Oxford Cambridge and RSA

For issue on or after: 13 March 2025

A Level Biology B (Advancing Biology)

H422/02 Scientific literacy in biology

Advance Notice Article

To prepare candidates for the examination taken on Friday 13 June 2025 – Morning

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INSTRUCTIONS
- **Before** the exam, read this article carefully and study the content of the learning outcomes for A Level Biology B (Advancing Biology).
- You can ask your teacher for advice and discuss this article with others in your class.
- You can investigate the topic of this article yourself using any resources available to you.
- Do **not** take this copy of the article or any notes into the exam.

INFORMATION
- A clean copy of this article will be given to you with the question paper.
- In the exam you will answer questions on this article. The questions are worth 20–25 marks.
- This document has **4** pages.

ADVICE
- In the exam you won't have time to read this article in full but you should refer to it in your answers.

Dormancy in cereals: not too much, not too little

Cereals are one of the most important plant sources of carbohydrates and proteins for human nutrition. Their many uses include milling, baking and brewing, as well as direct grain consumption.

Cereal grains are the seeds that are sown to produce a new cereal crop. These seeds can sometimes become dormant, which means they cannot germinate in the conditions that would normally lead to germination.

Studies performed with the main genera of cereals suggest that processes in the seed coat and the embryo interact to cause seed dormancy. The seed coat acts as a barrier to oxygen diffusion into the embryo. Removal of the seed coat reduces dormancy at a wide range of temperatures.

Embryo-based dormancy is determined by the interplay of two plant hormones: abscisic acid (ABA) and gibberellins (GA). ABA has a crucial role in causing dormancy in the developing seeds of all cereal species that have been studied. It has been known for a long time that GA promotes the germination of previously dormant seeds by blocking the inhibitory effect of ABA. Oxygen is required for the biosynthesis of GA.

Cell metabolism is activated soon after a seed takes up water. This triggers germination in a non-dormant seed. Metabolism is also activated in a dormant seed that has absorbed water, but the completion of germination remains blocked. This is because ABA represses enzymatic activity, which stops embryo growth.

While dormancy in cereal seeds can be useful for farmers, the length of dormancy presents a problem in many cases. Dormancy can be too short, or it can last for too long. Cereal crops with short dormancy periods can develop pre-harvest sprouting damage. Long-lasting dormancy can interfere with processes that rely on rapid germination, such as malting or the emergence of a uniform crop. The ancestors of cereal species developed in diverse environments. Many mechanisms to sense appropriate germination environments have therefore evolved.

The antagonism between the plant hormones ABA and GA is instrumental in cereal grains for establishing dormancy and for the release from dormancy. However, this antagonism operates differently in the many cereal species and involves different molecular steps. Environmental signals can modulate hormonal control of dormancy differently, depending on the species.

Rice has three subfamilies of starch-digesting enzymes. Subfamilies 1 and 2 respond to activation by GA, whereas subfamily 3 is activated by low oxygen and low sugar concentrations. In contrast, barley contains only subfamilies 1 and 2; no subfamily 3 enzymes are expressed in barley.

Seed dormancy is one example of the ways in which plants are adapted to the abiotic conditions in their environment. Delaying germination until after a period of cold ensures that seeds germinate only when temperature and water availability are favourable. Other adaptations can limit water loss from leaves; these adaptations allow plants to grow in places with high levels of wind or low water availability.

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