

Washington State Science Olympiad
2024 Division B/C
State Tournament

Botany KEY

Don't let the gremlins get
their hands on this!

Or else.....

- Grade harshly, but not unreasonably
- Be lenient with partial credit, but strict with full credit

Instructions:

Questions 1-3 refer to the figure on the left.

1. What type of tissue is demarcated by the red arrow? What is its function? (2 points) **Xylem. Transport water and nutrients from the roots to the stems and leaves.**
2. What type of tissue is demarcated by the yellow arrow? What is its function? (2 points) **Phloem. Transport photosynthetic products down**
3. What tissue separates the tissue types indicated by the red and yellow arrows? Beyond simply separating those tissues, name one other purpose it serves. (2 points) **Vascular Cambium. One of: It provides undifferentiated cells that can develop into Phloem or Xylem, hormonal regulation, formation of bark, and healing wounds.**

Questions 4-6 refer to the image on the left

4. What cells are indicated by the letter A? What is their function? (2 points) **Palisade cells (Palisade mesophyll), perform a majority of the photosynthetic activity.**
 5. What CELLS are indicated by the letter B? What is their function? (2 points) **Guard cells, control stomata and gas exchange.**
 6. What structure is indicated by the letter C? What is its function? (2 points) **Cuticle, water barrier (prevents evaporation and water entry into epidermis), also used for defense.**
 7. What structure does the letter A indicate? What larger flower organ is it a part of? (2 points) **Stigma, Pistil**
 8. What structure does the letter B indicate? What larger flower organ is it a part of? (2 points) **Filament, Stamen**
 9. Which of the letters indicates the endocarp? What is its purpose? (2 points) **A, protecting, sustaining and communicating with the seed.**
10. Give the fruit type that is described in each statement:

- Fruit type of cereal grains such as wheat. (1 point) **Caryopsis**
- Fruit type of ash, elm, and maple trees. Sometimes described as winged achenes. (1 point) **Samara/Key**
- Most common type of fleshy fruit in the plant world. (1 point) **Berry**
- Syncarpous, fleshy fruit developed from a half-inferior ovary. (1 point) **Pome**
- Fruit with a hard stone or pit. (1 point) **Drupe**

- 10.5 ~~10.~~ Plant micropropagation is used to propagate many plant species. Which of the following characteristics is a feature of micropropagation (select all that apply) (1 point)
- a. **Uses septic techniques and approaches**
 - b. **Relies on explant tissue that is the product of meiosis**
 - c. **Is an sexual process resulting in clones**
 - d. **The plant tissue/explant is usually reduced in size.**

11.

Auxin and cytokinin are plant hormones responsible for the development of shoots, roots, and callus. Based on this graph, what can you predict is the difference between cytokinin and auxin? (2 points)

- Auxin is responsible for callus growth, cytokinin is responsible for shoot and root development.

12. Why might somaclonal variations occur due to culture induced variation? (2 points)

- e. Regeneration of adventitious shoots from disorganized tissues from callus cultures, extended sub-culturing callus culture over time, use of auxins

13. Label the following phases of micropropagation in shoot growth (2 points)

- a. Isolation phase
- b. Stabilization phase
- c. Production phase

14. All of the following are advantages to using clones as cultivars except: (1 point)

- a. Genetic improvement and selections
- b. High genetic variation for breeding and selection
- c. High genetic diversity for resistance against pathogens
- d. Combination of multiple genotypes into one plant
- e. Latent mutations
- f. Control of plant development

15. (True or false) Periclinal chimeras are the only stable chimeras found in plants. (1 point)

True

16.

The snake plant on the left shows a chimera. However, when the horticulturist attempted to propagate it, the plant lost its variegation. What type of chimera development is this and why do some chimeras not successfully develop? (2 points)

- a. Mericlinal chimera; mutation occurs in a non-apical initial and therefore is only produced in a portion of one histogen layer which will revert back to the original non variegated phenotype.

Use the following scenario for questions 18-22.

The late blight potato blight disease is caused by *Phytophthora infestans* and has triggered the Irish potato famine of the 1840s. This was the first plant disease where a microorganism has proved to be the causal agent leading to the birth of plant pathology.

17. Late potato blight is an oomycete which are water-like molds. What is the main difference between oomycetes and fungi? (2 points)

- a. Oomycete cell walls are made of cellulose and fungi cell walls are made of chitin

18. As a plant pathologist, your job is to attempt to isolate this pathogen. You go through Koch's Postulate by observing that the organism is suffering from this disease and you isolate it in a pure culture. The cultured microorganism also caused disease when introduced into a healthy organism. What would the next step be? (2 points)

- a. Microorganism must be reisolated from the inoculated, diseased experimental host and identified as identical to the original agent.

19. True or false (explain your answer): Oomycetes are biotrophs and are able to be cultured on a petri dish. (2 points)

- a. False, oomycetes are hemibiotrophs; biotrophs also can't be cultured

20. You are a researcher communicating with farmers about how to better manage potato blight.

Understanding that oomycetes mainly travel through water, what is one suggestion that you would give the farmer? (2 points)

- a. Reduce irrigation, plant potatoes further apart

21. Name another plant disease caused by oomycetes. (2 points)

a. Sudden oak death and damping off

Use the following case study for questions 23-27: Witches' broom, *Moniliophthora perniciosa*, is a fungus that infects the limbs and trunks of chocolate trees, destroying the quality of beans. As this disease progresses, chocolate trees will be extinct by 2050. One of the most efficient and environmentally friendly methods of improving plant diseases is to find disease resistance genes.

22. Why might domesticated chocolate trees have less genetic diversity than wild species? (2 points)

a. Bottleneck; elite cultivars with superior growth and yield often contain fewer R genes

23. One way of breeding for disease-resistant is using conventional breeding (think Mendel style breeding). Name one disadvantage of this process. (2 points)

a. Phenotyping is tedious

b. Takes a very long time

c. Linkage drag associated with the phenotypic trait.

24. Name one advantage of using genetic engineering over conventional breeding. (2 points)

a. Much faster, more cost effective, no taxonomic constraints, no linkage drag

25. Resistance to plant diseases are typically rated on a scale from susceptible to partially resistant to completely resistant. What is the benefit to breeding multiple resistant genes into a singular plant? (2 points)

a. Increase disease resistance

26. Chocolate trees are diploid and hypothetically the gene you have isolated is resistant to Witches' broom and is a dominant trait. If you attempted to cross two heterozygous resistant plants, what is the ratio of resistant to susceptible plants? (Tiebreaker)

a. 3:1

27. What is the reasoning behind light absorption during photosynthesis? (2 points)

a. Water is split into energized electrons (anything other than this will not earn a point)

28. True or false: Cytochrome b6f complex occurs during Photosystem II. (Tiebreaker)

a. True

29. True or false: Photosystem I occurs before Photosystem II. (1 point)

a. False

30. The following experiment shows the importance of pH in regulating photosynthesis. Explain why photosynthesis is able to occur in the dark despite not having light. (2 points)

a. Calvin cycle, the second step of photosynthesis, occurs in the dark and the pH change drives the reaction

31. The following graphs show a difference in photosynthesis based on C4 and C3 plants.

Why are C4 plants called C4 plants? Which step during photosynthesis do C4 plants diverge from C3 plants? (2 points)

a. CO₂ combines with PEP to create Malate which is transported into the bundle sheath cells (first part of the question); this diverges during the RUBP; diverges after pyruvate synthesis.

32. What is the main factor that leads to flowering? Explain your answer. (2 points)

a. Internal programming modulated by environmental factors, an internal factor controlling the switch to reproductive development

33. Which is one of the advantages of internal and external control systems for flowering? Explain your answer. (2 points)

a. Cross pollination

- b. Pollination syndrome
- c. Avoiding natural mutants
- d. Availability of open spaces

The evolution of both internal (autonomous) and external (environment-sensing) control systems enables plants to precisely regulate flowering so that it occurs at the optimal time for reproductive success. For example, in many populations of a particular species, flowering is synchronized, which favors cross-pollination. Flowering in response to environmental cues also helps ensure that seeds are produced under favorable conditions, particularly with respect to water and temperature.

34. What is florigen? Select all that apply. (1 point)

- a. The protein that is the long-distance signal during flowering
- b. The RNA that is the long-distance signal during flowering
- c. The molecular complex that initiates the flowering cascade at the meristems
- d. The receptor activated by the long-distance signal to start flowering
- e. The flowering Locus T

35. Which plant hormone is linked to elongation of the meristem? (1 point)

- a. Gibberillic Acid

36. (True or false) The pericarp is composed of the seed coat fused to the fruit wall (1 point)

- a. True

37. The aleurone layer is a specialized secretory tissue that plays a role in dormancy regulation in eudicot seeds. Which of the following are the cells most likely composed of? (1 point)

- a. Sugars
- b. Hormones
- c. Vacuoles
- d. Water

38. ____ ABA and ____ GA sensitivity is found later in seed development and favors germination while ____ ABA and ____ GA sensitivity is found early in seed development. (1 point)

- a. Low, high, high, low
- b. Low, low, high, high
- c. High, high, low, low
- d. High, low, low, High

39. It is usually advantageous to a species if the offspring of a sporophyte are genetically different than the parent sporophyte. Which of the following would be the least likely to ensure genetically different offspring? (1 point)

- a. The pollen produced on a plant cannot germinate on stigmas on the same plant
- b. The plant is pollinated by bees
- c. The species is dioecious
- d. Pistils and stamens within a flower mature at different times
- e. The species is Monoecious

40. Under what conditions would it be likely for asexual reproduction to be more advantageous to a species than sexual reproduction? (1 point)

- a. Stable climate
- b. Global warming
- c. A rare late spring frost

- d. Introduction of a fungal disease
 - e. An unusually severe summer drought
41. (True or false) Most of the increase in size of a plant cell results from enlargement of the vacuole. (1 point)

a. True

42. Match each modified leaf with its primary function (6 points, 1 per right answer)
- a. Foliage Leaf **photosynthesis**
 - b. Bud scale **protection of dormancy**
 - c. Trap leaves **trap leaves**
 - d. Tendril **Support**
 - e. Kranz anatomy **C4 photosynthesis**
 - f. Spine **protection of active photosynthetic tissue**

Use the following figure for questions 43-45

43. In which direction would translocation in the phloem occur? (2 points)
- a. **Source leaf to sink leaf (credit if they say from leaf 14 to leaf 1)**
44. Based on this diagram, which leaf would be the source leaf? (1 point)
- a. **Leaf 14**
45. Which leaf would be the sink leaf(ves)? (1 point)
- a. **Leaves 1 and 6**
46. What is the main difference between starch synthesis and sucrose synthesis? (2 points)
- a. **Starch = chloroplast, sucrose = cytoplasm**
47. Why is it important that cellular respiration is much more rapid than during cooler periods? (2 points)
- a. **Heat adds energy to the closed system which speeds up respiration**
48. Which vitamin was added into GMO golden rice? (1 point)
- a. **Vitamin A**