

2024 年度
大学院理工学研究科
【生命理学専攻/環境共生工学専攻】
博士前期課程 一般選抜試験(第Ⅱ期)問題

英 語

開始時刻 午前 10 時 00 分

終了時刻 午前 11 時 00 分

【注意事項】

1. 解答用紙には受験番号、氏名を必ず記入してください。
2. 試験終了後、答案用紙は必ず提出してください（問題用紙は提出しなくてよい）。
3. 問題番号が明記された答案用紙を使用し、解答してください。

問1：次の文章を読んで、以下の問いに日本語で答えなさい。

Imperceptible to us, plants are surrounded by an invisible mist of airborne compounds that they use to communicate and protect themselves. (1) Similar to smells, these compounds repel hungry herbivores and warn neighboring plants of incoming assailants. Scientists have known about these plant defenses since the 1980s, detecting them in over 80 plant species. Now, a team of Japanese researchers has deployed real-time imaging techniques to reveal how plants receive and respond to these aerial alarms.

Although we previously knew how some plants send messages using airborne volatile organic compounds (VOCs), it was not known how they receive them. (2) In an experiment by Aratani *et al.* [2023], caterpillars were set upon leaves cut from tomato plants and a common *Arabidopsis* weed in the mustard family, pumped the emitted airborne compounds from the injured plants to undamaged *Arabidopsis* neighbors, and fluorometrically imaged the responses of the healthy, insect-free *Arabidopsis* weed plant to those danger cues. These healthy plants weren't any ordinary weeds: they had been genetically altered so their cells contained a biosensor that fluoresced green when an influx of calcium ions was detected. Calcium signaling is something human cells use to communicate too. The research team then fluorometrically visualized how plants responded to being showered in volatile compounds, which plants release within seconds of wounding.

The undamaged plants received the messages of their injured neighbors, responding with bursts of calcium signaling that rippled across their outstretched leaves. Analyzing the airborne compounds, the researchers found that two compounds called Z-3-HAL and E-2-HAL induced calcium signals in *Arabidopsis*. They also identified which cells are the first to respond to the danger cues by engineering *Arabidopsis* plants with fluorescent sensors exclusively in guard, mesophyll, or epidermal cells. (3) Guard cells are bean-shaped cells on plant surfaces that form stomata, small pores that open up to the atmosphere when plants 'breathe' in CO₂. Mesophyll cells are the inner tissue of leaves, and epidermal cells are the outermost layer or skin of plant leaves. (4) When *Arabidopsis* plants were exposed to Z-3-HAL, guard cells generated calcium signals within a minute or so, after which mesophyll cells picked up the message. Further, pre-treating plants with a phytohormone that shuts stomata significantly reduced calcium signaling, suggesting stomata act as the 'nostrils' of the plant.

[Source: Modified from C. Watson, "Scientist film plant 'talking' to its neighbor and the footage is incredible", *Science Alert* 15-Jan-2024; and Aratani *et al.* (2023) Green leaf volatile sensory calcium transduction in *Arabidopsis*, *Nature Communications*, <https://doi.org/10.1038/s41467-023-41589-9>.]

- (1) 下線部分を説明しなさい。
- (2) 下線部分実験内容を説明しなさい。
- (3) 下線部分からガード細胞の役割を説明しなさい。
- (4) 下線部分を和訳しなさい。

問2：次の語群から1つだけを選び、環境問題に関連して、その概要を英語で説明しなさい。少なくとも50語以上書くこと。

- (1) 持続可能な倫理 (Sustainable ethics)
- (2) 生物圏 (Biosphere)
- (3) 生物蓄積 (Bioaccumulation)
- (4) 遷移 (Ecological Succession)
- (5) ブルーカーボン (Blue Carbon)

問3：次の英文を読み、問い（1）～（3）に答えなさい。

(ア) In 1928, Alexander Fleming was starting another bread-and-butter experiment in his long-term research into how the human body fights off bacterial infections. After starting some cultures of the bacterium *Staphylococcus*, he noticed that some of the culture dishes had become contaminated by a common mold called *Penicillium*—the stuff that turns bread blue if you leave it. Around each spot where the mold was growing, Fleming noticed a zone where bacteria [あ]. (イ) He concluded that the mold was producing something that was killing the bacteria, and eventually isolated the molecule we now call penicillin, the first modern antibiotic.

An antibiotic works by inhibiting a chemical reaction which is essential to a bacterium's life. (ウ) Penicillin works by blocking molecules that build new cell walls for the bacterium, something like chewing gum stuck on a key preventing it from opening a lock. Penicillin has no effect on humans or other animals because [い].

Throughout the 1930s, people tried to perfect penicillin and other antibiotics, but were unable get the drugs in pure enough form. (エ) It wasn't until 1938 that two scientists at Oxford University, Howard Florey and Ernst Chain, managed to isolate penicillin in its pure form. (オ) Under intense pressure from the medical needs of World War II, the drug was brought into mass production in 1943. In 1945, Fleming, Florey, and Chain shared a Nobel prize for their work. Penicillin and other antibiotics have saved [う] since their discovery.

Quoted from "The Nature of Science" by James Trefil (2003)

(1) 下線部（ア）～（オ）を日本語に訳しなさい。

(2) [あ]～[う]に、適切な英語の句または文章を入れなさい。

(3) この文章に、英語でタイトルをつけなさい。