前期日程

富山大学

科目 外国語(英語)

医 学 部 医 学 科

注 意

1. 開始の合図があるまで，この問題冊子を開いてはいけません。
2. 問題は１ページから８ページにわたっています。問題冊子に不備がある場合は，直ちにその旨を監督者に申し出てください。
3. 解答用紙は３枚で，問題冊子とは別になっています。解答は，すべて解答用紙の所定の欄に記入してください。指定された解答用紙以外に記入した場合は，評価(採点)の対象としません。
4. 受験番号は，３枚の解答用紙のそれぞれの上部の欄に記入してください。
5. 解答用紙は持ち帰ってはいけません。
6. 下書き用紙には，下書き用のマス目が書いてありますので，活用してください。
7. 問題用紙と下書き用紙(１枚)は持ち帰ってください。

1 次の文章を読み，問いに答えなさい。

While poring over tissue slides in the 1920s, a Soviet **microscopist*** spotted an **oddball cell*** squeezed into the **intestinal*** lining. With its swollen shape and hairy top knot, it didn't look like any of its neighbors. He was puzzled — and so were later researchers who spotted the same kind of cells in the following decades. What they did was a mystery. (A)"It was amazing to me that this huge piece of biology was out there undiscovered," says **mucosal immunologist*** Michael Howitt of Stanford University in Palo Alto, California, who began to study those **tuft cells***, as they are called, in 2011.

What was known about them only made the mystery more intriguing. Some tuft cells display the same chemical-sensing surface proteins that act as taste receptors on the tongue. And the cells station themselves in the linings of many body structures and organs — not only the intestines, but also the lungs, **pancreas***, **gallbladder***, **urethra***, and nasal passages. "Almost any hollow tube in the body has something like a tuft cell," says immunologist Mark Anderson of the University of California, San Francisco (UCSF). But (B)why would the pancreas or urethra possibly need a sense of taste?

Now, a wave of recent research reveals a reason. Tuft cells serve as guards along the body's invasion routes, relying on their sensory capabilities to detect **pathogens*** and **allergens*** that are inhaled or trying to invade in other ways. Although not part of the immune or nervous system — they are a type of **epithelial cell*** — tuft cells interact with those systems to help coordinate protective responses in many parts of the body, scientists have found.

Through (C)this interplay with these other cell types, tuft cells may provide other benefits as well, such as healing damaged tissues, blocking cancer, and priming the maturation of certain immune system cells. But tuft cells can also betray us. They foster some cancers; offer support to **norovirus***, the stomach-upsetting pathogen that causes more than 600 million cases of food poisoning each year; and help initiate inflammatory conditions such as **asthma***.

The cells haven't shed all their mysteries. What pathogen molecules tuft cells recognize, which chemical-sensing receptors they use, and how much they contribute to certain diseases remain uncertain, for example. Still, their role in defending the body and organizing other cells suggests that "potentially, they are very important cells," says UCSF immunologist Richard Locksley.

A clue to their function comes from their resemblance to tufted cells on the skin of fish that detect chemicals in the water, alerting the animals to nearby food or predators. "As mammals went ashore, these cells became internalized," Locksley says. Besides their signature hairy top knot, tuft cells share with those fish skin cells details of their internal structure and an aptitude for detection. They are well equipped to sample their surroundings, carrying receptors for the tastes of bitter, sweet, and umami as well as for other molecules.

But researchers knew [perceive / what / little / tuft cells / about] and [provide / they / benefits / what] (D) until 2016. One study that helped clarify the cells' function began when Howitt made a disturbing observation. Two years into his **postdoc*** at Harvard University, he was exploring potential interactions between tuft cells and intestinal bacteria. If tuft cells adapted to those microbes, Howitt reasoned, their numbers might change in germ-free mice. (E) To test that possibility, he counted tuft cells in the intestines of mice born and raised at Harvard's animal facility in what was intended to be an environment free of infectious microbes and even the natural, helpful bacterial residents of the intestine. As he examined intestinal tissue from the mice, however, Howitt noticed single-celled **parasitic*** **protozoa*** called ***Tritrichomonas muris**** swimming through the microscope's field of view. The mice weren't free of pathogens after all.

"My response was not one of delight," Howitt says. Tuft cells were about 20 times more abundant in the supposedly germ-free mice than in normal mice or rats. He worried that contamination by the parasite had affected the result and that he would have to start over. But when he and colleagues fed the protozoa-rich intestinal contents of their mice that he had used in the experiment to parasite-free mice, tuft cell numbers increased dramatically. And when the researchers introduced the parasite into germ-free mice whose tuft cells couldn't sense chemicals, that increase did not occur, implying that (F) tuft cells normally act to detect protozoa, a potential threat, and when they do, they increase their numbers.

(G) At about the same time, Locksley and colleagues fortunately arrived at the same conclusion. He hadn't even heard of tuft cells when they began their experiments, recalls immunologist Jakob von Moltke, a former UCSF postdoc with Locksley who now runs a lab studying the cells at the University of Washington School of Medicine in Seattle. The group was trying to pin down which cells in the intestinal lining pump out **interleukin***-25 (IL-25), a protein signal that helps the body defend against parasites but also promotes allergy symptoms and asthma.

The researchers analyzed intestinal tissues from mice genetically modified so that any cells making IL-25 also produced **a red fluorescent protein***. A few bright red cells stood out, and **antibodies*** specific for different kinds of intestinal cells revealed their identity. "That's when we went and looked up what a tuft cell is," von Moltke says. A third group led by researchers from France simultaneously discovered an antiparasite role for tuft cells in the intestine.

The teams ultimately demonstrated that tuft cells are crucial for the body's defense against parasites (H). In that mechanism, **mucus***-producing **goblet cells*** in the intestinal lining divide rapidly and **secrete*** abundantly while muscle cells in the intestinal walls step up their **contractions*** — all to help force the invaders from the body. Tuft cells that sense parasites discharge IL-25 to begin those responses and stimulate immune cells; genetically altering mice to remove or disable their tuft cells impairs their ability to eliminate parasitic **worms***, the groups found.

(Mitch Leslie, 2019, *Science*, slightly modified)

*注：microscopist　顕微鏡学者
oddball cell　変わり種細胞
intestinal　腸(内)の
mucosal immunologist　粘膜免疫学者
tuft cells　刷子細胞
pancreas　すい臓
gallbladder　胆のう
urethra　尿道
pathogens　病原体
allergens　アレルゲン(アレルギーの原因物質)
epithelial cell　上皮細胞
norovirus　ノロウィルス
asthma　ぜんそく
postdoc　post doctoral fellow(博士号取得後の研究者)
parasitic　寄生虫の
protozoa　原虫，原生生物
Tritrichomonas muris　トリトリコモナス・ムリス
interleukin　インターロイキン(細胞から分泌されるタンパク質の一種)
red fluorescent protein　赤色蛍光タンパク質
antibodies　抗体
mucus　粘液
goblet cells　杯(さかずき)細胞(腸管などの粘膜に存在し，粘液を生成して分泌する細胞)
secrete　分泌する
contractions　収縮
worms　蠕(ぜん)虫(寄生虫の一種)

(1) 下線部(A)において，Howittはなぜamazingと感じたのですか。その理由を最も適格に表現した英文を下から1つ選び，解答欄にその記号を書きなさい。

(a) A number of outstanding discoveries in the shapes of cells have been made one after another.

(b) There were no other crucial issues for the progress of medical science than this if uncovered.

(c) These cells were found not only in intestines but also other hollow tubes all over the human body.

(d) Although these mysterious cells were found in the early 20th century, no one had yet uncovered their function.

(e) The size of these cells was finally measured for the first time ever in history.

(2) 下線部(B)について以下の問いに答えなさい。

(a) 筆者がこの疑問文において“a sense of taste”と表現したのはなぜですか。それを説明している英文を本文から1つ抜き出し，文頭と文末の3語ずつを解答欄に書きなさい。

(b) 次の文は下線部(B)の問いに対する答えをまとめたものです。空欄を指定された文字数の日本語で埋めなさい。

膵臓と尿道は，共に(ア)(2～5字)構造を有しており，そこを経由して病原体やアレルゲンが侵入できる。刷子細胞はそれらを(イ)(4～8字)を持っており，それによって(ウ)(2～3字)としての役割を果たすと考えられるから。

(3) 下線部(C)について次の問いに答えなさい。

(a) 下線部(C)を，thisとthese other cell typesが指す内容を明確にしつつ，日本語で説明しなさい。

(b) 下線部(C)によってもたらされる効果を示唆しているものを次の中から全て選び，記号を解答欄に書きなさい。

(ア) がん細胞を消滅させる
(イ) 傷害組織を治癒する
(ウ) 病原体分子を破壊する
(エ) がんの進行を阻止する
(オ) ノロウィルスを駆除する
(カ) 免疫細胞に成熟の開始を促す
(キ) 病原体分子の総数を認識する
(ク) 免疫細胞を初期化する

(4) 下線部(D)を正しい順序に並び替え，解答欄に書きなさい。

(5) 下線部(E)と下線部(F)について，次の問いに答えなさい。

(a) 下線部(E)の that possibility について，その内容を日本語で説明しなさい。

(b) 下のフローチャートは，下線部(E)の実験から始まり，下線部(F)の解釈に至るまでの流れを示したものです。それぞれの空欄を指定された文字数の日本語で埋めなさい。文字数が指定されている箇所とそうでない箇所があります。文字数が指定されている場合は読点も字数に数えます。

【当初の実験】

・彼は，ハーバード大学の動物施設で生まれ飼育されたマウスの [(ア)10字程度] を数えた。その施設は，[(イ)25字以上40字以下] であるように意図されていた。

⇩

【想定外の事実】

・マウスの腸内から原生生物の一種であるトリトリコモナス・ムリスが見つかり，このことから [(ウ)] という前提がくつがえされた。
・また，そのマウスの腸内で [(エ)] が観察された。

⇩

【実験 1】

・上記のマウスの，トリトリコモナス・ムリスを含んだ腸内内容物を，改めて [(オ)] に与えた。
・その結果，(オ)の [(カ)] 。

⇩

【実験 2】

・[(キ)] を有する無菌マウスの腸内に [(ク)] を取り込ませた。
・その結果，[(ケ)] 。

(6) 下線部(G)について，以下の問いに日本語で答えなさい。

(a) Locksley らが当初取り組んだ課題は何でしたか。

(b) Howitt と同じ結論に達したプロセスについて，次の空欄を埋めて文章を完成させなさい。

［(ア)］ように遺伝学的に操作されたマウスの小腸を分析した。すると［(イ)］細胞を見出し，さらに［(ウ)］に特有の抗体を用いて，それらの細胞の種類を特定した。その結果，それらは［(エ)］であることが判明した。

(7) 下線部(H)のメカニズムにおける刷子細胞の働きを具体的に表しているのは次のどれですか。当てはまるものを全て選び，記号を解答欄に書きなさい。

(a) To marshal goblet cells to divide rapidly

(b) To produce a red fluorescent protein

(c) To send signals to muscle cells so that they can increase their contractions

(d) To produce antibodies specific for intestinal cells

(e) To sense parasites through chemical detection

(f) To internalize themselves into the intestine from the skin

(g) To interact with immune cells by secreting IL-25

(h) To restrain allergic responses to eliminate parasites

2 The following article entitled "The way I am" describes the lessons an academic clinical fellow learned from his experiences of having interviews. Read the article and answer the questions.

A year ago, I had one of the most significant interviews of my life. It was for a job I had worked toward for years, as a medical doctor doing research and teaching along with treating patients — a rare and highly competitive type of post in the United Kingdom. Toward the end of the interview, I was asked how I would balance the different parts of the role. I had expected this question and had thought about how I would answer. Still, I hesitated. I could say what I thought the members of the interview panel wanted to hear: I'm good at multitasking, prioritizing, and assigning tasks to other people, and I was confident that I would be able to handle the various responsibilities. That would have been true — yet it didn't feel authentic. 【 (ア) 】 I wasn't sure which answer to give.

I faced a similar problem 12 years earlier, when I applied to medical school. I was only 17 years old, and my education had left me believing that there were only right and wrong answers, especially in exams. In my mind, the interview was an exam — it, too, had right and wrong answers. But I didn't know what they were. No one in my family was a doctor. I come from a poor neighborhood. I had worked my way into a decent local school and done well in my classes, but I didn't speak the way my classmates did — or the way I imagined doctors did.

So, I found model answers on the internet, which put my mind at ease. 【 (イ) 】

This tension led me to stumble during the interviews. My own answers competed in my mind with those I'd found from other sources. I got confused on at least one occasion, when an interviewer asked me to give an example of a time when I had been caring. The answer that came to mind was that I volunteered at a nursing home and felt privileged to sit with the residents and listen to their stories. But I didn't think that was dramatic enough to impress the interviewers. So, instead I told them about when one of the residents got sick and I cleaned it up. I immediately felt embarrassed. That wasn't caring; that was basic cleanliness and hygiene, and it suggested that my best quality was skill with a mop. 【 (ウ) 】

My next interview attempt came a few years later, for a position I would start after medical school — a clinical job with a small academic research component. I wasn't sure what the panel was looking for, but I felt I had little to lose: New doctors in the United Kingdom are almost guaranteed a "normal" clinical job somewhere in the country, and I hadn't expected to be invited to interview for this more specialized position in the first place. 【 (エ) 】 I didn't second-guess myself. My answers were just that — they were mine. I was at ease and genuinely enjoyed the experience. And I was offered the job.

Fast-forward to my most recent interview and the question about how I would juggle the multiple responsibilities of the role. I hesitated — but not for long. I had learned the importance of being true to myself. So I answered simply: "With difficulty."

To my surprise and relief, the review panel members nodded knowingly and chuckled. They seemed to relate and to appreciate my honesty and willingness to show my human side. I started the job a few months later.

I've come to realize that interviews don't have "right" or "wrong" answers. I still see them as exams, but they're not testing my ability to repeat somebody else's answers and present them as if they were my own. The answers were always easier than I thought, because the exam is about something I am well acquainted with: me.

(Artaza Gilani, 2019, *Science*, slightly modified)

(1) Select the most appropriate sentence for each blank (【 (ア) 】 to 【 (エ) 】) from the list below. Write the lettler corresponding to the sentence on the answer sheet.

(a) Right then and there, it was clear to me that trying to come across as someone other than myself was not the right approach.

(b) So I was satisfied to present myself as I am, not as who I thought the panel members wanted me to be.

(c) But when I tried to use these answers as templates, it felt fake, as if I was trying to be somebody I wasn't.

(d) I came to realize that it was an indispensable skill for interviewees to make their stories sound more dramatic.

(e) The more honest answer was that I knew it would be difficult, but I wanted to try anyway.

(2) Write an essay of about 200 to 250 words, responding to the following questions:

1) What do you think of the author's idea about how one should approach an interview?

2) Do you think you can/should apply the author's idea of being true to yourself to your own life? In answering this question, you can write about any experiences in your life, such as in your family life, school life, and/or future professional life.

If you quote a phrase or sentence from the text, put it in double quotation marks ("...").