

**AP<sup>®</sup> BIOLOGY**  
**2009 SCORING GUIDELINES (Form B)**

**Question 2**

**Discuss** the patterns of sexual reproduction in plants. **Compare** and **contrast** reproduction in nonvascular plants with that in flowering plants. **Include** the following topics in your discussion:

- (a) alternation of generations
- (b) mechanisms that bring female and male gametes together
- (c) mechanisms that disperse offspring to new locations

**Four points per part.** Student must write about all three parts for full credit. Within each part it is possible to get points for comparing and contrasting. Also, specific points are available from details provided about nonvascular and flowering plants.

**Discuss** the patterns of sexual reproduction in plants (**4 points maximum**):

- (a) Alternation of generations (**4 points maximum**):

Topic	Description (1 point each)
Alternating generations	Haploid stage and diploid stage.
Gametophyte	Haploid-producing gametes. Dominant in nonvascular plants. Double fertilization in flowering plants. Gametangia; archegonia and antheridia in nonvascular plants.
Sporophyte	Diploid-producing spores. Heterosporous in flowering plants. Flowering plants produce seeds; nonvascular plants do not. Flowering plants produce flower structures. Sporangia (megaspore and microspore). Dominant in flowering plants.

- (b) Mechanisms that bring female and male gametes together (**4 points maximum**):

Nonvascular Plants (1 point each)	Flowering Plants (1 point each)
Aquatic—requires water for motile sperm	Terrestrial—pollination by wind, water, or animal
	Micropyle in ovule for pollen tube to enter
	Pollen tube to carry sperm nuclei
	Self- or cross-pollination
Antheridia produce sperm	Gametophytes; no antheridia or archegonia
Archegonia produce egg	Ovules produce female gametophytes/gametes
	Pollen: male gametophyte that produces gametes

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**Question 2 (continued)**

(c) Mechanisms that disperse offspring to new locations (**4 points maximum**):

<b>Nonvascular Plants (1 point each)</b>	<b>Flowering Plants (1 point each)</b>
Dispersal of spores by wind	Dispersal through seeds
<b>or</b>	Carried by wind, water, or animal
Dispersal of spores in water	Detailed animal description: fur, etc.
	Detailed wind description: winged seeds, etc.
	Protection of seeds/seeds protect young sporophytes
	Fruits used to lure animals

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Alternation of generation occurs in plants, where the plant has two life stages; a sporophyte stage (diploid) and a gametophyte stage (haploid). Non-vascular plants have a dominant gametophyte ~~to~~ generation, and a dependent sporophyte generation. Flowering plants have a dominant sporophyte generation, and a dependent gametophyte generation.

In nonvascular plants, gametes are brought together when the flagellated sperm swim to the female gametes. The gametes fuse, forming a diploid zygote, which matures into a sporophyte.

In flowering plants, anthers contain microspore mother cells, which undergo meiosis to produce spores, which undergo mitosis to produce <sup>and pollen tube cells</sup> 2 sperm cells. Ovaries contain megaspore mother cells, which undergo meiosis to form megasporocytes, which undergo mitosis to form an ~~one~~ egg, 2 polar bodies, 2 antipodal cells and synergids. When sperm cells enter the stigma, ~~one sperm cell~~ a pollen tube is formed, allowing the sperm cells to travel to the ovary. When the sperm cells reach the ovary, one sperm cell fertilizes the egg, while the other ~~two~~ fuses with the polar bodies to form the cotyledons. The cotyledon will provide nutrients for the embryo. The ovary matures into a fruit, containing seeds, which house the each of which houses an embryo. Fruit encourages animals to eat the fruit, and excrete the ~~seed~~ seeds, maximizing the ~~of~~ dispersal of offspring. <sup>one to the protective seed coat,</sup> ~~seed~~ seeds also allow the embryo to survive for long periods <sup>due to the protective seed coat</sup> of time without water, allowing the seed enough time to be dispersed in the wind, and lie dormant until conditions are favorable.

## ADDITIONAL PAGE FOR ANSWERING QUESTION 2

Nonvascular plants' gametes ~~are~~ develop in spores, which may be carried by the wind to new locations.

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Every living things reproduce, and to ~~produce~~ carry out their reproduction, plants go through alternation of generations. Alternation of generation starts with haploid spores which develop into gametophyte. Gametophyte then go through mitosis to produce archegonium, which produce an egg and antheridium which give rise to sperms. Then this egg along with sperm go through Fertilization to produce diploid zygote, which further develop to sporophyte plant. Then this sporophyte plant go through ~~mitosis~~ meiosis to produce haploid spores, which starts another alternation of generations. In nonvascular plants, plants don't have vascular system to cover them and their dominant life stage is gametophyte plant. But in flowering plants, their fruit is covered with outer cover and their dominant life cycle is a sporophyte plant. And another significant feature of a flowering plants is that they undergo double fertilization. They produce <sup>(microsporophyte)</sup> two sperms and megasporophyte produce the egg and two polar nucleus. One sperm fuses with the egg, producing a zygote which later become and another sperm fuses with polar nucleus producing food storage ~~the~~ organ - endosperm.

There are many mechanisms that bring female and male gametes together. In non vascular ~~+~~ seedless plants for an example, these plants have sperms which have motility that swim across water to reach female gametes. Others, vascular - seed plants, which adapted to land life where there's no water, developed light and small pollen grains (sperm) which can be delivered by ~~wind~~ wind or ~~small~~ small insects to reach the another plant's stigma and undergo fertilization.

## ADDITIONAL PAGE FOR ANSWERING QUESTION 2

Mechanisms that disperse offspring to new locations include wind, or insects. For bryophytes, since their spores have motility, they don't have to be carried by other mechanisms. But for landplants, they evolved (developed) a light and tiny pollen grains which can easily delivered by winds or by ~~is~~ carried by small insects (bees). They also produce beautiful colors ~~to attract~~ and ~~the~~ good smells to attract insects.

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~~#~~ Nonvascular plants have alteration of generations; that means, for a certain period of time the whole plant stays as only a <sup>having only</sup> half of the chromosomes ( $n$ ) instead of the full number ( $2n$ ). However, flowering plants does not have alternation of generations; what it does is creating gametes, the female part and ~~gametes~~ <sup>gametes</sup> which ~~is~~ <sup>are</sup> male.

When nonvascular plants are in gamatophase (when the chromosome number is  $n$ ), they are ready to accept male gametes which are ~~often~~ often in ~~spei~~ form of sperms. They often travel through water to reach female gametes. On the other hand, flowering plants ~~have to kinds~~ do it differently; ~~the~~ <sup>certain</sup> types of flowering plant ~~spe~~ spread their male gametes via wind; therefore the amount of gametes is ~~huge~~ large because the chances of meeting female gametes are not very high. Another method is using other living organisms such as bees and butterflies.

When bees land on <sup>a</sup> flowers to eat the nectar, the female end, stigma, touches the bee to get male gametes from other plant but same species; at the same time, the male end, ~~a~~ anther, sticks some male gametes, which are in powder form, on the skin of the bee.

~~#~~ ~~AN~~ Nonvascular plants and flowering plants are similar that female gametes stay and male gamets move to reach the female.

When the offsprings are produced, non-vascular plants use spores to spread out them to new locations. Spores are small bag-like storing place, and they are often pop~~ple~~-opened so that the offsprings can travel far. However flowering plants use animals, by letting them eat the fruits with seeds in, and ~~s~~ also use wind fo

## ADDITIONAL PAGE FOR ANSWERING QUESTION 2

~~spread~~ disperse the offspring. The similarity is that the parent plant tries best to disperse the offsprings far way and spread out.



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**2009 SCORING COMMENTARY (Form B)**

**Question 2**

**Sample: 2A**

**Score: 10**

This well-organized response earned 3 points for providing a description of the alternation of generations in plants. The first point was earned for indicating that plants have a haploid and a diploid state. The next 2 points came from a description of the generation that is dominant in each type of plant: 1 point for stating that “[n]on-vascular plants have a dominant gametophyte” and 1 point for explaining that “[f]lowering plants have a dominant sporophyte.”

The response continues to compare and contrast nonvascular and flowering plants’ mechanisms for bringing female and male gametes together, earning a total of 4 points. Two points were earned for the indication that nonvascular plants have flagellated sperm that swim and that flowering plants have sporangia, microspore, and megaspore. The response gives a good description of the use of the pollen tube for movement of gametes in flowering plants, earning 1 point, and states that sperm cells fertilize both the egg and the polar bodies (double fertilization), earning another point.

The final 3 points were earned for describing how offspring are dispersed. Two points were earned for explaining that vascular plants utilize fruits to attract animals that will disperse the seeds, and that the seed protects the embryo, enabling it to survive. The final point was earned for explaining that nonvascular plants’ spores are distributed by wind.

**Sample: 2B**

**Score: 7**

This sample demonstrates how discussions that earned points are sometimes scattered throughout a response and do not fall under a specific part. Four points were earned for describing alternation of generations. The first point was earned for indicating that plants have a haploid and a diploid stage. Two additional points were earned for by describing the gametophyte generation as producing gametes (1 point) and for stating that the gametophyte generation is the dominant stage in nonvascular plants (1 point). The response explains that flowering plants have a dominant sporophyte stage, earning 1 point, but does so as it begins to answer the next part of the question.

The response earned 3 points for comparing and contrasting how plants bring gametes together. The first point was earned for indicating that flowering plants have a double fertilization process. Two points were earned for contrasting nonvascular plants, which have sperm that swim through water for dispersal, with flowering plants, which use pollen grains distributed by wind or insects.

**Sample: 2C**

**Score: 4**

The response earned 4 points with a general discussion of the reproductive process in plants. Although the response is just over one page, it covers all parts of the question. The first point was earned for a description of alternation of generation stages as having  $n$  chromosomes and then  $2n$ . The response earned 2 points for a correct description of how nonvascular plants’ gametes travel through water, while flowering plants spread gametes on the wind or on insects. The final point was earned in the discussion of offspring dispersal for the indication that fruits assist dispersal when they are eaten by animals or distributed by wind.