているので、１対の染色体に32億文字が格納されているわけではないので誤り。B：ゲノムの大半が遺伝情報と関係ないのは他の生物も同様で、人間に特別なわけではないので誤り。C：文中では米や小麦の遺伝子は人より25000多いと伝えているので誤り。

(4) ４段落によると、DNAがほぼミスなしに自己複製できる理由は

A. DNA in other cells can be a backup for copy errors
B. There is a rule for reproducing the whole double helix from a single chain
C. Each cell memorizes the sequence of DNA
D. Telomere is protecting the DNA from physical damages
A：バックアップになるのは他の細胞内のDNAではなく、２重螺旋の一対。C：細胞がDNAの配列を記憶しているという記述はない。D：テロメアについては文中では言及されていない。

(5) 文中の "analogy" と最も意味が近いのは

A. parallel（平行線、類似点）
B. narrative （物語）
C. anecdote（逸話）
D. outline（概略）
デジタル機器とDNAの類似点の話をしているので、Aが正解。

(6) 下線部の意図を最も表しているのは？

Genetic code functions quite similarly.
A. Both cells and computers exchange electrical signals for communication.
B. Just like computers require 8 digits to express a single letter we can comprehend, genome requires 3 digits to express one piece of information.
C. Just like a single letter in computer consists of 8-digit binary code, a protein consists of 20 kinds of amino acids.
D. Both lives and digital devices encrypt its information for security purpose
DNAが３文字暗号であるのはなぜか、について述べている段落なのでBが正解。

(7) ６段落によると、ゲノム配列決定技術は何に有用か

A. identifying potential health risks
B. creating healthier, smarter individuals
C. understanding how we ruin our health
D. reducing the social welfare costs
"you will learn the diseases to which you're most susceptible"に合致するAが正解。

(8) ７段落で述べられていることとして正しいのは

A. DNA moves to cytosol, then DNA is transcribed into RNA.
B. DNA is transcribed into RNA, and then a part of RNA is decoded.
C. Specific part of DNA is transcribed into RNA
D. DNA is decoded by cytosol to create RNA code
A：DNAはcytosol（細胞質）には移動せず、RNAが細胞核から細胞質に移動するので誤り。B：DNAの一部がRNAに転写されるので誤り。D：Aと同じ理由で誤り。

(9) According to paragraph 8, a kidney cell can remain a kidney cell because
A. only necessary proteins are turned on and unnecessary ones are turned off
B. the cell has lost its genetic information for other types of cells
C. the embryo is instructing the cell to remain a kidney cell
D. the DNA is activated selectively
A：必要に応じてオンオフされるのはタンパク質ではなくDNAなので誤り。B：遺伝情報を失うのではなく、オフ（不活性）になるだけなので誤り。C：胚は何も指示しないので誤り。DNAは選択的に（＝部分的に）活性化される＝必要に応じてオン・オフにされるという内容に合致しているのでDが正解。

(10) 全文の中で述べられていないのは

A. Lives and digital devices are evolving quite similarly.
B. DNA is a digital instruction to build and arrange amino acids.
C. Humans and other plants and animals share the central part of their genome.
D. Your brain cells and skin cells have the exact same sequence of DNA.
生命とデジタル機器の機能のしかたが似ているのは事実だが、evolving similary＝似たように"進化している"わけではないので動詞が誤っている。