

Graduate School of Medicine, Akita University  
Entrance Examination (Doctoral Course)  
(Second time)

Essay

12:40~14:10

December 18, 2025

You have four QUESTION SHEETS and three ANSWER SHEETS.  
Write all your answers on your ANSWER SHEETS.

Submit only your ANSWER SHEETS.

Do not open the questions until the supervisor gives instructions.

I Read the following article and answer the questions in English.

(Text omitted)

(Text omitted)

(Text omitted)

<Takeo Kusaka. “Why Do Flowers Fall? Mechanism Unraveled, Applications for Longer-Lasting Flowers Expected”. National Geographic Japan. 23 March, 2024.

<https://natgeo.nikkeibp.co.jp/atcl/news/24/032100165/?P=1>, excerpted with partial modifications>

*The original text was in Japanese [translated into English by the author of the examination].*

- Q1 Explain the function of jasmonic acid in 180 words or less.
- Q2 Compare autophagy in animals and plants, and describe the role of autophagy in plants in 150 words or less.
- Q3 Describe the points where autophagy could be useful in future agricultural fields, as indicated by the underlined (1), in 150 words or less.







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Essay

Sample Answer, Point Allocation

Q1 Explain the function of jasmonic acid in 180 words or less.

[Point Allocation] 30 points

[Purpose of the Question]

This question assesses the ability to summarize text based on scientific knowledge.

[Sample Answer]

Jasmonic acid is a plant hormone that is primarily synthesized in response to external stresses such as insect herbivory, where it induces the production of defensive compounds. It also promotes senescence and plays a key role in the mechanism of flower abscission. Research using *Arabidopsis thaliana* has shown that jasmonic acid accumulates at the base of the flower just before petal drop. This accumulation activates the ANAC102 gene, which is involved in stress responses. Consequently, autophagy-related genes are upregulated, enabling the degradation of cellular waste in vacuoles and ultimately leading to flower abscission. Furthermore, in mutants deficient in jasmonic acid biosynthesis, the accumulation of reactive oxygen species and the progression of autophagy are impaired, resulting in delayed flower drop. Thus, jasmonic acid serves as a crucial signaling molecule that mediates senescence and autophagy, thereby controlling the lifespan of flowers. These findings have potential practical applications, such as extending the vase life of cut flowers and regulating the harvest timing of crops. (161 words)

Q2 Compare autophagy in animals and plants, and describe the role of autophagy in plants in 150 words or less.

[Point Allocation] 30 points

[Purpose of the Question]

This question evaluates the ability to read and interpret academic texts, discern the author's intent, and express that understanding.

[Sample Answer]

While autophagy in animals and plants shares certain common features, there are also significant differences between them. Both rely on an "autophagic mechanism" that breaks

down and recycles cellular waste and unnecessary components; however, the organelles involved in the degradation process differ. In animals, a double-membrane structure called the autophagosome engulfs unwanted material, which then fuses with a lysosome for degradation. In plants, by contrast, the autophagosome fuses with a vacuole—a structure unique to plant cells—for degradation. Because plants continue to grow throughout their life cycle, autophagy plays an essential role in both development and metabolism, contributing to processes such as aging and flower senescence. This study demonstrated that the plant hormone jasmonic acid triggers autophagy activation at the base of petals, leading to flower senescence. This finding highlights the distinctive role of autophagy in plants. (138 words)

Q3 Describe the points where autophagy could be useful in future agricultural fields, as indicated by the underlined (1), in 150 words or less.

[Point Allocation] 40 points

[Purpose of the Question]

This question assesses the ability to interpret texts and formulate relevant questions.

[Sample Answer]

This study has elucidated the mechanism by which jasmonic acid activates autophagy during flower senescence, leading to petal wilting. This finding offers potential for developing technologies to artificially regulate flower lifespan. For instance, modulating autophagy could help maintain the freshness of cut flowers or extend the flowering period of ornamental plants. Such control may also improve distribution and sales by preserving quality during long-distance transport and reducing unsold inventory. Moreover, similar approaches may be applicable to agricultural crops, contributing to more efficient production and stable yields through optimized harvest timing and nutrient allocation. Further studies in other plant species and detailed clarification of nutrient recycling mechanisms are expected to enhance the feasibility of practical agricultural applications. (116 words)